(Govt. of India)
(Ministry of Railways)

QUESTION BANK
ON
FREIGHT STOCK



(For official use only)

IRCAMTECH/2005/M/W/QB/1.0

December 2005

Centre
for
Advanced
Maintenance
TECH*nology*

Excellence in Maintenance

MAHARAJPUR, GWALIOR--474020

FOREWORD

Standardisation of Hand Tools is an important step towards ensuring implementation of effective and uniform maintenance procedures. CAMTECH has taken an important lead in this direction by preparing this handbook giving compiled list of handtools required for open line wagon maintenance.

Detailed description of each hand tool with important parameters will prove to be useful to the maintenance depots at the time of indenting the material thereby ensuring availability of proper tools to the maintenance staff.

CAMTECH, Gwalior
December 2005 *Executive Director*

PREFACE

CAMTECH has already circulated a report on "Standardisation of Infrastructural facilities for Freight Stock Maintenance"and CAMTECH has prepared this handbook to supplement the same.

- Standard Quality Hand Tools are the backbone of the maintenance and repair. Sub standard/ poor quality tools may cause injury to staff and life of the tool will be less, as such while standardising tools proper material specification of tools as per job requirement should be considered. Availability of proper tools with artisan staff is necessary to enhance the productivity and quality of work.

- To standardise Hand Tools needed for maintenance of freight stock at yard and wagon depot (sick line and ROH) a consolidated list of tools has been prepared. This will ensure quality maintenance of freight stock, which in turn shall:
  - Minimise failure of rakes/wagons
  - Ensure effective and uniform maintenance procedure over various depots/sicklines/intensive examination points scattered all over Indian Railways.
  - Fatigue of artisan staff shall be minimised.
  - Avoid shortcut during maintenance
- Opinion and suggestions were gathered from various depots and seminar conducted in CAMTECH on 22-12-05 to 23-12-05 and incorporated in this hand book.

  Depots visited are:

  - Katni depot - West Central Railway
  - MGS depot - East Central Railway

- Baad depot - North Central Railway
- Bajwa depot - Western Railway
- Bhilai depot - South East Central Rly

- Due to time constraints and other limitations CAMTECH could locate only limited manufacturers/suppliers. As such, the list of manufacturers/suppliers provided in the handbook is in no way exhaustive and the Railways/ Indenters/ Users are free to explore for the availability of more manufacturers/suppliers in the open market.
- The budgetary estimated cost for the tools is subjected to variation on account of market factors and/or number of units purchased.
- The list of non-sparking tools required for maintenance of tank wagons handling petroleum products are contained in appendix-A. The material used in the manufacture of non-sparking tools has mechanical properties comparable to those of the beryllium copper. Non-sparking tools have an inherent quality to eliminate sparking caused by conventional steel tools causing explosion of gases and inflammatory material, which initiate combustion.

This handbook does not supersede any instructions laid down in the " Wagon Maintenance Manual", Railway Board & RDSO publications and instructions given in it are for the purpose of guidance only.

CAMTECH, Gwalior (Kundan Kumar)
Date : 28.12.2005 Director (Mech.)

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CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows :

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Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No. of C.Slip	Date of issue	Page no. and Item no. modified	Remarks

BOOK DETAILS

1.	NAME :-	“ Question Bank on Freight Stock”
2.	Reference No.:-	CAMTECH/2005/M/W/Q.B/1.0
3.	Edition :-	First edition
4.	Year of publication:-	2005
5.	Target group :-	Technicians & supervisors wagon examination yard, ROH/Sick line, STC’s & BTC’s of Indian Railways.
6.	Revision detail :-	Revision as per requirement
7.	Total number of pages:-	100 Nos.
8.	Compiled By :-	Dharmendra Agrawal STA (Mech), CAMTECH

CHAPTER 1

GENERAL

1.01 The standard wheel gauge of Goods wagon is-

(a) 1602 mm (b) 1601 mm (c) 1600 mm (d) 1599 mm

1.02 The minimum wheel gauge of Goods wagon is-

(a) 1599 mm (b) 1601 mm (c) 1600 mm (d) 1602 mm

1.03 The maximum wheel gauge of Goods wagon is-

(a) 1601.5 mm (b) 1600 mm (c) 1598.5 mm (d) 1602 mm

1.04 Permissible variation in new wheel tread diameter for four-wheeled trolley on the same axle on BG bogie wagon is -

(a) 0.45 mm (b) 0.5 mm (c) 0.35 mm (d) 0.3 mm

1.05 Permissible variation in wheel tread diameter for four-wheeled trolley on the same trolley on BG bogie wagon while changing the wheel is -

(a) 10 mm (b) 13 mm (c) 12 mm (d) 15 mm

1.06 Permissible variation in wheel tread diameter for four-wheeled trolley on the same wagon on BG bogie wagon while changing the wheel is -

(a) 13 mm (b) 25 mm (c) 30 mm (d) 28 mm

1.07 Permissible variation in new wheel tread diameter for six-wheeled trolley on the same axle on BG bogie wagon is -

(a) 0.45 mm (b) 0.50 mm (c) 0.35 mm (d) 0.48 mm

1.08 Permissible variation in wheel tread diameter for six-wheeled trolley on the same trolley on BG bogie wagon while changing the wheel is -

(a) 5.0 mm (b) 6.0 mm (c) 10.0 mm (d) 8.0 mm

1.09 Permissible variation in wheel tread diameter for six-wheeled trolley on the same wagon on BG bogie wagon while changing the wheel is -

(a) 6 mm (b) 13 mm (c) 12 mm (d) 15 mm

1.10 Permissible variation in new wheel tread diameter for six-wheeled unit on the same axle on BG bogie wagon wheel is -

(a) 0.8 mm (b) 0.5 mm (c) 0.6 mm (d) 0.7 mm

1.11 Permissible variation in wheel tread diameter for six-wheeled unit on the same trolley on BG bogie wagon while changing the wheel is -

(a) 4.0 mm (b) 8.0 mm (c) 6.0 mm (d) 10.0 mm

1.12 Permissible variation in wheel tread diameter for six-wheeled unit on the same wagon on BG bogie wagon while changing the wheel is -

(a) 4.0 mm (b) 5.0 mm (c) 6.0 mm (d) 8.0 mm

1.13 Permissible variation in new wheel tread diameter for four-wheeled unit on the same axle on BG bogie wagon is -

(a) 0.3 mm (b) 0.5 mm (c) 0.7 mm (d) 0.6 mm

1.14 Permissible variation in wheel tread diameter for four-wheeled unit on the same wagon on BG bogie wagon while changing the wheel is -

(a) 10 mm (b) 15 mm (c) 20 mm (d) 25 mm

1.15 The composite Brake block in yard for air Bk. train should be changed when thickness is -

(a) 10.0 mm (b) 15.0 mm (c) 20.0 mm (d) 25.0 mm

1.16 The Std. Gap between wheel & bk. Block in BOX wagon is -

(a) 8 mm (b) 8.5 mm (c) 6.25 mm (d) 6.8 mm

1.17 Of which brake van the quick coupling is the part-

(a) BVZT (b) BVZX (c) BVZC (d) BVZM

1.18 The 'f' type vacuum cylinder of 533- mm diameter is used in -

(a) BWL (b) Box (c) BRH (d) BOXN

1.19 In BOX/BCXT wagon the distance between Headstock & end of train pipe is -

(a) 200 mm (b) 216mm (c) 300 mm (d) 516mm

1.20 What is the length over Headstock of the BOXN wagon?

(a) 9774 mm (b) 9784 mm (c) 9777 mm (d) 9848 mm

1.21 Tare weight of the BOXN wagon is -

(a) 22.37 tons. (b) 22.47 tons. (c) 22.91 tons. (d) 22.90 tons.

1.22 Tare weight of the BRN wagon is -

(a) 25.2 tons. (b) 24.4 tons. (c) 23.80 tons. (d) 24.80 tons.

1.23 What is the length over couplers of the BOXN wagon?

(a) 10713 mm (b) 10813 mm (c) 11002 mm (d) 10100 mm

1.24 What is the length over couplers of the BCN wagon?

(a) 15400 mm (b) 15443 mm (c) 15429 mm (d) 15562 mm

1.25 What is the length over coupler s of the BRN wagon?

(a) 14645 mm (b) 14564 mm (c) 14332 mm (d) 14463 mm

1.26 Gross load of the BOXN wagon is -

(a) 78.92 t (b) 81.28 t (c) 86.78 t (d) 88.81 t

1.27 Gross load of the BRN wagon is -

(a) 78.92 t (b) 81.28 t (c) 81.3 t (d) 82.4 t

1.28 Axle load of the brake van goods (BVG) is -

(a) 14.2 t (b) 15.3 t (c) 16.3 t (d) 16.9 t

1.29 What is the wheel diameter on tread of the brake van goods (BVG)?

(a) 1000 mm (b) 1050 mm (c) 1060 mm (d) 1090 mm

1.30 In accident manual, train parting is under –

(a) J 3 class (b) J 4 class (c) J 5 class (d) J10 class

1.31 Overall height of BOBR wagon from rail level is –

(a) 3735 mm (b) 3998 mm (c) 4324 mm (d) 4532 mm

1.32 In what type of depot, the ROH of air brake wagon should not be carried out -

(a) ‘A’ category (b) ‘B’ category (c) ‘C’ category (d) ‘D’ category

1.33 In welding repair in UIC trolley, what RDSO pamphlet is used?

(a) R9 (b) R7 (c) R10 (d) R21.42

1.34 Minimum pressure required for door operation on BOBR wagon is –

(a) 5.0 kg/cm^2 (b) 4.92 kg/cm^2 (c) 3.9 kg/cm^2 (d) 6.3 kg/cm^2

1.35 The 'F' type vacuum cylinder of 560 mm diameter used in –

(a) BWL (b) BOBX (c) BOX (d) BVG

1.36 What is the diameter of side operated hand brake wheel for BOXN wagon is –

(a) 630 mm (b) 610 mm (c) 620 mm (d) 600 mm

1.37 Tare weight of the BCN wagon is -

(a) 22.47 tons. (b) 25.37 tons. (c) 27.20 tons. (d) 27.80 tons.

1.38 What type of draw gear used in brake van goods (BVG)?

(a) Screw coupling (b) CBC (c) HT coupling (d) NT coupling

1.39 Maximum pressure for door operation on BOBR wagon should not exceed -

(a) 8.56 kg/cm2 (b) 8.90 kg/cm2 (c) 9.14 kg/cm2 (d) 9.90 kg/cm2

1.40 Length over buffer/coupler of the brake van match truck (BVM) is –

(a) 7213 mm (b) 7313 mm (c) 7412 mm (d) 7122 mm

1.41 Wheel base of the brake van match truck (BVM) is –

(a) 3510 mm (b) 3515 mm (c) 3505 mm (d) 3525 mm

1.42 Newly built BOXN wagon first POH periodicity is –

(a) 4.5 year (b) 5.5 year (c) 6.0 year (d) 6.5 year

1.43 Newly built BLC containers wagon first POH periodicity is –

(a) 4.5 year (b) 2.0 year (c) 6.0 year (d) 3.5 year

1.44 The BOX bogie is designed for an axle load of –

(a) 20.50 t (b) 20.80 t (c) 20.30 t (d) 20.10 t

1.45 Board gauge track gauge is –

(a) 1676 mm (b) 1667 mm (c) 1698 mm (d) 1500 mm

1.46 Types of brake system used in brake van goods (BVG) is –

(a) Air brake (b) Dual brake (c) vacuum brake (d) Non of the above

1.47 POH of BG brake van is –

(a) 3.5 year (b) 2.0 year (c) 2.5 year (d) 3.0 year

1.48 Torque value of Cartridge type roller bearing cap screw is –

(a) 42.0 kg-m. (b) 40.0 kg-m. (c) 38.0 kg-m. (d) 44.0 kg-m.

1.49 The distances between centers of brake cylinder fulcrum bracket and the piston rod eye which shall be –

(a) 780±5 mm (b) 782±5 mm (c) 784±5 mm (d) 788±5 mm

1.50 The clearance between pins and bushes should not exceed -

(a) 1.0 mm (b) 0.5 mm

(c) 1.5 mm (d) None of the above

1.51 Which type of composite brake block is used in freight stock of under frame mounted brake system?

(a) 'K' type (b) 'L' type

(c) 'KL' type (d) 'Modified K ' type

1.52 During rolling out examination, it is seen that -

(a) Flat place on tyre (b) Smoke is coming from axle box

(c) No brake binding (d) Broken spring

1.53 After RDSO Recommendation, What material in used BVG brake van in place of wood dust bag?

(a) Glass wool (b) Cottonwood

(c) Steel wood (d) None of the above

1.54 Broad gauge roller bearing radial clearance is –

(a) 123 to .132 mm (b) 0.132 to 0.145 mm

(c) 0.145 to 0.19 mm (d) 0.19 to 0.25 mm

1.55 C- class ODC shall be moved during –

(a) Day light (b) Day-night time

(c) Only night time (d) None of the above

1.56 What type of coupler used in brake van match truck (BVM)?

(a) Screw coupling (b) CBC

(c) Non- transition (d) None of the above

1.57 In air brake system, the thread joints are tightened with which type of tape?

(a) Cello tape (b) Teflon tape

(c) Paper tape (d) None of the above

1.58 The 'E' type vacuum cylinder of 457mm diameter is used in -

(a) BOBR wagon (b) Box wagon

(c) Bk. van (d) Four Wheeled wagon

1.59 Instructions for maintenance and operation of BOX wagon, What RDSO's technical pamphlet is used?

(a) G-71 (b) G-73 (c) G-18 (d) G-16

1.60 What RDSO's technical pamphlet is used, for maintenance manual of Alliance-II coupler?

(a) G-45H (b) G-78 (c) G-62 (d) G-40

1.61 Instructions for inspection and maintenance of BOXN wagon fitted with CASNUB bogies and twin pipe air brake system, What RDSO's technical pamphlet is used?

(a) G-90 (b) G-70 (c) G-97 (d) WT- 77

1.62 Instructions for inspection and maintenance of BOBR wagon, What RDSO's technical pamphlet is used?

(a) G-73 (b) G-78 (c) G-97 (d) G- 16

1.63 Instructions for inspection and maintenance of CASNUB bogies, What RDSO's technical pamphlet is used?

(a) G-97 (b) G-86 (c) G-90 (d) G- 95

1.64 Instructions for inspection and maintenance of Air brake, What RDSO's technical pamphlet is used?

(a) G-97 (b) G-81 (c) G-73 (d) G- 71

1.65 As per Railway Board, In effective percentage of wagon in open line is –

(a) 3.5% (b) 2.5% (c) 4.0% (d) 10%

1.66 'A' category depot will issue BPC of CC Rake valid up to Km –

(a) 4500 Km (b) 5000 Km (c) 6000 Km (d) 6500 Km

1.67 Depot, other then 'A' category will issue BPC of CC rake valid up to Km –

(a) 4500 Km (b) 5000 Km (c) 6000km (d) 6500 Km

1.68 what time relaxation of period has been given to a loaded BOX wagon for returning for POH-

(a) After 15 days (b) After 30 days (c) Before 30 days (d) before 15 days

1.69 The mini rake will have composition of minimum –

(a) 10 wagon (b) 20 wagon (c) 25 wagon (d) 30 wagon

1.70 The free time for loading/unloading of mini rake shall be –

(a) 6 Hours (b) 8 Hours (c) 5 Hours (d) 2 Hours

1.71 The mini rake scheme will be applicable only to –

(a) Covered wagon (b) Open wagon (c) Tank wagon (d) Both of this

1.72 As per new wagon numbering scheme, first two digits will indicate-

(a) Owning Railway (b) Type of wagon (c) Year of manufacture (d) Cheek digit

1.73 what time relaxation of period has been given to a empty BOX wagon for returning for POH-

(a) Before 15 days (b) After 30 days (c) Before 30 days (d) before 15 days

1.74 What do you mean by PME?

(a) Pre medical examination (b) Pre maintenance examination

(c) Periodical maintenance examination (d) Power mechanical equipment

1.75 What do you mean by CC rakes?

(a) Content contact pad. (b) Close circuit rake

(c) Complete coal rake (d) Both of this

CHAPTER 2

CBC & DRAFT GEAR

2.01 The minimum permissible buffer height above rail line to center of H/ Stock under loaded condition is -

(a) 1105 mm (b) 1145 mm (c) 1115 mm (d) 1030 mm

2.02 Standard buffer projection from Headstock is -

(a) 650 mm (b) 635 mm (c) 620 mm (d) 660 mm

2.03 Min Permissible buffer projection from Headstock is -

(a) 635 mm (b) 605 mm (c) 590 mm (d) 584 mm

2.04 Standard diameter of knuckle pivot pin is -

(a) 50 mm (b) 43 mm (c) 41.28 mm (d) 34 mm

2.05 Permissible diameter of knuckle pivot pin is -

(a) 41 mm (b) 38.5 mm (c) 39.5 mm (d) 40.5 mm

2.06 Standard diameter of Clevis pin is -

(a) 35 mm (b) 38 mm (c) 39 mm (d) 37 mm

2.07 Permissible diameter of Clevis pin is -

(a) 35.8 mm (b) 38.5 mm (c) 36.5 mm (d) 37 mm

2.08 Standard dimension of shank wear plate for AAR coupler is -

(a) 12 mm (b) 8 mm (c) 6 mm (d) 14 mm

2.09 Standard dimension of distance between the nose of Knuckle and guard arm is -

(a) 140 mm (b) 150 mm (c) 127 mm (d) 12 mm

2.10 Wear limit of distance between the nose of Knuckle and guard arm is -

(a) 140 mm (b) 155 mm (c) 125 mm (d) 130 mm

2.11 For goods train, max. Buffer height from rail level is -

(a) 1105 mm (b) 1115 mm (c) 1015 mm (d) 1100 mm

2.12 The maximum permissible free slack in the draft gear in service is –

(a) 35 mm (b) 30 mm (c) 25 mm (d) 20 mm

2.13 No. of CBC gauge are –

(a) 5 (b) 8 (c) 12 (d) 2

2.14 For short case, what shall be the max buffer projection from the Headstock on BG wagon?

(a) 480 mm (b) 456 mm (c) 460 mm (d) 510mm

2.15 For short case, what shall be the min. buffer projection from the Headstock on BG wagon?

(a) 420 mm (b) 440 mm (c) 410 mm (d) 406mm

2.16 What is the max. Permissible wears in Draw Bars shackle pinhole?

(a) 5.23 mm (b) 6.35 mm (c) 7.21 mm (d) 6.69mm

2.17 What is the max. Permissible wear in draw Bars cotter pin hole?

(a) 10.7 mm (b) 12.3 mm (c) 12.7 mm (d) 13.1mm

2.18 What is the weakest link of the center buffer coupler?

(a) Knuckle (b) Draft gear (c) Lock (d) Yoke pin

2.19 The high capacity draft gears is -

(a) Mark -20 (b) Mark 50 (c) CF 21 (d) DF 39

2.20 The high capacity draft gears is -

(a) RF361 (b) RF-401 (c) RF-600 (d) RF-21

2.21 To Adjust buffer height for 930 mm wheel diameter on BCN wagon except CASNUB 22 W, packing piece used is –

(a) 38 mm (b) 37 mm (c) 33 mm (d) 32 mm

2.22 What type of center buffer coupler used in Indian Railway?

(a) APRT type (b) AARP type (c) AAR type (d) ARPA type

2.23 What type of head and shank are used in AAR type center buffer coupler?

(a) E&G Type (b) E&F Type (c) F&E Type (d) H&F Type

2.24 The yield strength of knuckle of material AAR –M- 201 Grade ‘C’ (STD) is –

(a) 180 t (b) 171 t (c) 142 t (d) 132 t

2.25 The yield strength of knuckle of material AAR –M- 201 Grade ‘E’ (HT) is –

(a) 180 t (b) 171 t (c) 142 t (d) 132 t

2.26 The yield strength of coupler body of AAR Grade ‘C’ (STD) is –

(a) 180 t (b) 169 t (c) 179 t (d) 159 t

2.27 The yield strength of coupler body of material AAR-M- 211 Grade ‘E’ (HT) is –

(a) 180 t (b) 200 t (c) 205 t (d) 211 t

2.28 The yield strength of the knuckle is 180 t compared to 132 t in standard coupler the draft capacity of HT coupler is –

(a) 45% higher (b) 36% higher (c) 22% higher (d) 18% higher

2.29 The working strength of center buffer coupler is -

(a) 100 t (b) 120 t (c) 140 t (d) 180 t

2.30 The diameter of knuckle pivot pin is –

(a) 40.0 mm (b) 38.0 mm (c) 37.0 mm (d) 35.0 mm

2.31 In (HR-40 I) Draft gear, the pack with 11 Nos of rubber pads and 10 Nos of spacer plates, when assembled in the housing with follower shall not be less then –

(a) 638 mm (b) 632 mm (c) 660 mm (d) 620 mm

2.32 The ultimate tensile strength of coupler body of AAR –M- 201 & 211 Grade ‘C’ (STD) is –

(a) 300 t (b) 320 t (c) 290 t (d) 270 t

2.33 The ultimate tensile strength of coupler body of AAR –M- 201 & 211 Grade ‘E’ (HT) is-

(a) 300 t (b) 330 t (c) 320 t (d) 370 t

2.34 The ultimate tensile strength of knuckle of AAR-M- 201 & 211 Grade ‘C’ (STD) is –

(a) 240 t (b) 250 t (c) 241 t (d) 251 t

2.35 The ultimate tensile strength of knuckle of AAR-M- 201 & 211 Grade 'E' (HT) is –

(a) 250 t (b) 280 t (c) 295 t (d) 305 t

2.36 The conventional screw coupling has a working load of –

(a) 2.9 t (b) 22.5 t (c) 24.3 t (d) 20.3 t

2.37 The working strength of center buffer coupler is –

(a) 180 t (b) 160 t (c) 120 t (d) 80 t

2.38 The working strength of Alliance –II coupler is -

(a) 100 t (b) 80 t (c) 70 t (d) 54 t

2.39 Which among the buffer gear assembly absorbing the buffer impact?

(a) Buffer spring (b) Plunger (c) Buffer casting (d) Spindle

2.40 The tractive effort of the Loco to the individual wagons is transmitted with the help of -

(a) CBC (b) Draw gear (c) Knuckle (d) Side frame

2.41 Material AAR –M- 201 & 211 Grade 'E' coupler is called as –

(a) High tensile (b) Non- Tensile (c) Standard (d) None of the above

2.42 Clevis and Clevis pin are the part of –

(a) Alliance- II coupler (b) Non- Transition coupler

(c) Transition coupler (d) Draw bar

NOTES

CHAPTER 3

WHEEL & AXLE

3.01 Standard diameters of wheel on tread on BOXN Wagon is -

(a) 1010 mm (b) 1000 mm (c) 950 mm (d) 906 mm

3.02 Minimum diameters of wheel on tread on BOXN Wagon during service is -

(a) 1000 mm (b) 960 mm (c) 906 mm (d) 915 mm

3.03 Standard diameter of wheel on treads on BOX Wagon is -

(a) 960 mm (b) 1000 mm (c) 906 mm (d) 860 mm

3.04 Minimum diameter of wheel on treads on BOX Wagon during service is -

(a) 860 mm (b) 960 mm (c) 906 mm (d) 990 mm

3.05 The axle load of BOXN, BCN, BRN, BOBR, BTPN wagon is -

(a) 22.9 t (b) 20.32 t (c) 16.6 t (d) 12.2 t

3.06 The axle load of BOX, BCX, BRH wagon is -

(a) 22.9 t (b) 20.32 t (c) 16.3 t (d) 12.2 t

3.07 The axle capacity of BVZC, CRT, BTAL, BTAG, BTPGL wagon is -

(a) 22.9 t (b) 20.3 t (c) 16.3 t (d) 12.2 t

3.08 The axle capacity of TPR, TORS, and TCL wagon is –

(a) 22.9 t (b) 20.3 t (c) 16.3 t (d) 12.2 t

3.09 The wheel gauge should be measured on –

(a) Off load condition (b) Loaded wagon (c) Both condition (d) Empty wagon

3.10 The lowest wheel dia permitted by workshop for BOXN wagon is -

(a) 919 mm (b) 906 mm (c) 925 mm (d) 860 mm

3.11 In CTRB the grease use per Axle box is -

(a) 455 ±30 gms (b) 490±15 gms (c) 500±35 gms (d) 550±20 gms

3.12 Maximums permissible wear on outer collar size of journals 255*127, 254*127, 229*114 are –

(a) 6.0 mm (b) 11 mm (c) 8.0 mm (d) 5.0 mm

3.13 RDSO has stipulated three intermediate profile BOXN/BCN wagon with flange thickness as 20,22 and -

(a) 28 mm (b) 25 mm (c) 24 mm (d) 23 mm

3.14 The condemning wheel diameter of BVG is -

(a) 919 mm (b) 906 mm (c) 925 mm (d) 990 mm

3.15 The condemning diameter of wheel of B0I wagon is -

(a) 990 mm (b) 906 mm (c) 813 mm (d) 860 mm

3.16 The new diameter of wheel for BOY wagon is -

(a) 990 mm (b) 1090 mm (c) 1000 mm (d) 915 mm

3.17 The condemning diameter of BOBR wheel is -

(a) 815 mm (b) 906 mm (c) 990 mm (d) 860 mm

3.18 The condemning diameter of BTPN wheel is -

(a) 813 mm (b) 990 mm (c) 906 mm (d) 860 mm

3.19 The condemning diameter of BWL wheel is -

(a) 813 mm (b) 906 mm (c) 915 mm (d) 860 mm

3.20 The radius at the root of the flange of new worn wheel profile is -

(a) 14 mm (b) 16mm (c) 18mm (d) 120 mm

3.21 Permissible maximum flat surface on tread on other BG wagon are –

(a) 75 mm (b) 60 mm (c) 75 mm (d) 70 mm

3.22 What should be permissible limit of ovality and taper on the journal?

(a) 0.5 mm (b) 0.05 mm (c) 0.1 mm (d) 0.15mm

3.23 Permissible maximum flat surface on tread on IRS BG wagon is –

(a) 75 mm (b) 50 mm (c) 60 mm (d) 70 mm

3.24 What is the minimum lateral play between axle box lug and horn check for UIC type trolleys?

(a) 20 mm (b) 22 mm (c) 18 mm (d) 12 mm

3.25 What is the maximum lateral play between axle box lug and horn check for UIC type trolleys?

(a) 20 mm (b) 22 mm (c) 25 mm (d) 28 mm

3.26 Minimum longitudinal clearance between axle box lug and horn check for UIC type trolleys are –

(a) 10 mm (b) 12 mm (c) 14 mm (d) 16 mm

3.27 Maximum longitudinal clearance between axle box lug and horn check for UIC type trolleys are –

(a) 12 mm (b) 14 mm (c) 16 mm (d) 18 mm

3.28 Maximum permissible wear on length of journal size of 255*127, 254*127,229*144 are-

(a) 6.0 mm (b) 11 mm (c) 5.0 mm (d) 8.0 mm

3.29 Maximum permissible wear on inner collar size of journal 255*127,254*127,229*144 are-

(a) 6.0 mm (b) 11 mm (c) 5.0 mm (d) 8.0 mm

3.30 The wheel gauge measures -

(a) The distance between flanges of two wheels on same axle.

(b) The distance between dia and axle.

(c) The distance between journal and bearing.

(d) The distance between two wheel.

3.31 What is an integrated portion of the axle?

(a) Cap (b) Roller bearing

(c) **Journal** (d) None of the above

3.32 For measuring the diameter of ovality & taper of the journal, how many locations are needed?

(a) Two Location both the vertical and horizontal axis

(b) Three locations both the vertical and horizontal axis

(c) Three location only vertical axis

(d) None of the above

NOTES

CHAPTER 4

AIR BRAKE

4.001 Standard dimension ‘e’ in SAB on Goods stock is -

(a) 570 mm (b) 575 mm (c) 580 mm (d) 565 mm

4.002 In yard leaving, minimum Permissible dimension ‘e’ in SAB on Goods stock is -

(a) 555 mm (b) 570 mm (c) 565 mm (d) 580 mm

4.003 The colour coding of distributor valve of air brake goods stock is –

(a) Yellow (b) Black (c) Green (d) White

4.004 In air brake empty stock end-to-end goods rakes, The empty rake after unloading should be offered for intensive examination before-

(a) Next station (b) Next Loading (c) Next Unloading (d) 36 Hours

4.005 In air brake end-to end rakes, After intensive examination validity of BPC remain up to the –

(a) Next station (b) Loading point (c) Destination point (d) 72 Hours

4.006 Control rod diameter of air brake wagon is –

(a) 30 mm (b) 32 mm (c) 38 mm (d) 40 mm

4.007 Piston stroke of BOXN wagon in empty conditions is -

(a) 85±10 mm (b) 70±15 mm (c) 75±5 mm (d) 80±10 mm

4.008 Piston stroke of BOXN wagon in loaded conditions is -

(a) 140±15 mm (b) 130±10 mm (c) 120±15 mm (d) 125±15 mm

4.009 Piston stroke is empty conditions of BOY wagon is -

(a) 90±10 mm (b) 90±5 mm (c) 90±15 mm (d) 90±10/5 mm

4.010 Piston stroke is loaded conditions of BOY wagon is -

(a) 135±5 mm (b) 135±10 mm (c)135±20 mm (d) 120±10 mm

4.11 In air brake stock, BPC becomes invalid, if the rake is stabled in any examination yard-

(a) 24 hours (b) 36 hours (c) 48 hours (d) 12 hours

4.012 Dirt collector should be cleaned within-

(a) At the time of ROH (b) 2 month (c) 6 month (d) 3 month

4.013 What is the capacity of control reservoir in goods train?

(a) 4 Lit. (b) 6 Lit (c) 8 Lit. (d) 10 Lit.

4.014 How much air pressure should be dropped in brake van/ last vehicle for continuity test?

(a) 0.8 Kg/Cm2 (b) 1.0 Kg/Cm2 (c) 1.2 Kg/Cm2 (d) 1.5 Kg/Cm2

4.015 The Colour of Brake Pipe in Twin pipe brake system is -

(a) Black (b) Yellow (c) Green (d) White

4.016 The Colour of Feed Pipe in twin pipe wagon is -

(a) Black (b) Yellow (c) Green (d) White

4.017 What should be the brake pipe pressure in engine?

(a) 4.8 Kg/Cm^2 (b) 4.7 Kg/ Cm^2 (c) 5.0 Kg/ Cm^2 (d) 6.0 Kg/ Cm^2

4.018 The BP pressure in Brake Van of 56 -BOXN wagon load should not be less than –

(a) 4.5kg/ Cm^2 (b) 3.7 kg/ Cm^2 (c) 4.8 kg/ Cm^2 (d) 5.8kg/ Cm^2

4.019 What should be the effective pressure in brake cylinder during full service application?

(a) 3.6 Kg/ Cm^2 (b) 3.2 Kg/ Cm^2 (c) 3.8 Kg/ Cm^2 (d) 4.1 Kg/ Cm^2

4.020 When we release manually KE type DV, the air pressure release form -

(a) CR & AR (b) BC & AR (c) BC & CR (d) AR & DV

4.021 The diameter of branch pipe of BP to DV for wagon is –

(a) 25 mm (b) 20 mm (c) 13 mm (d) 22 mm

4.022 If ELD handle is kept on loaded position of empty wagon, the result will be -

(a) Air Brake Power (b) Brake binding (c) None of the above

4.023 In one BOXN wagon total no. of brake block are -

(a) 4 (b) 8 (c) 12 (d) 16

4.024 ‘A’ dimension in Boxn wagon is -

(a) $70\pm^{2}_{0}$ mm (b) 172±3 mm (c) 175±4 mm (d) 175+1mm

4.025 For testing Air pressure locomotive the test plate hole diameter is-

(a) 8.2 mm (b) 7.5 mm (c) 9.5 mm (d) 10 mm

4.026 D.V. is directly attached with-

(a) Brake cylinder (b) Brake pipe (c) AR (d) Common pipe bracket

4.027 The diameter of air brake cylinder BOXN wagon is-

(a) 300 mm (b) 355 mm (c) 360 mm (d) 315 mm

4.028 The diameter of air bake cylinder in BVZC (Wagon) is -

(a) 300 mm (b) 295 mm (c) 305 mm (d) 315 mm

4.029 The capacity of Auxiliary Reservoir (wagon) in air brake except Bk.Van is-

(a) 200 litre (b) 100 litre (c) 300 litre (d) 150 litre

4.030 In Single pipe system the time taken in releasing of the wagon brake is-

(a) 60 Sec. (b) 120 Sec. (c) 210 Sec. (d) 90 Sec.

4.031 Distance between the control rod head and the barrel of SAB is named as -

(a) 'E' dimensions (b) 'C' dimension (c) 'A' dimension (d) "d" dimension

4.032 The capacity of compressor machine for air brake testing of rake is –

(a) 12-15 Kg/ Cm^2 (b) 8-10 Kg/ Cm^2 (c) 7-12 Kg/ Cm^2 (d) 7-8 Kg/ Cm^2

4.033 In single pipe air brake system, BP is charged with –

(a) 6 ± 0.2 Kg/Cm2 (b) 5 ± 0.1 Kg/Cm2 (c) 5.0 ± 0.2 Kg/Cm2 (d) 6.0 ± 0.1 Kg/Cm2

4.034 At the originating point, minimum brake power of premium end-to-end rake is -

(a) 85% (b) 95% (c) 90% (d) 98%

4.035 In twin pipe system the Auxiliary Reservoir pressure should be -

(a) 6.0 kg/ Cm^2 (b) 4.8 Kg/ Cm^2 (c) 5.0 Kg/ Cm^2 (d) 6.5 Kg/ Cm^2

4.036 With The help of cut of angle cock, the air pressure in air hose is exhaust or closed -

(a) True (b) false (c) None of the above

4.37 The brake power of CC rake from nodal point is –

(a) 90% (b) 100% (d) 85% (d) 75%

4.038 Brake power certified issued for such Premium end-to-end rakes will be valid for –

(a) 7±4 days (b) $10\pm^{2}_{0}$ days (c) 15 ±3 days (d) one month

4.039 The amount of air pressure in control reservoir of twin pipe system is -

(a) 3.8 Kg/ Cm^2 (b) 6.0 Kg/ Cm^2 (c) 5.0 Kg/ Cm^2 (d) 4.8 Kg/ Cm^2

4.040 What is the function of DC (Dirt collector)?

(a) Collect dirt (b) Collect air (c) Clean air (d) Clean CR

4.041 How much pressure should drop in a minute after putting a test plate in locomotive?

(a) 0.8 Kg/ Cm^2 (b) 1.0 Kg/ Cm^2 (c) 1.2 Kg/ Cm^2 (d) 1.5 Kg/ Cm^2

4.042 Diameter of brake pipe and feed pipe is (In a good train)-

(a) 28 mm (b) 34 mm (c) 32 mm (d) 36 mm

4.043 The three branch pipe attached to common pipe bracket, where the middle pipe lead to-

(a) CR (b) DV (c) BC (d) AR

4.044 How many cut of angle cock are provided in a vehicle in twin pipe system-

(a) Two (b) Four (c) Six (d) None

4.045 While isolating DV, the position of the handle in relation to rail line shall be

(a) Horizontal (b) vertical (c) None of the above

4.046 If brake block is not releasing, pin is remove to release the brake -

(a) Anchor link pin (b) control rod pin (c) Pull rod pin (d) equaliging pin

4.047 During Brake application, air flow from -

(a) AR to BC (b) PB to BC (c) BP to BC (d) CR to BC

4.048 The position of handle to close angle cock is -

(a) Horizontal to pipe line (b) Perpendicular to pipe line (c) Center to pie line

4.049 The position of handle to open angle cock is -

(a) Parallel to pipe line (b) Perpendicular to pipe line (c) Center to pie line

4.050 The leverage Ratio is obtained by -

(a) Brake cylinder (b) Tie Rod (c) Empty Rod (d) L/E Dives

4.051 BP pressure in working train is -

(a) 6.0 Kg/ Cm^2 (b) 5.5 Kg/ Cm^2 (c) 5.0 Kg/ Cm^2 (d) 15.2 Kg/ Cm^2

4.052 The colour for brake power certificate for Premium end-to-end rake is-

(a) Green (b) White (c) Pink (d) Yellow

4.053 The en-route Brake power percentage of goods train should be -

(a) 85% (b) 75% (c) 95% (d) 90%

4.054 For testing DV the time required for brake cylinder draining from 3.8 to .04 kg/cm^2 is -

(a) 30-40 sec (b) 40-50 sec (c) 45-60 sec (d) 50-75 sec

4.055 What is the piston stroke of BVZC wagons?

(a) 50±10 mm (b) 70±10 mm (c) 85±10 mm (d) 90± 5 mm

4.056 What is the empty piston stroke of BOBR/BOBRN wagon is -

(a) 70±10 mm (b) 75±10 mm (c) 80±10 mm (d) 100±10 mm

4.057 The diameter of piston rod of 355-mm brake cylinder is -

(a) 40 mm (b) 38 mm (c) 30 mm (d) 25mm

4.058 The diameter of piston rod of 300-mm brake cylinder is –

(a) 40 mm (b) 36 mm (c) 32 mm (d) 30 mm

4.059 'A' dimension of the BOBRN wagon is -

(a) 29+_ 2 $_0$ mm (b) 27+_ 2 $_0$ mm (c) 33± 2 mm (d) 25+_ 5 $_2$ mm

4.060 What is the colour of BPC of air brake system?

(a) Red (b) Pink (c) Green (d) Yellow

4.061 What is the colour of BPC of air brake CC rake?

(a) Red (b) Pink (c) Green (d) Yellow

4.062 During brake release, air from BC goes to -

(a) AR (b) CR (c) DV (d) Atmosphere

4.063 In twin pipe system, the FP is directly joined to branch pipe of -

(a) CR (b) BC (c) DV (d) AR

4.064 The max. Air pressure in BC after brake release is -

(a) 4.8 Kg/ Cm^2 (b5 Kg/ Cm^2 (c) 0.0 Kg/ Cm^2 (d) 2.5 Kg/ Cm^2

4.065 The max. Air pressure in BP during application is -

(a) 4.8±1 Kg/ Cm^2 (b) 5.0 Kg/ Cm^2 (c) 3.8 ± 0.1Kg/ Cm^2 (d) 3.8 Kg/ Cm^2

4.066 The capacity of AR for wagon is-

(a) 200 lit. (b) 200 lit. (c) 100 lit. (d) 150 lit.

4.067 In conventional air Brake system, the diameter of brake cylinder is-

(a) 255 mm (b) 155 mm (c) 355 mm (d) 455 mm

4.068 The air pressure during charging in single pipe system is -

i In AR- (a) 5 kg/ cm^2 (b) 5.2 kg/ cm^2 (c) 6.1 kg/ cm^2 (d) 5.5 kg/ cm^2

ii In CR- (a) 6 kg/ cm^2 (b) 5 kg/ cm^2 (c) 6.1 kg/ cm^2 (d) 5.5 kg/ cm^2

iii In BP- (a) 6 kg/ cm^2 (b) 5 kg/ cm^2 (c) 6.1 kg/ cm^2 (d) 5.5 kg/ cm^2

4.069 As per population of air brake stock the percentage of distribution value should be kept as spares -

(a) 10% (b) 2% (c) 5% (d) 10%

4.070 The diameter of ball in internal ball valve of cut of angle cock is -

(a) 15 mm (b) 13 mm (c) 17 mm (d) 10 mm

4.071 The diameter of air brake cylinder for BVZC is -

(a) 400 mm (b) 300 mm (c) 355 mm (d) 295 mm

4.072 The diameter of Std. Air brake Pressure gauge is-

(a) 60 mm (b) 70 mm (c) 90 mm (d) 100 mm

4.073 What type of cut of angle cock fitted in goods stock?

(a) Flat type (b) Ball type (c) Square type (d) None of the above

4.074 Full form of BP is -

(a) Big pipe (b) Brake pipe (c) Bent pipe (d) None of the above

4.075 For testing DV the time required for filling BC in single pipe system from 0-36 kg/cm2 is -

(a) 20-25 sec (b) 18-30 sec (c) 15-25 sec (d) 30-40 sec

4.076 What should be the pressure in feed pipe?

(a) 3.8 Kg/cm^2 (b) 5.0 Kg/Cm^2 (c) 6.0 Kg/Cm^2 (d) none of the above

4.077 When DV is working condition the position of DV handle is -

(a) Vertical (b) Horizontal (c) Inclined (d) Parallel

4.078 “e” dimension for SAB-600, in wagon is -

(a) 444 – 474 mm (b) 555-575 mm (c) 500- 575 mm (d) 440- 575 mm

4.079 Control rod of SAB when rotated for one round, control rod head moves by a distance of -

(a) 6.0 mm (b) 4.0 mm (c) 2.0 mm (d) 1.0 mm

4.080 Piston stroke of the BVZC is -

(a) 60±10 mm (b) 70±10 mm (c) 65±10 mm (d) 75±10 mm

4.081 For testing DV the time required for charging CR from 0-48 kg/cm2 is -

(a) 290±20 sec (b) 150±20 sec (c) 185±25 sec (d) 200±20 sec

4.082 In air brake system branch pipe of DV to AR is connected via common pipe bracket is -

(a) At the bottom (b) In Middle (c) At Top (d) To AR

4.083 The type of joint for FP& BP is -

(a) Grip seal (b) Flange (c) Thread coupling (d) knuckle

4.084 In air brake system branch pipe of DV to BC is connected via common pipe bracket is -

(a) At the bottom (b) In Middle (c) At the Top (d) To AR

4.085 FP charges -

(a) AR (b) CR (c) DV (d) BP

4.086 Which equipments are not charged, when C3W DV is isolated in twin pipe system?

(a) Brake cylinder only (b) Control reservoir and brake cylinder

(c) Control reservoir and auxiliary reservoir (d) Auxiliary reservoir and Brake cylinder

4.087 The leakage rate in BP or FP in air brake system is -

(a) 04 kg/ cm^2 /Min (b) 0.25 kg/ cm^2/Min

(c) 0.3 kg/ cm^2/Min (d) 0.1 kg/ cm^2/Min

4.088 The pressure of Auxiliary reservoir makes to work -

(a) Common pipe bracket (b) Brake cylinder

(c) Control Reservoir (d) DV

4.089 With what pressure of AR twin pipe system works -

(a) BP Pressure only (b) FP Pressure only

(c) BP&FP Pressure (d) BC Pressure

4.090 In single pipe system works -

(a) BP Pressure (b) FP Pressure

(c) BP& FP Pressure (d) none of the above

4.091 In wagon, hand brake is used when -

(a) Standing in yard (b) Running in down gradient

(c) Running in up gradient (d) None of the above

4.092 SAB adjust clearance between -

(a) Wheel and brake block (b) Tie Rod and Brake block

(c) Anchor pin to control rod (d) None of the above

4.093 The M.R. pressure of engine should be-

(a) 6.0 to 8.0 Kg/ Cm^2 (b) 8.0 to 10.0 Kg/ Cm^2

(c) 10.0 to 12.0 Kg/ Cm^2 (d) 12.0 to 15.0 Kg/ Cm^2

4.094 What do you mean of SWTR?

(a) Single wagon test rubber (b) Single wagon test rig

(c) Sliding wagon test ring (d) None of the above

4.095 In an air brake goods wagon in empty condition the handle of E/L box if kept in loaded condition, it resettled in -

(a) Brake winding (b) Brake power

(c) Poor brake power (d) None of the above

4.96 SAB fitted in-

(a) End pull rod (b) Main pull rod

(c) Control rod (d) Dead equaliging lever

4.97 Dropping BP pressure to do full service application is -

(a) 2.0 to 3.0 kg/ cm^2 (b) 3.0 to 3.2 kg/ cm^2

(c) 1.3 to 1.6 kg/ cm^2 (d) 1.5 kg/ cm^2

4.98 The function of dirt collector is to segregate dirt portion from the air -

(a) After coming DV (b) Before coming to DV (c) None of the above

4.99 What is the function of Control reservoir in air Brake system?

(a) To control the air pressure (b) To control the DV main valve

(c) To control the brake system (d) To control the AR

4.100 Auxiliary reservoir is assisting in –

(a) Charging of DV (b) Charging of BP

(c) Sanding air to BC (d) Charging of CR

4.101 When isolating handle of C3W type DV is kept in horizontal at charging position -

(a) Piston rods of BC come out (b) Piston rod of BC close not come out

(c) Brake applies and releases (d) Nothing happens

4.102 the control reservoir is mounted on the other face of –

(a) Distributor valve (b) Brake cylinder

(c) Common pipe bracket (d) Axially reservoir

4.103 Cut of angle cock can be fitted with –

(a) Feed pipe only (b) Brake pipe only

(c) Feed pipe & brake pipe both (d) None of the above

4.104 BP & FP Air hose pipe can be fitted to cut off angle cock by-

(a) Socket (b) Coupling

(c) Flange (d) Nut

4.105 The main BP pressure in brake van of working train with 56 wagon is -

(a) $4.8 \pm 0.1 kg/cm^2$ (b) $4.5 \pm 0.1 kg/ cm^2$ (c) $6.0 \pm 0.1 kg/ cm^2$ (d) None of the above

4.106 While some defect is notice in brake pipe in twin pipe system, the train can be worked as single pipe system -

(a) By passing BP (b) Not worked

(c) Work, any change (d) None of the above

4.107 If C3W type DV is manually released, pressure is released from -

(a) AR (b) Control reservoir

(c) Brake cylinder (d) All above

4.108 Full form of AR is -

(a) Accident of reservoir (b) Axle ring

(c) Auxiliary reservoir (d) None of the above

4.109 Full form of BC is -

(a) Brake control (b) Beside coach

(c) Brake cylinder (d) None of the above

4.110 The positions of Cut of angle cock handle while open is -

(a) Parallel to pipe (b) Perpendicular to pipe

(c) None of the above (d) Parallel to pipe & Perpendicular to pipe

4.111 The full form of CR is -

(a) Central Reservoir (b) Cylindrical Reservoir

(c) Control reservoir (d) None of the above

4.112 During twin pipe charging position, air pressure in Auxiliary Reservoir is -

(a) 6.5kg/ cm^2 (b) 5.8 kg/ cm^2 (c) 6.0 kg/ cm^2 (d) None of the above

4.113 What shall be the function of check valve of C3W type distributor valve?

(a) Charging the AR (b) Charging the CR

(c) Charging the BC (d) None of the above

4.114 For by pass the special device essential is -

(a) FP &BP exhauster (b) FP&BP reactor

(c) By pass coupler (d) BP FP jointer

4.115 In twin pipe system, the BP is directly jointed to branch pipe of -

(a) AR (b) BC

(c) DV (d) Common pipe bracket.

4.116 BC vent plug is used for-

(a) Brake application (b) Brake release

(c) Air leakage to stop (d) Air pressure maintenance

4.117 Brake system can be defective due to-

(a) Train movement (b) Airflow

(c) Bk. application & release (d) Cattle run over

4.118 The length of air hose is -

(a) 796 +-6 mm (b) 784+-6 mm

(c) 790+-6.1 mm (d) 660+-6 mm

4.119 In air brake system, during sensitivity test Brake should apply when the rate of drop of air pr in BP is -

(a) 0.3 kg/ cm^2in3 sec (b) 0.4 kg/ cm^2 in4 sec

(c) 0.5 kg/ cm^2 in5 sec (d) 0.6 kg/ cm^2 in 6 sec

4.120 In air brake system, during insensitivity test Brake should not apply when the rate of drop of air pr in BP is -

(a) 0.8 kg/ cm^2in 8 sec (b) 0.4 kg/ cm^2 in 4 sec

(c) 0.5 kg/ cm^2 in 5 sec (d) 0.3 kg/ cm^2 in 60 sec

4.121 the permissible leakage rate in air brake system in centrifugal dirt collector is -

(a) 02 kg/ cm^2/min (b) 0.2 kg/ cm^2/min

(c) 0.20 kg/ cm^2/min (d) No leakage

4.122 To uncouple BP or FP air hose it is essential to

(a) Open adjacent angle cock (b) Close adjacent angle cocks

(c) Close supply of air from loco (d) None of the above

4.123 In air Bk. system the rate of leakage should not be more then -

(a) 0.025 kg/ cm^2 /min (b) 0. 25 kg/ cm^2/min

(c) 0.0025 kg/cm^2/min (d) 0.255 kg/ cm^2/min

4.124 For running 1200mt long train, it is essential to have -

(a) Single pipe graduated release air bk. System

(b) Twin pipe graduated release air bk. System

(c) Single & double pipe-graduated release air bk. System

(d) None of the above

4.125 In working train having 56 wagon, the air pressure in Bk. van is -

(a) 0.25 kg/ cm^2 less then 5kg/ cm^2 (b) 0. 2 kg/ cm^2/min less then 5kg/ cm^2

(c) 4.8 kg/ cm^2 (d) None of the above

4.126 For releasing Brakes, SAB is rotated -

(a) Toward end panel clockwise (b) Toward trolley in clockwise

(c) Toward trolley in anticlockwise (d) Toward end panel Anti clockwise

4.127 The std. free heights and exert force of BC return spring is -

(a) 600 mm- 200 kg/cm2 (b) 700 mm- 250 kg/cm2

(c) 730 mm- 125 kg/cm2 (d) 800 mm- 100 kg/cm2

4.128 The ELB device indicator plate shows -

(a) Yellow empty, black loaded (b) Blue empty, black loaded

(c) White empty, black loaded (d) black empty, blue loaded

4.129 When isolating handle of KE type DV is kept in horizontal at charging position -

(a) Piston rods of BC come out (b) Piston rod of BC close not come out

(c) Brake applies and releases (d) Nothing happens

4.130 The trouble shooting for branch pipe broken of DV to BC is -

(a) Pipe to be tightened by wire and DV,AR to be isolated followed by manual releasing

(b) Pipe to be tightened by wire,release brake by rotating SAB and run train

(c) Non of the above

4.131 The first step of releasing brake binding in conventional A/B system is to -

(a) Open vent plug of BC (b) Rotate SAB

(c) Take out pin of SAB (d) Isolate DV & release manually.

4.132 The total no. of MU washer in a twin pipe wagon is –

(a) 4 (b) 4 palm & rubber sealing ring

(c) 4 coupling head no washer (d) 6

4.133 The Type of dirt collector, used in wagon is -

(a) 2-way (b) 3-way

(c) Branch pipe of BP to DV (d) In BP

4.134 The trouble shooting for twin pipe system, AR broken is -

(a) Isolate DV and release brake (b) Isolate DV, AR & release brake

(c) Release BC & open vent plug BC (d) By-pass AR

4.135 After isolating DV, handle should be -

(a) Tightened with thread (b) Keep horizontal and tightened with wire

(c) Tightened with wire (d) Open the handle

4.136 The function of double release valve of the DV is -

(a) To release the brake automatically

(b) To release the BC pressure

(c) To release the brake manually when a spring brief pull is given to the lever

(d) To release brake pipe pressure on AR chamber

4.137 The function of Non return valve used in air brake system is -

(a) To prevent flow of BP (b) To prevent flow of air from AR to FP

(c) To prevent flow of Air from CR to BP (d) To prevent CR to be charged

4.138 The function of main valve is to supply requisite amount of pressure into the brake cylinder when-

(a) BP pressure is reduced (b) FP pressure is reduced

(c) BP &FP is also reduced (d) BP pressure is reduced

4.139 The main valve in DV exhausts pressure from brake cylinder to atmosphere, when

(a) BP pressure is reduced (b) BP pressure is raised

(c) FP is reduced (d) FP pressure is raised

4.140 What type of grease to be used after cleaning and inspection all parts of slack adjuster?

(a) Graphite grease (b) Servogan - 2

(c) Servo- germ 4 (d) None of the above

4.141 The function of Return spring provided in air brake cylinder is -

(a) To push the spring out side the piston

(b) To push the piston inside the cylinder

(c) To push the deed lever

(d) To push the control rod

4.142 Air Hoses are connected to-

(a) Feed pipe cut of angle cocks only

(b) Brake pipe cut of angle cocks only

(c) Brake pipe & Feed pipe cut of angle cocks both

(d) None of the above

4.143 If DV is having leakage -

(a) Isolate DV

(b) Close the isolating cock of the AR

(c) Close the isolating cock of the BP/FP branch pipe

(d) None of the above

4.144 'A' dimension is measured between-

(a) SAB barrel & control rod head

(b) SAB nut & control road nut

(c) Anchor pin & Control Rod head

(d) None of the above

4.145 POH periodicity DV is done -

(a) 6 year or 5 Lakh km which ever is earlier

(b) 5 year or 5 Lakh km which ever is earlier

(c) 4 year

(d) 4 year or 4 Lakh km which ever is earlier

4.146 The vent hole, provided in the cut of angle cock to exhaust (when angle cock is closed)-

(a) Air hose side air pressure into atmosphere

(b) Twin pipe side air pressure to atmosphere

(c) None of the above

4.147 In case air brake CC rake are used as mini rakes, Close circuit pattern will be followed with BPC being valid for –

(a) 2000 Km or 20 days Whichever is earlier

(b) 4500 Km or 20 days Whichever is earlier

(c) 6000 Km or 30 days Whichever is earlier

(d) 3000 Km or 10 days Whichever is earlier

CHAPTER 5

BOGIE

5.001 Standard thickness of UIC/CASNUB bogies composite brake block is-

(a) 60 mm (b) 45 mm (c) 55 mm (d) 58 mm

5.002 Permissible thickness of UIC/CASNUB bogies composite brake block is -

(a) 20 mm (b) 10 mm (c) 9.0 mm (d) 8 mm

5.003 Standard clearance between side bearers on UIC stock is-

(a) 3 mm (b) 4 mm (c) 6 mm (d) 5 mm

5.004 Permissible clearance between side bearers on UIC stock is-

(a) 6 mm (b) 4 mm (c) 3 mm (d) 2 mm

5.005 How many types of CASNUB version in Indian Railway have been used?

(a) 4 (b) 6 (c) 10 (d) 7

5.006 What is the permissible variation in a group for load bearing & sunbber spring?

(a) 2.0 mm (b) 3.0 mm (c) 4.0 mm (d) 5.0 mm

5.007 The length of brake block of BOXN wagon is –

(a) 350 mm (b) 400 mm (c) Not specified (d) 450 mm

5.008 Variation in camber between any two spring on a bogie under load should not exceed –

(a) 10 mm (b) 11 mm (c) 13 mm (d) 14 mm

5.009 What is the Std. thickness of brake block of BOXN wagon is –

(a) 52 mm (b) 54 mm (c) 56 mm (d) 58 mm

5.010 How many side frame fitted in CASNUB trolley / bogie?

(a) 2 (b) 1 (c) 3 (d) Nil

5.011 What is the axle load of CASNUB trolley expects CASNUB 22HS?

(a) 19.2 ton (b) 22.9 ton (c) 20.3 ton. (d) 20.9 ton

5.012 What is the new wheel diameter CASNUB 22 w (Retrofitted)?

(a) 1000 mm (b) 960 mm (c) 956 mm (d) 946 mm

5.013 What type of side bearers fitted in CASNUB 22w bogie?

(a) CC type (b) Roller type (c) EM Type

5.014 What type of side bearers fitted in CASNUB 22w(m) bogie?

(a) CC type (b) Spring type (c) Roller type

5.015 What type of pivot used in CASNUB 22w trolley?

(a) IRS type (b) spherical type (c) other type

5.016 What type of pivot used in CASNUB 22w(m), 22NL and other type of CASNUB trolley?

(a) IRS type (b) UIC spherical type (c) other type

5.017 What is the nominal leteral clearance between side frame & bolster in CASNUB 22HS?

(a) 18 mm (b) 10 mm (c) 25 mm (d) 22 mm

5.018 What is the wear limit of axle box/adopter sides (Cylindrical roller bearing) in CASNUB bogie?

(a) 3 mm (b) 2 mm (c) 4 mm (d) 5 mm

5.019 What is the nominal leteral clearance between side frame & bolster in CASNUB 22W, 22WM, 22NL, 22NLB?

(a) 16 mm (b) 11mm (c) 18 mm (d) 20 mm

5.020 What is the nominal longitudinal clearance between side frame & Axle box/adopter of 22W(M) bogie?

(a) 5 mm (b) 8 mm (c) 10 mm (d) 12 mm

5.021 What is the nominal longitudinal clearance between side frame & Axle box/adopter 22W, 22W(Retro) trolley?

(a) 2 mm (b) 4 mm (c) 6 mm (d) Nil

5.022 What is the nominal leteral clearance between side frame & axle box/adopter Casnub 22NL, 22NLB, 22HS bogie?

(a) 18 mm (b) 16 mm (c) 22 mm (d) 25 mm

5.023 What is the standard wheel profile use in CASNUB bogie after the route radius?

(a) 1 in 20 (b) 1 in 22 (c) 1 in 18 (d) 1 in 25

5.024 What is the condemning wheel diameter in all CASNUB versions?

(a) 916 mm (b) 906 mm (c) 936 mm (d) 963 mm

5.025 What the condemning dimension of narrow jaw/wide jaw Adopter thrust shoulder?

(a) 0.4 mm (b) 0.6mm (c) 0.7 mm (d) 0.9 mm

5.026 What the condemning/wear limit of narrow jaw/wide jaw Adopter crown lugs?

(a) 2 mm (b) 4 mm (c) 6 mm (d) 8 mm

5.027 What is the leteral clearance between side frame & Axle box/adopter Casnub 22W, 22W(M)?

(a) 18 mm (b) 16 mm (c) 22 mm (d) 25 mm

5.028 What is the wear limit of axle box/adopter crown seat (Cylindrical roller bearing) in CASNUB bogie?

(a) 2 mm (b) 3 mm (c) 3.5 mm (d) 4.5 mm

5.029 What is the wear limit of axle box/adopter side lugs (Cylindrical roller bearing) in CASNUB bogie?

(a) 2 mm (b) 3 mm (c) 4 mm (d) 5 mm

5.030 What is the new renewal/dimension of axle box sides (Cylindrical roller bearing) in CASNUB bogie?

(a) 270 mm (b) 264 mm (c) 266 mm (d) 268 mm

5.031 What the worn/condemning dimension of axle box sides (Cylindrical roller bearing) in CASNUB bogie?

(a) 266 mm (b) 262 mm (c) 264 mm (d) 260 mm

5.032 What is the new renewal/dimension of axle box side lugs (Cylindrical roller bearing) in CASNUB bogie?

(a) 136 mm (b) 134 mm (c) 130 mm (d) 132 mm

5.033 What is the new/renewal dimension of wide jaw adopter crown lugs?

(a) 155mm (b) 156mm (c) 154 mm (d) 152 mm

5.034 What the worn/condemning dimension of axle box/adopter side lugs (Cylindrical roller bearing) in CASNUB bogie

(a) 136 mm (b) 140 mm (c) 132 mm (d) 134 mm

5.035 What is the new renewal/dimension of axle box crown seat (Cylindrical roller bearing) in CASNUB bogie?

(a) 32.5 mm (b) 36.5 mm (c) 37.5 mm (d) 38.5 mm

5.036 What the worn/condemning dimension of axle box crown seat (Cylindrical roller bearing) in CASNUB bogie?

(a) 32 mm (b) 31mm (c) 33 mm (d) 34 mm

5.037 What is the new renewal/dimension of axle box crown lugs (Cylindrical roller bearing) in CASNUB bogie?

(a) 160 mm (b) 159 mm (c) 158 mm (d) 157 mm

5.038 What is the new/renewal dimension of narrow jaw adopter crown lugs?

(a) 154.5 mm (b) 155.5 mm (c) 156.5 mm (d) 157.5 mm

5.039 What is the wear limit of wide/narrow jaw adopter crown seat?

(a) 2.5 mm (b) 3.5 mm (c) 4.5 mm (d) 5.5 mm

5.040 What is the new/renewal dimension of wide jaw adopter bore seat to crown seat?

(a) 46.5mm (b) 47.5mm (c) 48.5 mm (d) 49.5 mm

5.041 What is the new/renewal dimension of narrow jaw adopter bore seat to crown seat?

(a) 25.2 mm (b) 26.2 mm (c) 28.5 mm (d) 27.5 mm

5.042 What is the new/renewal dimension of modified wide jaw adopter bore seat to crown seat?

(a) 20.5 mm (b) 25.5 mm (c) 30.5 mm (d) 35.5 mm

5.043 What the worn/condemning dimension of axle box crown lugs (Cylindrical roller bearing) in CASNUB trolley?

(a) 165 mm (b) 166 mm (c) 167 mm (d) 168 mm

5.044 Worm limit of wide jaw adopter bore seat to crown seat is-

(a) 45 mm (b) 247 mm (c) 48 mm (d) 49 mm

5.045 Worm/condemning limit of modified wide jaw adopter bore seat to crown seat is-

(a) 25 mm (b) 22 mm (c) 27 mm (d) 29 mm

5.046 Worm/condemning limit of narrow jaw adopter bore seat to crown seat is-

(a) 20 mm (b) 22.5 mm (c) 22.7 mm (d) 24.5 mm

5.047 How many type of adopters used in CASNUB trolley?

(a) 2 (b) 1 (c) 3 (d) 4

5.048 What is the wear limit of wide/narrow jaw adopter side lugs?

(a) 1.0 mm (b) 3.0 mm (c) 5.0 mm (d) 2.0 mm

5.049 New/Renewal dimension of wide jaw adopter side lugs is -

(a) 130 mm (b) 132 mm (c) 134 mm (d) 131mm

5.050 New/Renewal dimension of narrow jaw adopter side lugs is -

(a) 100 mm (b) 97 mm (c) 99 mm (d) 92 mm

5.051 Worm/condemning limit of wide jaw adopter side lugs is -

(a) 140 mm (b) 136 mm (c) 134 mm (d) 132 mm

5.052 Worm/condemning limit of narrow jaw adopter side lugs is -

(a) 101 mm (b) 102 mm (c) 103 mm (d) 104 mm

5.053 The condemning size of BK block of goods stock is -

(a) 30 mm (b) 10 mm (c) 20 mm (d) 15 mm

5.054 Free camber of 10 plated laminated spring of BOX type wagon is -

(a) 47+6/-0 mm (b) 49 mm (c) 52 mm (d) 58 mm

5.055 Free camber of 13 plated laminated spring used to IRS type four-wheeled stock is –

(a) 75.5 mm (b) 76+6/-0 mm (c) 78.2 mm (d) 51.5 mm

5.056 Free camber of 9(Nine) plated laminated spring used to CRT wagon is -

(a) 55 mm (b) 57 mm (c) 58 mm (d) 59 mm

5.057 Nominal free height of inner spring of Casnub bogie except 2HS is –

(a) 260 mm (b) 262 mm (c) 264 mm (d) 266 mm

5.058 Clearance along the length of shackle pin assembly with shackle plate, scroll Iron, spring eye and cotter for vacuum brake stock is -

(a) Max. 1.5 mm (b) Max 2.00 mm (c) Max 2.5-mm (d) Max. 3 mm

5.059 What is the clearance between shackle pin diameter and shackle plate hole?

(a) Max. 1.5 mm (b) max 2.00 mm (c) max 1.0-mm (d) max. 2.5 mm

5.060 What is the nominal thickness of elastomeric pad of Casnub bogie?

(a) 49 mm (b) 46 mm (c) 48 mm (d) 52 mm

5.061 Condemning size of elastomeric pad for Casnub bogie is -

(a) 44 mm (b) 43 mm (c) 42 mm (d) 40 mm

5.062 Nominal dimension of side bearer rubber pad for Casnub bogie is -

(a) 114 mm (b) 116 mm (c) 118 mm (d) 120 mm

5.063 Condemning size of side bearer rubber pad for Casnub bogie is -

(a) 111 mm (b) 110 mm (c) 109 mm (d) 108 mm

5.064 IS– spec of lubricant used to lubricate center pivot of the Casnub trolley?

(a) IS: 495 (b) IS: 449 (c) IS :455 (d) None of the above

5.065 Maintenance manual of Casnub bogie is –

(a) G 97 (b) G 80 (c) G 95 (d) G 72

5.066 The nominal inside length of the shackle for BOX bogie is –

(a) 330±1 mm (b) 332+1/-0 mm (c) 333±2 mm (d) 325±1 mm

5.067 New dimension of side frame anti-Rotation lug for all Casnub bogie is –

(a) 520 mm (b) 522 mm (c) 524 mm (d) 528 mm

5.068 New pedestal crown roof for 22NL/NLB/HS Casnub bogie is –

(a) 300 mm (b) 320 mm (c) 323 mm (d) 330 mm

5.069 For BOX/UIC wagons, condemning limit of lateral clearance between axle box lug and horn Check is -

(a) 25 mm (b) 28 mm (c) 23 mm (d) 20 mm

5.070 The new limit of lateral clearance available between spring buckle and horn gap stiffener for UIC bogie is –

(a) 28 mm (b) 25 mm (c) 30 mm (d) 32 mm

5.071 What is the wear limit of axle box crown lugs (cylindrical roller bearing) in CASNUB bogie?

(a) 2 mm (b) 3 mm (c) 4 mm (d) 5 mm

5.072 Thickness of 10-platted bearing spring plate for BOX bogie is –

(a) 16+0.32/-0.24 mm (b) 18+3.0/-2.0 (c) 15+0.32/-0.24 (d) 17+0.32/-0.24

5.073 For BOX/ UIC wagons, the new limit of nominal lateral clearance between axle box lug and horn Check is -

(a) 25 mm (b) 23 mm (c) 28 mm (d) 20 mm

5.074 Condemning dimension of side frame anti-Rotation lug for all Casnub bogies is –

(a) 530 mm (b) 522 mm (c) 528 mm (d) 524 mm

5.075 Length of 10 platted bearing spring for BOX bogie is –

(a) 1205±3 mm (b) 1200±3 mm (c) 1155±3 mm (d) 1185±3 mm

5.076 Size of eye 10 platted bearing spring for BOX bogie is –

(a) 34+1/-0 mm (b) 33±2 mm (c) 36+1/-0 mm (d) 38±2 mm

5.077 Wear limit of pedestal sides for Casnub bogie is –

(a) 1 mm (b) 2 mm (c) 4 mm (d) None of the above

5.078 New dimension of all Casnub bogie crown sides is –

(a) 151 mm (b) 152 mm (c) 154 mm (d) 155 mm

5.079 New dimension of 22W, 22W(M) Casnub bogie pedestal sides is –

(a) 100 mm (b) 105 mm (c) 110 mm (d) None of the above

5.080 New dimension of 22 NL/NLB/HS Casnub bogie pedestal sides is –

(a) 80 mm (b) 85 mm (c) 81 mm (d) 82 mm

5.081 Wear limit of pedestal crown roof for Casnub bogie is –

(a) 4 mm (b) 5 mm (c) 6 mm (d) 3 mm

5.082 New pedestal crown roof for 22W(M) Casnub bogie is –

(a) 310 mm (b) 318 mm (c) 320 mm (d) 322 mm

5. 083 Distance between new pedestal jaw (long) of Casnub bogie is –

(a) 230 mm (b) 232 mm (c) 234 mm (d) 236 mm

5.084 Wear limit of pedestal jaw (long) of 22NL/NLB/HS Casnub bogie is –

(a) 2 mm (b) 3 mm (c) 4 mm (d) 5 mm

5.085 Distance between new pedestal jaw (short) of 22NL/NLB/HS Casnub bogie is-

(a) 182 mm (b) 186 mm (c) 188 mm (d) 190 mm

5.086 New dimension of pedestal jaw for Casnub 22W, 22W(Retro) bogie is –

(a) 270 mm (b) 272 mm (c0 268 mm (d) 190 mm

5.087 New dimension of pedestal jaw for Casnub 22W(M) bogie is –

(a) 270 mm (b) 274 mm (c) 278 mm (d) 290 mm

5.088 Wear limit of crown sides for Casnub bogie is –

(a) 4.0 mm (b) 3.0 mm (c) 2.0 mm (d) 5.0 mm

5.089 New dimensions of bolster column inner gibs of all Casnub bogies are –

(a) 144 mm (b) 136 mm (c) 138 mm (d) 132 mm

5.090 Wear limit of bolster column inner gibs of all Casnub bogies are –

(a) 2.0 mm (b) 5.0 mm (c) 6.0 mm (d) 8.0 mm

5.091 New dimensions of over bolster land surface of all Casnub bogies are –

(a) 444 mm (b) 446 mm (c) 448 mm (d) 450 mm

5.092 New dimension of over rotation stop lugs of all Casnub bogies are –

(a) 516 mm (b) 518 mm (c) 520 mm (d) 522 mm

5.093 Wear limit of bolster land surface of all Casnub bogies are –

(a) 2.0 mm (b) 3.0 mm (c) 5.0 mm (d) 7.0 mm

5.094 Wear limit of bolster rotation stop lug of all Casnub bogies are –

(a) 1.0 mm (b) 2.0 mm (c) 3.0 mm (d) 5.0 mm

5.095 Nominal free height of snubber spring of Casnub bogie except 22 HS is –

(a) 260 mm (b) 270 mm (c) 282 mm (d) 294 mm

5.096 Nominal free height of inner spring of Casnub 22 HS bogie is –

(a) 261 mm (b) 252 mm (c) 243 mm (d) 246 mm

5.097 Nominal free height of sunbber spring of Casnub 22 HS bogie is –

(a) 291 mm (b) 294 mm (c) 296 mm (d) 293 mm

5.098 New dimension of bolster column outer gibs of Casnub bogie is -

(a) 224 mm (b) 234 mm (c) 243 mm (d) 246 mm

5.099 New dimension of bolster column outer gibs of Casnub 22HS bogie is –

(a) 232 mm (b) 236 mm (c) 241 mm (d) 243 mm

5.100 Wear limit of bolster column outer gibs of Casnub bogie is –

(a) 2.0 mm (b) 3.0 mm (c) 5.0 mm (d) 6.0 mm

5.101 New dimension of friction shoes wedge block of Casnub bogie is –

(a) 60 mm (b) 62 mm (c) 63 mm (d) 61 mm

5.102 Condemning dimension of friction shoes wedge block of Casnub bogie is –

(a) 54 mm (b) 56 mm (c) 58 mm (d) 8.0 mm

5.103 Wear limit of vertical surface in friction shoes wedge block of Casnub bogie is –

(a) 5.0 mm (b) 6.0 mm (c) 7.0 mm (d) 8.0 mm

5.104 Wear limit of slope surface in friction shoes wedge block of Casnub bogie is –

(a) 1.0 mm (b) 2.0 mm (c) 3.0 mm (d) 4.0 mm

5.105 Nominal free height of outer spring of Casnub bogie is –

(a) 260 mm (b) 262 mm (c) 264 mm (d) 266 mm

5.106 What type of side bearers fitted in CASNUB 22HS trolley?

(a) Metal CC type (b) Spring loaded CC type side bearer & PU type

(c) Roller type (d) none of the above

5.107 Which types of steel are used in side frame column friction plates of Casnub bogie?

(a) Mild steel (b) Carbon steel

(c) Silico manganese steel (d) None of the above

CHAPTER 6

VACUUM

6.01 What is the period/interval of over hauling Vacuum Brake cylinder?

(a) 15-24 months (b) 18-24 months (c) 24-36 months (d) none of the above

6.02 What is the validity of BPC for vacuum brake system?

(a) 1000 Km. (b) 800 Km. (c) 1200 Km. (d) 600 Km.

6.03 The maximum Leakage rate while turning out Loco from shed-

(a) 7 Cm/Min. (b) 5 Cm/Min. (c) 10 Cm/Min. (d) 8 Cm/Min.

6.04 The atmospheric air pressure is -

(a) 1.303 Kg/ Cm^2 (b) 2.5 Kg/ Cm^2 (c) 1.9 Kg/ Cm^2 (d) 1.03 Kg/Cm^2

6.05 The vacuum brake system is dependent on 51cm of vacuum which given pressure of -

(a) 0.9 kg/ Cm^2 (b) 0.7 kg/ Cm^2 (c) 0.1 kg/ Cm^2 (d) 02 kg/ Cm^2

6.06 The air pressure required in loco for leakage test in vacuum brake system is -

(a) 2.0 kg/ Cm^2 (b) 5.0 kg/ Cm^2 (c) 7.0 kg/ Cm^2 (d) 10.0 kg/ Cm^2

6.07 The capacity of reservoir for 560- mm ‘F’ type vacuum cylinder is -

(a) 0.1596 cu.m (b) 0.226 cu.m (c) 0.1896 cu.m (d) 0.1926 cu.m

6.08 The total height of the pan for 457-mm ‘F’ type vacuum cylinder is –

(a) 150 mm (b) 160 mm (c) 140 mm (d) 130 mm

6.09 Vacuum cylinder is divided into two chambers by -

(a) Release valve (b) Piston rod (c) Rolling ring (d) Joint ring

6.10 In four wheels Tank wagon, the diameter & No. of vacuum cylinder is/are -

(a) 457 mm 'E' type-2 (b) 457 mm 'E' type-I (c) 533 mm 'E' type-I

6.11 During creation of Vac./Application of brakes, the 'F' type vacuum cylinder of 560-mm diameter reservoir is directly connected to -

(a) Release valve (b) train pipe (c) Upper chamber (d) Lower chamber

6.12 The no. of cylinder in 533 mm diameter 'F' type in BRH wagon is -

(a) 2 (b) 3 (c) 4 (d) 1

6.13 The Colour of BPC of vacuum brake system is –

(a) Rad (b) Green (c) Yellow (d) Pink

6.14 For inspection of hose pipe & siphon pipe it is essential to create vacuum is -

(a) 460 mm (b) 400 mm (c) 225 mm (d) 255 mm

6.15 The type of SAB used in vacuum brake wagon is -

(a) DRV-2-600 (b) DRV-2-450 (c) DRV-2-300 (d) None of the above

6.16 The diameter of rolling ring for 560 mm 'F' type vacuum cylinder is -

(a) 13.1-17.5 mm (b) 13.1-13.5 mm (c) 12.1-127.5 mm (d) 10.1-11.2 mm

6.17 Which type of vacuum cylinder used in BOB, BOBS, BOBX wagon?

(a) E-457 type (b) E- 533 type (c) F- 560 type (d) F-610 type

6.18 Which type of vacuum cylinder used in all 16-ton axles loads wagons except BVG, BVH?

(a) E- 457 type (b) E- 533 type (c) F-533 type (d) F-560 type

6.19 560-mm vacuum cylinder means it is diameter of -

(a) Barrel (b) Piston head (c) Lower pan (d) Vac. cylinder

6.20 The machine required for testing of vacuum brake system -

(a) Compressor (b) Vacuum pump (c) Exhauster (d) AC machine

6.21 For testing of loco vacuum, diameter of hole of the test plate is -

(a) 6mm (b) 7.5mm (c) 8 mm (d) 8.5 mm

6.22 The validity period for examined empty UIC rake/Vacuum brake BPC to reach the loading point is –

(a) One day (b) Two day (c) Three day (d) Four day

6.23 The size of ball valve passage in vacuum brake cylinder is –

(a) 6.0 mm (b) 8.0 mm (c) 10 mm (d) 11 mm

6.24 In vacuum brake, Minimum clearance bolster stuffing box & crank shaft after destruction of vacuum is –

(a) 35 mm (b) 20 mm (c) 25 mm (d) 30 mm

6.25 What is the shape of the barrel in vacuum brake cylinder?

(a) Square (b) Semi Sparical (c) Sparical (d) Cylindrical

6.26 SAB DRV –2 600 is fitted on-

(a) WGSCM (b) BOX (c) WGS (d) BKH

6.27 In Which type of vacuum cylinder it is easy to change the rolling ring is?

(a) 'F' type (b) 'E' type (c) 'B' type (d) None of the above

6.28 Standard dimension 'A' in SAB on BOX wagons is -

(a) 50 mm (b) 52 mm (c) 55 mm (d) 85 mm

6.29 Permissible dimension 'A' on BOX wagons is -

(a) 52 mm (b) 50 mm (c) 55 mm (d) 51 mm

6.30 Standard dimension of piston stroke in empty condition in BOX wagon is -

(a) 150 mm (b) 130 mm (c) 90 mm (d) 110 mm

6.31 Standard dimension of Piston stroke of loaded condition in Box-wagon is -

(a) 130 mm (b) 150 mm (c) 110 mm (d) 180 mm

6.32 The BPC of ballast train is valid for -

(a) 3 day (b) 7 day (c) 15 day (d) 30 day

6.33 What minimum distance is being maintained between adjacent two tracks for intensive examination?

(a) At least 3m (b) At least 3.5 m (c) At least 4.0 m (d) At least 2.0 m

6.34 What is the allowed leakage rate of one wagon in vacuum brake in one min.?

(a) Not more then 70 mm (b) Not more then 20 mm

(c) Not more then 50 mm (d) Not more then 30 mm

6.35 What is the allowed leakage rate of one rake in vacuum brake in one min.?

(a) Not more then 100 mm/min. (b) Not more then 130 mm/min.

(c) Not more then 150 mm/min. (d) Not more then 180 mm/min.

6.36 In the 'F' type vacuum cylinder of 560-mm diameter release valve used is -

(a) Double branch release valve 'F' (b) Single branch release valve 'E'

(c) Single branch release valve 'F' (d) None of the above

6.37 In the 'E' type vacuum cylinder of 533-mm diameter release valve used is -

(a) Single branch release value 'E' (b) Single branch release value 'F'

(c) Double branch release value 'E' (d) None of the above

6.38 In working train, what is the standard level of vacuum in goods train?

(a) 53 Cm and 47 Cm b) 50 Cm and 44 Cm

(c) 55 Cm and 50 Cm d) 46 Cm and 38 Cm

6.39 In Box wagon, the diameter & no. of vacuum cylinder is/are -

(a) 610 mm 'E' type-2 (b) 610 mm 'F' type-2

(c) 560 mm 'F' type-2 (d) 533 mm 'F' type-2

6.40 In vacuum brake system the train pipe is connected by -

(a) Grip seal joint (b) Flange joint

(c) Thread coupling & 'T' joint (d) Welding joint

6.41 Swan neck is fitted on train pipe at -

(a) Centre of train pipe (b) Joint of train pipe

(c) None of the above (d) End of train pipe

6.42 Vacuum cylinder is divided between two chambers are -

(a) Left chamber & Right chamber (b) Upper chamber & lower chamber

(c) Chamber 90 Degree & 60-degree (d) Chamber 90 degree & 90-degree chamber

6.43 The vacuum brake testing procedure is called as –

(a) Single car-testing (b) Balance vacuum testing

(c) Ultra sound testing (d) Single wagon test ring

6.44 The hose pipe are connected to each other with the help of -

(a) Coupling head (b) Palm end

(c) Universal coupling (d) None of the above

6.45 Which type of vacuum cylinder use in BWL, BWT wagon is -

(a) 533m ‘F’ type (b) 533 mm ‘E’ type

(c) 560 mm ‘F’ type (d) 610mm ‘F’ type

6.46 The Syphon pipe is fitted on vacuum brake -

(a) Between release valve & train

(b) Between release valve & vac. reservoir

(c) Vac. reservoir & van reservoir

(d) None of the above

6.47 In vacuum brake at release position, free lift is essential between -

(a) Stuffing box & crank arm head of 25mm

(b) 13 mm between Fork of crank arm & piston rod cotter

(c) Piston rod & pin of 25 mm

(d) None of the above

NOTES

CHAPTER 7

UNDER FRAME/ BODY

7.01 The inside length (riveted) tolerance permitted in the new wagon construction is -

(a) ± 5 mm (b) ± 3 mm (c) ± 4.5 mm (d) ± 2.5 mm

7.02 The inside length (welded) tolerance permitted in the new wagon construction is -

(a) +8/-3 mm (b) +7/-3 mm (b) +5/-3 (d) +3/-0 mm

7.03 The inside width tolerance are permitted in the new wagon construction is -

(a) ± 3 mm (b) ± 5 mm (c) ± 7 mm (d) ± 2 mm

7.04 The inside height tolerance permitted in the new wagon construction is -

(a) ± 5 mm (b) ± 3.5 mm (c) ± 3 mm (d) ± 4 mm

7.05 In new wagon construction what shell be the tolerance between bogie pivot centers (riveted)?

(a) ± 1 mm (b) ± 1.5mm (c) ± 2 mm (d) ± 3 mm

7.06 In new wagon construction what shell be the tolerance between bogie pivot centers (welded)?

(a) +5/ -2 mm (b) +3/-2 mm (c) +7/-5 mm (d) +15/-0 mm

7.07 In new wagon construction what is the door opening (vertical or horizontal) tolerances permitted?

(a) +2/-0 mm (b) +0/-3 mm (c) +3/-0 mm (d) +5/-4 mm

7.08 In new wagon, what is the door length tolerance permitted?

(a) +2/-3 mm (b) +4/-3 mm (c) +5/-0 mm (d) +0/-5 mm

7.09 In new wagon, what is the door width tolerance permitted?

(a) +5/-0mm (b) +0/-5 mm (c) +0/-3 mm (d) +3/-0 mm

7.10 What shall be tolerance permitted between door centerline to centerline of door hinge in a new wagon?

(a) +2/-1 mm (b) +2.5/-1.5 mm (c) ± 1.5 mm (d) ± 2.5 mm

7.11 What shall be the tolerance on dimensions of length of barrel measured over the center of non-pressure tank wagon?

(a) +10/-5 mm (b) +10/-3 mm (c) +15/-10 mm (d) +5/-10 mm

7.12 What shall be the tolerance of non-pressure tank wagon barrel diameter including ovality?

(a) ± 3 mm (b) ± 4 mm (c) ± 5 mm (d) None of the above

7.13 What shall be the tolerance on dimension of inside dia of main hole of non- pressure tank wagon barrels?

(a) ± 4 mm (b) ± 5 mm (c) ± 3 mm (d) ± 3.5 mm

7.14 The box bogie is designed for an axle load is -

(a) 22.1 t (b) 20.3 t (c) 21.9 t (d) 16.8 t

7.15 How many bearing springs used in primary suspension for UIC bogie -

(a) 4 (b) 6 (c) 8 (d) 10

7.16 For UIC trolley, the thickness of sole plate is -

(a) 4 mm (b) 6 mm (c) 8 mm (d) 10mm

7.17 What type of electrode is used in drew bar reclamation?

(a) B & E type (b) D & B type (c) D & E type (d) A & E type

7.18 The primary lock clearance of BOBR door is –

(a) 3 mm (b) 5 mm (c) 7 mm (d) 4 mm

NOTES

CHAPTER 8

TANK WAGON

8.01 Pay load of BTPN tank wagon is –

(a) 58.88 tons (b) 54.28 tons (c) 55.80 tons (d) 52.3 tons

8.02 Axle load of BTPN tank wagon is –

(a) 20.32 tons (b) 22.35 tons (c) 21.35 tons (d) 25.22 tons

8.03 Cleaning of bitumen barrel is carried out with –

(a) Kerosene oil (b) patrol (c) ledium (d) None of the above

8.04 Inspection of thickness of H_2SO_4 barrel carried out with –

(a) D- meter (b) C- meter (c) L- meter (d) MN – meter

8.05 Barrel length of BTPN tank wagon is –

(a) 11460 mm (b) 11550 mm (c) 11458 mm (d) 12100 mm

8.06 Barrel diameter of BTPN tank wagon is –

(a) 2860 mm (b) 2850 mm (c) 2840 mm (d) 2830 mm

8.07 Distance between copular to coupler of BTPN tank wagon is –

(a) 12420 mm (b) 12560 mm (c) 12600 mm (d) 12345 mm

8.08 During Hydraulic testing of master valve of tank wagon, the water to be filled up to be –

(a) 130 Cm (b) 150 Cm (c) 180 Cm (d) 200 Cm

8.09 Thickness of rubber lining of fragile disc and safety bent is –

(a) 3 mm (b) 5 mm (c) 4 mm (d) 6 mm

8.10 Distance between Headstock to Headstock of BTPN tank wagon is –

(a) 11499 mm (b) 11569 mm (c) 11491 mm (d) 11591 mm

8.11 What is the inside barrel diameter of the TPGLR tank wagon?

(a) 2100 mm (b) 2230 mm (c) 2300 mm (d) 2330 mm

8.12 Length over Headstock of the TPGLR tank wagon is -

(a) 9252 mm (b) 8382 mm (c) 9632 mm (d) 4326 mm

8.13 Tare weight of the TPGLR tank wagon is -

(a) 17.82 t (b) 17.32 (c) 18.2 t (d) 17.1 t

8.14 The mechanical code of bogie Patrol tank wagon fitted with pneumatic brake is -

(a) BTPAN (b) LBM (c) LBM (d) LCT

8.15 The mechanical code of bogie Liquefied anhydrous ammonia gas tank wagon is -

(a) BTAL &BTALN (b) TBS & BTSA (c) AST & TSMBA (d) TBT& MBTOX

8.16 The mechanical code of caustic soda tank wagon is -

(a) CTB & CTBS (b) TCS & BTCS (c) THA & BTCS (d) TCS& MBTS

8.17 The mechanical code of Lubricating oil tank wagon is -

(a) MBTOV (b) TORX (c) TRP (d) BTCS

8.18 The mechanical code of bitumen tank wagon type is -

(a) TBT (b) TBAT (c) TRP (d) TPR

8.19 No of safety valves fitted in sulphuric acid tank is -

(a) One (b) Two (c) Three (d) None of the above

8.20 No. of pressure release valve fitted in sulphuric acid tank is -

(a) One (b) Two (c) Three (d) None of the above

8.21 No. of safety valve fitted in liquefied petroleum gas tank is -

(a) One (b) Two (c) Three (d) None of the above

8.22 Codal life of Tank wagon is -

(a) 35 year (b) 45 year (c) 50 year (d) 25 year

8.23 No of safety vent with frangible disc fitted in sulphuric acid tank wagon is -

(a) One (b) Two (c) Three (d) None of the above

8.24 How many no of safety vent with frangible disc fitted in liquid chlorine tank wagon is -

(a) One (b) Two (c) Three (d) None of the above

8.25 What is the hydraulic test pressure in the barrel of chlorine tanks wagon?

(a) 43.7 kg/ Cm^2 (b) 47.8 kg/ Cm^2 (c) 41.23 kg/ Cm^2 (d) 49.93 kg/ Cm^2

8.26 What is the hydraulic test pressures in a barrel of LPG tanks wagon?

(a) 26.36kg/ Cm^2 (b) 23.7 kg/ Cm^2 (c) 28.33 kg/ Cm^2 (d) 33.23 kg/ Cm^2

8.27 In the tank wagon, close the master valve after -

(a) Un loading (b) Loading (c) Running (d) None of the above

8.28 In the tank wagon, close the vapour extractor cock after -

(a) Un loading (b) Loading (c) Running (d) None of the above

8.29 What is the estimated weight of Phosphoric acid tank barrel?

(a) 6.54 t (b) 7.54 t (c) 7.12 t (d) 8.27 t

8.30 The diameter of master valve of BTPN tank wagon is –

(a) 90 mm (b) 100 mm (c) 110 mm (d) 200 mm

8.31 What is the density of LPG at 55º C?

(a) 0.470 to 0.499 (b) 0.499 to 0.677 (c) 0.677 to 0.899 (d) 0.899 to 0.999

8.32 Thickness of barrel plate (Cylindrical portion) of BTPGL tank barrel is-

(a) 10 mm (b) 12 mm (c) 15 mm (d) 18 mm

8.33 Thickness of barrel plate (Dished ends) of BTPGL tank barrel is –

(a) 10 mm (b) 12 mm (c) 15 mm (d) 17 mm

8.34 Volumetric capacity of BTALN tank barrel is –

(a) 60.66 Cu.m (b) 66.60 Cu.m (c) 70.33 Cu.m (d) 71.12 Cu.m

8.35 Corrosion allowance of BTALN tank barrel is –

(a) 1.0 mm (b) 1.5 mm (c) 2.0 mm (d) 2.5 mm

8.36 What type of brake system used in BTAL tank wagon?

(a) Air brake (b) Vacuum brake (c) Bogie mounted brake (d) Duel brake

8.37 Volumetric capacity of Liquefied Chlorine tank barrel is –

(a) 15.22 Cu.m (b) 12.175 Cu.m (c) 14.22 Cu.m (d) 17.15 Cu.m

8.38 Overall width of Liquid Chlorine tank wagon is –

(a) 2708 mm (b) 2705 mm (c) 2805 mm (d) 2900 mm

8.39 Working pressure of BTPN safety valve is –

(a) 1.4 Kg/cm^2 (b) 4.1 Kg/cm^2 (c) 2.1 Kg/cm^2 (d) 1.2 Kg/cm^2

8.40 Bogie centers of Phosphoric acid tank wagon are –

(a) 8000 mm (b) 8400 mm (c) 8800 mm (d) 8900 mm

8.41 Interval of POH in four-wheel tank wagon is –

(a) 4.5 and 3.5 year (b) 4.0 and 3.5 year

(c) 3.0 and 4.0 year (d) 4.0 and 5.0 year

8.42 Interval of POH in TCL and THA tank wagon is –

(a) 2.0 year (b) 5.5 year

(c) 3.5 year (d) 4.0 year

8.43 Interval of ROH in BTPN tank wagon is –

(a) 16 month (b) 20 month

(c) 18 month (d) 24 month

8.44 Cleaning of H_2SO_4 tank wagon is carried out with –

(a) 1.9 to 2 % Sodium phosphate (b) 0.5 to 1 % Sodium phosphate

(c) 2 to 3% Sodium phosphate (d) None of the above

8.45 Air tightens test pressure of master valve is –

(a) 0.35 to .056 kg/ Cm^2 (b) 0.45 to 0.65 kg/ Cm^2

(c) 0.65 to 0.75 kg/ Cm^2 (d) None of the above

8.46 What is the type of coupler used in BTPGL tank wagon?

(a) Screw coupling (b) HT coupling

(c) NT coupling (d) Transition CBC Knuckle type

8.47 Hydraulic Testing of BTAL, BTALN tank barrel is carried at –

(a) 58 kg/ Cm^2 (b) 55.5 kg/ Cm^2

(c) 56.3 kg/ Cm^2 (d) 59.0 kg/ Cm^2

8.48 Hydraulic Testing of TCL tank barrel is carried out at –

(a) 44.5 kg/ Cm^2 (b) 48.3 kg/ Cm^2

(c) 47.3 kg/ Cm^2 (d) 43.7 kg/ Cm^2

8.49 What is the location of safety valves fitted in liquefied petroleum gas tank wagon?

(a) Inside dome (b) Outside dome

(c) Outside on barrel (d) None of the above

8.50 What is the location of safety valve fitted in caustic soda tank wagon?

(a) Inside dome (b) Outside dome

(c) Outside on barrel (d) None of the above

8.51 What is the location of safety valve fitted in sulphuric acid tank wagon?

(a) Inside dome (b) Outside dome

(c) Outside on barrel (d) None of the above

NOTES

CHAPTER 9

CONTAINER WAGON

9.01 Condemning limit of BLC wheel set is –

(a) 900 mm (b) 800 mm (c) 670 mm (d) 780 mm

9.02 Maximum height of side frame from Rail level of container bogie type LCCF 20 (C) trolley is –

(a) 851 mm (b) 715 mm (c) 932 mm (d) 786 mm

9.03 In BLC wagon, width over sole bar at centre line wagon is –

(a) 2200 mm (b) 2100 mm (c) 2150 mm (d) 2180 mm

9.04 For lifting the container, force required to lift the container on automatic twist lock is-

(a) 1050 Kg (b) 1000 Kg (c) 1100 Kg (d) 11590 Kg

9.05 How many load side bearers are fitted in BLC wagon?

(a) 4 (b) 6 (c) 5 (d) 2

9.06 What is the measurement of ‘A’ dimension of BFKI?

(a) 65±5 mm (b) 67±3 mm (c) 60+2 mm (d) 58+3 mm

9.07 In place of empty load box what device is used in BLC wagon?

(a) BSD (b) LSD (c) SDF (d) SAB

9.08 As per RDSO standard what shall be the Max. Allowed speed of BFKI?

(a) 75 Km/h (b) 80 Km/h (c) 100 Km/h (d) 110Km/h

9.09 What is the material specification of BLC wagon trolley?

(a) Cast steel (b) Low cast steel (c) Steel (d) Micro steel

9.10 At the time of load distribution what is the percentage of load come on centre pivot?

(a) 10% (b) 15% (c) 20% (d) 25%

9.11 Length of over Slack less draw bar for B-car of BLC wagon is –

(a) 14566 mm (b) 13156 mm (c) 12212 mm (d) 14763 mm

9.12 What shall be maximum length of container platform in BLC wagon?

(a) 30 feet (b) 28 feet (c) 299 feet (d) 32 feet

9.13 The standard height of platform for BLC wagon from Rail level is –

(a) 1010 mm (b) 1015 mm (c) 1009 mm (d) 1100 mm

9.14 The axle load capacity of BLC wagon is –

(a) 20.10 ton. (b) 20.32 ton. (c) 21.10 ton. (d) 23.10 ton.

9.15 The tare weight of A-car of BLC wagon is –

(a) 21.20 ton. (b) 19.10 ton. (c) 19.80 ton. (d) 20.22 ton.

9.16 The tare weight of B- car of BLC wagon is –

(a) 18.10 ton. (b) 19.10 ton. (c) 19.80 ton. (d) 20.20 ton.

9.17 Length of over Headstock to Headstock for A-car of BLC wagon is –

(a) 13650 mm (b) 13625 mm (c) 13555 mm (d) 13365 mm

9.18 In BLC wagon, height of slackness drowbar system from Rail level is –

(a) 890 mm (b) 848 mm (c) 845 mm (d) 910 mm

9.19 Length of over coupler for A-car of BLC wagon is –

(a) 14566 mm (b) 14556 mm (c) 14655 mm (d) 14255 mm

9.20 How many automatic twist locks used in BLC wagon?

(a) 6 (b) 8 (c) 10 (d) 12

9.21 Distance between bogie centers of BLC wagon is –

(a) 9678 mm (b) 9687 mm (c) 9765 mm (d) 9675 mm

9.22 Height of side frame bottom from Rail level of container bogie type LCCF 20 (C) trolley is –

(a) 149 mm (b) 156 mm (c) 178 mm (d) 123 mm

9.23 Rake carrying capacity of the BLC wagon is –

(a) 40 wagons 90 TEUs (b) 45 wagons 90 TEUs

(c) 40 wagons 80 TEUs (d) 48 wagons 90 TEUs

9.24 Which type of side bearer arrangement used in BLC trolley?

(a) Elestromatic (b) constant contact type

(c) Spring loaded side bearer (d) None of the above

9.25 Which type of trolley used in BLC wagon?

(a) UIC trolley (b) Cast steel bogie type LCCF 20 (C)

(c) IRS trolley (d) Diamond frame trolley

9.26 For automatic locking & for lifting of automatic twist lock how much force is Kg required, respectively?

(a) 600 & 1000 Kg (b) 800 & 1200 Kg

(c) 1000 & 500 Kg (d) 500 & 1350 Kg

9.27 What type of roller bearing used in BLC wagon?

(a) Cartage type (b) tapered two-row cartridge roller bearing

(c) Sparical type (d) plan bearing

9.28 What is the loading capacity of containers in BLC wagon?

(a) Two 20' or one 40' (b) Two 22' or one 45'

(c) Three 15' or two 20' (d) Two 20' or one 45'

9.29 Name the type of coupling used in BLC wagon?

(a) CBC & SLD (b) HT CBC

(c) Screw coupling (d) Slackness drew bars

CHAPTER 10

ABBREVIATIONS

WRITE THE FULL FORMS OF THE FOLLOWING: -

1 ART

2 AAR

3 AR

4 ARME

5 BKH

6 BVZI

7 BOY

8 BOBX

9 BOBC

10 BOXC

11 BOXR

12 BOXS

13 BOXT

14 BOI

15 BC

16 BCXR

17 BCXT

18 BVGT

19 BVGC

20 BTA

21 BTE

22 BTK

23 BTL

24 BTM

25 BTP

26 BTV

27 BTPN

28 BTAP

29 BTALN

30 BOBR

31 BLC

32 BC

33 BPC

34 BP

35 BWL

36 CT

37 CRT

38 CS

39 CLW

40 C&W

41 CR

42 CDD

43 CRS

44 CME

45 CRSE

46 CPB

47 CAMTECH

48 CRB

49 COFMOW

50 CRIS

51 CBC

52 CTRB

53 DV

54 D&A

55 DLW

56 DMRC

57 DCW

58 ELB

59 FOIS

60 FP

61 FO .

62 GM

63 HB

64 HSD

65 HDD

66 IRCON

67 ICF

68 IVRS

69 IRCA

70 IRWO

71 IRFC

72 IRIMEE

73 KRC

74 K

75 LHB

76 LDO

77 MBTSA

78 OP

79 ODC

80 PEV

81 PEASD

82 RDSO

83 PRS

84 RCF

85 RITES

86 RSC

87 RRB

88 SWTR

89 SMF

90 SAB

91 SPTM

92 TPGLR

93 THA

94 TCL

95 UTS

96 V

97 VB

98 WAP

99 WT

100 WWP

NOTES

ANSWERS: -

GENERAL

1.01 – (c)	1.02 – (a)	1.03 – (d)	1.04 – (b)	1.05 – (b)	1.06 – (b)
1.07 – (b)	1.08 – (b)	1.09 – (a)	1.10 – (b)	1.11 – (c)	1.12 – (c)
1.13 – (b)	1.14 – (d)	1.15 – (a)	1.16 – (c)	1.17 – (c)	1.18 – (c)
1.19 – (b)	1.20 – (b)	1.21 – (b)	1.22 – (b)	1.23 – (a)	1.24 – (c)
1.25 – (a)	1.26 – (b)	1.27 – (c)	1.28 – (c)	1.29 – (d)	1.30 – (c)
1.31 – (a)	1.32 – (d)	1.33 – (b)	1.34 – (b)	1.35 – (c)	1.36 – (b)
1.37 – (c)	1.38 – (a)	1.39 – (c)	1.40 – (a)	1.41 – (c)	1.42 – (c)
1.43 – (c)	1.44 – (c)	1.45 – (a)	1.46 – (c)	1.47 – (b)	1.48 – (b)
1.49 – (b)	1.50 – (c)	1.51 – (b)	1.52 – (c)	1.53 – (a)	1.54 – (c)
1.55 – (a)	1.56 – (b)	1.57 – (b)	1.58 – (d)	1.59 – (d)	1.60 – (c)
1.61 – (b)	1.62 – (a)	1.63 – (d)	1.64 – (a)	1.65 – (b)	1.66 – (c)
1.67 – (a)	1.68 – (b)	1.69 – (b)	1.70 – (c)	1.71 – (a)	1.72 – (b)
1.73 – (c)	1.74 – (c)	1.75 – (b)			

CBC & DRAFT GEAR

2.01 – (d)	2.02 – (b)	2.03 – (d)	2.04 – (c)	2.05 – (c)	2.06 – (b)
2.07 – (c)	2.08 – (c)	2.09 – (c)	2.10 – (d)	2.11 – (a)	2.12 – (c)
2.13 – (b)	2.14 – (b)	2.15 – (d)	2.16 – (b)	2.17 – (c)	2.18 – (a)
2.19 – (b)	2.20 – (a)	2.21 – (b)	2.22 – (c)	2.23 – (b)	2.24 – (d)
2.25 – (a)	2.26 – (b)	2.27 – (c)	2.28 – (b)	2.29 – (b)	2.30 – (a)
2.31 – (b)	2.32 – (c)	2.33 – (b)	2.34 – (d)	2.35 – (c)	2.36 – (b)
2.37 – (c)	2.38 – (d)	2.39 – (a)	2.40 – (b)	2.41 – (a)	2.42 – (c)

WHEEL & AXLE

3.01 – (b)	3.02 – (c)	3.03 – (b)	3.04 – (a)	3.05 – (b)	3.06 – (b)
3.07 – (b)	3.08 – (c)	3.09 – (a)	3.10 – (a)	3.11 – (a)	3.12 – (d)
3.13 – (b)	3.14 – (d)	3.15 – (b)	3.16 – (c)	3.17 – (b)	3.18 – (c)
3.19 – (d)	3.20 – (a)	3.21 – (b)	3.22 – (c)	3.23 – (a)	3.24 – (a)
3.25 – (c)	3.26 – (b)	3.27 – (d)	3.28 – (b)	3.29 – (a)	3.30 – (a)
3.31 – (c)	3.32 – (b)				

AIR BRAKE

4.001 – (b)	4.002 – (a)	4.003 – (a)	4.004 – (b)	4.005 – (c)	4.006 – (b)
4.007 – (a)	4.008 – (b)	4.009 – (a)	4.010 – (b)	4.011 – (a)	4.012 – (a)
4.013 – (b)	4.014 – (b)	4.015 – (c)	4.016 – (d)	4.017 – (c)	4.018 – (c)
4.019 – (c)	4.020 – (c)	4.021 – (b)	4.022 – (b)	4.023 – (b)	4.024 – (a)
4.025 – (b)	4.026 – (d)	4.027 – (b)	4.028 – (c)	4.029 – (b)	4.030 – (a)
4.031 – (c)	4.032 – (b)	4.033 – (b)	4.034 – (b)	4.035 – (a)	4.036 – (a)
4.037 – (b)	4.038 – (b)	4.039 – (c)	4.040 – (c)	4.041 – (b)	4.042 – (c)
4.043 – (d)	4.044 – (b)	4.045 – (a)	4.046 – (c)	4.047 – (a)	4.048 – (b)
4.049 – (a)	4.050 – (d)	4.051 – (c)	4.052 – (a)	4.053 – (d)	4.054 – (c)
4.055 – (b)	4.056 – (d)	4.057 – (a)	4.058 – (d)	4.059 – (b)	4.060 – (c)
4.061 – (d)	4.062 – (d)	4.063 – (d)	4.064 – (c)	4.065 – (c)	4.066 – (c)
4.067 – (c)	4.068 i – (a)	4.068 ii–(b)	4.068 iii–(b)	4.069 – (c)	4.070 – (d)
4.071 – (b)	4.072 – (d)	4.073 – (b)	4.074 – (b)	4.075 – (b)	4.076 – (c)
4.077 – (a)	4.078 – (b)	4.079 – (c)	4.080 – (b)	4.081 – (c)	4.082 – (b)
4.083 – (b)	4.084 – (a)	4.085 – (a)	4.086 – (b)	4.087 – (b)	4.088 – (b)
4.089 – (b)	4.090 – (a)	4.091 – (a)	4.092 – (a)	4.093 – (b)	4.094 – (b)
4.095 – (a)	4.096 – (b)	4.097 – (c)	4.098 – (b)	4.099 – (b)	4.100 – (c)
4.101 – (a)	4.102 – (c)	4.103 – (c)	4.104 – (d)	4.105 – (a)	4.106 – (a)
4.107 – (d)	4.108 – (c)	4.109 – (c)	4.110 – (a)	4.111 – (c)	4.112 – (c)
4.113 – (a)	4.114 – (c)	4.115 – (d)	4.116 – (b)	4.117 – (d)	4.118 – (d)
4.119 – (d)	4.120 – (d)	4.121 – (d)	4.122 – (b)	4.123 – (b)	4.124 – (b)

4.125 – (c)	4.126 – (c)	4.127 – (b)	4.128 – (a)	4.129 – (c)	4.130 – (a)
4.131 – (d)	4.132 – (a)	4.133 – (b)	4.134 – (b)	4.135 – (c)	4.136 – (c)
4.137 – (b)	4.138 – (a)	4.139 – (b)	4.140 – (b)	4.141 – (b)	4.142 – (c)
4.143 – (a)	4.144 – (a)	4.145 – (a)	4.146 – (a)	4.147 – (b)	

BOGIE

5.001 – (d)	5.002 – (a)	5.003 – (b)	5.004 – (a)	5.005 – (c)	5.006 – (b)
5.007 – (c)	5.008 – (c)	5.009 – (d)	5.010 – (a)	5.011 – (b)	5.012 – (c)
5.013 – (b)	5.014 – (a)	5.015 – (a)	5.016 – (b)	5.017 – (c)	5.018 – (a)
5.019 – (c)	5.020 – (c)	5.021 – (a)	5.022 – (b)	5.023 – (a)	5.024 – (b)
5.025 – (c)	5.026 – (b)	5.027 – (d)	5.028 – (c)	5.029 – (b)	5.030 – (d)
5.031 – (b)	5.032 – (c)	5.033 – (b)	5.034 – (a)	5.035 – (b)	5.036 – (c)
5.037 – (b)	5.038 – (b)	5.039 – (b)	5.040 – (c)	5.041 – (b)	5.042 – (b)
5.043 – (c)	5.044 – (a)	5.045 – (b)	5.046 – (c)	5.047 – (c)	5.048 – (b)
5.049 – (a)	5.050 – (b)	5.051 – (b)	5.052 – (c)	5.053 – (b)	5.054 – (a)
5.055 – (b)	5.056 – (b)	5.057 – (b)	5.058 – (a)	5.059 – (c)	5.060 – (b)
5.061 – (c)	5.062 – (a)	5.063 – (c)	5.064 – (a)	5.065 – (c)	5.066 – (b)
5.067 – (b)	5.068 – (c)	5.069 – (a)	5.070 – (b)	5.071 – (c)	5.072 – (a)
5.073 – (d)	5.074 – (c)	5.075 – (b)	5.076 – (c)	5.077 – (b)	5.078 – (b)
5.079 – (b)	5.080 – (c)	5.081 – (b)	5.082 – (b)	5.083 – (d)	5.084 – (c)
5.085 – (d)	5.086 – (a)	5.087 – (c)	5.088 – (a)	5.089 – (b)	5.090 – (b)
5.091 – (a)	5.092 – (b)	5.093 – (b)	5.094 – (c)	5.095 – (d)	5.096 – (c)
5.097 – (d)	5.098 – (b)	5.099 – (c)	5.100 – (c)	5.101 – (d)	5.102 – (a)
5.103 – (c)	5.104 – (c)	5.105 – (a)	5.106 – (b)	5.107 – (c)	

VACUUM

6.01 – (b)	6.02 – (b)	6.03 – (a)	6.04 – (d)	6.05 – (b)	6.06 – (a)
6.07 – (a)	6.08 – (c)	6.09 – (c)	6.10 – (b)	6.11 – (c)	6.12 – (a)
6.13 – (d)	6.14 – (d)	6.15 – (a)	6.16 – (a)	6.17 – (b)	6.18 – (a)
6.19 – (c)	6.20 – (c)	6.21 – (c)	6.22 – (d)	6.23 – (b)	6.24 – (c)

6.25 – (d)	6.26 – (b)	6.27 – (a)	6.28 – (a)	6.29 – (a)	6.30 – (b)
6.31 – (d)	6.32 – (d)	6.33 – (c)	6.34 – (c)	6.35 – (b)	6.36 – (a)
6.37 – (a)	6.38 – (d)	6.39 – (c)	6.40 – (a)	6.41 – (d)	6.42 – (b)
6.43 – (b)	6.44 – (c)	6.45 – (b)	6.46 – (b)	6.47 – (b)	6.48 – (b)

UNDER FRAME / BODY

7.01 – (a)	7.02 – (b)	7.03 – (a)	7.04 – (c)	7.05 – (d)	7.06 – (a)
7.07 – (b)	7.08 – (c)	7.09 – (b)	7.10 – (c)	7.11 – (b)	7.12 – (a)
7.13 – (c)	7.14 – (b)	7.15 – (a)	7.16 – (c)	7.17 – (c)	7.18 – (b)

TANK WAGON

8.01 – (b)	8.02 – (a)	8.03 – (a)	8.04 – (a)	8.05 – (c)	8.06 – (b)
8.07 – (a)	8.08 – (b)	8.09 – (b)	8.10 – (c)	8.11 – (c)	8.12 – (b)
8.13 – (c)	8.14 – (a)	8.15 – (a)	8.16 – (b)	8.17 – (b)	8.18 – (a)
8.19 – (d)	8.20 – (a)	8.21 – (d)	8.22 – (b)	8.23 – (a)	8.24 – (d)
8.25 – (a)	8.26 – (b)	8.27 – (a)	8.28 – (b)	8.29 – (a)	8.30 – (b)
8.31 – (a)	8 .32 – (c)	8.33 – (d)	8.34 – (a)	8.35 – (b)	8.36 – (b)
8.37 – (b)	8.38 – (b)	8 .39 – (a)	8.40 – (c)	8.41 – (b)	8.42 – (a)
8.43 – (d)	8.44 – (b)	8.45 – (a)	8 .46 – (d)	8.47 – (c)	8.48 – (d)
8.49 – (a)	8.50 – (c)	8.51 – (d)			

BLC WAGON

9.01 – (d)	9.02 – (d)	9.03 – (b)	9.04 – (b)	9.05 – (a)	9.06 – (c)
9.07 – (b)	9.08 – (c)	9.09 – (a)	9.10 – (a)	9.11 – (c)	9.12 – (b)
9.13 – (c)	9.14 – (b)	9.15 – (b)	9.16 – (a)	9.17 – (b)	9.18 – (c)
9.19 – (a)	9.20 – (b)	9.21 – (d)	9.22 – (a)	9.23 – (b)	9.24 – (c)
9.25 – (b)	9.26 – (a)	9.27 – (b)	9.28 – (a)	9.29 – (a)	

Abbreviations

1	ART	Accident and tool van or relief train.
2	AAR	American association of Rail Road
3	AR	Auxiliary reservoir.
4	ARME	Accident relief and medical equipment
5	BKH	Open wagon hopper
6	BVZI	Bogie covered brake van fitted with ICF trolley & pneumatic brakes.
7	BOY	Open wagon with straight CBC
8	BOBX	Open wagon hopper with centre and side discharge arrangement
9	BOBC	Open wagon hopper with centre discharge arrangement
10	BOXC	Open BOX wagon with straight CBC at both side and also with straight CBC at one end transition coupler at the other end.
11	BOXR	Open box wagon with screw coupling
12	BOXS	BOX wagon with swing cum-flap doors and sliding roofs.
13	BOXT	Open BOX wagon with transition couplings
14	BOI	Open wagon gondola
15	BC	Bogie Covered wagon
16	BCXR	Covered BOX wagons with screw couplers.
17	BCXT	Covered BOX wagon with transition couplers.
18	BVGT	Covered brake van with CBC and transition type coupling on both sides.

19	BVGC	Covered brake van with CBC and high coupling draft gear with screw coupling at the other end.
20	BTA	Tank wagon acid.
21	BTE	Tank wagon liquid caustic soda.
22	BTK	Tank wagon Kerosene.
23	BTL	Tank wagon heavy oil.
24	BTM	Tank wagon molasses.
25	BTP	Tank wagon petrol.
26	BTV	Tank wagon vegetable oil.
27	BTPN	Bogie patrol tank wagon.
28	BTAP	Bogie tank wagon for aluimina type.
29	BTALN	Bogie liquefied anhydrous ammonia gas tank wagons.
30	BOBR	Bogie open bottom rapid discharge hopper wagon.
31	BLC	Bogie low height container flat wagon.
32	BC	Brake cylinder.
33	BPC	Brake power certificate.
34	BP	Brake pipe.
35	BWL	Bogie well wagon
36	CT	Tours car
37	CRT	Covered wagon with lightweight transition type CBC
38	CS	Covered wagon, Salt.

39	CLW	Chittranjan locomotive works.
40	C&W	Carriage and Wagon.
41	CR	Control reservoir.
42	CDD	Compact disk drive
43	CRS	Commissioner of Railway safety.
44	CME	Chief mechanical Engineer
45	CRSE	Chief Rolling Stock Engineer
46	CPB	Common pipe bracket
47	CAMTECH	Center for advanced maintenance technology.
48	CRB	Chairman Railway board
49	COFMOW	Central organization for modernization of workshops.
50	CRIS	Central for Railway information system.
51	CBC	Center buffer coupler.
52	CTRB	Cartridge type roller bearing
53	DV	Distributor valve
54	D&A	Discipline and appeal rules.
55	DLW	Diesel locomotive works
56	DMRC	Delhi metro rail corporation Ltd.
57	DCW	Diesel component works
58	ELB	Empty load box
59	FOIS	Freight operating information system.

60	FP	Feed pipes.
61	FO	Furnace oil
62	GM	General manager.
63	HB	Hand brake
64	HSD	High speed diesel.
65	HDD	Hard disc drives.
66	IRCON	Indian railway construction corporation Ltd.
67	ICF	Integral coach factory.
68	IVRS	Interactive voice response system.
69	IRCA	Indian Railway conference association.
70	IRWO	Indian Railway welfare organization.
71	IRFC	Indian Railway finances corporation Ltd.
72	IRIMEE	Indian railway institute of mechanical & electrical engineering.
73	KRC	Konkan Railway corporation.
74	K	Open wagon
75	LHB	Link Halfman Boseh
76	LDO	Light Diesel oil
77	MBTSA	Sulphuric acid tank wagon.
78	OP	Oil pressure.
79	ODC	Over dimensional consignment.
80	PEV	Passenger emergency valve

81	PEASD	Passenger emergency Alarm signal device
82	RDSO	Research, Design and standard organization.
83	PRS	Public reservation system.
84	RCF	Rail coach factory.
85	RITES	Rail India technical and economy services Ltd.
86	RSC	Railway staff college.
87	RRB	Railway recruitment board.
88	SWTR	Single wagon test ring
89	SMF	Sealed maintenance free.
90	SAB	Slack adjuster barrel.
91	SPTM	Self printing ticket machine.
92	TPGLR	4- Wheeled liquefied petroleum gas tank wagon.
93	THA	Hydrochloric acid tank wagon.
94	TCL	Liquid chlorine tank wagon.
95	UTS	unreserved ticket system.
96	V	Brake van. Ordinary.
97	VB	Rest van ordinary.
98	RWF	Rail wheel Factory.
99	WT	Water tight.
100	WWP	Worn wheel profile

DIMENSION CHART OF WAGON

APPENDIX-i

PARTICULARS	**BOXN**	**BCN**	**BRN**	**BTPN**	**BTCS**	**TPGLR**	**BOBR**	**BTAP**	**Bogie Phosphoric acid tank wagon**	**8-Axle BG wall type Special wagon**	**BTALN**	**BTPGL**	**THA**	**BLC**	
Length Over Headstock (mm)	9784	14500	13716	11491	9784	8382	10671	11400	12000	26160	16600	18000	5537	**CAR-A**	**CAR-B**
Length Over Coupler (mm)	10713	13429	14645	12420	10713	9652	11600	12329	12929	27442	17529	19282	6807	13625	12212
Length Inside / Length of Wall (mm)	9784	14494	13716	11458	9780	8382	8732	-	9270	7500	16325	17944	5312	13625	12212
Width/ Diameter Inside (mm)	2950	1944	2845	3126	2560	2300	3500	3200	2550	2930	2449	-	2210	2100	2100
Inside Height / Height Of Wall (mm)	3225	2490	-	4265	4110	4125	3735	4350	3897	1080	4265	4004	4070	1009	1009
Wheel Base (mm)	2000	2000	2000	2000	2000	4878	2000	2000	2000	2000	2000	2000	3505	2000	2000
Bogie Center (mm)	6524	10000	9144	9144	6524	--	7571	8300	8800	17960	11570	12970	-	9675	8812
Journal Size (mm)	144.5	144.5	144.5	144.5	-	120	144.5	-	-	-	130	130	127	-	144.5
Journal Center (mm)	2260	2260	2240	2240	2260	1955	2260	2260	2260	2360	2240	-	1955	2260	2260
Wheel Dia on Tread (mm)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1092	840	840
Max. Axle Load (t)	20.32	20.32	20.32	20.32	20.32	16.32	20.32	20.3	20.32	20.3	20.3	20.32	16.26	20.32	20.32
Tare Weight (t)	22.47	27.2	24.4	27	26	18.2	26	26.28	28.28	66.56	49.13	45.78	12.19	19.1	18
Pay Load (t)	58.81	54.08	56.9	54.28	55.28	14.3	55.28	53.96	53	96	32.13	35.5	20.32	61	61
Gross Load (t)	81.28	81.28	81.3	81.28	81.28	32.5	81.28	81.28	81.28	162.56	81.26	81.28	32	80.1	79
Ratio Gross Load/ Tear Loading	3.62	2.99	3.33	2.01	2.12	-	2.12	-	-	-	-	4.21	-	-	-
Carrying Capacity Per Meter (t/m)	7.59	5.27	5.55	6.54	7.59	-	7	6.59	-	-	-	1.84	-	-	-
Floor Area (Sq. m)	28.86	42.67	34	-	-	-	-	-	-	-	-	-	-	-	-
Cubic/ Loadiable Volume Capacity	56.28	104.37	-	70.91	36.75	-	57.2	65.4	34.35	-	60.66	74.97	18.6	-	-
Total Brake Power (Empty) In Kg.	18900	18900	18900	-	-	-	-	-	-	-	-	-	-	18595	17574
Total Brake Power (Loaded) In Kg.	33692	33642	33642	-	-	-	-	-	-	-	-	-	-	35184	33357
Coupling Arrangement	Std. CBC	Std.CBC	Std. CBC	Std CBC	Std. CBC	Buffer arrangement	Non-Transition CBC	Std CBC	Std. CBC	Transition CBC	Std. CBC	Transition CBC	Buffer Type	Std. CBC	
Length of Barrel (mm)	-	-	-	11458	9780	8350	-	8745	11294	-	16325	17960	5312	-	SDB
Diameter Inside of Barrel (mm)	-	-	-	2850	2300	2300	-	2300	2000	-	2200	2400	2210	-	-
Thickness Of Dished End (mm)	-	-	-	12	10	16	-	-	12	-	25	17	11	-	-
Loadaible Volume	-	-	-	68.13	36.81	-	-	-	-	-	-	95% of	-	-	-
Working Pressure (Kg/cm2)	-	-	-	1.4	2	15.85	-	-	4	-	22.15	15.85	-	-	
Test Pressure (Kg/cm2)	-	-	-	2.8	4.5	21.65	-	-	5.9	-	-	21.1	-	-	
Thickness of Barrel Plate (mm)	-	-	-	8	10	14	-	-	8	-	25	15	10	-	
Bogie Arraignment	Casnub all version	Casnub all version	Casnub all version	Casnub 22w(M)	Casnub all version	Four wheeled	Casnub 22w(M)	Casnub all version	Fabricated UIC Bogie	Fabricated UIC Bogie	Fabricated UIC Bogie	Fabricated UIC Bogie	Four wheeled	Container bogie type LCCF-20(C)	
Brake System	Air Brake	Air Brake			Air Brake	Vacuum		Air Brake	Air brake	Vacuum	Air Brake	vacuum	Vacuum	Air Brake	

APPENDIX-ii

Status of Bogie Clearances to be mentioned During ROH

i) After dismantling the bogies, full gauging should be done and all measurements recorded.

ii) For all bearing surfaces whether these are having provision of liners or not, the recommended dimensions of Important locations of CASNUB boogies after ROH are as follows:

Sr. No.	Surface/Component	Nominal Size	Condemning size	Depot dimensions (in mm)
(1)	S.F. pedestal jaw 22 W (M)	278	286	281
(2)	S.F. pedestal jaw (short)	190	198	193
(3)	S.F. pedestal jaw (long)	236	244	239
(4)	S.F. anti-rotation lug	522	528	524.5
(5)	S.F. column sides	216	206	212
(6)	Thickness of S.F. column friction plate	10	6	8.5
(7)	Side of pedestal (a) In short jaw in short jaw bogie. (b) In 22 W (M)	 81 105	 77 101	 79.5 103.5
(8)	Pedestal crown sides (for all bogies)	152	144	149
BOLSTER				
(9)	Bolster land surface	444	438	441.5
(10)	Thickness of slope surface liner	8	3	6
(11)	Bolster rotation slope lug	518	512	515.5
(12)	Bolster column gib;			
	Inner	136	146	140
	Outer	234	244	238
C/PIVOT				
(13)	Thickness of vertical wall	19	11	16.0
(14)	Wear in bowl area	-	4	1.5
BREAK BEAM POCKET				
(15)	thickness of pocket liner	5	2	3.5
GAUGE				
(16)	Wear in vertical surface	-	7	3.0
(17)	Wear in slope surface	-	3	1.0

As per G-95/railway board letter No. 93/M/(N)/951/37 Dated-26.3.04

THE SOURCES OF THE ANSWER OF THE QUESTION ARE: –

IMPORTANT RULE BOOKS AND REFERENCES: -

i. IRCA Conference Rules Part III (2000) - Rules for Maintenance, Examination and Interchange of Goods Stock (BG & MG System) of Indian Government Railways
ii. RDSO's Technical Pamphlet G-16 - Instructions for Maintenance and Operation of Box Wagons
iii. RDSO's Technical Pamphlet G-40 - Manual of Instructions for Anhydrous Ammonia Tank.
iv. RDSO's tech. Pamphlet No. G-55H/Aug.76 Instructions for maintenance and operation of hydrochloric acid tank wagon type THA.
v. RDSO's tech. Pamphlet No. G-62/June.77 Maintenance manual of alliance II coupler
vi. Indian Railways Code for the Mechanical Department (Workshops)
vii. RDSO's Technical Pamphlet G-65 Instructions for inspection and maintenance of TPGLR
viii. RDSO's Technical Pamphlet G-70 Instructions for inspection and maintenance of BOXN wagons fitted with CASNUB Bogies and twin pipe air brake system.
ix. RDSO's tech. Pamphlet No. G-71 Maintenance manual for phosphoric acid tank wagon.
x. RDSO's Technical Pamphlet G-73 Instructions for inspection and maintenance of BOBR
xi. RDSO's tech. Pamphlet No. G-79 Instructions for operation and maintenance for BTAL/BTALN
xii. RDSO's Technical Pamphlet G-81 Instructions for inspection and maintenance of CTRB
xiii. RDSO's tech. Pamphlet No. G-82 Instructions for operation and maintenance BG bogie tank wagon for alumina type BTAL.
xiv. RDSO's tech. Pamphlet No. G-83 Instructions for operation for maintenance of BTCS wagon
xv. RDSO's Technical Pamphlet G-86 Instructions for inspection and maintenance of BTPGL/BTPGLN
xvi. RDSO's Technical Pamphlet G-90 Instructions for inspection and maintenance of BTPN
xvii. RDSO's Technical Pamphlet G-92 Instructions for inspection and maintenance of Slack Adjuster type IRSA 450 & 600
xviii. RDSO's Technical Pamphlet G-95 Instructions for inspection and maintenance of CASNUB Bogies
xix. RDSO's Technical Pamphlet G-97 Instructions for inspection and maintenance of Air Brakes
xx. RDSO's Technical Pamphlet No. WT-77-1 & WT-79-1 for inspection and maintenance of 20.3 Tonnes Roller Bearing and 16.3 Tonnes Roller Bearing axle boxes fitted wagons.
xxi. Modern rolling stock guide by P.C Gupta.
xxii. Wagon maintenance manual

OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and man power which inter-alia would cover reliability, availability, utilisation and efficiency.

If you have any suggestions and any specific comments, please write to us.

Contact person : Director (Mech.)

Postal address : Indian Railways,
Centre for Advanced
Maintenance Technology,
Maharajpur, Gwalior.
Pin code - 474 020

Phone : 0751- 2470890, 0751-2470803
Fax : 0751- 2470841

Question.1: If a bus starts suddenly, the passengers in the bus will tend to fall
(a) In the direction opposite to the direction of motion of bus.
(b) In the same direction as the direction of motion of bus.
(c) Sideways.
(d) None of the above.
Answer: a

Question.2: An athlete runs some distance before taking a long jump because
(a) He gains energy to take him through long distance.
(b) It helps him to apply large force.
(c) By running action and reaction forces increase.
(d) By running the athlete gives himself larger inertia of motion.
Answer: d

Question.3: A rider on a horseback falls back when horse starts running all of a sudden because
(a) Rider is taken back.
(b) Rider is suddenly afraid of falling.
(c) Inertia of rest keeps the upper part of body at rest whereas the lower part of the body moves forward with the horse.
(d) None of the above.
Answer: c

Question.4: Inertia is a property of a body by virtue of which the body is
(a) Unable to change by itself the state of rest.
(b) Unable to change by itself the state of uniform motion in a straight line.
(c) Unable to change by itself the direction of motion.
(d) Unable to change by itself the state of rest or uniform motion in a straight line.
Answer: d

Question.5: Qualitative definition of force is given by
(a) Newton’s first law of motion.
(b) Newton’s second law of motion.
(c) Newton’s third law of motion.
(d) Newton’s law of gravitation.
Answer: a

Question.6: SI unit of force is
(a) kg m/s.
(b) Newton.
(c) Dyne.
(d) None of these.
Answer: b

Question.7: A driver accelerates his car first at the rate of 1.8 m/s2 and then at the rate of 1.2 m/s2. The ratio of the two forces exerted by the engine in the two cases will be
(a) 1: 2
(b) 2: 1
(c) 2: 3
(d) 3: 2
Answer: d

Question.8: Newton’s law of motion gives the measure of
(a) Force
(b) Acceleration
(c) Momentum
(d) Impulse.
Answer: a

Question.9: An object will continue to accelerate until
(a) The resultant force begins to decrease.
(b) The resultant force on it is zero.
(c) The velocity changes direction.
(d) The resultant force on it is increased continuously.
Answer: b

Question.10: A canon after firing recoils due to
(a) Conservation of energy.
(b) Backward thrust of gases.
(c) Newton’s third law of motion.
(d) Newton’s first law of motion.
Answer: c

Question.11: A rocket or jet engine works on the principle of
(a) Conservation of energy
(b) Conservation of momentum
(c) Conservation of mass
(d) Newton’s second law of motion.
Answer: b

Question.12: kg.m/s2 is the unit of
(a) Momentum
(b) Speed
(c) Acceleration
(d) Force
Answer: d

Question.13: Rate of change of momentum is equal to
(a) Acceleration
(b) Work done
(c) Force
(d) Impulse
Answer: c

Question.14: When an object undergoes acceleration
(a) Its speed always increases
(b) Its velocity always increases.
(c) It always falls towards the earth
(d) A force always acts on it.
Answer: d

Question.15: When a net force acts on an object, the object will be accelerated in the direction of the force with acceleration proportional to
(a) The force on the object

(b) The velocity of the object
(c) The mass of the object
(d) The inertia of the object
Answer: a

Question.16: The action and reaction forces referred to in the third law
(a) Must act on the same object.
(b) May act on different objects.
(c) Must act on different objects.
(d) Need not be equal in magnitude but must have the same direction.
Answer: c

SN	Question	Level	Option1	Option2	Option3	Option4	Correct_Ans
1	SMAW is about _____ degree C	1	About 1550°	Above 3000°	up to 2400°	Below 1000	**B**
2	produced by an arc accumulated at the positive end	1	60 TO 70	40 TO 25	65 TO 75	55 TO 65	**A**
3	D.A. cylinder shall always be placed in _____ position	1	Horizontal	Vertical	Tilted	Straight	**B**
4	M.S. filler rod is coated with copper for	1	Better conductivity	Rust protection	Serving as flux	None of the Above	**B**
5	Welding is applied for joining _____ Metals	1	Similar	Two dissimilar	Two similar or Dissimilar	two similar	**C**
6	connected to the acetylene cylinder is	1	Green	Red	Blue	Black	**B**
7	preferred for weldind of non ferrous metals by arc welding	1	AC low frequency	AC high frequency	D.C	All of the above	**C**
8	How many kinds of oxy-acetylene flames are there	1	2	4	3	1	**C**
9	How much current range required for 3.15mm electrodes	1	140-170 amps	60-100 amps	90-130 amps	180-230 amps	**C**
10	How much current range required for 4mm electrode	1	140-170 amps	60-100 amps	90-130 amps	180-230 amps	**A**
11	In electrical ARC welding	1	and current is low	low and current is high	voltage and current are	voltage and	**B**
12	Oxygen to acetylene ratio in case of neutral flame is	1	0.8 : 1.0	1:1	1.2:1	2:01	**B**
13	the current passes through the metals, the greatest resistance	1	Surface	contact of Electrode	electrode and metal	None of the above	**C**
14	In gas welding, maximum flame temperature occurs at	1	Inner cone	Outer cone	Next of inner cone	tip of the flame	**A**
15	In single V-butt welds, the angle between edges is kept about	1	40 to 50 degree	50 to 60 degree	60 to 70 degree	70 to 90 degree	**D**
16	In MIG welding	1	no flux is required	welding speeds is high	Both A & B	unclean surface	**C**
17	In MIG welding, helum or argon is used in order to	1	provide cooling effect	act as flux	shileding medium	welding process	**C**
18	Arc length in arc welding should be nearly equal to	1	diameter of electrode	1.5 d	2 d	3 d	**A**
19	Black colour is generally painted on	1	oxygen cylinder	acetylene cylinder	hydrogen cylinder	none of the above	**A**
20	H.A.Z. Means….	1	Heat Affected Zone	Annealed Zone	Heat Area Zone	Affected Zone	**A**
21	____ type of electrode is used for cutting ferrous metals	1	A1	D	N1	A2	**C**
22	3.15mm, 4mm, Electrode lengths in general	1	350mm, 450mm long	450mm, 550mm	550, 650mm	None of the above	**A**
23	A good weld joint should have	1	No cracks in the weld	Good penetration	correct shape	All the above	**D**
24	Amperage to be used in arc welding is dependent upon	1	work thickness	arc gap	rod thickness	considerat ion	**C**

25	welds are for sheets of approximate thickness	1	1 to 5 mm	5 to 15 mm	15 to 25 mm	than 25 mm	**B**
26	which of the following welding process	1	Gas	Resistance	Thermit	Arc	**D**
27	less than 5 mm bevelling of its edges	1	is done to a single V or	is done to a double V or	double V or U-	is not required	**D**
28	Gas torch is usually lighted by a friction lighter because	1	it is easier to operate	of low intial cost	created for very short	of operator	**D**
29	CO2 welding is an example of	1	TIG Welding	MAG Welding	MMA Welding	None of the above	**B**
30	Colour of D.A. Gas hose pipe is ….	1	Black	Red	Meroon	Yellow	**C**
31	Colour of Oxygen gas hose pipe is ….	1	Black	Red	White	Yellow	**A**
32	Current is measured in	1	Amperes	Volts	Ohms	None of the above	**A**
33	D' class electrodes are pre-heated upto	1	250 degree C two and	Pre-heating is not	150 degree C one hour	None of the above	**A**
34	Earth connections is directly given to the	1	job	Near to the job	Pole	Both A & B	**D**
35	Three types of fillet welds are	1	Convex, Flat, concave	convex, flat, vertical	Flat,vertical,Inclined	None of the above	**A**
36	Too high welding current in arc welding would result in	1	excessive piling up of	excessive spatter, under	bead, weak weld	piling up of	**B**
37	Undercuts occursdue to	1	Too high current	cleaning on the	Faster arc travel speed	All of the above	**D**
38	Unit of current is	1	Volt	coulomb	Ampere	Ohm	**C**
39	edge preparation for welding is not required?	1	4 mm	5 mm	8 mm	10 mm	**A**
40	The material used for coating the electrode is called	1	Protective layer	Slag	Binder	Flux	**D**
41	The oxygen cylinder is usally painted with	1	Black colour	White colour	Maroon colour	Yellow colour	**A**
42	terminals of the arc Welding power source when no current	1	Duty cycle	Load voltage	Open circuit voltage	None of the above	**C**
43	Weld spark is	1	Flux	welding defect	electrode coating	none of the above	**D**
44	the negative terminal and the electrode holder to the positive	1	straight polarity	reversed polarity	both (a) and (b) above	none of the above	**B**
45	the positive terminal and the electrode holder to the negative	1	straight polarity	reversed polarity	both (a) and (b)	None of the above	**A**
46	When Welding is going on, Arc voltage is of the order of	1	40-95 volts	100-125 volts	18-40 volts	130-170 volts	**C**
47	preferred for welding of non-ferrous metals by arc welding?	1	A.C low frequency	A.C high frequency	D.C	All of the above	**C**
48	Welding transformer is a	1	Step up transformer	Step down transformer	Both A&B	None of the above	**B**
49	Weld spatter defect in welding is due to	1	too high welding	welding current	low voltage	high voltage	**A**

50	Neutral flam consists of	1	Excess of oxygen	volumes of oxygen	Excess of acetylene	None of the above	**B**
51	Spatter occurs due to	1	Too high arc current	Long arcs	Damp electrodes	All of the above	**D**
52	removing ____from the matal prior to welding	1	Oil	Grease	Rust or dirt	All of the above	**C**
53	Which of the following joint have high corrosion resistance?	1	Welding joint	Riveted joint	Bolted joint	None of the above	**A**
54	elements to be controlled to obtain satisfactory welding	1	voltage and speed	voltage and arc	arc length and speed	Voltage, arc length	**A**
55	Arc-welding uses following electric supply	1	A.C.	D.C.	Both AC and DC	Spiral waveform	**C**
56	Arc stability is better with.....	1	AC welding	DC welding	Both AC with DC welding	Specially designed	**A**
57	Arc blow will occur in _____ welding	1	AC	DC	Resistance		**B**
58	The electrode size refers to:	1	Diameter of its core wire	Diameter (overall) of	Thickness of flux	Length of electrode	**A**
59	The function of the central hole in the tip of the cutting blow pipe is:	1	a. Supply oxygen for preheating	b. Supply acetylene for	c. Supply oxygen for cutting	d. Supply acetylene for	**C**
60	The electrodes are manufactured in two standards lengths namely	1	350mm and 250mm	350mm and 450mm	400mm and 500mm	18” an.	**A**
61	The size of the cutting nozzle used in oxy-acetylene cutting process depends mainly ON	1	Thickness of metal to be cut	Purity of oxygen	Duration of cut	Type of cutting blow pipe.	**A**
62	The last bit of an electrode which is discarded is called	1	Dead end	Stub end	Red end	Waste end.	**B**

SN	Question	Level	Option1	Option2	Option3	Option4	Correct_Ans
1	In the arc welding, the electric circuit is completed through	2	Electric arc	Electrode	Job	None of the Above	B
2	The first digit of the electrode code represents	2	flux	welding position	tensile strength	Above all	C
3	The maximum temperature of an oxy – acetylene flame is found	2	Tip of the inner cone	in the middle of the flame	outside the flame	Above all	A
4	IS specification for training of Welder code of practice	2	IS 817-1992	IS 2062-92	IS 9857-90	IS 4559-1968	A
5	In welding process, flux is used	2	the weld pool	to prevent oxidation	both (a) and (b) above	none of the above	C
6	If the weld is made from right to left, it is known as	2	fore-hand welding	back-hand welding	vertical welding	none of the above	B
7	If I,R and V are the current, resistance and the potential difference, then V is equal to	2	I/R	R/I	IR	I/IR	C
8	In straight polarity welding	2	Electrode is Positive	Electrode is Negative	either (a) or (b)	None	A
9	In which form Acetylene gas is stored in cylinders?	2	Solid form	Gaseous form	Dissolved in Liquid form	None of the above	C
10	temperature of the oxyacetylene gas used is	2	1200 degrees C	1800 degrees C	2400 degrees C	3200 degrees C	D
11	thickness of material which can be welded with a 3 mm	2	3 mm	6 mm	15 mm	300 mm	A
12	In metallic arc welding, the transfer of metal from the electrode is due to	2	molecular attraction	surface tension and	gravitional force	both (a) and (b) above	D
13	In MIG welding, the metal is transferred in the form of	2	fine spray of metal	molten drops	weld pool	molecules	A
14	Grey cast iron is usually welded by	2	Gas welding	Resistance welding	Arc welding	Any of the above	A
15	Arc length in electric arc welding is the distance between the tip of the electrode and the	2	work piece	centre of crater	bottom of crate	work piece minus	C
16	electrodes are used for welding of	2	to corten steel	Mild steel to stain less	Mild steel to spring steel	cost iron to copper	A
17	Carburising flame is obtained by supplying	2	equal volumes of	volume of acetylene	volume of oxygen and	none of the above	B
18	Carburising flame is used to weld	2	castiron, copper	brass and bronze/c	surfacing materials	all of the above	C
19	Back fire occure due to	2	Oil or grease	Rust	Touch the job	All of the above	D

20	used for Welding where strength requirement is not	2	C2	A5	A1	A4	**C**
21	_____ type of electrode is used for semi dynamic application and radiographic quality (IS 2062 Gr-B)	2	A1	A2	A5	A4	**B**
22	A consumable electrode is used in	2	TIG Welding	MIG Welding	Submerged arc welding	carbon arc welding	**B**
23	Filler material is essentially used in	2	gas welding	spot welding	scam welding	all of the above	**A**
24	Filler metal is used in	2	spot welding	seam welding	projection welding	none of the above	**D**
25	order to protect the molten metal and the surfaces to be	2	Oxidation	Carburising	Dirt	Distortion and warping	**A**
26	Following gases are used in tungstem inert gas welding	2	and oxygen	CO2 and H2	Argon and helium	Argon and neon	**C**
27	thickness more than 12.5 mm bevelling of its edges	2	a single V or	is done to a double V or	double V or U-	is not required	**C**
28	Generally the oxy-acetylene welding is done with	2	neutral flame	oxidising flame	carburising	all of the above	**A**
29	Copper is a	2	conductor of	conductor of electricity	Both A & B	None of the above	**A**
30	Cracks occurs due to	2	Too high arc current	travel speed	Ductility of base metal	All of the above	**D**
31	Too low welding speed in arc welding would result in	2	pilling up of metal	excessive spatter	bead and weak	excessive current use	**A**
32	TIG welding means	2	tungstem inert gas	gas metal arc welding	both a & b	none of the above	**A**
33	between the two electrodes known as arc voltage,	2	increases	degreases	remains same	none of the above	**A**
34	The cooling rate increases with	2	weld speed	decreasing weld speed	depend upon weld	both (a) and (b) above	**A**
35	Incomplte penetration occurs due to	2	Root gap too small	electrode dia	Improper level	All of the above	**D**
36	The highest size of nozzle for cuttozen type cutter is	2	1/32"	5/64"	1/16"	1/8"	**D**
37	The phenomenon of weld delay occurs in	2	Cast iron	Brass	Bronze	Stainless Steel	**D**
38	The smallest size nozzle for cuttozen type cutter is	2	1/32"	5/64"	1/16"	1/8"	**A**
39	The weld pool is surrounded by an inert gas in	2	arc welding	carbon arc	MIG	submerged arc	**C**
40	The major problem in welding of stainless steel is	2	of oxide film	electrical resistance	poor thermal conduction	formation of chromium	**D**

41	Which of the following electorde is used in Tungsten Inert gas gas welding?	2	Consumable electrode	Non-consumable	Both A & B	None	**B**
42	When no welding voltage across the terminals is of the order of the	2	18-40 volts	40-95 volts	100-125 volts	130-170 volts	**B**
43	Which of the following is used to measure the current flowing through a circuit?	2	Volt Meter	Ammeter	Golvanometer	None	**B**
44	welding process uses non consumable electrode	2	LASER welding	MIG welding	TIG welding	Plasma welding	**C**
45	Which is the specified standard for corten steel ?	2	IRS-M-40	IRS-M-41	IRS-M-42	IRS-M-43	**B**
46	Welded rod coated with fluxing material is used in	2	gas welding	shielded arc welding	D.C arc welding	argon arc welding	**B**
47	Parent metal metalurgically affected by the heat of welding or cutting but neither melted nor made plastic is known as	2	heat affected zone	weld zone	fusion zone	weld face	**A**
48	It is not possible to arc weld all types of metals with transformer set because it does not have provision	2	Control of current	Control of voltage	Control of time duration	Change of polarity	**D**
49	to voltage during welding in arc welding is	2	same	more	less	unpredicatable	**B**
50	The best weldable steel is	2	carbon steel	carbon steel	0.6% carbon steel	0.8% carbon steel	**A**
51	Poor fusion in a welded joint is due to	2	welding speed	dirty metal surface	improper current	lock of flux	**C**
52	Porosity and blow holes occurs due to	2	travel speed	Demp electrodes	Too low and high current	All of the above	**D**
53	Rutile coated electrodes are classified as	2	A1 class	B1 class	C1 class	D1 class	**A**
54	Which of the following ray is not produced during welding?	2	a. Gamma rays	b. Visible light rays	c. Infrared ray	d. Ultra violet rays	**A**
55	Single-V and single-U butt welds are used for sheets of thickness	2	a. upto 10mm	b. 5-15mm	c. 10-20mm	d. 15-25mm	**B**
56	Which of the following types is not fillet weld?	2	a. butt joint	b. lap joint	c. T-joint	d. Corner joint	**A**
57	Which of the following is an example of fusion welding?	2	a. Arc welding	b. Forge welding	Resistance welding	welding with pressure	**A**

58	Which flame is suitable for cutting operations?	2	Oxidising flame	Carburising flame	c. Neutral flame	d. None of the above	**A**
59	welding of non ferrous metals (brasses and	2	Oxidising flame	Carburising flame	c. Neutral flame	d. None of the above	**A**
60	which of the following polarity is generally used	2	current straight	current reverse	c. Alternating Current high	d. All of the above	**A**
61	weldability, in descending order are	2	steel, iron, carbon	steel, iron, cast steel,	carbon steel, cast steel,	iron, carbon steel, cast	**A**
62	Which of the following is not true for gas welding?	2	effected zone and	suitable for thin sheets	than arc welding	safety problems in	**A**
63	Distortion in welding occures due to.....	2	excessive current	clamping methods	wrong electrodes	Oxidation of weld pool	**B**
64	carbon steel is most weldable.....	2	carbon steel	carbon steel	0.50 % carbon steel	0.75 % carbon steel	**A**
65	…… is done at the highest temperature	2	welding	brazing	soldering	braze welding	**A**
66	place at right angles to the line of a welded joint is	2	angular	transverse	longitudinal	latitudinal	**B**
67	Lack of fusion is a defect due to	2	short arc	low current setting	high current setting		**B**
68	For welding in vertical position a _____are used	2	Medium	Long	Short		**C**
69	Due to uneven heating and cooling of the job while welding_____ will take place.	2	Arc blow	Cracter	Distortion		**C**
70	In Acetylene Gas Cylinder, the acetylene gas is dissolved in ……	2	Water	Alkaline	Acetone.		**C**
71	welding acts as……	2	A coolant	A combustible	A shielding gas		**C**
72	converting…… current	2	AC to AC	AC to DC	DC to DC).		**B**
73	porosity in a weld metal is due to ……	2	High voltage	Less Current	Damp Electrodes		**C**
74	_____is not a safety device in Arc welding	2	Helmet	Dark glasses	Blow pipe	None	**C**
75	Which one the following is temporary joint:-	2	welded joints	Riveted joint	Solder joints	Press fit joints	**D**
76	The distance between the tip of the electrode and the parent metal where the strikes	2	Arc gap	Arc length	Arc distance	Arc width	**B**
77	A depression formed at the end of the weld is called	2	Pinhole	Blow hole	Crater	Crack	**C**

78	Acetylene can be dissolved in	2	Water	Acetone	Calcium hydroxide	Kerosene	**B**
79	Tips of the welding blow pipes are made of:	2	Copper	Brass	Mild steel	Bronze	**A**
80	An arc cannot be maintained with a voltage lower than	2	14 volts	24 volts	34 volts	44 volts	**A**
81	are thrown out of the arc during welding along the	2	Porosity	Spatter	Overlap	Undercut	**B**
82	the parts to be welded in alignment is called:	2	Welding jig	welding fixture	Welding positioner	Welding manipulator	**A**
83	As the arc length increase, the operating voltage will	2	Increase	Decrease	Remain the same	May increase or	**A**
84	Arc blow especially noticeable when welding with	2	Bare electrodes	Coated electrodes	Heavily coated electrodes	Low hydrogen elec	**A**
85	right ward welding technique if the mild steel plates to be	2	1.5mm	3.0mm	5.0mm	10.0mm	**C**
86	The correct colors for oxygen and acetylene hoses are:	2	a. Red for oxygen and blue for DA	b. Black for oxygen and Maroon for	c. Black for oxygen and red DA	d. Red for oxygen and black for DA	**B**
87	Arc blow is caused by	2	Magnetic disturbance	Electrical disturbance	Electronic disturbance	Radio disturbance	**A**
88	Lack of penetration in arc welding is due to:	2	High current	Low current	Short arc length	Too low welding	**B**
89	The two commonly used inert gases are:	2	Argon and carbon dioxide	Helium and carbon	Carbon dioxide and	Argon and helium.	**D**
90	Heat- affected zone is that portion of metal, which	2	Melts and becomes	Neither melts nor	Melts but does not	Does not melt but	**B**
91	Which on of the following methods of welding is not a method used to control distortion?	2	Back –step welding	Skip welding	Intermediate welding	Right-hand welding.	**D**
92	Which of the following is not true in regard to welding joint?	2	excellent strength characteristics equal to or even stronger than the base	Heavy in weight	Economical	Have a pleasing appearance	**B**
93	Which of the following is a weld joint?	2	butt and lap joints	T joints	Corner joints and edge	all of the above	**D**

SN	Question	Level	Option1	Option2	Option3	Option4	Correct_Ans
1	A cellulosic electrode requires ____ arc length	3	Long	Short	Medium	Large	**A**
2	The highest temperature is produced by ……flame	3	Oxy-hydrogen	oxy-acetylene	oxy-propane	Above all	**B**
3	……. Before its welding or brazing	3	strong	hard	porous	crack resistant	**D**
4	How much oxygen pressure required for 100mm MS plate cutting purpose	3	1.4kg/cm sq	2.5kg/cm sq	4.2kg/cm sq	5.3kg/cm sq	**C**
5	I.S specification number of steeel for general structural purpose	3	IS 2062 - 1992	IS 4559 - 1968	IS 9857 - 1990	None of the above	**A**
6	welding zone is shielded by an atmosphere of	3	helium gas	argon gas	either (a) or (b) above	none of the above	**C**
7	In submerged arc welding, the flux is in the form of	3	Coating on the	Core wires	Granuels	An inert gas	**C**
8	oxygen and acetylene cylinders, pressure of gas is more in	3	acetylene cylinder	oxygen cylinder	equal in both the cylinders	none of the above	**B**
9	In inert gas arc welding, which of the following is used for welding carbon steel ?	3	Non-combustible	combustible electrode	Straight polarity d.c. current	Carbon dioxide because	**D**
10	An example of fusion welding is	3	arc welding	gas welding	thermit welding	forge welding	**B**
11	An example of plastic welding is	3	arc welding	gas welding	forge welding	all of the above	**C**
12	Argon gas cylinder painted with	3	Black	Maroon	Red	Blue	**D**
13	Chemical used in producing acetylene gas is	3	carbon	crushed bone	charcoal	all of the above	**B**
14	compared to oxidising flame is	3	more luminous	less luminous	equally luminous	unpredictable	**A**
15	Carburizing flame is used for the welding of	3	high carbon steel	brass and copper	low carbon steel	medium carbon steel	**A**
16	Class 'L' is used for	3	For Welding of aluminium	For Welding of brass	For Welding of mild steel	For Welding of S.S	**A**
17	Ferrous metals are	3	Aluminium	Zinc	Lead	Cast iron	**D**
18	Gases used in tungsten inert gas welding are	3	hydrogen and oxygen	CO2 and H2	argon and neon	argon and helium	**D**
19	Gray iron is generally welded by	3	gas welding	arc welding	TIG welding	MIG Welding	**A**
20	Cylinder in which oxygen gas is stored are	3	Fabricated by casting	Fabricated by forging	Fabricated by welding	Seamless steel cylinder	**D**

21	TIG welding is best suited for welding	3	Mild steel	Stainless steel	Aluminium	Silver	**C**
22	metals to be joined are heated to the plastic state	3	plasitc welding	fusion welding	thermit welding	none of the above	**A**
23	A.C arc welding are coated with	3	silicate binders	silicate binders	both (a) and (b) above	none of the above	**A**
24	The electrode used for D.C arc welding are coated with	3	potassium silicate	silicate binders	both (a) and (b) above	none of the above	**B**
25	Which of the following materials is best weldable itself?	3	Stainless steel	Copper	Aluminium	Mild steel	**D**
26	for cutting and welding for non-ferrous metals is	3	inert gas arc welding	MIG welding	Submerged arc welding	D.C arc welding	**A**
27	The commonly used flux for Brazing is …….	3	Resin	Pewter	Borax	Soft Iron	**C**
28	equipment for eye & face protection during welding	3	IS 1179 - 1967	IS 2573 - 1975	IS 9857 - 1990	IS 4559 - 1968	**A**
29	are to be dried in the oven at	3	100 degree C	150 degree C	300 degree C	for minimum 1hr	**D**
30	Melting point of iron	3	2000 degree c	1600 degree c	1535 degree c	1700 degree c	**C**
31	metal in brazing should be above	3	420 degrees C	600 degrees C	800 degrees C	900 degrees C	**D**
32	Per heating is essential in welding	3	High speed steel	Stainless steel	Cost iron	German silver	**C**
33	Strongest brazing joint is	3	butt	scarf (inclined)	lap	all are equally strong	**C**
34	Double-V and double-U butt welds are used for plates of thickness	3	1-5mm	b. 5-10mm	c. 10-15mm	d. Over 15mm	**D**
35	resistance welding is expressed by	3	a. I2Rt	b. IR2t	c. IRt2	d. 2IRT	**A**
36	In resistance welding, two electrodes are made of	3	e. Aluminium	f. Copper	g. Iron	h. Bronze	**B**
37	Hot cracking occurs at a minimum temperature of	3	500° c	1300°c	1500°c	2000°c	**B**
38	put up on a lap joint the stress set up is normally	3	shear stress	tensile stress	compressive stress	residual stress	**A**
39	than 11 per cent of chromium added to it , the	3	high tensile steel	low alloy steel	creep-resistant steel	stainless steel	**D**
40	refinement takes place in a multi deposit it is known by	3	weld annealing	weld refining	weld normalizing	weld recrystallizatio	**C**
41	short arc will reduce	3	heat	undercut	rate of melting		**B**
42	heating of a weld is done to minimize	3	Arc Blow	Distortion,	Under cut		**B**

43	In _____the base metal is not heated	3	Soldering	Brazing	welding		**A**
44	Soldering is a method of joining metals by means of an alloy of ……	3	Tin and Zine	Zine and Copper	Lead and Tin		**C**
45	In submerged are welding, Arc is shielded by …….	3	Argon Gas	CO2 Gas	Granular fusible flux		**C**
46	metallic surface to obtain thickness and hardsurface	3	Surfacing	Hard facing	Weld facing		**B**
47	in which a deep groove is made the process is known	3	Groove cutting	Gauging	Flame snapping		**B**
48	One of the functions of electrode flux	3	a. To increase welding current	b. To stabilize the arc	c. To prevent rusting	d. To control arc tempe	**B**
49	chemical reaction between calcium carbon and	3	Air	Water	Kerosene oil	Lubricating oil.	**B**
50	The size of a welding machine is determined by:	3	Input amperage	Output amperage	Open circuit Voltage	Closed circuit Voltage	**B**
51	The type of electrode will pick up moisture easily:	3	Acid coated electrodes	Retile coated ele	Basic coated ele	Titanium coated ele	**C**
52	Cast iron contains two elements which make it difficult to cut it by gas cutting. What are these elements?	3	Sulphur and Phosphorous	Silicon and Graphite	Graphite and Phosphorous	Silicon and Sulphur	**B**
53	flash butt welding are different methods of:	3	Resistance welding	Friction welding	Termite welding	Electro-slag welding	**A**
54	An earth clamp is clamp is used connect the earth cable firmly to the job on welding table. What is it made of?	3	Mild steel	Copper/Copper alloy	Plastic	Brass.	**B**
55	If the main electric supply is not available, arc welding can be done with:	3	Motor generator set	Transformer set	Engine generator set	Rectifier set.	**C**
56	Always cellulose materials will be used in this type of electrode flux coating. These electrodes are:	3	Low hydrogen electro	Gouging electrodes	Deep penetration elect	Stainless steel	**C**
57	one volume of acetylene requires	3	1.5 volume of oxygen	2.5 Volume of oxygen	3.5 volume of oxygen	4.5 volume of oxygen.	**B**
58	lying in the same plane, what is this joint called	3	Butt joint	Lap joint	Tee joint	Edge joint	**A**
59	are available in various forms. Which one of the	3	Coil	Power	Paste	Liquid	**A**
60	the surface of the weld metal is known as:	3	Fusion zone	350 mm and 450 mm	Penetration	Heat affected zone	**C**

61	current is doubled, the heating effect becomes	3	Double	Four times	Eight times	Sixteen times	**B**
62	extinguisher is used in a welding shop?	3	Foam type extinguisher	Dry powder extinguisher	CO2 Extinguisher	Holan Extinguisher	**C**
63	butt welding joint is given to:	3	Keep the job in alignment	Control the distortion	Obtain penetration	Maintain correct	**C**
64	The use of wrong polarity in DC welding will result in:	3	Electrode becoming hot	Excessive spatter and	Electrode freezing with	Edge plates melting off.	**A**
65	During overhead arc welding, it is more convenient to use?	3	Welding goggles	Helmet	Hand screen	Sun glasses	**B**
66	Leftward gas welding technique is used for welding mild steel up to thickness of?	3	1.5mm	3.0mm	5.0mm	10.0mm	**C**
67	In soldering the melting point of filler metal is	3	below 420°C	above 420°C	below 520°C	above 520°C	**B**

SN	Question	Level	Option1	Option2	Option3	Option4	Correct_Ans
1	Resistance welding requires current ……the manual metallic arc welding	4	higher than	lower than	equal to	Above all	A
2	Flux used in Bronze welding ____	4	Borax	No flux is used	Any flux	None of the above	A
3	I.S specification number for compressed oxygen gas	4	IS 308/1999	IS 309/1992	Both	None of the above	B
4	In electrical resistance welding, cleaning of metals to be welded is	4	immeterial	important	not effecting the welding	none of the above	B
5	In spot welding, spacing between two spot welds should not be less than (d dia of spot)	4	d	1.5d	3d	4.5d	C
6	In spot welding, the tip of electrodes is of	4	stainless steel	aluminium	copper	brass	C
7	In the manual TIG welding, the angle of the electrode holder with the direction of welding is electrode heater	4	30 degrees	45 degrees	60 degrees	70 degrees	D
8	In thermit welding, aluminium and iron oxide are mixed in the proportion	4	1:01	1:03	3:1	2:1	B
9	In thermit welding, heat is generated from	4	chemical reaction	combusion of gases	electric arc	none of the above	A
10	In thermit welding, thermit used is mixture of	4	aluminium and iron	aluminium and charcoal	iron oxide and charcoal	none of the above	A
11	In TIG welding, the cooling rate as compares to electroslag welding is	4	fast	slow	science	none of the above	A
12	thickness of metal is limited to	4	2 mm	3 mm	6 mm	10 mm	B
13	In which type of welding a pool of molten metal is used	4	electroslag	submerged arc	MIG	TIG	A
14	oxide and aluminium oxide are mixed in the proposition of	4	1:01	1:3	1.2:1	2:1	B
15	which of the following electrode is used for welding magnesium	4	Non-combstible	Combustible electrodes	straight polarity d.c.current	Carbon dioxide, because	A
16	In electrical resistance welding, pressure applied varies in the range	4	50 to 100 kgf/sq.cm	100 to 200 kgf/sq.cm	250 to 550 kgf/sq.cm	600 to 900 kgf/sq.cm	C
17	In resistance welding voltage used for heating is	4	1 V	10 V	100 V	1000 V	B

18	In resistance welding, the pressure is released	4	just at the time of passing the current	just after completion of current	after the weld cools	during heating period	C
19	Amount of current necessary in resistance welding is of the order of	4	1-2 kVA/cm square	2.5-40 kVA/cm square	4.5-6.2 kVA/cm square	6.5-8.9 kVA/cm square	C
20	Brazing metals and alloy commonly used are	4	Copper	Copper alloys	Silver alloys	All of the above	D
21	A collimated light beam is used for producing heating in	4	TIG welding	MIG welding	Laser welding	Plasma welding	C
22	Advantage of electroslag welding is / are	4	ability to weld metals of	high welding speed	little distortion and good	all of the above	D
23	Ends of two pipes of uniform cross section are welded by	4	spot welding	seam welding	projection welding	upset butt welding	D
24	Flux used for brazing cast iron is	4	Mixture of boric acid	boric acid, borax	chlorides and fluorides	none of the above	B
25	applications, welding preferred is	4	thermit welding	arc welding	laser welding	all of the above	C
26	Forge welding is best suited for	4	Stainless steel	High carbon steel	Cast iron	Wrought iron	D
27	For joining rails_____ welding is used	4	Thermit welding	T.G	Both	None of the above	A
28	Electro beam welding is carried out in	4	air	vaccum	not in vaccum	not in air	B
29	The electordes commonly used in submerged arc welding are	4	Bare rods	Coated electrodes	Core wires	Copper electrodes	A
30	The electroslag welding is suitable for welding	4	thick plates	thin plates	both (a) and (b) above	none of the above	A
31	The width of Heat Affected Zone is more in	4	plasma arc welding	electron beam welding	electro-slag welding	electric resistance welding	C
32	The welding process in which two pieces to be joined are overlapped and placed between two electrodes	4	spot welding	projection welding	seam welding	butt welding	A
33	Welding preferred for wrought iron is	4	spot welding	seam welding	forge welding	laser welding	C
34	heat is produced for welding by chemical reaction, is known as	4	gas welding	thermit welding	forge welding	resistance welding	B
35	Temperature of the plasma torch is of the order of	4	1000 degrees C	5000 degrees C	10000 degrees C	33000 degrees C	D

36	In which of the following process, heat is created by blacksmith fire	4	a. Forge welding	b. Spot welding	c. Projection welding	d. Seam welding	A
37	an exothermal chemical reaction to develop high temperature	4	a. Electroslag welding	b. Plasma arc welding	c. Thermit welding	d. Stud welding	C
38	Which process allows fusion welds of great depth with minimum width?	4	a. Electron beam welding	b. Ultrasonic welding	c. Plasma arc welding	d. Friction welding	A
39	Which of the following is not a resistance welding?	4	a. Spot welding	b. Butt welding	c. Pressure welding	d. Percussion welding	C
40	The resistance welding process suitable for welding ferrous and non-ferrous metals upto 8mm thickness is	4	a. Spot welding	b. Projection welding	c. Butt welding	d. Pressure welding	A
41	In spot welding, the spacing between two spot welds is	4	a. 4t	b. 8t	c. 12t	d. 16t	C
42	Which welding process is used to join two thick plates in one single pass?	4	a. Oxy-acetylene welding	b. Gas tungsten arc welding	c. Gas metal arc welding	d. Electroslag welding	D
43	Forge welding is best suited for.....	4	Stainless steel	High carbon steel	Cast iron	Wrought iron	D
44	When a cold worked metal is heated upon its recrystallization temperature it becomes	4	harder	softer	stays unchanged	stay unchanged	B
45	low alloy steel pipes before they are electric arc welded is to	4	refine grain structure	relieve internal stress	retard rapid cooling	regulate exensive	C
46	Hard zone cracking in low alloy steel due to welding is the result of an absorption of	4	hydrogen	oxygen	nitrogen	carbon	C
47	found in a single run arc weld in the as – welded condition is	4	equi-axed	columnar	polycrystalline	dendritic	B
48	effected by zone of the parent metal nearest the weld deposit	4	large crystal grains	small crystal grains	elongated crystals	distorted grains	A
49	to sulphur contamination during welding and this enrichment to	4	cold cracking	hot cracking	hard zone cracking	season cracking	B
50	problems associated with welding of clad steels is one of	4	dilution	precipitation	oxidation	distortion	A
51	A hydraulic Back pressure valve is used in	4	Low Pressure gas welding	A.C. welding	D.C.welding	high pressure gas	A

52	The type of filler metal used in submerged arc welding is:	4	Bare wire	Light coated wire	Heavily coated wire	Cored wire.	A
53	Welding transformer are equipped with condensers so as to improve	4	Power factor	Energy factor	Voltage factor	Current factor	A
54	The depth of fusion from the surface of weld metal is known as	4	Fusion zone	Heat-affected zone	Penetration	Leg length.	C
55	Which of the processes can be classified as solid state welding?	4	Oxyfuel welding	Electron beam welding	Diffusion welding	Resistance welding	C
56	Which of the following processes do not use flux during welding?	4	Submerged Arc	Oxyfuel	Flux Cored Arc	Friction	D
57	The composition of soft solder is	4	lead-37%, tin-63%	lead-50%, tin-50%	lead-63%, tin-37%	lead-70%, tin-30%	A
58	Filler material used in adhesive bonding	4	Metallic	nonmetallic	both	none of these	B
59	which of the following material?	4	Glass	Cu	Al	all of the above	D

Question.1. The deformation per unit length is called

(a) Strain

(b) Stress

(c) Elasticity

(d) None of these

Question.2. The ability of the material to deform without breaking is called

(a) Elasticity

(b) Plasticity

(c) Creep

(d) None of these

Question.3. Which of the following material is more elastic?

(a) Rubber

(b) Glass

(c) Steel

(d) Wood

Question.4. The percentage elongation and the percentage reduction in area depends upon

(a) Tensile strength of the material

(b) Ductility of the material

(c) Toughness of the material

(d) None of these

Question.5. The property of a material by which it can be beaten or rolled into thin sheets, is called

(a) Elasticity

(b) Plasticity

(c) Ductility

(d) Malleability

Question.6. A bar of square cross section of side 'a' is subjected to a tensile load P on a plane inclined at 45^0 to the axis of the bar, the normal stress will be.

(a) $\frac{P}{a^2}$

(b) $\frac{P}{2a^2}$

(c) $\frac{2P}{a^2}$

(d) $\frac{P}{4a^2}$

Question.7. A load of 1 kN acts on a bar having cross-sectional area 0.8 cm^2 and length 10 cm. The stress developed in the bar is

(a) $12.5\ \mathrm{N/mm^2}$

(b) $25\ \mathrm{N/mm^2}$

(c) $50\ \mathrm{N/mm^2}$

(d) $75\ \mathrm{N/mm^2}$

Question.8. A steel bar 100 mm long is subjected to a tensile stress σ .If the change in length of the bar is $\frac{1}{20}$ mm, what will be the value of σ? $\mathrm{E\ for\ steel} = 2 \times 10^5\ \mathrm{N/mm^2}$.

(a) $25\ \mathrm{N/mm^2}$

(b) $50\ \mathrm{N/mm^2}$

(c) $75\ \mathrm{N/mm^2}$

(d) 100 $\mathrm{N/mm^2}$

Question.9. The property of a material by which it can be drawn to a smaller section by applying a tensile load is called

(a) Elasticity

(b) Plasticity

(c) Ductility

(d) Malleability

Question.10. If a material has identical properties in all directions, it is called

(a) Elastic

(b) Plastic

(c) Isotropic

(d) Homogeneous

Question.11. The stress at which extension of a material takes place more quickly as compared to increase in load, is called

(a) No elastic zone

(b) Plastic point

(c) Yield point

(d) Breaking point

Question.12. A brittle material has

(a) No elastic zone

(b) No plastic zone

(c) Large plastic zone

(d) None of these

Question.13. Every material obeys the Hooke's law within

(a) Elastic limit

(b) Plastic limit

(c) Limit of proportionality

(d) None of these

Question.14. Units of strain

(a) cm/cm

(b) m/m

(c) N/cm^2

(d) No unit

Question.15. The increase in the length of a bar of length l area A, modulus of elasticity E due to a tensile load P is given by

(a) $\frac{Pl}{A^2E}$

(b) $\frac{Pl}{AE}$

(c) $\frac{PlA}{E}$

(d) $\frac{AE}{Pl}$

Question.16. The ratio of lateral strain to linear strain is called

(a) Modulus of Elasticity

(b) Modulus of Rigidity

(c) Bulk Modulus

(d) Poisson's Ratio

Question.17. Dimensional formula for Young's modulus of elasticity is

(a) $ML^{-1}T^2$

(b) MLT^2

(c) $M^{-1}L^{-1}T^{-1}$

(d) $ML^{-2}T^{-2}$

Question.18. A perfectly elastic body

(a) Can move freely

(b) Has perfectly smooth surface

(c) Is not deformed by any external surface

(d) Recovers its original size and shape when the deforming force is removed.

Question. 19. The value of Poison's ratio depends upon

(a) Nature of load, tensile or compressive

(b) Magnitude of load

(c) Material of the test specimen

(d) Dimensions of the test specimen

Question. 20. When a section is subjected to two equal and opposite forces tangentially to the section, the stress produced is known as

(a) Tensile stress

(b) Lateral stress

(c) Shear stress

(d) No stress

Question.21. Which of the following is a dimensionless quantity?

(a) Shear stress

(b) Poison's ratio

(c) Strain

(d) Both (b) and (c)

Question.22. Percentage elongation during tensile test is indication of

(a) Ductility

(b) Malleability

(c) Creep

(d) Rigidity

Question.23. Brittleness is opposite to

(a) Toughness

(b) Plasticity

(c) Malleability

(d) None of these

Question.24. The statement: stress is proportional to strain, i.e. the Hooke's law holds good upto

(a) Elastic Limit

(b) Proportional Limit

(c) Plastic Limit

(d) Yield point

Question.25. The limit beyond which the material does not behave elastically is known as

(a) Proportional limit

(b) Elastic limit

(c) Plastic limit

(d) Yield Point

Question.26. When mild steel is subjected to a tensile load, its fracture will conform to

(a) Star shape

(b) Granular shape

(c) Cup and cone shape

(d) Fibrous shape

Question.27. When a wire is stretched to double in length, the longitudinal strain produced in it is

(a) 0.5

(b) 1.0

(c) 1.5

(d) 2.0

Question.28. The length of a wire is increased by 1 mm on the application of a certain load. In a wire of the same material but of twice the length and half the radius, the same force will produce an elongation of

(a) 0.5 mm

(b) 2 mm

(c) 4 mm

(d) 8 mm

Question.29. A cylindrical rod of length l and diameter d is rigidly fixed at its upper end and hangs vertically. The elongation produced in the rod due to its self weight W is

(a) $\frac{Wl}{AE}$

(b) $\frac{Wl}{2AE}$

(c) $\frac{2AE}{Wl}$

(d) $\frac{3Wl}{2AE}$

Question.30. The Young's modulus E, the shear modulus G and the Poisson's ratio μ for a material are related by the expression

(a) $E = 2G(1 + \mu)$

(b) $E = 3G(1 - \mu)$

(c) $E = 3G(1 - 2\mu t)$

(d) $E = 3G(1 + 2\mu)$

Question.31. The elastic constant E, G and K are related by the expression

(a) $E = \frac{GK}{2K+G}$

(b) $E = \frac{2GK}{2K+G}$

(c) $E = \frac{3GK}{K+2G}$

(d) $E = \frac{9GK}{3K+G}$

Question.32. The independent elastic constants for a homogeneous and isotropic material are

(a) E, G, K, μ

(b) E, G, K

(c) F, G

(d) E, K

Question.33. When a bar is subjected to a change of temperature and its longitudinal deformation is prevented, the stress induced in the bar is

(a) Tensile

(b) Compressive

(c) Shear

(d) Temperature

Question.34. When a bar is subjected to increase in temperature and its deformation is prevented, the stress induced in the bar is

(a) Tensile

(b) Compressive

(c) Shear

(d) None of the above

Question.35. In a composite body, consisting of two different materials…….will be same in both materials.

(a) Stress

(b) Strain

(c) Both stress and strain

(d) None of these

Answers

1. (a) 2.(b) 3. (c) 4. (b) 5. (d) 6. (b) 7. (a)

8. (d) 9. (c) 10. (c) 11. (c) 12. (b) 13. (c) 14. (d)

15.(b) 16. (d) 17. (a) 18. (d) 19. (c) 20. (c) 21. (d)

22. (a) 23. (b) 24. (b) 25. (b) 26. (c) 27. (b) 28. (d)

29. (b) 30. (a) 31. (d) 32. (a) 33. (d) 34. (b) 35. (b)

******

1. Strain is defined as the ratio of
(a) change in volume to original volume
(b) change in length to original length.
(c) change in cross-sectional area to original cross-sectional area.
(d) any one of the above.
(e) none of the above..
Ans: d.
2. Hookes law holds good up to .
(a) yield point.
(b) limit of proportionality.
(c) breaking point.
(d) elastic limit.
(e) plastic limit..

Ans: b.

3. Youngs modulus is defined as the ratio of .
(a) volumetric stress and volumetric strain.
(b) lateral stress and lateral strain.
(c) longitudinal stress and longitudinal strain.
(d) shear stress to shear strain.
(e) longitudinal stress and lateral strain..

Ans: c.

4. The unit of Youngs modulus is .
(a) mm/mm.
(b) kg/cm.
(c) kg.
(d) kg/cm2.
(e) kg cm2..

Ans: d.

5. Deformation per unit length in the direction of force is known as .
(a) strain.
(b) lateral strain.
(c) linear strain.
(d) linear stress.
(e) unit strain..

Ans: c.

6. It equal and opposite forces applied to a body tend to elongate it, the stress so produced is called .
(a) internal resistanpe.
(b) tensile stress.
(c) transverse stress.
(d) compressive stress.
(e) working stress..

Ans: b.

7. The materials having same elastic properties in all directions are called .
(a) ideal materials.
(b) uniform materials.
(c) isotropic materials.
(d) paractical materials.
(e) elastic materials..

Ans: c.

8. A thin mild steel wire is loaded by adding loads in equal increments till it breaks. The extensions noted with increasing loads will behave as under.
(a) uniform throughout.
(b) increase uniformly.
(c) first increase and then decrease.
(d) increase uniformly first and then increase rapidly.
(e) increase rapidly first and then uniformly..

Ans: d.

9. Modulus of rigidity is defined as the ratio of .
(a) longitudinal stress and longitudinal strain.
(b) volumetric stress and volumetric strain.
(c) lateral stress and lateral strain.
(d) shear stress and shear strain.
(e) linear stress and lateral strain..

Ans: d.

10. If the radius of wire stretched by a load is doubled, then its Youngs modulus will be .

(a) doubled.
(b) halved.
(c) become four times.
(d) become one-fourth.
(e) remain unaffected..

Ans: e.

11. The ultimate tensile stress of mild steel compared to ultimate compressive stress is .

(a) same.
(b) more.
(c) less.
(d) more or less depending on other factors.
(e) unpredictable..

Ans: b.

12. Tensile strength of a material is obtained by dividing the maximum load during the test by the .

(a) area at the time of fracture.
(b) original cross-sectional area.
(c) average of (a) and (b).
(d) minimum area after fracture.
(e) none of the above..

Ans: b.

13. The impact strength of a material is an index of its .

(a) toughness.
(b) tensile strength.
(c) capability of being cold worked.
(d) hardness.
(e) fatigue strength..

Ans: a.

14. The Youngs modulus of a wire is defined as the stress which will increase the length of wire compared to its original length .

(a) half.
(b) same amount.
(c) double.
(d) one-fourth.
(e) four times..

Ans: b.

15. Percentage reduction of area in performing tensile test on cast iron may be of the order of .

(a) 50%.
(b) 25%.
(c) 0%.
(d) 15%.
(e) 60%..

Ans: c.

16. The intensity of stress which causes unit strain is called .

(a) unit stress.
(b) bulk modulus.
(c) modulus of rigidity.
(d) modulus of elasticity.
(e) principal stress..

Ans: d.

17. True stress-strain curve for materials is plotted between .

(a) load/original cross-sectional area and change in length/original length.
(b) load/instantaneous cross-sectional area original area and log..
(c) load/instantaneous cross-sectional area and change in length/original length.
(d) load/instantaneous area and instantaneous area/original area.
(e) none of the above..

Ans: b.

18. During a tensile test on a specimen of 1 cm cross-section, maximum load observed was 8 tonnes and area of cross-section at neck was 0.5 cm2. Ultimate tensile strength of specimen is .

(a) 4 tonnes/cm2.
(b) 8 tonnes/cm2.
(c) 16 tonnes/cm2.
(d) 22 tonnes/cm2.
(e) none of the above..

Ans: b.

19. For steel, the ultimate strength in shear as compared to in tension is nearly.

(a) same.
(b) half.
(c) one-third.
(d) two-third.
(e) one-fourth..

Ans: b.

20. Which of the following has no unit .

(a) kinematic viscosity.
(b) surface tension.
(c) bulk modulus.
(d) strain.
(e) elasticity..

Ans: d.

Multiple Choice Practice Questions

Speed, Velocity, Acceleration, Free Fall, Motion Curves

Skip the hard ones

1. Starting from rest, object 1 falls freely for 4.0 seconds, and object 2 falls freely for 8 seconds. Compared to object 1, object 2 falls:

A. half as far
B. twice as far
C. three times as far
D. four times as far
E. sixteen time as far

2. A car starts from rest and uniformly accelerates to a final speed of 20.0 m/s in a time of 15.0 s. How far does the car travel during this time?

A. 150 m
B. 300 m
C. 450 m
D. 600 m
E. 800 m

3. A car moves 0.80 m in 1.0 s at the constant velocity. If it continues, how far will it travel in 3.0 s?

A. 2.4 m
B. 3.6 m
C. 4.8 m
D. 7.2 m
E. 14.4 m

4. A freely falling body is found to be moving downwards at 27 m/s at one instant. If it continues to fall, one second later the object would be moving with a downward velocity closest to:

A. 270 m/s/s
B. 37 m/s
C. 27 m/s
D. 17 m/s
E. 10 m/s

5. A rocket near the surface of the earth is accelerating vertically upward at 10 m/s^2 . The rocket releases an instrument package. Immediately after release the acceleration of the instrument **package is:**

A. 20 m/s^2 up
B. 10 m/s^2 up
C. 0
D. 10 m/s^2 down
E. 20 m/s^2 down

6. A car starts from rest and accelerates at 0.80 m/s^2 for 10 s. It then continues at constant velocity. Twenty seconds after it began to move, the car has:

A. velocity 8.0 m/s and has traveled 40 m.
B. velocity 8.0 m/s and has traveled 80 in.
C. velocity 8.0 m/s and has traveled 120 m.
D. velocity 16 m/s and has traveled 160 in.
E. velocity 16 m/s and has traveled 320 in.

7. When a falling object reaches terminal velocity, it:

A. is no longer subject to the friction of air.
B. moves downward with constant velocity.
C. has an acceleration of approximately 10 m/s^2.
D. has no downward velocity.
F. has an upward acceleration.

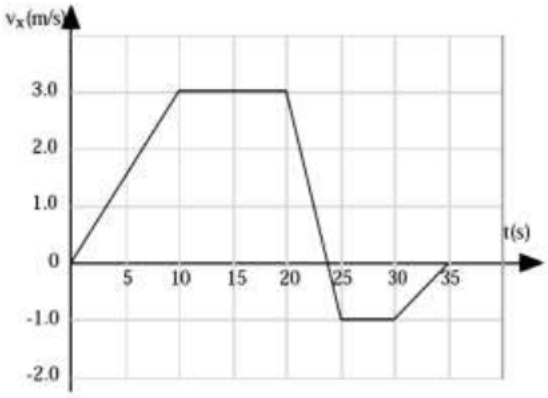
8. A ball which is dropped from the top of building strikes the ground with a speed of 30 m**/s.**
Assume air resistance can be ignored. The height of the building is approximately:

A. 15m
B. 30 m
C. 45 m
D. *75 m*
E. 90 m

9. At a certain time, an object in free fall has velocity 4.0 m/s in the upward direction. What is the approximate velocity of the object one second later?
A. 14 m/s up
B. 10 m/s up
C. 4.0 m/s tip
D. 6.0 m/s down
E. 10 m/s down

10. A motorist travels 400 km at 80 km/h and 400 km at 100 km/h. What is the average speed of the motorist on this trip?
A. 84 km/h
B. 89 km/h
C. 90 km/h
D. 91 km/h
E. 95 km/h

Questions 11, 12, and 13 refer to the motion of a toy car traveling along the x-axis. The graph shown below is a plot of the car's velocity **in** the x direction. v_x versus time **t.**



11. During what time interval was the car moving towards its initial position at constant velocity?
A. 0-lOs
B. 10-20s
C. 20-25 s
D. 25-30 s
E. 30-35 s

12. What was the acceleration at 33 s?
A. +0.40 m/s^2
B. +0.20 m/s^2
C. 0
D. -0.20 m/s^2
E. -0.40 m/s^2

13. How far did the car travel during first 15 seconds?
A. 0
B. 3.0 m
C. 15 m
D. 30 m
E. 45 m

14. When a falling object moves with terminal velocity, it

A. has zero velocity.
B. has zero acceleration.
C. has an upward acceleration.
D. is no longer subject to air resistance.
E. has an acceleration of approximately 10 m/s^2 .

15. How long must a 2.5 m/s^2 acceleration act to change the velocity of a 2.0-kg object by 3.0 m/s?

A. 0.83 s
B. 1.2 s
C. 1.7 s
D. 2.5 s
E. 7.5 s

16. A freely falling object is found to be moving downward at 18 m/s. If it continues to fall, two seconds later the object would be moving with a speed of
A. 8.0 m/s
B. 10 m/s
C. 18 m/s
D. 38 m/s
E. 180 m/s

17. Coin I is thrown upward from the top of a 100-m tower with a speed of 15 m/s. Coin II is dropped from the top of the tower 2.0 s later. Assume g is 10 m/s^2. How far below the top of the tower does coin I pass coin II?

A. 1.6 m
B. 16 m
C. 20 m
D. 80 m
E. 96m

18. The change of distance per unit time without reference to a particular direction is called

A. inertia B. speed C. velocity D. acceleration E. position

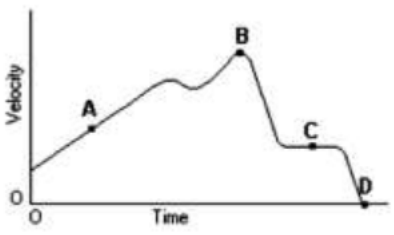
19. Which of the following terms is **NOT** related conceptually to the others?
A. vector B. resultant C. component D. exponent E. equilibrant

20. In the absence of air resistance. if an object were to fall freely near the surface of the Moon.

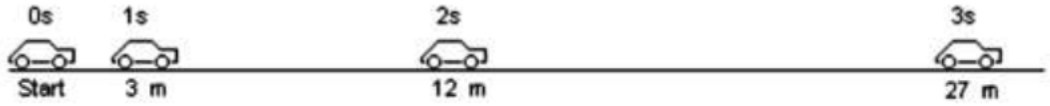
A. its velocity could never exceed 10 m/s.
B . its acceleration would gradually decrease until the object moves with a terminal velocity.
C . the acceleration is constant.
D. it will fall with a constant speed.
E. the acceleration is zero.

20. Given the graph of the velocity vs. time of a chick flying due south for the winter. At what B point did the duck stop its forward motion?

A. A B. B C. C D. D E. none of these points



The next 2 questions refer to tile diagram below which shows the position and elapsed time of a car starting from rest and uniformly accelerating in a straight line.



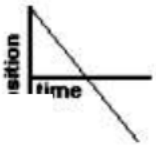
22. What was the average velocity of the car during the third second?

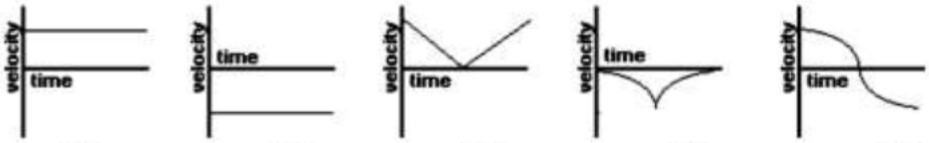
A. 15 m/s B. 12 m/s C. 9 m/s D. 5 m/s E. 2 m/s

23. The average acceleration during the entire 3 second interval is closest to

A. 27 m/s^2 B. 9 m/s^2 C. 6 m/s^2 D. 5 m/s^2 E. 3 m/s^2

20. What is the shape of the velocity time graph for an object with the position time graph shown in the diagram at right?



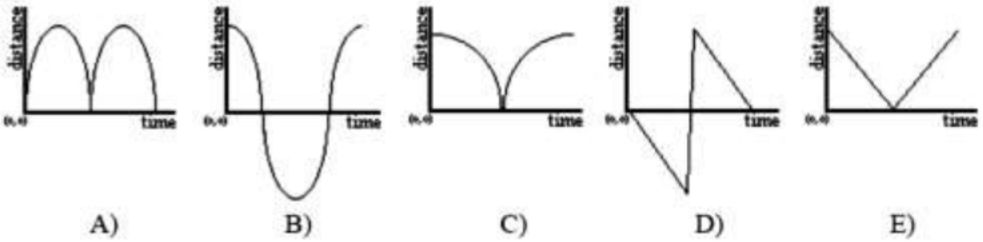


25. Is it possible for an object's velocity to increase while its acceleration decreases?

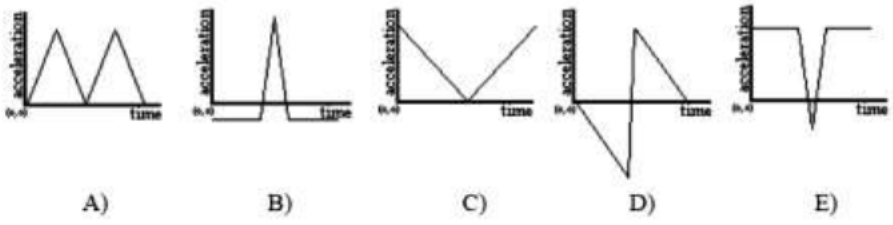
A. No. this is impossible because of the way in which acceleration is defined.
B. No. because if acceleration is decreasing the object will be slowing down.
C. No. because velocity and acceleration must always be in the same direction.
D. Yes. an example would be a falling object near the surface of the moon.
E. Yes. an example would be a falling object in the presence of air resistance.

The following TWO questions refer to the following information. An ideal elastic rubber ball is dropped from a height of about 2 meters. hits the floor and rebounds to its original height.

26. Which of the following graphs would best represent the distance above the floor versus time for the above bouncing ball?



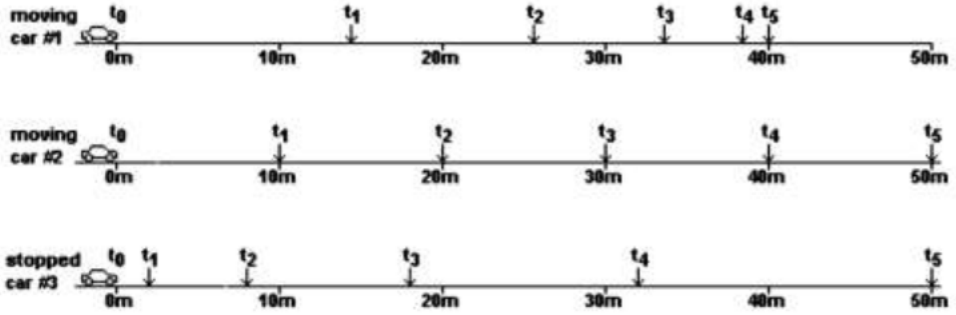
27. Which of the following graphs would best represent acceleration versus time for the bouncing ball?



28. Suppose two cars are racing on a circular track one kilometer in circumference. The first car can circle the track in 15 seconds at top speed while the second car can circle the track in 12 seconds at top speed. How much lead does the first car need stalling the last lap of the race not to lose?

A) at least 250 m B) at least 200 m C) at least 104 m
D) at least 83 m E) at least 67 m

Next four questions refer to the following scenario:
At to. two cars moving along a highway are side-by-side as they pass a third car stopped on the side of the road. At this moment the driver of the first car steps on the brakes while the driver of the stopped car begins to accelerate. The diagram below show the positions of each car for the next 5 seconds.



29. During which time interval would cars #2 and #3 be moving at the same average speed?

A. t_0 to t_1 B. t_1 to t_2 C. t_2 to t_3 D. t_3 to t_4 E. t_4 to t_5

30. About what position after t_0 would car #1 and car #2 have been side by side?

A. O B. 15m C. 26m D. 37m E. 39m

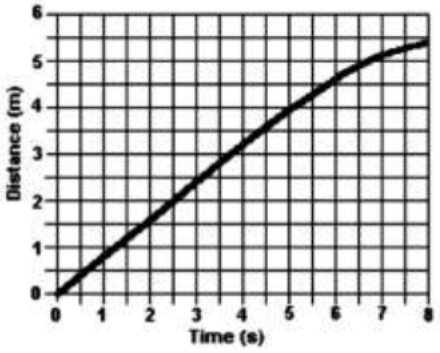
31. Which of the three cars had the greatest average speed during these 5 seconds?

A) car #1
B) car #2
C) car #3
D) car #2 and car #3 had the same average speed
E) all three cars had the same average speed

32. If car #3 continues to constantly accelerate at the same rate what will be its position at the end of 6 seconds?

A) 22 m B) 68 m C) 72 m B) 78 m F) 94 m

33. The graph represents tile relationship between distance and time for an object that is moving along a straight line. What is the instantaneous speed of the object at t = 5.0 seconds?



A. 0.0 m/s
B. 0.8 m/s
C. 2.5 m/s
D. 4.0 m/s
E. 6.8 m/s

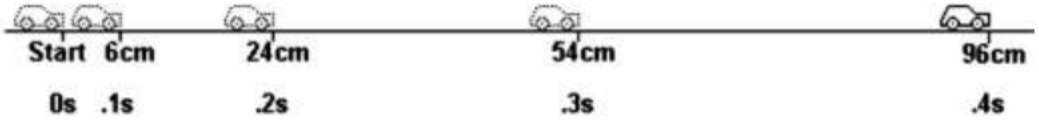
Between what times did the object have a non-zero acceleration?

A. 0 s only
B. 0 s to 5 s
C. 5 s to 8 s
B. 0 s to 8 s
E. the object was not accelerating at any time4.

34. If a bali is thrown directly upwards with twice tile initial speed of another, how much higher will it be at its apex?

A. 8 times B. 4 times C. 2√2 D. 2 times E. √2 times

THE NEXT THREE QUESTIONS REFER TO THE FOLLOWING SCENARIO
The diagram below represents a toy car starting from rest and uniformly accelerating across the floor. The time and distance traveled from the start are shown i the diagram.



35. What was the average speed of the cart between 0.1 seconds and 0.3 seconds?

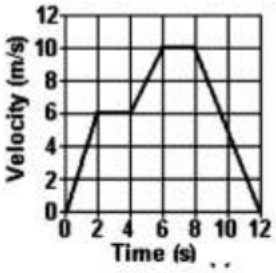
A. 0.6 m/s B. 1.9 m/s C. 2.4 m/s D. 4.8 m/s E. 60 m/s

36. What was the acceleration of the cart during the first 0.4 seconds?

A. 6.0 m/s/s B. 9.8 m/s/s C. 12 m/s/s D. 25 m/s/s E. 50 m/s/s

37. What was the instantaneous velocity of the cart at 96 centimeters from the start?
A. 0.6 m/s B. 1.9 m/s C. 2.4 m/s D. 4.8 m/s E. 60 m/s

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING SCENARIO
The motion of a circus clown on a unicycle moving in a straight line is shown in the graph.



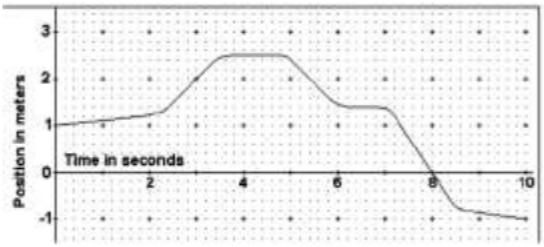
38. What would be the acceleration of the clown at 5 s?
A. 1.6 m!s^2
B. 2.0 m!s^2
C. 3.4 m!s^2
D) 8.O m!s^2
E) none of the above

39. After 12 seconds, how far is the clown from her original starting point?

A. O m
B. 10 m
C. 34 m
D. 47m
E. 74m

40. When an object falls freely in a vacuum near the surface of the earth
A) the velocity can not exceed 10 mIs2
B) the terminal velocity will be greater than when dropped in air
C) the velocity will increase but the acceleration will be zero
D) the acceleration will constantly increase
E) the acceleration will remain constant

THE NEXT THREE QUESTIONS REFER TO THE FOLLOWING SCENARIO
The accompanying graph describes the motion of a marble on a table top for 10 seconds.



41. For which time interval(s) did the marble have a negative velocity?

A. from t = 8.0 s to t = 10.0 s only
B. from t = 6.9 s to t = 10.0 s only
C. from t = 4.8 s to t = 10.0 s only
D. from t = 4.8 s to t = 6.2 s and from t = 6.9 s to t = 10.O s only
E. from t = 3.2 s to t = 3.6 s, from t = 4.8 s to t = 5 s, and from t = 6.8 s to t= 7.2 s only.

42. For which time interval(s) did the marble have a positive acceleration?

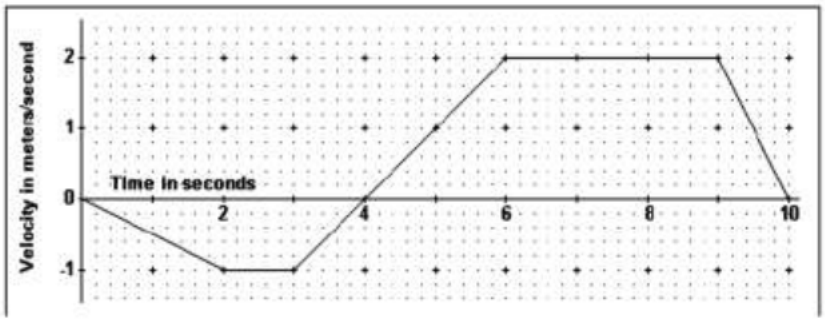
A. from t = 8.0 s to t = 8.0 s only
B. from t = 0.0 s to t = 3.6 s only
C. from t = 3.8 s to t = 4.8 s and from t = 6.2 s to t = 6.8 s only
D. from t = 2.0 s to t = 2.5 s, from t = 5.8 s to t = 6.2 s, and from t = 8.4 s to t = 8.8 s only.
E. from t = 3.2 s to t = 3.7 s, from t = 4.8 s to t = 5.0 s, and from t = 6.8 s to t= 7.2 s only.

43. What is the marbles average acceleration between t = 3.3 s and t = 3.8 s
A. -2.0 m/s^2
B. 0.0 m/s^2
C. 0.8 m/s^2
D. 2.0 m/s^2
E. 3.0 m/s^2

44. A car accelerates uniformly from rest for a time of 2.OO s through a distance of 4.00 m. What was the acceleration of the car?
A) 0.50 m/s^2
B) 0.71 m/s^2
C) 1.00 m/s^2
D) 1.41 m/s^2
F) 2.00 m/s^2

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING SCENARIO

The accompanying graph describes the motion of a toy car across the floor for 10 seconds.



45. What is the acceleration of the toy car at t = 4 s?

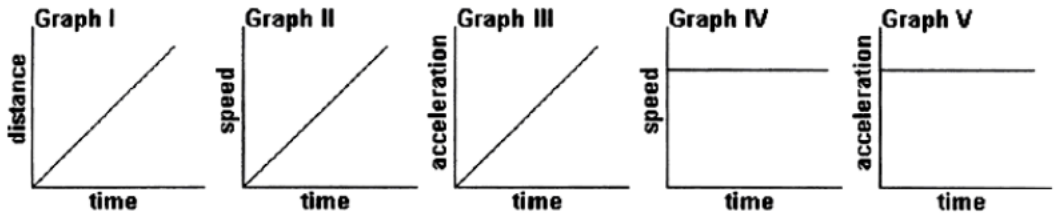
A. -1 m/s^2
B. 0 m/s^2
C. 1 m/s^2
D. 2 m/s^2
E. 4 m/s^2

46. What was the total displacement of the toy car for the entire 10 second interval shown?
A. 0 meters
B. 6.5 meters
C. 9 meters
D. 10 meters
E. 11.5 meters

47. An object is thrown upwards with a velocity of 30 m/s near the surface of the earth. After two seconds what would be the direction of the displacement, velocity and acceleration?

	displacement	velocity	acceleration
A.	up	up	up
B.	up	up	down
C	up	down	down
D.	up	down	up
C.	down	down	down

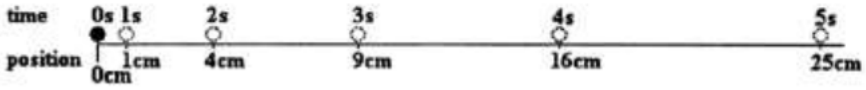
48. Which of the following graphs could correctly represent the motion of an object moving with a constant speed in a straight line?



A. Graph I only B. Graph II only C. Graphs I and IV only
D. Graphs II and V only E. All of the above graphs represent constant velocity.

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING SCENARIO

The diagram shows a uniformly accelerating ball. The position of the ball each second is indicated.



49. What is the average speed of the ball between 3 and 4 seconds?

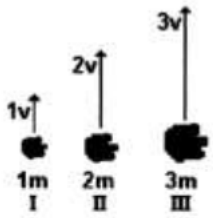
A. 3.0 cm/s
B. 3.5 cm/s
C. 4.0 cm/s
D. 7.0 cm/s
E. 12.5 cm/s

50. Which of the following is closest to the acceleration of the ball?

A. 1 cm/s^2
B. 2 cm/s^2
C. 3 cm/s^2
D. 4 cm/s^2
E. 5 cm/s^2

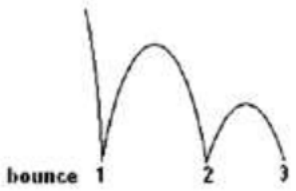
51. Three stones of different mass (1m, 2rn & 3m) are thrown vertically upward with different velocities (lv, 2v & 3v respectively). The diagram indicates the mass and velocity of each stone. Rank from high to low the maximum height of each stone. Assume air resistance is negligible.

A) (high) I, II, III (low)
B) (high) 11, I, III (low)
C) (high) Ill, II, I (low)
D) (high) I, IlL II (low)
E) all reach the same height



52. A rubber ball bounces on the ground as shown. After each bounce, the ball reaches one-half the height of the bounce before it. If the time the ball was in the air between the first and second bounce was 1 second, what would be the time between the second and third bounce?

A. 0.50 s
B. 0.71 s
C. 1.O s
D. l.4 s
E. 2.O s



53. A pebble is dropped from a high vertical cliff. The collision of the pebble with the ground below is seen 1.50 seconds after the pebble is dropped. With what speed did the pebble hit the ground? Ignore air resistance.

A. 10 m/s
B. 15 m/s
C. 48.6 m/s
D. 100.4 m/s
E. 343 m/s

54. A snail is moving along a straight line. Its initial position is Xo = —5 meters and it is moving away from the origin and slowing down. In this coordinate system, the signs of the initial position, initial velocity and acceleration, respectively, are

Choice	x_0	v_0	a
(a)	-	+	+
(b)	-	-	+
(c)	-	-	-
(d)	-	+	-
(e)	+	+	+

1. D	2. A	3. A	4. B	5. D	6. C	7. B	8. C	9. D	10. B	11. D	12. B	13. D
14. B	15. B	16. D	17. C	18. B	19. D	20. C	21. D	22. A	23. C	24. B	25. E	26. C
27. B	28. A	29. C	30. D	31. D	32. C	33. B, C	34. B	35. C	36. C	37. D	38. B	39. E
40. **E**	**41. D**	**42. D**	**43. A**	**44. E**	**45. C**	**46. B**	**47. B**	**48. C**	**49. D**	**50. B**	**51. C**	**52. B**
53. B	54. B											

1) Which among the following is a type of clearance fit?

a. Force fit
b. Push fit
c. Slide fit
d. Tight fit

ANS: c

2) What does allowance represent in clearance fits?

a. It represents minimum clearance and is positive
b. It represents maximum clearance and is positive
c. It represents minimum clearance and is negative
d. It represents maximum clearance and is negative

ANS: a

3) Which of the following statements is/are false?

a. Interference is observed in tight fit
b. Allowance represents minimum interference for interference fits
c. Clearance is observed in push fit
d. All of the above

ANS: b

4) Which of the following is true for interference fit?

a. Shaft is always smaller than the hole
b. Shaft is always bigger than the hole
c. Interference fits have shaft and hole of same dimension
d. None of the above

ANS: b

5) How is interference between shaft and hole calculated?

a. Interference = maximum shaft – minimum hole
b. Interference = minimum shaft – maximum hole
c. Interference = minimum shaft + maximum hole
d. None of the above

ANS: a

6) The snap gauge having go dimension corresponds to

a. maximum metal condition
b. minimum metal condition
c. minimum material condition
d. none of the above

ANS: b

7) Which type of deviation is observed while calculating hole dimensions?

a. Positive
b. Negative
c. Zero
d. All of the above

ANS: d

8) In hole basis system, basic size is equal to

a. maximum hole size
b. minimum hole size
c. upper deviation which is zero
d. none of the above

ANS: b

9) The principle of 'Interchangeability' is normally employed for

a. Mass production
b. Production of identical parts
c. Parts within the prescribed limits of sizes
d. All of the above
(Ans: d)

10) _____ is equal to the differences of the two limits of size of the part

a. Tolerance
b. Low limit
c. High limit
d. Design size
(Ans: a)

****

1. Interference Fit used for fitting Wheel sets on Axle.

2. The bolt both the ends are threaded, with out head is called : Stud

3. The key in which one side is kept flat and the other side is kept half round is called wood ruf key.

4. The face angle of hexagonal nut is: 60º

5. Which type of bolt used for installing a machine on the ground: Foundation bolt

6. Which type of joint used when two shafts at are at desired angles: knuckle joint

7. Which type of bolt is used for lifting of heavy machinery and electrical motors: Eye bolt

8. In a screw jack _____ threads are used Ans A

A: SQUARE B: ACME C: BUTTERS D: METRIC

9. A negative difference between the diameter of a hole and the shaft is called…. Ans D

A: Fit B: Limit C: Clearance D: Interference

10. A nut having raised height and slots cut on that raised portion is called Ans C

A: Swan nut B: Slotted nut C: Castle nut D: Pin hole nut

11. A positive difference between the diameter of hole and the shaft is called….. Ans C

A: Allowance B: Tolerance C: Clearance D: Fit

12. Gauges used for checking shafts is called……. Ans D

A) Plug B) Steel rule C) Thread D) Snap

13. Feeler gauge is used for Ans C

A) To measure B) to measure the Hole size C) to measure gap between Two mating Parts D) To measure depth of the thickness hole

14. Hardening is a process Ans C

A: To soften the material B: To refine the grain Structure

C: To increase the hardness D: None of the above

15. The purpose of Normalizing steel is to

(a) Remove induced stress b) Improve machinability c) Soften the steel Ans: a

d) Increasing the toughness and reduce brittleness

16. To reduce internal stresses of hardened tool, the method of heat treatment

Generally applied is

(a) Stabilizing (b) annealing (c) normalizing (d) tempering Ans: d

17. The purpose of heat treatment is

(a) To change the mechanical properties of steel Ans :a

(b) To change the internal structure of steel

(c) To change the appearance of the component

(d) To change the chemical properties of steel

18. Cyaniding and nitriding are two methods of

(a) Hardening (b) case hardening (c) tempering (d) normalizing Ans: b

19. The main purpose of annealing is

(a) To improve machinability (b) To improve magnetism Ans: a

(c) To improve hardness (d) To improve toughness

20. In case hardening process, ammonia gas is introduced on steel; the process is known

(a) Cyaniding (b) nitriding (c) carburizing (d) ammonizing Ans: b

21. During heat treatment when carbon is dissolved to form solid solution, it is known as

(a) Ferrite (b) Pearlite (c) Austenite (d) Cementite Ans: c

22. After hardening process, the metal becomes more hardened and also will become more

(a) Brittle (b) Ductile (c) malleable (d) Tough Ans: a

23. Which one of the following quenching media is used for hardening H.S.S.tool?

(a) water (b) Brine solution (c) Oil (d) soda water Ans: c

24. Which one of the following is used to guide the tool and hold the job in mass production?

(a) gauge (b) housing (c) Jig (d) Fixture Ans: c

25. Lathe mandrels can be termed as a

(a) Jig (b) Fixture (c) gauge (d) template Ans; b

26. Tolerance on jig should be

(a) 5% of the tolerance on the job Ans: c

(b) 10% of the tolerance on the job

(c) 20 to 50% of the tolerance on the job

(d) 100% of the tolerance on the job

27. Which among the following statements is NOT CORRECT?

(a) jig is used for planning operations Ans: a

(b) Jig is used for drilling operations

(c) Jig is used for indexing operations

(d) Jig is used for boring operations

28. Which among the following jigs is used for location from a bore?

(a) Plate jig (b) solid jig (c) post jig (d) box jig Ans: c

29 The process of decomposing martensitic structure, by heating martensitic steel below its critical temperature is called as _____

a. Austenitizing Ans: c

b. Quenching

c. Tempering

d. None of the above

1. NUMBERS

IMPORTANT FACTS AND FORMULAE

I..Numeral : In Hindu Arabic system, we use ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 called ***digits*** to represent any number.

A group of digits, denoting a number is called a ***numeral.***

We represent a number, say 689745132 as shown below :

Ten Crores (10^8)	Crores(10^7)	Ten Lacs (Millions) (10^6)	Lacs(10^5)	Ten Thousands (10^4)	Thousands (10^3)	Hundreds (10^2)	Tens(10^1)	Units(10^0)
6	**8**	**9**	**7**	**4**	**5**	**1**	**3**	**2**

We read it as : 'Sixty-eight crores, ninety-seven lacs, forty-five thousand, one hundred and thirty-two'.

II Place Value or Local Value of a Digit in a Numeral :

In the above numeral :

Place value of 2 is (2 x 1) = 2; Place value of 3 is (3 x 10) = 30;

Place value of 1 is (1 x 100) = 100 and so on.

Place value of 6 is $6 \times 10^8 = 600000000$

III.Face Value : The ***face value*** of a digit in a numeral is the value of the digit itself at whatever place it may be. In the above numeral, the face value of 2 is 2; the face value of 3 is 3 and so on.

IV.TYPES OF NUMBERS

1.Natural Numbers : Counting numbers 1, 2, 3, 4, 5,..... are called ***natural numbers.***

2.Whole Numbers : All counting numbers together with zero form the set of ***whole numbers***. Thus,

(i) 0 is the only whole number which is not a natural number.

(ii) Every natural number is a whole number.

3.Integers : All natural numbers, 0 and negatives of counting numbers *i.e.*, {..., -3, -2, -1, 0, 1, 2, 3,.....} together form the set of integers.

(i) **Positive Integers** : {1, 2, 3, 4, ...} is the set of all positive integers.

(ii) **Negative Integers** : {- 1, - 2, - 3,.....} is the set of all negative integers.

(iii) **Non-Positive and Non-Negative Integers** : 0 is neither positive nor negative. So, {0, 1, 2, 3,....} represents the set of non-negative integers, while {0, -1, -2, -3, ...} represents the set of non-positive integers.

4. Even Numbers : A number divisible by 2 is called an even number, e.g., 2, 4, 6, 8, 10, etc.

5. Odd Numbers : A number not divisible by 2 is called an odd number. e.g., 1, 3, 5, 7, 9, 11, etc.

6. Prime Numbers : A number greater than 1 is called a prime number, if it has exactly two factors, namely 1 and the number itself.

Prime numbers upto 100 are : 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

Prime numbers Greater than 100 : Let p be a given number greater than 100. To find out

whether it is prime or not, we use the following method :

Find a whole number nearly greater than the square root of p. Let k > *jp. Test whether p is divisible by any prime number less than k. If yes, then p is not prime. Otherwise, p is prime.

e.g,,We have to find whether 191 is a prime number or not. Now, 14 > V191.

Prime numbers less than 14 are 2, 3, 5, 7, 11, 13.

191 is not divisible by any of them. So, 191 is a prime number.

7.Composite Numbers : Numbers greater than 1 which are not prime, are known as composite numbers, e.g., 4, 6, 8, 9, 10, 12.

Note : (i) 1 is neither prime nor composite.

(ii) 2 is the only even number which is prime.

(iii) There are 25 prime numbers between 1 and 100.

8. Co-primes : Two numbers a and b are said to be co-primes, if their H.C.F. is 1. e.g., (2, 3), (4, 5), (7, 9), (8, 11), etc. are co-primes,

V.TESTS OF DIVISIBILITY

1. Divisibility By 2 : A number is divisible by 2, if its unit's digit is any of 0, 2, 4, 6, 8.

Ex. 84932 is divisible by 2, while 65935 is not.

2. Divisibility By 3 : A number is divisible by 3, if the sum of its digits is divisible by 3.

Ex.592482 is divisible by 3, since sum of its digits = (5 + 9 + 2 + 4 + 8 + 2) = 30, which is divisible by 3.

But, 864329 is not divisible by 3, since sum of its digits =(8 + 6 + 4 + 3 + 2 + 9) = 32, which is not divisible by 3.

3. Divisibility By 4 : A number is divisible by 4, if the number formed by the last two digits is divisible by 4.

Ex. 892648 is divisible by 4, since the number formed by the last two digits is 48, which is divisible by 4.

But, 749282 is not divisible by 4, since the number formed by the last tv/o digits is 82, which is not divisible by 4.

4. Divisibility By 5 : A number is divisible by 5, if its unit's digit is either 0 or 5. Thus, 20820 and 50345 are divisible by 5, while 30934 and 40946 are not.

5. Divisibility By 6 : A number is divisible by 6, if it is divisible by both 2 and 3. Ex. The number 35256 is clearly divisible by 2.

Sum of its digits = (3 + 5 + 2 + 5 + 6) = 21, which is divisible by 3. Thus, 35256 is divisible by 2 as well as 3. Hence, 35256 is divisible by 6.

6. Divisibility By 8 : A number is divisible by 8, if the number formed by the last three digits of the given number is divisible by 8.

Ex. 953360 is divisible by 8, since the number formed by last three digits is 360, which is divisible by 8.

But, 529418 is not divisible by 8, since the number formed by last three digits is 418, which is not divisible by 8.

7. Divisibility By 9 : A number is divisible by 9, if the sum of its digits is divisible by 9.

Ex. 60732 is divisible by 9, since sum of digits * (6 + 0 + 7 + 3 + 2) = 18, which is divisible by 9.

But, 68956 is not divisible by 9, since sum of digits = (6 + 8 + 9 + 5 + 6) = 34, which is not divisible by 9.

8. Divisibility By 10 : A number is divisible by 10, if it ends with 0.
Ex. 96410, 10480 are divisible by 10, while 96375 is not.
9. Divisibility By 11 : A number is divisible by 11, if the difference of the sum of its digits at odd places and the sum of its digits at even places, is either 0 or a number divisible by 11.
Ex. The number 4832718 is divisible by 11, since :
(sum of digits at odd places) - (sum of digits at even places)
(8 + 7 + 3 + 4) - (1 + 2 + 8) = 11, which is divisible by 11.
10. Divisibility By 12 ; A number is divisible by 12, if it is divisible by both 4 and 3.
Ex. Consider the number 34632.
(i) The number formed by last two digits is 32, which is divisible by 4,
(ii) Sum of digits = (3 + 4 + 6 + 3 + 2) = 18, which is divisible by 3. Thus, 34632 is divisible by 4 as well as 3. Hence, 34632 is divisible by 12.
11. Divisibility By 14 : A number is divisible by 14, if it is divisible by 2 as well as 7.
12. Divisibility By 15 : A number is divisible by 15, if it is divisible by both 3 and 5.
13. Divisibility By 16 : A number is divisible by 16, if the number formed by the last4 digits is divisible by 16.
Ex.7957536 is divisible by 16, since the number formed by the last four digits is 7536, which is divisible by 16.
14. Divisibility By 24 : A given number is divisible by 24, if it is divisible by both3 and 8.
15. Divisibility By 40 : A given number is divisible by 40, if it is divisible by both 5 and 8.
16. Divisibility By 80 : A given number is divisible by 80, if it is divisible by both 5 and 16.
Note : If a number is divisible by p as well as q, where p and q are co-primes, then the given number is divisible by pq.
If p arid q are not co-primes, then the given number need not be divisible by pq, even when it is divisible by both p and q.
Ex. 36 is divisible by both 4 and 6, but it is not divisible by (4x6) = 24, since 4 and 6 are not co-primes.

VI MULTIPLICATION BY SHORT CUT METHODS

1. Multiplication By Distributive Law :
(i) a x (b + c) = a x b + a x c (ii) ax(b-c) = a x b-a x c.
Ex. (i) 567958 x 99999 = 567958 x (100000 - 1)
= 567958 x 100000 - 567958 x 1 = (56795800000 - 567958) = 56795232042. (ii) 978 x 184 + 978 x 816 = 978 x (184 + 816) = 978 x 1000 = 978000.
2. Multiplication of a Number By 5^n : Put n zeros to the right of the multiplicand and divide the number so formed by 2^n
Ex. 975436 x 625 = 975436 x 5^4= 9754360000 = 609647600

VII. BASIC FORMULAE

1. $(a + b)^2 = a^2 + b^2 + 2ab$ 2. $(a - b)^2 = a^2 + b^2 - 2ab$
3. $(a + b)^2 - (a - b)^2 = 4ab$ 4. $(a + b)^2 + (a - b)^2 = 2 (a^2 + b^2)$
5. $(a^2 - b^2) = (a + b) (a - b)$
6. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2 (ab + bc + ca)$
7. $(a^3 + b^3) = (a +b) (a^2 - ab + b^2)$ 8. $(a^3 - b^3) = (a - b) (a^2 + ab + b^2)$
9. $(a^3 + b^3 + c^3 -3abc) = (a + b + c) (a^2 + b^2 + c^2 - ab - bc - ca)$
10. If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.

VIII. DIVISION ALGORITHM OR EUCLIDEAN ALGORITHM

If we divide a given number by another number, then :

Dividend = (Divisor x Quotient) + Remainder

IX. {i) $(x^n - a^n)$ is divisible by $(x - a)$ for all values of n.
(ii) $(x^n - a^n)$ is divisible by $(x + a)$ for all even values of n.
(iii) $(x^n + a^n)$ is divisible by $(x + a)$ for all odd values of n.

X. PROGRESSION

A succession of numbers formed and arranged in a definite order according to certain definite rule, is called a progression.

1. Arithmetic Progression (A.P.) : If each term of a progression differs from its preceding term by a constant, then such a progression is called an arithmetical progression. This constant difference is called the *common difference* of the A.P.

An A.P. with first term a and common difference d is given by a, (a + d), (a + 2d),(a + 3d),.....

The **nth term of this A.P. is given by $T_n = a (n - 1) d$.**

The sum of n terms of this A.P.

$S_n = n/2 [2a + (n - 1) d] = n/2$ (first term + last term).

SOME IMPORTANT RESULTS :

(i) $(1 + 2 + 3 + \ldots + n) = n(n+1)/2$
(ii) $(l^2 + 2^2 + 3^2 + ... + n^2) = n (n+1)(2n+1)/6$
(iii) $(1^3 + 2^3 + 3^3 + ... + n^3) = n^2(n+1)^2$

2. Geometrical Progression (G.P.) : A progression of numbers in which every term bears a constant ratio with its preceding term, is called a geometrical progression.

The constant ratio is called the common ratio of the G.P. A G.P. with first term a and common ratio r is :

a, ar, ar^2,

In this G.P. $T_n = ar^{n-1}$

sum of the n terms, $Sn = \frac{a(1-r^n)}{(1-r)}$

SOLVED EXAMPLES

Ex. 1. Simplify : (i) 8888 + 888 + 88 + 8
(ii) 11992 - 7823 - 456

Sol. i) 8888
888
88
\+ 8
9872

ii) 11992 - 7823 - 456 = 11992 - (7823 + 456)
= 11992 - 8279 = 3713-

7823
\+ 456
8279

11992
\- 8279
3713

Ex. 2, What value will replace the question mark in each of the following equations ?
(i) ? - 1936248 = 1635773 (ii) 8597 - ? = 7429 - 4358

Sol. (i) Let x - 1936248=1635773.Then, x = 1635773 + 1936248=3572021.
(ii) Let 8597 - x = 7429 - 4358.
Then, x = (8597 + 4358) - 7429 = 12955 - 7429 = 5526.

Ex. 3. What could be the maximum value of Q in the following equation? 5P9 + 3R7 + 2Q8 = 1114

Sol. We may analyse the given equation as shown :
Clearly, 2 + P + R + Q = ll.
So, the maximum value of Q can be
(11 - 2) i.e., 9 (when P = 0, R = 0);

1 2
5 P 9
3 R 7
2 Q 8
11 1 4

Ex. 4. Simplify : (i) 5793405 x 9999 (ii) 839478 x 625
Sol.
i)5793405x9999=5793405(10000-1)=57934050000-5793405=57928256595.b

ii) 839478 x 625 = 839478 x 5^4 = 8394780000 = 524673750.

Ex. 5. Evaluate : (i) 986 x 137 + 986 x 863 (ii) 983 x 207 - 983 x 107
Sol.
(i) 986 x 137 + 986 x 863 = 986 x (137 + 863) = 986 x 1000 = 986000.
(ii) 983 x 207 - 983 x 107 = 983 x (207 - 107) = 983 x 100 = 98300.

Ex. 6. Simplify : (i) 1605 x 1605 ii) 1398 x 1398
Sol.
i) 1605 x 1605 = $(1605)^2$ = $(1600 + 5)^2$ = $(1600)^2$ + $(5)^2$ + 2 x 1600 x 5
= 2560000 + 25 + 16000 = 2576025.
(ii) 1398 x 1398 - $(1398)^2$ = $(1400 - 2)^2$= $(1400)^2$ + $(2)^2$ - 2 x 1400 x 2
=1960000 + 4 - 5600 = 1954404.

Ex. 7. Evaluate : (313 x 313 + 287 x 287).

Sol.

$(a^2 + b^2) = 1/2 [(a + b)^2 + (a- b)^2]$

$(313)^2 + (287)^2 = 1/2 [(313 + 287)^2 + (313 - 287)^2] = ½[(600)^2 + (26)^2]$

$= 1/2 (360000 + 676) = 180338.$

Ex. 8. Which of the following are prime numbers?

(i) 241 (ii) 337 (Hi) 391 (iv) 571

Sol.

(i) Clearly, 16 > Ö241. Prime numbers less than 16 are 2, 3, 5, 7, 11, 13.
241 is not divisible by any one of them.
241 is a prime number.

(ii) Clearly, 19>Ö337. Prime numbers less than 19 are 2, 3, 5, 7, 11,13,17.
337 is not divisible by any one of them.
337 is a prime number.

(iii) Clearly, 20 > Ö39l". Prime numbers less than 20 are 2, 3, 5, 7, 11, 13, 17, 19.
We find that 391 is divisible by 17.
391 is not prime.

(iv) Clearly, 24 > Ö57T. Prime numbers less than 24 are 2, 3, 5, 7, 11, 13, 17, 19, 23.
571 is not divisible by any one of them.
571 is a prime number.

Ex. 9. Find the unit's digit in the product (2467)153 x (341)72.

Sol. Clearly, unit's digit in the given product = unit's digit in 7^{153} x 1^{72}.

Now, 7 POWER 4 gives unit digit 1.

7^{152} gives unit digit 1,

∴ 7^{153} gives unit digit (l x 7) = 7. Also, 1^{72} gives unit digit 1.

Hence, unit's digit in the product = (7 x 1) = 7.

Ex. 10. Find the unit's digit in $(264)^{102} + (264)^{103}$

Sol. Required unit's digit = unit's digit in $(4)^{102} + (4)^{103.}$

Now, 4^2 gives unit digit 6.

∴ $(4)^{102}$ gives unjt digit 6.

∴ (4)103 gives unit digit of the product (6 x 4) i.e., 4.

Hence, unit's digit in (264)m + (264)103 = unit's digit in (6 + 4) = 0.

Ex. 11. Find the total number of prime factors in the expression $(4)^{11}$ x $(7)^5$ x $(11)^2$.

Sol. $(4)^{11}x (7)^5 x (11)^2 = (2 x 2)^{11} x (7)^5 x (11)^2 = 2^{11} x 2^{11} x7^5x 11^2 = 2^{22} x 7^5 x11^2$

Total number of prime factors = (22 + 5 + 2) = 29.

Ex.12. Simplify : (i) 896 x 896 - 204 x 204

(ii) 387 x 387 + 114 x 114 + 2 x 387 x 114
(iii) 81 X 81 + 68 X 68-2 x 81 X 68.

Sol.

(i) Given exp = $(896)^2 - (204)^2 = (896 + 204)(896 - 204) = 1100 \times 692 = 761200$.

(ii) Given exp = $(387)^2 + (114)^2 + (2 \times 387 \times 114)$
$= a^2 + b^2 + 2ab$, where a = 387, b=114
$= (a+b)^2 = (387 + 114)^2 = (501)^2 = 251001$.

(iii) Given exp = $(81)^2 + (68)^2 - 2 \times 81 \times 68 = a^2 + b^2 - 2ab$, Where a =81, b=68
$= (a-b)^2 = (81 - 68)^2 = (13)^2 = 169$.

Ex.13. Which of the following numbers is divisible by 3 ?
(i) 541326 (ii) 5967013

Sol.

(i) Sum of digits in 541326 = (5 + 4 + 1 + 3 + 2 + 6) = 21, which is divisible by 3.
Hence, 541326 is divisible by 3.

(ii) Sum of digits in 5967013 =(5+9 + 6 + 7 + 0+1 +3) = 31, which is not divisible by 3.
Hence, 5967013 is not divisible by 3.

Ex.14.What least value must be assigned to * so that the number 197*5462 is r 9 ?

Sol.

Let the missing digit be x.
Sum of digits = (1 + 9 + 7 + x + 5 + 4 + 6 +»2) = (34 + x).
For (34 + x) to be divisible by 9, x must be replaced by 2 .
Hence, the digit in place of * must be 2.

Ex. 15. Which of the following numbers is divisible by 4 ?
(i) 67920594 (ii) 618703572

Sol.

(i) The number formed by the last two digits in the given number is 94, which is not divisible by 4.
Hence, 67920594 is not divisible by 4.

(ii) The number formed by the last two digits in the given number is 72, which is divisible by 4.
Hence, 618703572 is divisible by 4.

Ex. 16. Which digits should come in place of * and $ if the number 62684*$ is

divisible by both 8 and 5 ?

Sol.

Since the given number is divisible by 5, so 0 or 5 must come in place of $. But, a number ending with 5 is never divisible by 8. So, 0 will replace $.

Now, the number formed by the last three digits is 4*0, which becomes divisible by 8, if * is replaced by 4.

Hence, digits in place of * and $ are 4 and 0 respectively.

Ex. 17. Show that 4832718 is divisible by 11.

Sol. (Sum of digits at odd places) - (Sum of digits at even places)

= (8 + 7 + 3 + 4) - (1 + 2 + 8) = 11, which is divisible by 11.

Hence, 4832718 is divisible by 11.

Ex. 18. Is 52563744 divisible by 24 ?

Sol. 24 = 3 x 8, where 3 and 8 are co-primes.

The sum of the digits in the given number is 36, which is divisible by 3. So, the given number is divisible by 3.

The number formed by the last 3 digits of the given number is 744, which is divisible by 8. So, the given number is divisible by 8.

Thus, the given number is divisible by both 3 and 8, where 3 and 8 are co-primes.

So, it is divisible by 3 x 8, i.e., 24.

Ex. 19. What least number must be added to 3000 to obtain a number exactly divisible by 19 ?

Sol. On dividing 3000 by 19, we get 17 as remainder.

$\therefore$ Number to be added = (19 - 17) = 2.

Ex. 20. What least number must be subtracted from 2000 to get a number exactly divisible by 17 ?

Sol. On dividing 2000 by 17, we get 11 as remainder.

$\therefore$ Required number to be subtracted = 11.

Ex. 21. Find the number which is nearest to 3105 and is exactly divisible by 21.

Sol. On dividing 3105 by 21, we get 18 as remainder.

$\therefore$ Number to be added to 3105 = (21 - 18) - 3.

Hence, required number = 3105 + 3 = 3108.

Ex. 22. Find the smallest number of 6 digits which is exactly divisible by 111.

Sol. Smallest number of 6 digits is 100000.

On dividing 100000 by 111, we get 100 as remainder.

∴ Number to be added = (111 - 100) - 11.

Hence, required number = 100011.-

Ex. 23. On dividing 15968 by a certain number, the quotient is 89 and the remainder is 37. Find the divisor.

Sol. Divisor = $\frac{\text{Dividend - Remainder}}{\text{Quotient}} = \frac{15968-37}{89} = 179.$

Ex. 24. A number when divided by 342 gives a remainder 47. When the same number ift divided by 19, what would be the remainder ?

Sol. On dividing the given number by 342, let k be the quotient and 47 as remainder.

Then, number – 342k + 47 = (19 x 18k + 19 x 2 + 9) = 19 (18k + 2) + 9.

∴ The given number when divided by 19, gives (18k + 2) as quotient and 9 as remainder.

Ex. 25. A number being successively divided by 3, 5 and 8 leaves remainders 1, 4 and 7 respectively. Find the respective remainders if the order of divisors be reversed,

Sol.

3	X	
5	y	- 1
8	z	- 4
	1	- 7

∴ z = (8 x 1 + 7) = 15; y = {5z + 4) = (5 x 15 + 4) = 79; x = (3y + 1) = (3 x 79 + 1) = 238.

Now,

8	238	
5	29	- 6
3	5	- 4
	1	- 9,

∴ Respective remainders are 6, 4, 2.

Ex. 26. Find the remainder when 2^{31} is divided by 5.

Sol. 2^{10} = 1024. Unit digit of 2^{10} x 2^{10} x 2^{10} is 4 [as 4 x 4 x 4 gives unit digit 4].

∴ Unit digit of 2 POWER 31 is 8.

Now, 8 when divided by 5, gives 3 as remainder.

Hence, 231 when divided by 5, gives 3 as remainder.

Ex. 27. How many numbers between 11 and 90 are divisible by 7 ?

Sol. The required numbers are 14, 21, 28, 35, ... 77, 84.
This is an A.P. with a = 14 and d = (21 - 14) = 7.
Let it contain n terms.
Then, $T_n = 84 \Rightarrow a + (n - 1)\,d = 84$
$\Rightarrow 14 + (n - 1) \times 7 = 84$ or n = 11.
$\therefore$ Required number of terms = 11.

Ex. 28. Find the sum of all odd numbers upto 100.
Sol. The given numbers are 1, 3, 5, 7, ..., 99.
This is an A.P. with a = 1 and d = 2.
Let it contain n terms. Then,
1 + (n - 1) x 2 = 99 or n = 50.
$\therefore$ Required sum = $\frac{n}{2}$ (first term + last term)
$= \frac{50}{2}(1 + 99) = 2500.$

Ex. 29. Find the sum of all 2 digit numbers divisible by 3.
Sol. All 2 digit numbers divisible by 3 are :
12, 51, 18, 21, ..., 99.
This is an A.P. with a = 12 and d = 3.
Let it contain n terms. Then,
12 + (n - 1) x 3 = 99 or n = 30.
$\therefore$ Required sum = $\frac{30}{2} \times (12+99) = 1665.$

Ex.30.How many terms are there in 2,4,8,16……1024?
Sol. Clearly 2,4,8,16……..1024 form a GP. With a=2 and r = 4/2 =2.
Let the number of terms be n . Then
$2 \times 2^{n-1} = 1024$ or $2^{n-1} = 512 = 2^9$.
$\therefore$ n-1=9 or n=10.

Ex. 31. $2 + 2^2 + 2^3 + ... + 2^8 = ?$
Sol. Given series is a G.P. with a = 2, r = 2 and n = 8.
$\therefore$ sum = $\frac{a(r^n-1)}{(r-1)} = \frac{2 \times (2^8 - 1)}{(2-1)} = (2 \times 255) = 510$

2. H.C.F. AND L.C.M. OF NUMBERS

IMPORTANT FACTS AND FORMULAE

I. Factors and Multiples : If a number **a** divides another number **b** exactly, we say that a is a factor of b. In this case, b is called a multiple of a.

II. Highest Common Factor (H.C.F.) or Greatest Common Measure (G.C.M.) or Greatest Common Divisor (G.C.D.): The H.C.F. of two or more than two numbers is the greatest number that divides each of them exactly.

There are *two methods* of finding the H.C.F. of a given set of numbers :

1. Factorization Method : Express each one of the given numbers as the product of prime factors. The product of least powers of common prime factors gives H.C.F.

2. Division Method: Suppose we have to find the H.C.F. of two given numbers. Divide the larger number by the smaller one. Now, divide the divisor by the remainder. Repeat the process of dividing the preceding number by the remainder last obtained till zero is obtained as remainder. The last divisor is the required H.C.F.

Finding the H.C.F. of more than two numbers : Suppose we have to find the H.C.F. of three numbers. Then, H.C.F. of [(H.C.F. of any two) and (the third number)] gives the H.C.F. of three given numbers.

Similarly, the H.C.F. of more than three numbers may be obtained.

III. Least Common Multiple (L.C.M.) : The least number which is exactly divisible by each one of the given numbers is called their L.C.M.

1. Factorization Method of Finding L.C.M.: Resolve each one of the given numbers into a product of prime factors. Then, L.C.M. is the product of highest powers of all the factors,

2. Common Division Method {Short-cut Method) of Finding L.C.M.: Arrange the given numbers in a row in any order. Divide by a number which divides exactly at least two of the given numbers and carry forward the numbers which are not divisible. Repeat the above process till no two of the numbers are divisible by the same number except 1. The product of the divisors and the undivided numbers is the required L.C.M. of the given numbers,

IV. Product of two numbers =Product of their H.C.F. and L.C.M.

V. Co-primes: Two numbers are said to be co-primes if their H.C.F. is 1.

VI. H.C.F. and L.C.M. of Fractions:

$$1.\ H\ C\ F = \frac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}} \qquad 2.\ L\ C\ M = \frac{\text{L.C.M of Numerators}}{\text{H.C.F. of Denominators}}$$

VII. H.C.F. and L.C.M. of Decimal Fractions: In given numbers, make the same number of decimal places by annexing zeros in some numbers, if necessary. Considering these numbers without decimal point, find H.C.F. or L.C.M. as the case may be. Now, in the result, mark off as many decimal places as are there in each of the given numbers.

VIII. Comparison of Fractions: Find the L.C.M. of the denominators of the given fractions. Convert each of the fractions into an equivalent fraction with L.C.M. as the denominator, by multiplying both the numerator and denominator by the same number. The resultant fraction with the greatest numerator is the greatest.

SOLVED EXAMPLES

Ex. 1. Find the H.C.F. of $2^3 \times 3^2 \times 5 \times 7^4$, $2^2 \times 3^5 \times 5^2 \times 7^3$, $2^3 \times 5^3 \times 7^2$

Sol. The prime numbers common to given numbers are 2,5 and 7.

H.C.F. = $2^2 \times 5 \times 7^2 = 980$.

Ex. 2. Find the H.C.F. of 108, 288 and 360.

Sol. $108 = 2^2 \times 3^3$, $288 = 2^5 \times 3^2$ and $360 = 2^3 \times 5 \times 3^2$.

H.C.F. = $2^2 \times 3^2 = 36$.

Ex. 3. Find the H.C.F. of 513, 1134 and 1215.

Sol.

```
1134 ) 1215 ( 1
       1134
      ------
        81 ) 1134 ( 14
             81
             ---
             324
             324
             ---
              x
```

∴ H.C.F. of 1134 and 1215 is 81.

So, Required H.C.F. = H.C.F. of 513 and 81.

```
81 )  513 ( 6
      486
      ---
       27) 81 ( 3
           81
           --
            0
```

H.C.F. of given numbers = 27.

Ex. 4. Reduce $\frac{391}{667}$ to lowest terms.

to lowest terms.

Sol. H.C.F. of 391 and 667 is 23.

On dividing the numerator and denominator by 23, we get :

$\frac{391}{667} = \frac{391 \div 23}{667 \div 23} = \frac{17}{29}$

Ex.5.Find the L.C.M. of $2^2 \times 3^3 \times 5 \times 7^2$, $2^3 \times 3^2 \times 5^2 \times 7^4$, $2 \times 3 \times 5^{3 \times 7 \times 11}$.

Sol. L.C.M. = Product of highest powers of 2, 3, 5, 7 and 11 = $2^3 \times 3^3 \times 5^3 \times 7^4 \times 11$

Ex.6. Find the L.C.M. of 72, 108 and 2100.

Sol. $72 = 2^3 \times 3^2$, $108 = 3^3 \times 2^2$, $2100 = 2^2 \times 5^2 \times 3 \times 7$.

L.C.M. = $2^3 \times 3^3 \times 5^2 \times 7 = 37800$.

Ex.7.Find the L.C.M. of 16, 24, 36 and 54.

Sol.

2	16	-	24	-	36	- 54
2	8	-	12	-	18	- 27
2	4	-	6	-	9	- 27
3	2	-	3	-	9	- 27
3	2	-	1	-	3	- 9
	2	-	1	-	1	- 3

$\therefore$ L.C.M. = 2 x 2 x 2 x 3 x 3 x 2 x 3 = 432.

Ex. 8. Find the H.C.F. and L.C.M. of $\frac{2}{3}$, $\frac{8}{9}$, $\frac{16}{81}$ and $\frac{10}{27}$.

Sol. H.C.F. of given fractions = $\frac{\text{H.C.F. of 2,8,16,10}}{\text{L.C.M. of 3,9,81,27}} = \frac{2}{81}$

L.C.M of given fractions = $\frac{\text{L.C.M. of 2,8,16,10}}{\text{H.C.F. of 3,9,81,27}} = \frac{80}{3}$

Ex. 9. **Find the H.C.F. and L.C.M. of 0.63, 1.05 and 2.1.**

Sol. Making the same number of decimal places, the given numbers are 0.63, 1.05 and 2.10.

Without decimal places, these numbers are 63, 105 and 210.

Now, H.C.F. of 63, 105 and 210 is 21.

H.C.F. of 0.63, 1.05 and 2.1 is 0.21.

L.C.M. of 63, 105 and 210 is 630.

L.C.M. of 0.63, 1.05 and 2.1 is 6.30.

Ex. 10. Two numbers are in the ratio of 15:11. If their H.C.F. is 13, find the numbers.

Sol. Let the required numbers be 15.x and llx.

Then, their H.C.F. is x. So, x = 13.

The numbers are (15 x 13 and 11 x 13) i.e., 195 and 143.

Ex. 11. TheH.C.F. of two numbers is 11 and their L.C.M. is 693. If one of the numbers is 77,find the other.

Sol. Other number = $\frac{11 \text{ X } 693}{} = 99$

Ex. 12. Find the greatest possible length which can be used to measure exactly the lengths 4 m 95 cm, 9 m and 16 m 65 cm.

Sol. Required length = H.C.F. of 495 cm, 900 cm and 1665 cm.

$495 = 3^2 \times 5 \times 11$, $900 = 2^2 \times 3^2 \times 5^2$, $1665 = 3^2 \times 5 \times 37$.

$\therefore$ H.C.F. $= 32 \times 5 = 45$.

Hence, required length = 45 cm.

Ex. 13. Find the greatest number which on dividing 1657 and 2037 leaves remainders 6 and 5 respectively.

Sol. Required number = H.C.F. of (1657 - 6) and (2037 - 5) = H.C.F. of 1651 and 2032

```
          _______
1651 )  2032 ( 1 1651
        1651_____
         381 )  1651 ( 4
                1524_____
                 127 )  381 ( 3
                        381
                        0
```

Required number = 127.

Ex. 14. Find the largest number which divides 62, 132 and 237 to leave the same remainder in each case.

Sol . Required number = H.C.F. of (132 - 62), (237 - 132) and (237 - 62)

= H.C.F. of 70, 105 and 175 = 35.

Ex.15.Find the least number exactly divisible by 12,15,20,27.

Sol.

3	12	-	15	-	20	-	27
4	4	-	5	-	20	-	9
5	1	-	5	-	5	-	9
	1	-	1	-	1	-	9

Ex.16.Find the least number which when divided by 6,7,8,9, and 12 leave the same

remainder 1 each case

Sol. Required number = (L.C.M OF 6,7,8,9,12) + 1

3	6	-	7	-	8	- 9 -	12
4	2	-	7	-	8	- 3 -	4
5	1	-	7	-	4	- 3 -	2
	1	-	7	-	2	- 3 -	1

∴L.C.M = 3 X 2 X 2 X 7 X 2 X 3 = 504.

Hence required number = (504 +1) = 505.

Ex.17. Find the largest number of four digits exactly divisible by 12,15,18 and 27.

Sol. The Largest number of four digits is 9999.

Required number must be divisible by L.C.M. of 12,15,18,27 i.e. 540.

On dividing 9999 by 540,we get 279 as remainder .

∴Required number = (9999-279) = 9720.

Ex.18.Find the smallest number of five digits exactly divisible by 16,24,36 and 54.

Sol. Smallest number of five digits is 10000.

Required number must be divisible by L.C.M. of 16,24,36,54 i.e 432,

On dividing 10000 by 432,we get 64 as remainder.

∴Required number = 10000 +(432 – 64) = 10368.

Ex.19.Find the least number which when divided by 20,25,35 and 40 leaves remainders 14,19,29 and 34 respectively.

Sol. Here,(20-14) = 6,(25 – 19)=6,(35-29)=6 and (40-34)=6.

∴Required number = (L.C.M. of 20,25,35,40) – 6 =1394.

Ex.20.Find the least number which when divided by 5,6,7, and 8 leaves a remainder 3, but when divided by 9 leaves no remainder .

Sol. L.C.M. of 5,6,7,8 = 840.

∴ Required number is of the form 840k + 3

Least value of k for which (840k + 3) is divisible by 9 is k = 2.

∴Required number = (840 X 2 + 3)=1683

Ex.21.The traffic lights at three different road crossings change after every 48 sec., 72 sec and 108 sec.respectively .If they all change simultaneously at 8:20:00 hours,then at what time they again change simultaneously .

Sol. Interval of change = (L.C.M of 48,72,108)sec.=432sec.

So, the lights will agin change simultaneously after every 432 seconds i.e,7 min.12sec

Hence , next simultaneous change will take place at 8:27:12 hrs.

Ex.22.Arrange the fractions 17/31, 43/59 in the ascending order.

18 36 45 60

Sol.L.C.M. of 18,36,45 and 60 = 180.

Now, $\frac{17}{18} = \frac{17 \times 10}{18 \times 10} = \frac{170}{180}$; $\frac{31}{36} = \frac{31 \times 5}{36 \times 5} = \frac{155}{180}$;

$43 = \frac{43 \times 4}{45} = \frac{172}{180}$; $\frac{59}{60} = \frac{59 \times 3}{60 \times 3} = \frac{177}{180}$;

Since, 155<170<172<177, so, $\frac{155}{180} < \frac{170}{180} < \frac{172}{180} < \frac{177}{180}$

Hence, $\frac{31}{36} < \frac{17}{18} < \frac{43}{45} < \frac{59}{60}$

3. DECIMAL FRACTIONS

IMPORTANT FACTS AND FORMULAE

I. Decimal Fractions : Fractions in which denominators are powers of 10 are known as **decimal fractions.**

Thus ,1/10=1 tenth=.1;1/100=1 hundredth =.01;

99/100=99 hundreths=.99;7/1000=7 thousandths=.007,etc

II. Conversion of a Decimal Into Vulgar Fraction : Put 1 in the denominator under the decimal point and annex with it as many zeros as is the number of digits after the decimal point. Now, remove the decimal point and reduce the fraction to its lowest terms.

Thus, 0.25=25/100=1/4;2.008=2008/1000=251/125.

III. 1. Annexing zeros to the extreme right of a decimal fraction does not change its value

Thus, 0.8 = 0.80 = 0.800, etc.

2. If numerator and denominator of a fraction contain the same number of decimal places, then we remove the decimal sign.
Thus, 1.84/2.99 = 184/299 = 8/13; 0.365/0.584 = 365/584=5

IV. Operations on Decimal Fractions :

1. Addition and Subtraction of Decimal Fractions : The given numbers are so placed under each other that the decimal points lie in one column. The numbers so arranged can now be added or subtracted in the usual way.

2. **Multiplication of a Decimal Fraction By a Power of 10** : Shift the decimal point to the right by as many places as is the power of 10.

Thus, 5.9632 x 100 = 596,32; 0.073 x 10000 = 0.0730 x 10000 = 730.

3.**Multiplication of Decimal Fractions** : Multiply the given numbers considering them without the decimal point. Now, in the product, the decimal point is marked off to obtain as many places of decimal as is the sum of the number of decimal places in the given numbers.

Suppose we have to find the product (.2 x .02 x .002). Now, 2x2x2 = 8.
Sum of decimal places = (1 + 2 + 3) = 6. .2 x .02 x .002 = .000008.

4.**Dividing a Decimal Fraction By a Counting Number :** Divide the given number without considering the decimal point, by the given counting number. Now, in the quotient, put the decimal point to give as many places of decimal as there are in the dividend.

Suppose we have to find the quotient (0.0204 + 17). Now, 204 ^ 17 = 12. Dividend contains 4 places of decimal. So, 0.0204 + 17 = 0.0012.

5. **Dividing a Decimal Fraction By a Decimal Fraction :** Multiply both the dividend and the divisor by a suitable power of 10 to make divisor a whole number. Now, proceed as above.

Thus, 0.00066/0.11 = (0.00066*100)/(0.11*100) = (0.066/11) = 0.006V

V. Comparison of Fractions : Suppose some fractions are to be arranged in ascending or descending order of magnitude. Then, convert each one of the given fractions in the decimal form, and arrange them accordingly.

Suppose, we have to arrange the fractions 3/5, 6/7 and 7/9 in descending order.

now, 3/5=0.6,6/7 = 0.857,7/9 = 0.777....

since 0.857>0.777...>0.6, so 6/7>7/9>3/5

VI. Recurring Decimal : If in a decimal fraction, a figure or a set of figures is repeated continuously, then such a number is called a *recurring decimal.*

In a recurring decimal, if a single figure is repeated, then it is expressed by putting a dot on it. If a set of figures is repeated, it is expressed by putting a bar on the set

Thus $1/3 = 0.3333\ldots = 0.\dot{3}$; $22/7 = 3.142857142857..... = 3.\overline{142857}$

Pure Recurring Decimal: A decimal fraction in which all the figures after the decimal point are repeated, is called a pure recurring decimal.

Converting a Pure Recurring Decimal Into Vulgar Fraction : Write the repeated figures only once in the numerator and take as many nines in the denominator as is the number of repeating figures.

thus ,$0.5 = 5/9$; $0.\overline{53} = 53/59$;$0.067 = 67/999$;etc...

Mixed Recurring Decimal: A decimal fraction in which some figures do not repeat and some of them are repeated, is called a mixed recurring decimal.

e.g., $0.17333. = 0.173\dot{3}$.

Converting a Mixed Recurring Decimal Into Vulgar Fraction : In the numerator, take the difference between the number formed by all the digits after decimal point (taking repeated digits only once) and that formed by the digits which are not repeated, In the denominator, take the number formed by as many nines as there are repeating digits followed by as many zeros as is the number of non-repeating digits.

Thus $0.16 = (16-1)/90 = 15/19 = 1/6$;

$0.2\overline{273} = (2273 - 22)/9900 = 2251/9900$

VII. Some Basic Formulae :

1. $(a + b)(a - b) = (a^2 - b^2)$.
2. $(a + b)^2 = (a^2 + b^2 + 2ab)$.
3. $(a - b)^2 = (a^2 + b^2 - 2ab)$.
4. $(a + b+c)^2 = a^2 + b^2 + c^2+2(ab+bc+ca)$
5. $(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$
6. $(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$.
7. $(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2-ab-bc-ca)$
8. When $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$

SOLVED EXAMPLES

Ex. 1. Convert the following into vulgar fraction:

(i) 0.75 (ii) 3.004 (iii) 0.0056

Sol. (i). 0.75 = 75/100 = 3/4 (ii) 3.004 = 3004/1000 = 751/250 (iii) 0.0056 = 56/10000 = 7/1250

Ex. 2. Arrange the fractions 5/8, 7/12, 13/16, 16/29 and 3/4 in ascending order of magnitude.

Sol. Converting each of the given fractions into decimal form, we get :
5/8 = 0.624, 7/12 = 0.8125, 16/29 = 0.5517, and 3/4 = 0.75
Now, 0.5517<0.5833<0.625<0.75<0.8125
$\therefore$ 16/29 < 7/12 < 5/8 < 3/4 < 13/16

Ex. 3. arrange the fractions 3/5, 4/7, 8/9, and 9/11 in their descending order.

Sol. Clearly, 3/5 = 0.6, 4/7 = 0.571, 8/9 = 0.88, 9/111 = 0.818.
Now, 0.88 > 0.818 > 0.6 > 0.571
$\therefore$ 8/9 > 9/11 > 3/4 > 13/ 16

Ex. 4. Evaluate : (i) 6202.5 + 620.25 + 62.025 + 6.2025 + 0.62025
(ii) 5.064 + 3.98 + 0.7036 + 7.6 + 0.3 + 2

Sol. (i)
6202.5
620.25
62.025
6.2025
+ 0.62025
6891.59775

(ii)
5.064
3.98
0.7036
7.6
0.3
2.0
19.6476

Ex. 5. Evaluate : (i) 31.004 – 17.2368 **(ii) 13 – 5.1967**

Sol. (i)
31.0040
– 17.2386
13.7654

(ii)
31.0000
– 5.1967
7.8033

Ex. 6. What value will replace the question mark in the following equations ?
(i) 5172.49 + 378.352 + ? = 9318.678
(ii) ? – 7328.96 + 5169.38

Sol. (i) Let 5172.49 + 378.352 + x = 9318.678
Then , x = 9318.678 – (5172.49 + 378.352) = 9318.678 – 5550.842 = 3767.836
(ii) Let x – 7328.96 = 5169.38. Then, x = 5169.38 + 7328.96 = 12498.34.

Ex. 7. Find the products: (i) 6.3204 * 100 (ii) 0.069 * 10000

Sol. (i) 6.3204 * 1000 = 632.04 (ii) 0.069 * 10000 = 0.0690 * 10000 = 690

Ex. 8. Find the product:

(i) 2.61 * 1.3 (ii) 2.1693 * 1.4 (iii) 0.4 * 0.04 * 0.004 * 40

Sol. (i) 261 8 13 = 3393. Sum of decimal places of given numbers = (2+1) = 3.
2.61 * 1.3 = 3.393.
(ii) 21693 * 14 = 303702. Sum of decimal places = (4+1) = 5
2.1693 * 1.4 = 3.03702.
(iii) 4 * 4 * 4 * 40 = 2560. Sum of decimal places = (1 + 2+ 3) = 6
0.4 * 0.04 * 0.004 * 40 = 0.002560.

Ex. 9. Given that 268 * 74 = 19832, find the values of 2.68 * 0.74.

Sol. Sum of decimal places = (2 + 2) = 4
2.68 * 0.74 = 1.9832.

Ex. 10. Find the quotient:

(i) 0.63 / 9 (ii) 0.0204 / 17 (iii) 3.1603 / 13

Sol. (i) 63 / 9 = 7. Dividend contains 2 places decimal.
0.63 / 9 = 0.7.
(ii) 204 / 17 = 12. Dividend contains 4 places of decimal.
0.2040 / 17 = 0.0012.
(iii) 31603 / 13 = 2431. Dividend contains 4 places of decimal.
3.1603 / 13 = 0.2431.

Ex. 11. Evaluate :

(i) 35 + 0.07 (ii) 2.5 + 0.0005
(iii) 136.09 + 43.9

Sol. (i) 35/0.07 = (35*100) / (0.07*100) = (3500 / 7) = 500
(ii) 25/0.0005 = (25*10000) / (0.0005*10000) = 25000 / 5 = 5000
(iii) 136.09/43.9 = (136.09*10) / (43.9*10) = 1360.9 / 439 = 3.1

Ex. 12. What value will come in place of question mark in the following equation?

(i) 0.006 +? = 0.6 (ii) ? + 0.025 = 80

Sol. (i) Let 0.006 / x = 0.6, Then, x = (0.006 / 0.6) = (0.006*10) / (0.6*10) = 0.06/6 = 0.01
(ii) Let x / 0.025 = 80, Then, x = 80 * 0.025 = 2

Ex. 13. If (1 / 3.718) = 0.2689, Then find the value of (1 / 0.0003718).

Sol. (1 / 0.0003718) = (10000 / 3.718) = 10000 * (1 / 3.718) = 10000 * 0.2689 = 2689.

Ex. 14. Express as vulgar fractions : (i) 0.37 (ii) $0.\overline{053}$ (iii) $3.\overline{142857}$

Sol. (i) $0.\overline{37} = 37 / 99$. (ii) $0.\overline{053} = 53 / 999$

(iii) $3.\overline{142857} = 3 + 0.\overline{142857} = 3 + (142857 / 999999) = 3 (142857/999999)$

Ex. 15. Express as vulgar fractions : (i) 0.17 (ii) $0.12\overline{54}$ (iii) $2.5\overline{36}$

Sol. (i) $0.\overline{17} = (17 – 1)/90 = 16 / 90 = 8/ 45$

(ii) $0.12\overline{54} = (1254 – 12)/ 9900 = 1242 / 9900 = 69 / 550$

(iii) $2.536 = 2 + 0.536 = 2 + (536 – 53)/900 = 2 + (483/900) = 2 + (161/300) = 2 (161/300)$

Ex. 16. Simplify: $\frac{0.05 * 0.05 * 0.05 + 0.04 * 0.04 * 0.04}{0.05 * 0.05 – 0.05 * 0.04 + 0.04 * 0.04}$

Sol. Given expression $= (a^3 + b^3) / (a^2 – ab + b^2)$, where a = 0.05 , b = 0.04
$= (a +b) = (0.05 +0.04) =0.09$

4. SIMPLIFICATION

IMPORTANT CONCEPTS

I. 'BODMAS'Rule: This rule depicts the correct sequence in which the operations are to be executed,so as to find out the value of a given expression.

Here, 'B' stands for 'bracket' ,'O'for 'of' , 'D' for' division' and 'M' for 'multiplication', 'A' for 'addition' and 'S' for 'subtraction'.
Thus, in simplifying an expression, first of all the brackets must be removed, strictly in the order(), {} and [].

After removing the brackets, we must use the following operations strictly in the order:
(1)of (2)division (3) multiplication (4)addition (5)subtraction.

II. Modulus of a real number : Modulus of a real number a is defined as

$|a| = \{a, \text{ if } a>0$
$\quad\quad -a, \text{ if } a<0$

Thus, |5|=5 and |-5|=-(-5)=5.

III. Virnaculum (or bar): When an expression contains Virnaculum, before applying the 'BODMAS' rule, we simplify the expression under the Virnaculum.

SOLVED EXAMPLES

Ex. 1. Simplify: (i)5005-5000+10 (ii) 18800+470+20

Sol. (i)5005-5000+10=5005-(5000/10)=5005-500=4505.

(ii)18800+470+20=(18800/470)+20=40/20=2.

Ex. 2. Simplify: b-[b-(a+b)-{b-(b-a-b)}+2a]

Sol. Given expression=b-[b-(a+b)-{b-(b-a+b)}+2a]
=b-[b-a-b-{b-2b+a}+2a]
=b-[-a-{b-2b+a+2a}]
=b-[-a-{-b+3a}]=b-[-a+b-3a]
=b-[-4a+b]=b+4a-b=4a.

Ex. 3. What value will replace the question mark in the following equation?

$4\frac{1}{2}+3\frac{1}{6}+?+2\frac{1}{3}=13\frac{2}{5}$.

Sol. Let 9/2+19/6+x+7/3=67/5
Then x=(67/5)-(9/2+19/6+7/3)⇔x=(67/5)-((27+19+14)/6)=((67/5)-(60/6)
⇔x=((67/5)-10)=17/5=$3\frac{2}{5}$

Hence, missing fractions =$3\frac{2}{5}$

Ex.4. 4/15 of 5/7 of a number is greater than 4/9 of 2/5 of the same number by 8. What is half of that number?

Sol. Let the number be x. then 4/15 of 5/7 of x-4/9 of 2/5 of x=8⇔4/21x-8/45x=8
⇔(4/21-8/45)x=8⇔(60-56)/315x=8⇔4/315x=8
⇔x=(8*315)/4=630⇔1/2x=315
Hence required number = 315.

Ex. 5. Simplify: $\left[3\frac{1}{4}\div\{1\frac{1}{4}-1/2(2\frac{1}{2}-1/4-\overline{1/6})\}\right]$

Sol. Given exp. =[13/4÷{5/4-1/2(5/2-(3-2)/12)}]=[13/4÷{5/4-1/2(5/2-1/12)}]
=[13/4÷{5/4-1/2((30-1)/12)}]=[13/4÷{5/4-29/24}]
=[13/4÷{(30-39)/24}]=[13/4÷1/24]=[(13/4)*24]=78

Ex. 6. Simplify: $108\div 36 \text{ of } \frac{1}{4}+\frac{2}{5}*3\frac{1}{4}$

Sol. Given exp.= $108\div 9+\frac{2}{5}*\frac{13}{4}=\frac{108}{9}+\frac{13}{10}=12+\frac{13}{10}=\frac{133}{10}=13\frac{3}{10}$

Ex.7 Simplify: $\frac{(7/2)\div(5/2)*(3/2)}{(7/2)\div(5/2)\text{of }(3/2)} \div 5.25$

sol.

Given exp. $\frac{(7/2)\times(2/5)\times(3/2)}{(7/2)\div(15/4)} \div 5.25 = \frac{(21/10)}{(525/100)} = (21/10)\times(15/14)$

Ex. 8. Simplify: (i) 12.05*5.4+0.6 (ii) 0.6*0.6+0.6*0.6 (Bank P.O 2003)

Sol. (i) Given exp. = 12.05*(5.4/0.6) = (12.05*9) = 108.45

(ii) Given exp. = 0.6*0.6+(0.6*6) = 0.36+0.1 = 0.46

Ex. 9. Find the value of x in each of the following equation:

(i) [(17.28/x) / (3.6*0.2)] = 2

(ii) 3648.24 + 364.824 + x – 36.4824 = 3794.1696

(iii) 8.5 – { 5 ½ – [7 ½ + 2.8]/x}*4.25/$(0.2)^2$ = 306 (Hotel Management,1997)

Sol. (i) (17.28/x) = 2*3.6*0.2 ⇔ x = (17.28/1.44) = (1728/14) = 12.

(ii) (364.824/x) = (3794.1696 + 36.4824) – 3648.24 = 3830.652 – 3648.24 = 182.412.

⇔ x = (364.824/182.412) =2.

(iii) 8.5-{5.5-(7.5+(2.8/x))}*(4.25/0.04) = 306

⇔ 8.5-{5.5-{(7.5x+2.8)/x)}*(425/4) = 306

⇔ 8.5-{(5.5x-7.5x-2.8)/x}*(425/4) = 306

⇔ 8.5-{(-2x-2.8)/x}*106.25 = 306

⇔ 8.5-{(-212.5x-297.5)/x} = 306

⇔ (306-221)x = 297.5 ⇔ x =(297.5/85) = 3.5.

Ex. 10. If (x/y)=(6/5), find the value $(x^2+y^2)/(x^2-y^2)$

Sol. $(x^2+y^2)/(x^2-y^2) = (x^2/y^2+1)/(x^2/y^2-1) = [(6/5)^2+1]/[(6/5)^2-1]$

$= [(36/25)+1]/[(36/25)-1] = (61*25)/(25*11) = 61/11$

Ex. 11. Find the value of $4 - \cfrac{5}{1+\cfrac{1}{3+\cfrac{1}{2+\cfrac{1}{4}}}}$

Sol. Given exp. $= 4 - \cfrac{5}{1+\cfrac{1}{3+\cfrac{1}{2+\cfrac{1}{4}}}} = 4 - \cfrac{5}{1+\cfrac{1}{3+\cfrac{4}{9}}} = 4 - \cfrac{5}{1+\cfrac{1}{(31/9)}}$

$$= 4 - \frac{5}{1 + \frac{9}{31}} = 4 - \frac{5}{(40/31)} = 4 - (5*31)/40 = 4 - (31/8) = 1/8$$

Ex. 12. If $\dfrac{2x}{1 + \dfrac{1}{1 + \dfrac{x}{1 - x}}} = 1$., then find the value of x .

Sol. We have : $\dfrac{2x}{1 + \dfrac{1}{\dfrac{(1 - x) - x}{1 - x}}} = 1 \Leftrightarrow \dfrac{2x}{1 + \dfrac{1}{[1/(1- x)]}} = 1 \Leftrightarrow \dfrac{2x}{1+ (1 - x)} = 1$

$\Leftrightarrow 2x = 2-x \Leftrightarrow 3x = 2 \Leftrightarrow x = (2/3).$

Ex.13.(i)If a/b=3/4 and 8a+5b=22,then find the value of a.
(ii)if x/4-x-3/6=1,then find the value of x.

Sol. (i) $(a/b)=3/4 \Rightarrow b=(4/3)\, a.$
$\therefore\ 8a+5b=22 \Rightarrow 8a+5*(4/3)\, a=22 \Rightarrow 8a+(20/3)\, a=22$
$\Rightarrow 44a = 66 \Rightarrow a=(66/44)=3/2$
(ii) $(x /4)-((x-3)/6)=1 \Leftrightarrow (3x-2(x-3))/12 = 1 \Leftrightarrow 3x-2x+6=12 \Leftrightarrow x=6.$

Ex.14.If 2x+3y=34 and ((x + y)/y)=13/8,then find the value of 5y+7x.

Sol. The given equations are:
$2x+3y=34$ …(i) and, $((x + y) /y)=13/8 \Rightarrow 8x+8y=13y \Rightarrow 8x-5y=0$ …(ii)
Multiplying (i) by 5,(ii) by 3 and adding, we get : $34x=170$ or $x=5$.
Putting x=5 in (i), we get: y=8.
$\therefore\ 5y+7x=((5*8)+(7*5))=40+35=75$

Ex.15.If 2x+3y+z=55,x-y=4 and y - x + z=12,then what are the values of x , y and z?

Sol. The given equations are:
$2x+3y+z=55$ …(i); $x + z - y=4$ …(ii); $y -x + z =12$ …(iii)
Subtracting (ii) from (i), we get: $x+4y=51$ …(iv)
Subtracting (iii) from (i), we get: $3x+2y=43$ …(v)
Multiplying (v) by 2 and subtracting (iv) from it, we get: $5x=35$ or $x=7$.
Putting x=7 in (iv), we get: $4y=44$ or $y=11$.
Putting x=7,y=11 in (i), we get: z=8.

Ex.16.Find the value of (1-(1/3))(1-(1/4))(1-(1/5))….(1-(1/100)).

Sol. Given expression = (2/3)*(3/4)*(4/5) *…….* (99/100) = 2/100 = 1/50.

Ex.17. Find the value of (1/(2*3))+(1/(3*4))+(1/(4*5))+(1/(5*6))+…..+ ((1/(9*10)).

Sol. Given expression=((1/2)-(1/3))+((1/3)-(1/4))+((1/4)-(1/5))+
((1/5)-(1/6))+….+ ((1/9)-(1/10))
=((1/2)-(1/10))=4/10 = 2/5.

Ex.18.Simplify: $99^{48}/_{49}$ * 245.

Sol. Given expression = (100-1/49) ***** 245=(4899/49) * 245 = 4899 * 5=24495.

Ex.19.A board 7ft. 9 inches long is divided into 3 equal parts . What is the length of each part?

Sol. Length of board=7ft. 9 inches=(7*12+9)inches=93 inches.
∴Length of each part = (93/3) inches = 31 inches = 2ft. 7 inches

20.A man divides Rs. Among 5 sons,4daughters and 2 nephews .If each daughter receives four times as much as each nephews and each son receives five times as much as each nephews ,how much does each daughter receive?
Let the share of each nephews be Rs.x.
Then,share of each daughter=rs4x;share of each son=Rs.5x;
So,5*5x+4*4x+2*x=8600
25x+16x+2x=8600
=43x=8600
x=200;

21.A man spends 2/5 of his salary on house rent,3/10 of his salary on food and 1/8 of his salary on conveyence.if he has Rs.1400 left with him,find his expenditure on food and conveyence.
Part of salary left=1-(2/5+3/10+1/8)
Let the monthly salary be Rs.x
Then, 7/40 of x=1400
X=(1400*40/7)
=8600
Expenditure on food=Rs.(3/10*800)=Rs.2400
Expenditure on conveyence=Rs.(1/8*8000)=Rs.1000

22.A third of Arun's marks in mathematics exeeds a half of his marks in english by 80.if he got 240 marks In two subjects together how many marks did he got inh english?
Let Arun's marks in mathematics and english be x and y
Then 1/3x-1/2y=30
2x-3y=180……>(1)
x+y=240…….>(2)
solving (1) and (2)

x=180
and y=60

23.A tin of oil was 4/5full.when 6 bottles of oil were taken out and four bottles of oil were poured into it, it was ¾ full. how many bottles of oil can the tin contain?
Suppose x bottles can fill the tin completely
Then4/5x-3/4x=6-4
X/20=2
X=40
Therefore required no of bottles =40

24.if 1/8 of a pencil is black ½ of the remaining is white and the remaining 3 ½ is blue find the total length of the pencil?
Let the total length be xm
Then black part =x/8cm
The remaining part=(x-x/8)cm=7x/8cm
White part=(1/2 *7x/8)=7x/16 cm
Remaining part=(7x/8-7x/16)=7x/16cm
7x/16=7/2
x=8cm

25.in a certain office 1/3 of the workers are women ½ of the women are married and 1/3 of the married women have children if ¾ of the men are married and 2/3 of the married men have children what part of workers are without children?
Let the total no of workers be x
No of women =x/3
No of men =x-(x/3)=2x/3
No of women having children =1/3 of ½ ofx/3=x/18
No of men having children=2/3 of ¾ of2x/3=x/3
No of workers having children = x/8 +x/3=7x/18
Workers having no children=x-7x/18=11x/18=11/18 of all wprkers

26.a crate of mangoes contains one bruised mango for every thirty mango in the crate. If three out of every four bruised mango are considerably unsaleble and there are 12 unsaleable mangoes in the crate then how msny mango are there in the crate?

Let the total no of mangoes in the crate be x
Then the no of bruised mango = 1/30 x
Let the no of unsalable mangoes =3/4 (1/30 x)
1/40 x =12
x=480

27. a train starts full of passengers at the first station it drops 1/3 of the passengers and takes 280more at the second station it drops one half the new total and takes

twelve more .on arriving at the third station it is found to have 248 passengers. Find the no of passengers in the beginning?

Let no of passengers in the beginning be x
After first station no passengers=(x-x/3)+280=2x/3 +280
After second station no passengers =1/2(2x/3+280)+12
½(2x/3+280)+12=248
2x/3+280=2*236
2x/3=192
x=288

28.if $a^2+b^2=177$and ab=54 then find the value of a+b/a-b?

$(a+b)^2=a^2+b^2+2ab=117+2*24=225$
a+b=15
$(a-b)^2=a^2+b^2-2ab=117-2*54$
a-b=3
a+b/a-b=15/3=5

29.find the value of (75983*75983- 45983*45983/30000)
Given expression=$(75983)^2-(45983)^2/(75983-45983)$
$=(a-b)^2/(a-b)$
=(a+b)(a-b)/(a-b)
=(a+b)
=75983+45983
=121966

30.find the value of $\left(\dfrac{343*343*343-113*113*113}{343*343+343*113+113*113}\right)$

Given expression= $\dfrac{(a^3-b^3)}{a^2+ab+b^2}$
$=(a-b)$
=(343-113)
.=230

31.Village X has a population of 68000,which is decreasing at the rate of 1200 per year.VillagyY has a population of 42000,which is increasing at the rate of 800 per year .in how many years will the population of the two villages be equal?

Let the population of two villages be equal after p years
Then,68000-1200p=42000+800p
2000p=26000
p=13

32.From a group of boys and girls,15 girls leave.There are then left 2 boys for each girl.After this,45 boys leave.There are then 5 girls for each boy.Find

the number of girls in the beginning?
Let at present there be x boys.
Then,no of girls at present=5x
Before the boys had left:no of boys=x+45
And no of girls=5x
X+45=2*5x
9x=45
x=5
no of girls in the beginning=25+15=40

33.An employer pays Rs.20 for each day a worker works and for feits Rs.3 for each day is ideal at the end of sixty days a worker gets Rs.280 . for how many days did the worker remain ideal?
Suppose a worker remained ideal for x days then he worked for 60-x days
20*(60-x)-3x=280
1200-23x=280
23x=920
x=40

Ex 34.kiran had 85 currency notes in all , some of which were of Rs.100 denaomination and the remaining of Rs.50 denomination the total amount of all these currency note was Rs.5000.how much amount did she have in the denomination of Rs.50?
Let the no of fifty rupee notes be x
Then,no of 100 rupee notes =(85-x)
50x+100(85-x)=5000
x+2(85-x)=100
x=70
so,,required amount=Rs.(50*70)= Rs.3500

Ex. 35. When an amount was distributed among 14 boys, each of them got rs 80 more than the amount received by each boy when the same amount is distributed equally among 18 boys. What was the amount?

Sol. Let the total amount be Rs. X the,

$$\frac{x}{14} - \frac{x}{18} = 80 \Leftrightarrow \frac{2x}{126} = 80 \Leftrightarrow \frac{x}{63} = 63 \times 80 = 5040.$$

Hence the total amount is 5040.

Ex. 36. Mr. Bhaskar is on tour and he has Rs. 360 for his expenses. If he exceeds his tour by 4 days, he must cut down his daily expenses by Rs. 3. for how many days is Mr. Bhaskar on tour?

Sol. Suppose Mr. Bhaskar is on tour for x days. Then,

$$\frac{360}{x} - \frac{360}{x+4} = 3 \Leftrightarrow \frac{1}{x} - \frac{1}{x+4} = \frac{1}{120} \Leftrightarrow x(x+4) = 4 \times 120 = 480$$

$\Leftrightarrow x^2 + 4x - 480 = 0 \Leftrightarrow (x+24)(x-20) = 0 \Leftrightarrow x = 20.$

Hence Mr. Bhaskar is on tour for 20 days.

Ex. 37. Two pens and three pencils cost Rs 86. four Pens and a pencil cost Rs. 112. find the cost of a pen and that of a pencil.

Sol. Let the cost of a pen ands a pencil be Rs. X and Rs. Y respectively.

Then, $2x + 3y = 86$ ….(i) and $4x + y = 112$.

Solving (i) and (ii), we get: $x = 25$ and $y = 12$.

Cost of a pen =Rs. 25 and the cost of a pencil =Rs. 12.

Ex. 38. Arjun and Sajal are friends . each has some money. If Arun gives Rs. 30 to Sajal, the Sajal will have twice the money left with Arjun. But, if Sajal gives Rs. 10 to Arjun, the Arjun will have thrice as much as is left with Sajal. How much money does each have?

Sol. Suppose Arun has Rs. X and Sjal has Rs. Y. then,

$2(x-30) = y+30 \Rightarrow 2x - y = 90$ …(i)

and $x + 10 = 3(y-10) \Rightarrow x - 3y = -40$ …(ii)

Solving (i) and (ii), we get $x = 62$ and $y = 34$.

Arun has Rs. 62 and Sajal has Rs. 34.

Ex. 39. In a caravan, in addition to 50 hens there are 45 goats and 8 camels with some keepers. If the total number of feet be 224 more than the number of heads, find the number of keepers.

Sol. Let the number of keepers be x then,

Total number of heads $= (50 + 45 + 8 + x) = (103 + x)$.

Total number of feet $= (45 + 8) \times 4 + (50 + x) \times 2 = (312 + 2x)$.

$(312 + 2x) - (103 + x) = 224 \Leftrightarrow x = 15$.

Hence, number of keepers =15.

SQUARE ROOTS AND CUBE ROOTS

IMPORTANT FACTS AND FORMULAE

Square Root: If $x^2 = y$, we say that the square root of y is x and we write, $\sqrt{y} = x$.

Thus, $\sqrt{4} = 2$, $\sqrt{9} = 3$, $\sqrt{196} = 14$.

Cube Root: The cube root of a given number x is the number whose cube is x. We denote the cube root of x by $\sqrt[3]{x}$.

Thus, $\sqrt[3]{8} = \sqrt[3]{2 \times 2 \times 2} = 2$, $\sqrt[3]{343} = \sqrt[3]{7 \times 7 \times 7} = 7$ etc.

Note:

1. $\sqrt{xy} = \sqrt{x} * \sqrt{y}$ 2. $\sqrt{(x/y)} = \sqrt{x} / \sqrt{y} = (\sqrt{x} / \sqrt{y}) * (\sqrt{y} / \sqrt{y}) = \sqrt{xy} / y$

SOLVED EXAMPLES

Ex. 1. Evaluate $\sqrt{6084}$ by factorization method .

Sol. **Method:** Express the given number as the product of prime factors. Now, take the product of these prime factors choosing one out of every pair of the same primes. This product gives the square root of the given number.

Thus, resolving 6084 into prime factors, we get:

$6084 = 2^2 \times 3^2 \times 13^2$

$\therefore \sqrt{6084} = (2 \times 3 \times 13) = 78.$

2	6084
2	3042
3	1521
3	507
13	169
	13

Ex. 2. Find the square root of 1471369.

Sol. **Explanation:** In the given number, mark off the digits in pairs starting from the unit's digit. Each pair and the remaining one digit is called a period.

Now, $1^2 = 1$. On subtracting, we get 0 as remainder.

Now, bring down the next period *i.e.*, 47.

Now, trial divisor is $1 \times 2 = 2$ and trial dividend is 47.

So, we take 22 as divisor and put 2 as quotient.

The remainder is 3.

Next, we bring down the next period which is 13.

Now, trial divisor is $12 \times 2 = 24$ and trial dividend is 313. So, we take 241 as dividend and 1 as quotient.

The remainder is 72.

Bring down the next period *i.e.*, 69.

Now, the trial divisor is $121 \times 2 = 242$ and the trial dividend is 7269. So, we take 3as quotient and 2423 as divisor. The remainder is then zero.

Hence, $\sqrt{1471369} = 1213$.

1	1471369 (1213
	1
22	47
	44
241	313
	241
2423	7269
	7269
	x

Ex. 3. Evaluate: $\sqrt{248 + \sqrt{51 + \sqrt{169}}}$.

Sol. Given expression $= \sqrt{248 + \sqrt{51 + 13}} = \sqrt{248 + \sqrt{64}} = \sqrt{248 + 8} = \sqrt{256} = 16.$

Ex. 4. If $a * b * c = \sqrt{(a + 2)(b + 3)} / (c + 1)$, find the value of 6 * 15 * 3.

Sol. $6 * 15 * 3 = \sqrt{(6 + 2)(15 + 3)} / (3 + 1) = \sqrt{8 * 18} / 4 = \sqrt{144} / 4 = 12 / 4 = 3.$

Ex. 5. ***Find the value of*** $\sqrt{25/16}$.

Sol. $\sqrt{25 / 16} = \sqrt{25} / \sqrt{16} = 5 / 4$

Ex. 6. ***What is the square root of 0.0009?***

Sol. $\sqrt{0.0009} = \sqrt{9 / 1000} = 3 / 100 = 0.03.$

Ex. 7. ***Evaluate*** $\sqrt{175.2976}$.

Sol. Method: We make even number of decimal places by affixing a zero, if necessary. Now, we mark off periods and extract the square root as shown.

$\therefore \sqrt{175.2976} = 13.24$

1	175.2976 (13.24
	1
23	75
	69
262	629
	524
2644	10576
	10576
	x

Ex. 8. ***What will come*** **in** ***place of question mark*** **in** ***each of the following*** **questions?**

(i) $\sqrt{32.4 / ?} = 2$ ***(ii)*** $\sqrt{86.49} + \sqrt{5 + (?)^2} = 12.3.$

Sol. (i) Let $\sqrt{32.4 / x} = 2$. Then, $32.4/x = 4 \iff 4x = 32.4 \iff x = 8.1.$

(ii) Let $\sqrt{86.49} + \sqrt{5 + x^2} = 12.3.$

Then, $9.3 + \sqrt{5+x^2} = 12.3 \iff \sqrt{5+x^2} = 12.3 - 9.3 = 3$

$\iff 5 + x^2 = 9 \iff x^2 = 9 - 5 = 4 \iff x = \sqrt{4} = 2.$

Ex.9. Find the value of $\sqrt{0.289 / 0.00121}$.

Sol. $\sqrt{0.289 / 0.00121} = \sqrt{0.28900/0.00121} = \sqrt{28900/121} = 170 / 11.$

Ex.10. If $\sqrt{1 + (x / 144)} = 13 / 12$, ***the find the value of x.***

Sol. $\sqrt{1 + (x / 144)} = 13 / 12 \Rightarrow (1 + (x / 144)) = (13 / 12)^2 = 169 / 144$

$\Rightarrow x / 144 = (169 / 144) - 1$

$\Rightarrow x / 144 = 25/144 \Rightarrow x = 25.$

Ex. 11. Find the value of $\sqrt{3}$ up to three places of decimal.

Sol.

1	3.000000	(1.732
	1	
27	200	
	189	
343	1100	
	1029	
3462	7100	
	6924	

$\therefore \sqrt{3} = 1.732.$

Ex. 12. ***If $\sqrt{3}$ = 1.732, find the value of $\sqrt{192} - \frac{1}{2}\sqrt{48} - \sqrt{75}$ correct to 3 places of decimal.*** **(S.S.C. 2004)**

Sol. $\sqrt{192} - (1 / 2)\sqrt{48} - \sqrt{75} = \sqrt{64 * 3} - (1/2)\sqrt{16 * 3} - \sqrt{25 * 3}$

$= 8\sqrt{3} - (1/2) * 4\sqrt{3} - 5\sqrt{3}$

$= 3\sqrt{3} - 2\sqrt{3} = \sqrt{3} = 1.732$

Ex. 13. Evaluate: $\sqrt{(9.5 * 0.0085 * 18.9) / (0.0017 * 1.9 * 0.021)}$

Sol. Given exp. $= \sqrt{(9.5 * 0.0085 * 18.9) / (0.0017 * 1.9 * 0.021)}$

Now, since the sum of decimal places in the numerator and denominator under the radical sign is the same, we remove the decimal.

$\therefore$ Given exp $= \sqrt{(95 * 85 * 18900) / (17 * 19 * 21)} = \sqrt{5 * 5 * 900} = 5 * 30 = 150.$

Ex. 14. ***Simplify*: $\sqrt{[(12.1)^2 - (8.1)^2] / [(0.25)^2 + (0.25)(19.95)]}$**

Sol. Given exp. $= \sqrt{[(12.1 + 8.1)(12.1 - 8.1)] / [(0.25)(0.25 + 19.95)]}$

$= \sqrt{(20.2 * 4) / (0.25 * 20.2)} = \sqrt{4 / 0.25} = \sqrt{400 / 25} = \sqrt{16} = 4.$

Ex. 15. ***If $x = 1 + \sqrt{2}$ and $y = 1 - \sqrt{2}$, find the value of $(x^2 + y^2)$.***

Sol. $x^2 + y^2 = (1 + \sqrt{2})^2 + (1 - \sqrt{2})^2 = 2[(1)^2 + (\sqrt{2})^2] = 2 * 3 = 6.$

Ex. 16. ***Evaluate: $\sqrt{0.9}$ up to 3 places of decimal.***

Sol.

9	0.900000(0.948	
	81	

184	900
	736
1888	16400
	15104

$\therefore \sqrt{0.9} = 0.948$

Ex.17. If $\sqrt{15} = 3.88$, find the value of $\sqrt{(5/3)}$.

Sol. $\sqrt{(5/3)} = \sqrt{(5 * 3) / (3 * 3)} = \sqrt{15} / 3 = 3.88 / 3 = 1.2933\ldots. = 1.29\overline{3}$.

Ex. 18. Find the least square number which is exactly divisible by 10,12,15 and 18.

Sol. L.C.M. of 10, 12, 15, 18 = 180. Now, $180 = 2 * 2 * 3 * 3 * 5 = 2^2 * 3^2 * 5$.
To make it a perfect square, it must be multiplied by 5.

$\therefore$ Required number = $(2^2 * 3^2 * 5^2) = 900$.

Ex. 19. Find the greatest number of five digits which is a perfect square.

(R.R.B. 1998)

Sol. Greatest number of 5 digits is 99999.

3	99999(316
	9
61	99
	61
626	3899
	3756
	143

$\therefore$ Required number == (99999 - 143) = 99856.

***Ex. 20. Find the smallest number that must be added to 1780 to make it a perfect square*.**

Sol.

4	1780 (42
	16
82	180
	164
	16

$\therefore$ Number to be added = $(43)^2 - 1780 = 1849 - 1780 = 69$.

Ex. 21. $\sqrt{2} = 1.4142$, find the value of $\sqrt{2} / (2 + \sqrt{2})$.

Sol. $\sqrt{2} / (2 + \sqrt{2}) = \sqrt{2} / (2 + \sqrt{2}) * (2 - \sqrt{2}) / (2 - \sqrt{2}) = (2\sqrt{2} - 2) / (4 - 2)$
$= 2(\sqrt{2} - 1) / 2 = \sqrt{2} - 1 = 0.4142$.

22. If $x = (\sqrt{5} + \sqrt{3}) / (\sqrt{5} - \sqrt{3})$ and $y = (\sqrt{5} - \sqrt{3}) / (\sqrt{5} + \sqrt{3})$, find the value of $(x^2 + y^2)$.

Sol.

$x = [(\sqrt{5} + \sqrt{3}) / (\sqrt{5} - \sqrt{3})] * [(\sqrt{5} + \sqrt{3}) / (\sqrt{5} + \sqrt{3})] = (\sqrt{5} + \sqrt{3})^2 / (5 - 3)$

$=(5 + 3 + 2\sqrt{15}) / 2 = 4 + \sqrt{15}$.

$y = [(\sqrt{5} - \sqrt{3}) / (\sqrt{5} + \sqrt{3})] * [(\sqrt{5} - \sqrt{3}) / (\sqrt{5} - \sqrt{3})] = (\sqrt{5} - \sqrt{3})^2 / (5 - 3)$

$=(5 + 3 - 2\sqrt{15}) / 2 = 4 - \sqrt{15}$.

$\therefore \quad x^2 + y^2 = (4 + \sqrt{15})^2 + (4 - \sqrt{15})^2 = 2[(4)^2 + (\sqrt{15})^2] = 2 * 31 = 62.$

Ex. 23. Find the cube root of 2744.

Sol. **Method:** Resolve the given number as the product of prime factors and take the product of prime factors, choosing one out of three of the same prime factors. Resolving 2744 as the product of prime factors, we get:

2	2744
2	1372
2	686
7	343
7	49
	7

$2744 = 2^3 \times 7^3$.

$\therefore \quad \sqrt[3]{2744} = 2 \times 7 = 14.$

Ex. 24. By what least number 4320 be multiplied to obtain a number which is a perfect cube?

Sol. Clearly, $4320 = 2^3 * 3^3 * 2^2 * 5$.

To make it a perfect cube, it must be multiplied by $2 * 5^2$ i.e,50.

6.AVERAGE

Ex.1:Find the average of all prime numbers between 30 and 50?

Sol: there are five prime numbers between 30 and 50.

They are 31,37,41,43 and 47.

Therefore the required average=(31+37+41+43+47)/5 ⇔199/5 ⇔ 39.8.

Ex.2. find the average of first 40 natural numbers?

Sol: sum of first n natural numbers=n(n+1)/2;

So,sum of 40 natural numbers=(40*41)/2 ⇔820.

Therefore the required average=(820/40) ⇔20.5.

Ex.3. find the average of first 20 multiples of 7?

Sol: Required average =7(1+2+3+…….+20)/20 ⇔(7*20*21)/(20*2) ⇔(147/2)=73.5.

Ex.4. the average of four consecutive even numbers is 27. find the largest of these numbers?

Sol: let the numbers be x,x+2,x+4 andx+6. then,

(x+(x+2)+(x+4)+(x+6))/4) = 27

⇔(4x+12)/4 = 27

⇔x+3=27 ⇔ x=24.

Therefore the largest number=(x+6)=24+6=30.

Ex.5. there are two sections A and B of a class consisting of 36 and 44 students respectively. If the average weight of section A is 40kg and that of section B is 35kg, find the average weight of the whole class?

Sol: total weight of(36+44) students=(36*40+44*35)kg =2980kg.

Therefore weight of the total class=(2980/80)kg =37.25kg.

Ex:6.nine persons went to a hotel for taking their meals 8 of them spent Rs.12 each on their meals and the ninth spent Rs.8 more than the average expenditure of all the nine.What was the total money spent by them?

Sol: Let the average expenditure of all nine be Rs.x

Then 12*8+(x+8)=9x or 8x=104 or x=13.

Total money spent = 9x=Rs.(9*13)=Rs.117.

Ex.7: Of the three numbers, second is twice the first and is also thrice the third.If the average of the three numbers is 44.Find the largest number.

Sol: Let the third number be x.

Then second number = 3x.

First number=3x/2.

Therefore x+3x+(3x/2)=(44*3) or x=24

So largest number= 2^{nd} number=3x=72.

Ex.8:The average of 25 result is 18.The average of 1^{st} 12 of them is 14 & that of last 12 is 17.Find the 13^{th} result.

Sol: Clearly 13^{th} result=(sum of 25 results)-(sum of 24 results)

=(18*25)-(14*12)+(17*12)

=450-(168+204)

=450-372

=78.

Ex.9:The Average of 11 results is 16, if the average of the 1^{st} 6 results is 58 & that of the last 63. Find the 6^{th} result.

Sol: 6^{th} result = (58*6+63*6-60*11)=66

Ex.10:The average waight of A,B,C is 45 Kg. The avg wgt of A & B be 40Kg & that of B,C be 43Kg. Find the wgt of B.

Sol. Let A,B,c represent their individual wgts.

Then,

A+B+C=(45*3)Kg=135Kg

A+B=(40*2)Kg=80Kg & B+C=(43*2)Kg=86Kg

B=(A+B)+(B+C)-(A+B+C)

=(80+86-135)Kg

=31Kg.

Ex. 11. The average age of a class of 39 students is 15 years. If the age of the teacher be included, then the average increases by3 months. Find the age of the teacher.

Sol. Total age of 39 persons = (39 x 15) years

= 585 years.

Average age of 40 persons= 15 yrs 3 months

= 61/4 years.

Total age of 40 persons = ((61/4)x 40) years= 610 years.

:. Age of the teacher = (610 - 585) years=25 years.

Ex. 12. The average weight of 10 oarsmen in a boat is increased by 1.8 kg when one of the crew, who weighs 53 kg is replaced by a new man. Find the weight of the new man.

Sol. Total weight increased =(1.8 x 10) kg =18 kg.

:. Weight of the new man =(53 + 18) kg =71 kg.

Ex. 13. There were 35 students in a hostel. Due to the admission of 7 new students, ;he expenses of the mess were increased by Rs. 42 per day while the average expenditure per head diminished by Rs 1. Wbat was the original expenditure of the mess?

Sol. Let the original average expenditure be Rs. x. Then,

42 (x - 1) - *35x*=42 ⇔ *7x*= 84 ⇔ x =12.

Original expenditure = Rs. (35 x 12) =Rs. 420. .

14. A batsman makes a score of 87 runs in the 17th inning and thus increases his avg by 3. Find his average after 17th inning.

Sol. Let the average after 17th inning = x.

Then, average after 16th inning = *(x* - 3).

:. 16 (x - 3) + 87 = *17x* or *x* = (87 - 48) = 39.

Ex.15. Distance between two stations A and B is 778 km. A train covers the journey from A to B at 84 km per hour and returns back to A with a uniform speed of 56 km perhour. Find the average speed of the train during the whole journey.

Sol. Required average speed = ((2xy)/(x+y)) km / hr

=(2 x 84 x 56)/(84+56)km/hr

= (2*84*56)/140 km/hr

=67.2 km/hr.

7. PROBLEMS ON NUMBERS

In this section, questions involving a set of numbers are put in the form of a puzzle. You have to analyze the given conditions, assume the unknown numbers and form equations accordingly, which on solving yield the unknown numbers.

SOLVED EXAMPLES

Ex.1. A number is as much greater than 36 as is less than 86. Find the number.

Sol. Let the number be x. Then, x - 36 = 86 - x => 2x = 86 + 36 = 122 => x = 61.
Hence, the required number is 61.

Ex. 2. Find a number such that when 15 is subtracted from 7 times the number, the
Result is 10 more than twice the number. (Hotel Management, 2002)

Sol. Let the number be x. Then, 7x - 15 = 2x + 10 => 5x = 25 =>x = 5.
Hence, the required number is 5.

Ex. 3. The sum of a rational number and its reciprocal is 13/6. Find the number.
(S.S.C. 2000)

Sol. Let the number be x.
Then, $x + (1/x) = 13/6 \Rightarrow (x^2 + 1)/x = 13/6 \Rightarrow 6x^2 - 13x + 6 = 0$
$\Rightarrow 6x^2 - 9x - 4x + 6 = 0 \Rightarrow (3x - 2)(2x - 3) = 0$
⇨ x = 2/3 or x = 3/2
Hence the required number is 2/3 or 3/2.

Ex. 4. The sum of two numbers is 184. If one-third of the one exceeds one-seventh of the other by 8, find the smaller number.

Sol. Let the numbers be x and (184 - *x)*. Then,
(X/3) - ((184 – x)/7) = 8 => 7x – 3(184 – x) = 168 => 10x = 720 => x = 72.
So, the numbers are 72 and 112. Hence, smaller number = 72.

Ex. 5. The difference of two numbers is 11 and one-fifth of their sum is 9. Find the numbers.

Sol. Let the number be x and y. Then,
x – y = 11 ----(i) and 1/5 *(x + y)* = 9 => *x* + *y* = 45 ----(ii)
Adding (i) and (ii), we get: 2x = 56 or x = 28. Putting x = 28 in (i), we get: y = 17.
Hence, the numbers are 28 and 17.

Ex. 6. If the sum of two numbers is 42 and their product is 437, then find the absolute difference between the numbers. (S.S.C. 2003)

Sol. Let the numbers be x and y. Then, x + y = 42 and xy = 437
x - *y* = sqrt[$(x + y)^2$ - 4xy] = sqrt[$(42)^2$ - 4 x 437] = sqrt[1764 – 1748] = sqrt[16] = 4.
Required difference = 4.

Ex. 7. The sum of two numbers is 16 and the sum of their squares is 113. Find the numbers.

Sol. Let the numbers be x and (15 - *x).*
Then, $x^2 + (15 - x)^2 = 113$ => $x^2 + 225 + X^2 - 30x = 113$
=> $2x^2 - 30x + 112 = 0$ => $x^2 - 15x + 56 = 0$
=> *(x* - 7) *(x* - 8) = 0 => x = 7 or x = 8.

So, the numbers are 7 and 8.

Ex. 8. The average of four consecutive even numbers is 27. Find the largest of these numbers.

Sol. Let the four consecutive even numbers be x, x + 2, x + 4 and x + 6.
Then, sum of these numbers = (27 x 4) = 108.
So, x + *(x* + 2) + *(x* + 4) + *(x* + 6) = 108 or *4x* = 96 or x = 24.
:. Largest number = *(x* + 6) = 30.

Ex. 9. The sum of the squares of three consecutive odd numbers is 2531.Find the numbers.

Sol. Let the numbers be x, x + 2 and x + 4.
Then, $X^2 + (x + 2)^2 + (x + 4)^2 = 2531 \Rightarrow 3x^2 + 12x - 2511 = 0$
=> $X^2 + 4x - 837 = 0 \Rightarrow (x - 27)(x + 31) = 0 \Rightarrow x = 27.$
Hence, the required numbers are 27, 29 and 31.

Ex. 10. Of two numbers, 4 times the smaller one is less then 3 times the 1arger one by 5. If the sum of the numbers is larger than 6 times their difference by 6, find the two numbers.

Sol. Let the numbers be x and *y,* such that x > y
Then, *3x* - 4y = 5 ...(i) and *(x + y)* - 6 *(x - y)* = 6 => *-5x* + 7y = 6 …(ii)
Solving (i) and *(ii),* we get: x = 59 and *y* = 43.
Hence, the required numbers are 59 and 43.

Ex. 11. The ratio between a two-digit number and the sum of the digits of that number is 4 : 1.If the digit in the unit's place is 3 more than the digit in the ten's place, what is the number?

Sol. Let the ten's digit be x. Then, unit's digit = *(x* + 3).
Sum of the digits = x + *(x* + 3) = *2x* + 3. Number = l0x + *(x* + 3) = llx + 3.
11x+3 / 2x + 3 = 4 / 1 => 1lx + 3 = 4 (2x + 3) => 3x = 9 => *x* = 3.
Hence, required number = *11x* + 3 = 36.

Ex. 12. A number consists of two digits. The sum of the digits is 9. If 63 is subtracted from the number, its digits are interchanged. Find the number.

Sol. Let the ten's digit be x. Then, unit's digit = (9 - *x).*
Number = l0x + (9 - x) = *9x* + 9.
Number obtained by reversing the digits = 10 (9 - x) + x = 90 - 9x.
therefore, *(9x* + 9) - 63 = 90 - *9x* => *18x* = 144 => x = 8.
So, ten's digit = 8 and unit's digit = 1.
Hence, the required number is 81.

Ex. 13. A fraction becomes 2/3 when 1 is added to both, its numerator and denominator.

And ,it becomes 1/2 when 1 is subtracted from both the numerator and

denominator. Find the fraction.

Sol. Let the required fraction be x/y. Then,

x+1 / y+1 = 2 / 3 => 3x – 2y = - 1 …(i) and x – 1 / y – 1 = 1 / 2

⇨ 2x – y = 1 …(ii)

Solving (i) and (ii), we get : x = 3 , y = 5

therefore, Required fraction= 3 / 5.

Ex. 14. 50 is divided into two parts such that the sum of their reciprocals is 1/ 12.Find the two parts.

Sol. Let the two parts be x and (50 - *x).*

Then, 1 / x + 1 / (50 – x) = 1 / 12 => (50 – x + x) / x (50 – x) = 1 / 12

=> x^2 – 50x + 600 = 0 => (x – 30) (x – 20) = 0 => x = 30 or x = 20.

So, the parts are 30 and 20.

Ex. 15. If three numbers are added in pairs, the sums equal 10, 19 and 21. Find the numbers)

Sol. Let the numbers be x, *y* and z. Then,

x+ *y* = 10 ...*(i)* *y* + z = 19 ...*(ii)* x + z = 21 …(iii)

Adding (i) ,*(ii)* and *(iii),* we get: *2 (x + y + z)* = 50 or (x + *y* + z) = 25.

Thus, x= (25 - 19) = 6; *y* = (25 - 21) = 4; z = (25 - 10) = 15.

Hence, the required numbers are 6, 4 and 15.

8. PROBLEMS ON AGES

Ex. 1. Rajeev's age after 15 years will be 5 times his age 5 years back. What is the present age of Rajeev ? (Hotel Management,2002)

Sol. Let Rajeev's present age be x years. Then,

Rajeev's age after 15 years = (x + 15) years.

Rajeev's age 5 years back = (x - 5) years.

:. x + 15 = 5 (x - 5)⇔x + 15 = 5x - 25 ⇔ 4x = 40 ⇔ x = 10.

Hence, Rajeev's present age = 10 years.

Ex. 2. ***The ages*** **of** ***two persons differ by*** **16** ***years.*** **If 6** ***years ago, the elder*** **one be 3** ***times as old as the younger*** **one,** ***find their present ages.*** (A.A.O. Exam,2003)

Sol. Let the age of the younger person be x years.

Then, age of the elder person = (x + 16) years.

:. 3 (x - 6) = (x + 16 - 6) ⇔ 3x -18 = x + 10 ⇔ 2x = 28⇔ x = 14.

Hence, their present ages are 14 years and 30 years.

Ex. 3. ***The product*** **of** ***the ages*** **of** ***Ankit and Nikita is 240.*** **If** ***twice the*** **age of Nikita**

is more than Ankit's age by* 4 *years, what is Nikita's age?

(S.B.I.P.O,1999)

Sol. Let Ankit's age be x years. Then, Nikita's age = 240/xyears.

$\therefore\ 2 \times (240/x) - x = 4 \Leftrightarrow 480 - x^2 = 4x \Leftrightarrow x^2 + 4x - 480 = 0$

$\Leftrightarrow (x+24)(x-20) = 0 \Leftrightarrow x = 20.$

Hence, Nikita's age = (22 0) years = 12 years. 1

Ex. 4. ***The present age*** **of a** ***father is*** **3** ***years more than three times the*** **age of his** ***son. Three years hence, father's age will be 10 years more than twice the*** **age** ***of the*** **son.** ***Find the present age*** **of** ***the*** **father. . (S.S.C, 2003)**

Sol. Let the son's present age be x years. Then, father's present age = $(3x + 3)$ years

$\therefore\ (3x + 3 + 3) = 2(x + 3) + 10 \Leftrightarrow 3x + 6 = 2x + 16 \Leftrightarrow x = 10.$

Hence, father's present age = $(3x + 3) = ((3 \times 10) + 3)$ years = 33 years.

Ex. 5. R*ohit was* 4 *times as old as his son* 8 *years ago. After* 8 *years, Rohit will be twice as old as his son. What are their present ages?*

Sol. Let son's age 8 years ago be x years. Then, Rohit's age 8 years ago = 4x years.

Son's age after 8 years = $(x + 8) + 8 = (x + 16)$ years.

Rohit's age after 8 years = $(4x + 8) + 8 = (4x + 16)$ years.

$\therefore\ 2(x + 16) = 4x + 16 \Leftrightarrow 2x = 16 \Leftrightarrow x = 8.$

Hence, son's 'present age = $(x + 8) = 16$ years.

Rohit's present age = $(4x + 8) = 40$ years.

Ex. 6. One ***year ago, the ratio*** **of** ***Gaurav's and Sachin's age was*** **6: 7** ***respectively. Four years hence, this ratio would become*** **7: 8.** ***How old is Sa chin ?***

(NABARD, 2002)

Sol:

. Let Gaurav's and Sachin's ages one year ago be 6x and 7x years respectively. Then, Gaurav's age

4 years hence = $(6x + 1) + 4 = (6x + 5)$ years.

Sachin's age 4 years hence = $(7x + 1) + 4 = (7x + 5)$ years.

$\frac{6x+5}{7x+5} = \frac{7}{8} \Leftrightarrow 8(6x+5) = 7(7x + 5) \Leftrightarrow 48x + 40 = 49x + 35 \Leftrightarrow x = 5.$

Hence, Sachin's present age = $(7x + 1) = 36$ years.

,7. ***Abhay's age after six years will be three-seventh*** **of** ***his fathers age. Ten years*** **ago the** ***ratio*** **of** ***their ages was 1*** **: 5.** ***What is Abhay's father's age*** **at** ***present?***

Sol. Let the ages of Abhay and his father 10 years ago be x and 5x years respectively. Then,

Abhay's age after 6 years = (x + 10) + 6 = (x + 16) years.

Father's age after 6 years = *(5x* + 10) + 6 = *(5x* + 16) years.

x + 16) = $\frac{3}{7}$ *(5x* + 16) ⇔ 7 *(x* + 16) = 3 *(5x* + 16) ⇔ *7x* + 112 = *15x* + 48

⇔ *8x* = 64 ⇔ x = 8.

Hence, Abhay's father's present age = *(5x* + 10) = 50 years.

9. SURDS AND INDICES

I IMPORTANT FACTS AND FORMULAE I

1. LAWS OF INDICES:

(i) $a^m \times a^n = a^{m+n}$

(ii) $a^m / a^n = a^{m-n}$

(iii) $(a^m)^n = a^{mn}$

(iv) $(ab)^n = a^n b^n$

(v) $(a/ b)^n = (a^n / b^n)$

(vi) $a^0 = 1$

2. SURDS: *Let a be a rational number and* n *be a positive integer such that* $a^{1/n} = {}^n sqrt(a)$ *is irrational. Then* ^{n}sqrt(a) is *called a surd of order* n.

3. LAWS OF SURDS:

(i) $\sqrt[n]{a} = a^{1/2}$

(ii) $\sqrt[n]{ab} = \sqrt[n]{a} * \sqrt[n]{b}$

(iii) $\sqrt[n]{a/b} = \sqrt[n]{a} \ / \ \sqrt[n]{b}$

(iv) $(\sqrt[n]{a})^n = a$

(v) $\sqrt[m]{(\sqrt[n]{(a)}} = \sqrt[mn]{(a)}$

(vi) $(\sqrt[n]{a})^m = \sqrt[n]{a^m}$

I SOLVED EXAMPLES

Ex. 1. Simplify : (i) $(27)^{2/3}$ (ii) $(1024)^{-4/5}$ (iii)$(8 / 125)^{-4/3}$

Sol . (i) $(27)^{2/3} = (3^3)^{2/3} = 3^{(3*(2/3))} = 3^2 = 9$

(ii) $(1024)^{-4/5} = (4^5)^{-4/5} = 4^{\{5*((-4)/5)\}} = 4^{-4} = 1/4^4 = 1/256$

(iii) $(8/125)^{-4/3} = \{(2/5)^3\}^{-4/3} = (2/5)^{\{3*(-4/3)\}} = (2/5)^{-4} = (5/2)^4 = 5^4/2^4 = 625/16$

Ex. 2. Evaluate: (i) *(.00032)$^{3/5}$* *(ii)l* $(256)^{0.16} \times (16)^{0.18}$.

Sol. (i) $(0.00032)^{3/5} = (32/100000)^{3/5} = (2^5/10^5)^{3/5} = \{(2/10)^5\}^{3/5} = (1/5)^{(5*3/5)} = (1/5)^3 = 1/125$

(ii) $(256)^{0.16} * (16)^{0.18} = \{(16)^2\}^{0.16} * (16)^{0.18} = (16)^{(2*0.16)} * (16)^{0.18}$

$= (16)^{0.32} * (16)^{0.18} = (16)^{(0.32+0.18)} = (16)^{0.5} = (16)^{1/2} = 4.$

Ex. 3. *What is the quotient when* $(x^{-1} - 1)$ *is divided by* $(x - 1)$?

Sol. $\frac{x^{-1}-1}{x-1} = \frac{(1/x)-1}{x-1} = \frac{1-x}{x} * \frac{1}{(x-1)} = \frac{-1}{x}$

Hence, the required quotient is $-1/x$

Ex. 4. If $2^{x-1} + 2^{x+1} = 1280$, *then find the value* of x.

Sol. $2^{x-1} + 2^{x+1} = 1280 \Leftrightarrow 2^{x-1}(1 + 2^2) = 1280$

$\Leftrightarrow 2^{x-1} = 1280/5 = 256 = 2^8 \Leftrightarrow x - 1 = 8 \Leftrightarrow x = 9.$

Hence, x = 9.

Ex. 5. *Find* the value of $[5(8^{1/3} + 27^{1/3})^3]^{1/4}$

Sol. $[5(8^{1/3} + 27^{1/3})^3]^{1/4} = [5\{(2^3)^{1/3} + (3^3)^{1/3}\}^3]^{1/4} = [5\{(2^{3*1/3})^{1/3} + (3^{3*1/3})^{1/3}\}^3]^{1/4}$

$= \{5(2+3)^3\}^{1/4} = (5 * 5^3)^{1/4} = 5^{(4*1/4)} = 5^1 = 5.$

Ex. 6. Find the Value of $\{(16)^{3/2} + (16)^{-3/2}\}$

Sol. $[(16)^{3/2} + (16)^{-3/2} = (4^2)^{3/2} + (4^2)^{-3/2} = 4^{(2*3/2)} + 4^{\{2*(-3/2)\}}$

$= 4^3 + 4^{-3} = 4^3 + (1/4^3) = (64 + (1/64)) = 4097/64.$

Ex. 7. *If* $(1/5)^{3y} = 0.008$, *then find the value of* $(0.25)^y$.

Sol. $(1/5)^{3y} = 0.008 = 8/1000 = 1/125 = (1/5)^3 \Leftrightarrow 3y = 3 \Leftrightarrow Y = 1.$

$\therefore (0.25)^y = (0.25)^1 = 0.25.$

Ex. 8. *Find the value* of $\dfrac{(243)^{n/5} \times 3^{2n+1}}{9^n \times 3^{n-1}}$.

Sol. $\dfrac{(243)^{n/5}\, x3^{2n+l}}{(3^2)^n \times 3^{n-1}} = \dfrac{3^{(5 * n/5)} \times 3^{2n+l}}{3^{2n} \times 3^{n-1}} = \dfrac{3^n \times 3^{2n+1}}{32n \times 3^{n-l}}$

$$= \frac{3^{n+(2n+1)}}{3^{2n+n-1}} = \frac{3^{(3n+1)}}{3^{(3n-1)}} = 3^{(3n+l)-(3n-l)} = 3^2 = 9.$$

Ex. 9. *Find the value Of* $(2^{1/4}-1)(2^{3/4}+2^{1/2}+2^{1/4}+1)$

Sol.

Putting $2^{1/4} = x$, we get :

$(2^{1/4}-1)(2^{3/4}+2^{1/2}+2^{1/4}+1) = (x-1)(x^3+x^2+x+1)$, *where* $x = 2^{1/4}$

$= (x-1)[x^2(x+1)+(x+1)]$

$= (x-1)(x+1)(x^2+1) = (x^2-1)(x^2+1)$

$= (x^4-1) = [(2^{1/4})^4-1] = [2^{(1/4*4)} - 1] = (2-1) = 1.$

Ex. 10. Find the value of $\dfrac{6^{2/3} \times \sqrt[3]{6^7}}{\sqrt[3]{6^6}}$

Sol. $\dfrac{6^{2/3} \times \sqrt[3]{6^7}}{\sqrt[3]{6^6}} = \dfrac{6^{2/3} \times (6^7)^{1/3}}{(6^6)^{1/3}} = \dfrac{6^{2/3} \times 6^{(7 * 1/3)}}{6^{(6 * 1/3)}} = \dfrac{6^{2/3} \times 6^{(7/3)}}{6^2}$

$$= 6^{2/3} \times 6^{((7/3)-2)} = 6^{2/3} \times 6^{1/3} = 6^1 = 6.$$

Ex. 11. If $x = y^a$, $y = z^b$ *and* $z = x^c$, *then find the value of abc.*

Sol. $z^1 = x^c = (y^a)^c$ [since $x = y^a$]

$= y^{(ac)} = (z^b)^{ac}$ [since $y = z^b$]

$= z^{b(ac)} = z^{abc}$

$\therefore$ $abc = 1.$

Ex. 12. Simplify $[(x^a / x^b)^{(a^2+b^2+ab)}] * [(x^b / x^c)^{b^2+c^2+bc)}] * [(x^c/x^a)^{(c^2+a^2+ca)}]$

Sol. Given Expression

$= [\{x^{(o-b)}\}^{(a^2 + b^2 + ob)}].[\{x^{(b-c)}\}^{(b^2 + c^2 + bc)}].[\{x^{(c-a)}\}^{(c^2 + a^2 + ca)}]$

$= [x^{(a-b)(a2+b2+ab)} \cdot x^{(b-c)(b2+c2+bc)} \cdot x^{(c-a)(c2+a2+ca)}]$

$= [x^{(a^3-b^3)}].[x^{(b^3-e^3)}].[x^{(c^3-a^3)}] = x^{(a^3-b^3+b^3-c^3+c^3-a^3)} = x^0 = 1.$

Ex. 13. *Which is larger* $\sqrt{2}$ or $\sqrt[3]{3}$?

Sol. Given surds are of order 2 and 3. Their L.C.M. is 6. Changing each to a surd of order 6, we get:

$\sqrt{2} = 2^{1/2} = 2^{((1/2)*(3/2))} = 2^{3/6} = 8^{1/6} = \sqrt[6]{8}$

$\sqrt[3]{3} = 3^{1/3} = 3^{((1/3)*(2/2))} = 3^{2/6} = (3^2)^{1/6} = (9)^{1/6} = \sqrt[6]{9}.$

Clearly, $\sqrt[6]{9} > \sqrt[6]{8}$ and hence $\sqrt[3]{3} > \sqrt{2}$.

Ex. 14. *Find the largest from among* $4\sqrt{6}$, $\sqrt{2}$ *and* $\sqrt[3]{4}$.

Sol. Given surds are of order 4, 2 and 3 respectively. Their L.C,M, is 12, Changing each to a surd of order 12, we get:

$\sqrt[4]{6} = 6^{1/4} = 6^{((1/4)*(3/3))} = 6^{3/12} = (6^3)^{1/12} = (216)^{1/12.}$

$\sqrt{2} = 2^{1/2} = 2^{((1/2)*(6/6))} = 2^{6/12} = (2^6)^{1/12} = (64)^{1/12}.$

$\sqrt[3]{4} = 4^{1/3} = 4^{((1/3)*(4/4))} = 4^{4/12} = (4^4)^{1/12} = (256)^{1/12}.$

Clearly, $(256)^{1/12} > (216)^{1/12} > (64)^{1/12}$

Largest one is $(256)^{1/12}$. i.e. $\sqrt[3]{4}$.

10.PERCENTAGE

IMPORTANT FACTS AND FORMULAE

1. **Concept of Percentage:** By a certain percent, we mean that many hundredths. Thus x percent means x hundredths, written as x%.

   To express x% as a fraction : We have , x% = x/100.

   Thus, 20% =20/100 =1/5; 48% =48/100 =12/25, etc.

   To express a/b as a percent : We have, a/b =((a/b)*100)%.

   Thus, ¼ =[(1/4)*100] = 25%; 0.6 =6/10 =3/5 =[(3/5)*100]% =60%.

2. If the price of a commodity increases by R%, then the reduction in consumption so as not to increase the expenditure is

   [R/(100+R))*100]%.

   If the price of the commodity decreases by R%, then the increase in consumption so as to decrease the expenditure is

   [(R/(100-R)*100]%.

3. Results on Population : Let the population of the town be P now and suppose it increases at the rate of

R% per annum, then :

1. Population after n yeras = P [1+(R/100)]^n.
2. Population n years ago = P /[1+(R/100)]^n.

4. Results on Depreciation : Let the present value of a machine be P. Suppose it depreciates at the rate

R% per annum. Then,

1. Value of the machine after n years = $P[1-(R/100)]^n$.
2. Value of the machine n years ago = $P/[1-(R/100)]^n$.

5. If A is R% more than B, then B is less than A by

$[(R/(100+R))*100]\%$.

If A is R% less than B , then B is more than A by

$[(R/(100-R))*100]\%$.

SOLVED EXAMPLES

Ex. 1. Express each of the following as a fraction :

(i) 56% (ii) 4% (iii) 0.6% (iv) 0.008%

sol. (i) 56% = 56/100= 14/25. (ii) 4% =4/100 =1/25.
(iii) 0.6 =6/1000 = 3/500. (iv) 0.008 = 8/100 = 1/1250.

Ex. 2. Express each of the following as a Decimal :

(i) 6% (ii)28% (iii) 0.2% (iv) 0.04%

Sol. (i) 6% = 6/100 =0.06. (ii) 28% = 28/100 =0.28.
(iii) 0.2% =0.2/100 = 0.002. (iv) 0.04%= 0.04/100 =0.004.

Ex. 3. Express each of the following as rate percent :

(i) 23/36 (ii) 6 ¾ (iii) 0.004

Sol. (i) 23/36 = [(23/36)*100]% = [575/9]% = 63 8/9%.

(ii) 0.004 = [(4/1000)*100]% = 0.4%.

(iii) 6 ¾ =27/4 =[(27/4)*100]% = 675%.

Ex. 4. Evaluate :

(i) 28% of 450+ 45% of 280
(ii) 16 2/3% of 600 gm- 33 1/3% of 180 gm

Sol. (i) 28% of 450 + 45% of 280 =[(28/100)*450 + (45/100)*280] = (126+126) =252.

(iii) 16 2/3% of 600 gm –33 1/3% of 180 gm = [((50/3)*(1/100)*600) – ((100/3)*(1/3)*280)]gm = (100-60) gm = 40gm.

Ex. 5.
(i) 2 is what percent of 50 ?
(ii) ½ is what percent of 1/3 ?
(iii)What percent of 8 is 64 ?
(iv)What percent of 2 metric tones is 40 quintals ?
(v)What percent of 6.5 litres is 130 ml?

Sol.

(i) Required Percentage = [(2/50)*100]% = 4%.

(ii) Required Percentage = [(1/2)*(3/1)*100]% = 150%.

(iii)Required Percentage = [(84/7)*100]% = 1200%.

(iv) 1 metric tonne = 10 quintals.

Required percentage = [(40/(2 * 10)) * 100]% = 200%.

(v) Required Percentage = [(130/(6.5 * 1000)) * 100]% = 2%.

Ex. 6.
Find the missing figures :

(i) ?% of 25 = 2.125 (ii) 9% of ? = 6.3 (iii) 0.25% of ? = 0.04

Sol.

(i) Let x% of 25 = 2.125. Then , (x/100)*25 = 2.125
X = (2.125 * 4) = 8.5.

(ii) Let 9% of x =6.3. Then , 9*x/100 = 6.3
X = [(6.3*100)/9] =70.

(iii) Let 0.25% of x = 0.04. Then , 0.25*x/100 = 0.04
X= [(0.04*100)/0.25] = 16.

Ex. 7.
Which is greatest in 16 (2/3) %, 2/5 and 0.17 ?

Sol. 16 (2/3)% =[(50/3)*)1/100)] = 1/6 = 0.166, 2/15 = 0.133. Clearly, 0.17 is the greatest.

Ex. 8.
If the sales tax reduced from 3 1/2 % to 3 1/3%, then what difference does it make to a person who purchases an article with market price of Rs. 8400 ?

Sol. Required difference = [3 ½ % of Rs.8400] – [3 1/3 % of Rs.8400]
= [(7/20-(10/3)]% of Rs.8400 =1/6 % of Rs.8400
= Rs. [(1/6)8(1/100)*8400] = Rs. 14.

Ex. 9. An inspector rejects 0.08% of the meters as defective. How many will be examine to project if there are 2 defective meters?

Sol. Let the number of meters to be examined be x.

Then, 0.08% of x =2

[(8/100)*(1/100)*x] = 2

x = [(2*100*100)/8] = 2500.

Ex. 10. Sixty five percent of a number is 21 less than four fifth of that number. What is the number ?

Sol. Let the number be x.

Then, 4*x/5 –(65% of x) = 21

4x/5 –65x/100 = 21

5 x = 2100

x = 140.

Ex.11. Difference of two numbers is 1660. If 7.5% of the number is 12.5% of the other number, find the number ?

Sol. Let the numbers be x and y. Then, 7.5 % of x =12.5% of y

X = 125*y/75 = 5*y/3.

Now, x-y =1660

5*y/3 –y =1660

2*y/3= 1660

y =[(1660*3)/2] =2490.

One number = 2490, Second number =5*y/3 =4150.

Ex. 12.

In expressing a length 81.472 km as nearly as possible with three significant digits , find the percentage error.

Sol. Error = (81.5 – 81.472)km = 0.028.

Required percentage = [(0.028/81.472)*100]% = 0.034%.

Ex. 13.

In an election between two candidates, 75% of the voters cast their votes, out of which 2% of the votes were declared invalid. A candidate got 9261 votes which were 75% of the total valid votes. Find the total number of votes enrolled in that election.

Sol.

Let the number of votes enrolled be x. Then ,

Number of votes cast =75% of x. Valid votes = 98% of (75% of x).

75% of (98% of (75%of x)) =9261.

[(75/100)*(98/100)*(75/100)*x] =9261.

X = [(9261*100*100*100)/(75*98*75)] =16800.

Ex.14. Shobha's mathematics test had 75 problems i.e.10 arithmetic, 30 algebra and 35 geometry problems. Although she answered 70% of the arithmetic ,40% of the algebra, and 60% of the geometry problems correctly. she did not pass the test because she got less than 60% of the problems right. How many more questions she would have to answer correctly to earn 60% of the passing grade?

Sol. Number of questions attempted correctly=(70% of 10 + 40% of 30 + 60% 0f 35)
=7 + 12+21= 45
questions to be answered correctly for 60% grade=60% of 75 = 45

therefore required number of questions= (45-40) = 5.

Ex.15. if 50% of (x-y) = 30% of (x+y) then what percent of x is y?

Sol.50% of (x-y)=30% of(x+y) ⇔ (50/100)(x-y)=(30/100)(x+y)
⇔5(x-y)=3(x+y) ⇔ 2x=8y ⇔ x=4y
therefore required percentage =((y/x) X 100)% = ((y/4y) X 100) =25%

Ex.16. Mr.Jones gave 40% of the money he had to his wife. he also gave 20% of the remaining amount to his 3 sons. half of the amount now left was spent on miscellaneous items and the remaining amount of Rs.12000 was deposited in the bank. how much money did Mr.jones have initially?

Sol. Let the initial amount with Mr.jones be Rs.x then,
Money given to wife= Rs.(40/100)x=Rs.2x/5.Balance=Rs(x-(2x/5)=Rs.3x/5.
Money given to 3 sons= Rs(3X((20/200) X (3x/5)) = Rs.9x/5.
Balance = Rs.((3x/5) – (9x/25))=Rs.6x/25.
Amount deposited in bank= Rs(1/2 X 6x/25)=Rs.3x/25.

Therefore 3x/25=12000 ⇔ x= ((12000 x 35)/3)=100000

So Mr.Jones initially had Rs.1,00,000 with him.

Short-cut Method : Let the initial amount with Mr.Jones be Rs.x
Then,(1/2)[100-(3*20)]% of x=12000

⇔ (1/2)*(40/100)*(60/100)*x=12000
⇔x=((12000*25)/3)=100000

Ex 17 10% of the inhabitants of village having died of cholera.,a panic set in , during

which 25% of the remaining inhabitants left the village. The population is then reduced to 4050. Find the number of original inhabitants.
Sol:
Let the total number of orginal inhabitants be x.
((75/100))*(90/100)*x)=4050 ⇔ (27/40)*x=4050

⇔x=((4050*40)/27)=6000.

Ex.18 A salesman`s commission is 5% on all sales upto Rs.10,000 and 4% on all sales exceeding this.He remits Rs.31,100 to his parent company after deducing his commission . Find the total sales.
Sol:
Let his total sales be Rs.x.Now(Total sales) – (Commission)=Rs.31,100
x-[(5% of 10000 + 4% of (x-10000)]=31,100
x-[((5/100)*10000 + (4/100)*(x-10000)]=31,100
⇔x-500-((x-10000)/25)=31,100
⇔x-(x/25)=31200 ⇔ 24x/25=31200⇔x=[(31200*25)/24)=32,500.
Total sales=Rs.32,500

Ex .19 Raman`s salary was decreased by 50% and subsequently increased by 50%.How much percent does he lose?
Sol:
Let the original salary = Rs.100
New final salary=150% of (50% of Rs.100)=
Rs.((150/100)*(50/100)*100)=Rs.75.
Decrease = 25%

Ex.20 Paulson spends 75% of his income. His income is increased by 20% and he increased his expenditure by 10%.Find the percentage increase in his savings .
Sol:
Let the original income=Rs.100 . Then , expenditure=Rs.75 and savings =Rs.25
New income =Rs.120 , New expenditure =
Rs.((110/100)*75)=Rs.165/2
New savings = Rs.(120-(165/2)) = Rs.75/2
Increase in savings = Rs.((75/2)-25)=Rs.25/2
Increase %= ((25/2)*(1/25)*100)% = 50%.

Ex21. The salary of a person was reduced by 10% .By what percent should his reduced salary be raised so as to bring it at par with his original salary ?
Sol:
Let the original salary be Rs.100 . New salary = Rs.90.
Increase on 90=10 , Increase on 100=((10/90)*100)%
= (100/9)%

Ex.22 When the price fo a product was decreased by 10% , the number sold increased by 30%. What was the effect on the total revenue ?

Sol:
Let the price of the product be Rs.100 and let original sale be 100 pieces.
Then , Total Revenue = Rs.(100*100)=Rs.10000.
New revenue = Rs.(90*130)=Rs.11700.
Increase in revenue = ((1700/10000)*100)%=17%.

Ex 23 . If the numerator of a fraction be increased by 15% and its denominator be diminished by 8% , the value of the fraction is 15/16. Find the original fraction.
Sol:
Let the original fraction be x/y.
Then (115%of x)/(92% of y)=15/16 => (115x/92y)=15/16
⇨ ((15/16)*(92/115))=3/4

Ex.24 In the new budget , the price of kerosene oil rose by 25%. By how much percent must a person reduce his consumption so that his expenditure on it does not increase ?
Sol:
Reduction in consumption = [((R/(100+R))*100]%
⇨ [(25/125)*100]%=20%.

Ex.25 The population of a town is 1,76,400 . If it increases at the rate of 5% per annum , what will be its population 2 years hence ? What was it 2 years ago ?
Sol:
Population after 2 years = 176400*[1+(5/100)]^2
=[176400*(21/20)*(21/40)]
= 194481.
Population 2 years ago = 176400/[1+(5/100)]^2
=[716400*(20/21)*(20/21)]= 160000.

Ex.26 The value of a machine depreiates at the rate of 10% per annum. If its present is Rs.1,62,000 what will be its worth after 2 years ? What was the value of the machine 2 years ago ?
Sol.
Value of the machine after 2 years
=Rs.[162000*(1-(10/100))^2] = Rs.[162000*(9/10)*(9/10)]
=Rs. 131220
Value of the machine 2 years ago
= Rs.[162000/(1-(10/100)^2)]=Rs.[162000*(10/9)*(10/9)]=Rs.200000

Ex27. During one year, the population of town increased by 5% . If the total population is 9975 at the end of the second year , then what was the population size in the beginning of the first year ?
Sol:
Population in the beginning of the first year
= 9975/[1+(5/100)]*[1-(5/100)] = [9975*(20/21)*(20/19)]=10000.

Ex.28 If A earns 99/3% more than B,how much percent does B earn less then A ?
Sol:
Required Percentage = [((100/3)*100)/[100+(100/3)]]%
=[(100/400)*100]%=25%

Ex. 29 If A`s salary is 20% less then B`s salary , by how much percent is B`s salary more than A`s ?
Sol:
Required percentage = [(20*100)/(100-20)]%=25%.

Ex30 .How many kg of pure salt must be added to 30kg of 2% solution of salt and water to increase it to 10% solution ?
Sol:
Amount of salt in 30kg solution = [(20/100)*30]kg=0.6kg
Let x kg of pure salt be added
Then , (0.6+x)/(30+x)=10/100⇔60+100x=300+10x
⇔90x=240 ⇔ x=8/3.

Ex 31. Due to reduction of 25/4% in the price of sugar , a man is able to buy 1kg more for Rs.120. Find the original and reduced rate of sugar.
Sol:
Let the original rate be Rs.x per kg.
Reduced rate = Rs.[(100-(25/4))*(1/100)*x}]=Rs.15x/16per kg
120/(15x/16)-(120/x)=1 ⇔ (128/x)-(120/x)=1
⇔ x=8.
So, the original rate = Rs.8 per kg
Reduce rate = Rs.[(15/16)*8]per kg = Rs.7.50 per kg

Ex.32 In an examination , 35% of total students failed in Hindi , 45% failed in English and 20% in both . Find the percentage of those who passed in both subjects .
Sol:
Let A and B be the sets of students who failed in Hindi and English respectively .
Then , n(A) = 35 , n(B)=45 , n(A∩B)=20.
So , n(A∪B)=n(A)+n(B)- n(A∩B)=35+45-20=60.
Percentage failed in Hindi and English or both=60%
Hence , percentage passed = (100-60)%=40%

Ex33. In an examination, 80% of the students passed in English , 85% in Mathematics and 75% in both English and Mathematics. If 40 students failed in both the subjects, find the total number of students.
Sol:
Let the total number of students be x .

Let A and B represent the sets of students who passed in English and Mathematics respectively.
Then, number of students passed in one or both the subjects
= $n(A \cup B)=n(A)+n(B)- n(A \cap B)$=80% of x + 85% of x –75% of x
=[(80/100)x+(85/100)x-(75/100)x]=(90/100)x=(9/10)x
Students who failed in both the subjects = [x-(9x/10)]=x/10.
So, x/10=40 of x=400 .
Hence, total number of students = 400.

11. PROFIT AND LOSS

IMPORTANT FACTS

COST PRICE: THE PRICE AT WHICH ARTICLE IS PURCHASED.ABBREVATED AS C.P.

SELLING PRICE: THE PRICE AT WHICH ARTICLE IS SOLD.

PROFIT OR GAIN:IF SP IS GREATER THAN CP,THE SELLING PRICE IS SAID TO HAVE PROFIT OR GAIN.

LOSS: IF SPIS LESS THAN CP,THE SELLER IS SAID TO INCURED A LOSS.

FORMULA

1.GAIN=(SP)-(CP). 2.LOSS=(CP)-(SP).
3.LOSS OR GAIN IS ALWAYS RECKONED ON CP
4. GAIN %={GAIN*100}/CP.
5.LOSS%={LOSS*100}/CP.
6.SP={(100+GAIN%) /100}*CP.
7.SP={(100-LOSS%)/100}*CP.
8.{100/(100+GAIN%)} *SP
9.CP=100/(100-LOSS%)}*SP

10.IF THE ARTICLE IS SOLD AT A GAIN OF SAY 35%, THEN SP =135% OF CP

11.IF A ARTICLE IS SOLD AT A LOSS OF SAY 35%. THEN SP=65% OF CP.

12.WHEN A PERSON SELLS TWO ITEMS,ONE AT A GAIN OF X% AND OTHER AT A LOSS OF X%.THEN THE SELLER ALWAYS INCURES A LOSS GIVEN:

{LOSS%=(COMON LOSS AND GAIN)^2}/10.=(X/10)^2

13.IF THE TRADER PROFESSES TO SELL HIS GOODS AT CP BUT USES FALSE WEIGHTS,THEN

GAIN=[ERROR/(TRUE VALUE)-(ERROR)*100]%

SOLVED PROBLEMS

ex.1 A man buys an article for rs.27.50 and sells it for rs.28.50. find his gain %.

sol. cp=rs27.50, sp=rs 28.50

gain=rs(28.50 –27.50)=rs1.10

so gain%={(1.10/27.50)*100}=4%

Ex.2. If the a radio is sold for rs 490 and sold for rs 465.50.find loss%.

sol. cp=rs490,sp= 465.50.

loss=rs(490-465.50)=rs 24.50.

loss%=[(24.50/490)*100]%=5%

Ex.3.find S.P when

(i)CP=56.25,gain=20%.

sol.

(i)SP =20% of rs 56.25 ,=rs{(120/100)*56.25}=rs67.50.

(ii)CP=rs 80.40,loss=5%

sol: sp=85% of rs 80.40

=rs {(85/100)*80.40}=rs 68.34.

ex.4 find cp when:

(i) sp =rs 40.60 : gain=16%

(ii) sp=rs51.70:loss=12%

(i) cp=rs{(100/116)*40.60}=rs 35.

(ii) cp=rs{(100/88)*51.87}=rs58.75.

ex.5 A person incures loss for by selling a watch for rs1140.at what price should the watch be sold to earn a 5% profit ?

sol. let the new sp be rsx.then

(100-loss%) : (1^{st} sp)=(100+gain%) (2^{nd} sp)

⇨ {(100-5)/1400}={(100+5)/x}=> x={(105*1140)/95} =1260.

⇨

ex.6 A book was sold for rs 27.50 with a profit of 10%. if it were sold for rs25.75, then what would be % of profit or loss?

sol. SP=rs 27.50: profit =10%.

sol. CP=rs {(100/110)*27.50}=rs 25.

When sp =Rs25.75 ,profit =Rs(25.75-25)=Rs 0.75

Profit%={(0.75/25)*100}%=25/6%=3%

Ex7 .If the cost price is 96% of sp then what is the profit %

Sol. sp=Rs100 : then cp=Rs 96:profit =Rs 4.

Profit={(4/96)*100}%=4.17%

Ex.8. The cp of 21 articles is equal to sp of 18 articles.find gain or loss %

CP of each article be Rs 1

CP of 18 articles =Rs18 ,sp of 18 articles =Rs 21.

Gain%=[(3/18)*100]%=50/3%

Ex.9 By selling 33 metres of cloth, one gains the selling price of 11 metres . Find the gain percent .

Sol:

(SP of 33m)-(CP of 33m)=Gain=SP of 11m

SP of 22m = CP of 33m

Let CP of each metre be Re.1 , Then, CP of 22m= Rs.22,SP of 22m=Rs.33.

Gain%=[(11/22)*100]%=50%

Ex10 A vendor bought bananas at 6 for Rs.10 and sold them at Rs.4 for Rs.6 .Find his gain or loss percent .

Sol:

Suppose , number of bananas bought = LCM of 6 and 4=12

CP=Rs.[(10/6)*12]=Rs.20 ; SP= Rs[(6/4)*12]=Rs.18

Loss%=[(2/20)*100]%=10%

Ex.11. A man brought toffees at for a rupee. How many for a rupee must he sell to gain 50%?

Sol. C.P of 3 toffees=Re 1; S.P of 3 toffees =150% of Re.1=3/2.

For Rs.3/2, toffees sold =3, for Re.1, toffees sold = [3*(2/3)] = 2.

Ex. 12.A grocer purchased 80 kg of sugar at Rs.13.50 per kg and mixed it with 120kg sugar at Rs.16per kg. At what rate should he sell the mixer to gain 16%?

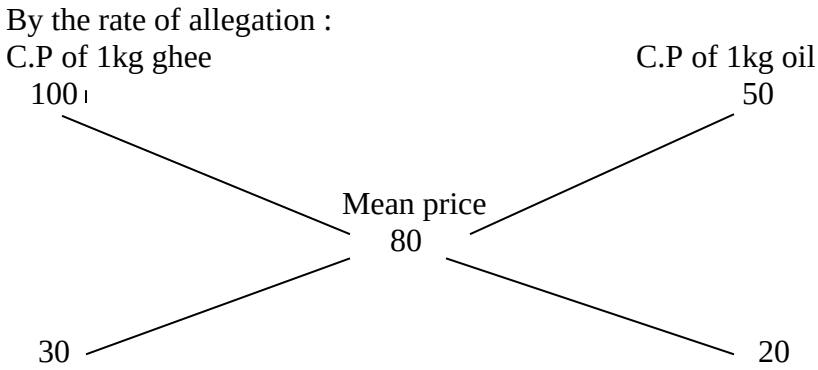
Sol .C.P of 200 kg of mixture = Rs. (80 * 13.50+120*16) = Rs.3000.

S.P =116% 0f Rs.3000 =Rs.[(116/200) *3000]=Rs.3480.

∴ Rate of S.P of the mixture =Rs.[3480/200] per kg =Rs.17.40 per kg.

Ex.13. Pure ghee cost Rs.100 per kg. After adulterating it with vegetable oil costing Rs.50 per kg, A shopkeeper sells the mixture at the rate of Rs.96 per kg, thereby making a profit of 20%.In What ratio does he mix the two?

Sol. Mean cost price =Rs. [(100/120)*96] =Rs.80 per kg.



∴ Required ratio =30:20 =3:2.

Ex. 14. A dishonest dealer professes to sell his goods at cost price but uses a weight of 960 gms for a kg weight . Find his gain percent.

Sol .Gain% =[Error *100]% = [(40/960)*100] % = 4 1/6 %
(error value)-(error)

Ex 15. If the manufacturer gains 10%,the wholesale dealer 15% and the retailer 25%, then find the cost of production if the retail price of which is Rs.1265?

Sol:

Let the cost of production of the table be Rs x

The ,125% of 115% of 110% of x=1265

⇨ 125/100*115/100*110/100*x=1265=>253/160*x=>1265=>x=(1265 *160/253)=Rs.800

Ex16 . Monika purchased a pressure cooker at 9/10th of its selling price and sold it at 8% more than its S.P .find her gain percent.

Sol:

Let the s.p be Rs. X .then C.P = Rs.9x/10,Receipt=108% of rs.x=Rs 27x/25

Gain=Rs (27x/25*9x/10)=Rs(108x-90x/100)=Rs18x/100

Gain%=(18x/100*10/9x*100)%=20%

Ex .17 An article is sold at certain price. By selling it at 2/3 of its price one losses 10%,find the gain at original price ?

sol:

let the original s.p be Rs x. then now S.P=Rs2x/3,loss=10%

now C.P=Rs20x/27*27/20x*100)%=35%

Ex .18. A tradesman sold an article at a loss of 20%.if the selling price has been increased by Rs100,ther would have been a gain of 5%.what was the cost price of the article?

Sol:

Let C.P be Rs x. then (105% of x)-(80 % of x)=100 or 25% of x=100

⇨ x/4=100 or x=400

⇨ so,C.P =Rs 400

Ex 19. A man sells an article at a profit of 25%if he had bought it 20% less and sold it for Rs 10.50 less, he would have gained 30%find the cost price of the article.

Sol:

Let the C.P be Rs x

1st S.P=125% of x =125x/100=5x/4;2nd S.P=80% of x=80x/100=4x/5

2nd S.P=130% of 4x/5=(130/100*4x/5)=26x/25

=>5x/4-26x/25=10.50⇔x=(10.50*100)/21=50

hence C.P=Rs.50

Ex 20.The price of the jewel, passing through three hands, rises on the whole by65%.if the first and the second sellers 20%and25% profit respectively find the percentage profit earned by the third seller.

Sol:

Let the orginal price of the jewel be Rs p and let the profit earned by the thrid seller be x%

Then,(100+x)% of 125% OF 120% OF P=165% OF P

⇨ ((100+X)/100*125/100*120/100*P)=(165/100*P)

⇨ (100+X)=(165*100*100)/(125*120)=110=>X=10%

Ex21 . A man 2 flats for Rs 675958 each.on one he gains 16% while on the other he losses 16%. How much does he gain/loss in the whole transaction?

Sol:

In this case there will be alwalys loss. The selling price is immaterial

Hence, loss % = (common loss and gain%)^2 /10=(16/10)%=(64/25)%=2.56%

Ex.22. A dealer sold three-fourth of his article at a gain of 20% and remaining at a cost price. Find the gain earned by him at the two transcation.

Sol:

Let the C.P of the whole be Rs x

C.P of 3/4th =Rs 3x/4,C.P of 1/4th =Rs x/4

⇨ total S.P=Rs [(120%of 3x/4)+x/4]=Rs(9x/10+x/4)=Rs 23x/20

⇨ gain=Rs(23x/20-x)=Rs 3x/20

⇨ gain%=3x/20*1/x*100)%=15%

Ex 23 .A man bought a horse and a car riage for Rs 3000.he sold the horse at a gain of 20% and the carriage at a loss of 10%,thereby gaining 2% on the whole.find the cost of the horse.

Sol:

Let the C.p of the horse be Rs.x, then C.P of the carriage =Rs(3000-x)

20% of x-10% of(3000-x)=2% of 3000

⇨ x/5-(3000-x)/10=60=.2x-3000+x=600=.3x+3600=>x=1200

⇨ hence,C.P of the horse =Rs 1200

Ex 24 find the single discount equivalent to a series discount of 20% ,10% and 5%'

sol:

let the marked price be Rs 100

then, net S.P=95% of 90% of 80% of Rs 100

=Rs(95/100*90/100*80/100*100)=Rs68.40

Ex .25 After getting 2 successive discounts, a shirt with a list price of Rs 150 is available at Rs 105. If the second discount is 12.55,find the first discount.

Sol:

Let the first discount be x%

Then,87.5% of (100-x)% of 150= 105

⇨ 87.5/100*(100-x)/100*450=150=>105=>100-x=(105*100*100)/(150*87.5)=80

⇨ x=(100-80)=20

⇨ first discount = 20%

Ex .26 An uneducated retailar marks all its goods at 50% above the cost price and thinking that he will still make 25% profit, offers a discount of 25% on the marked price. what is the actual profit on the sales?

Sol:

Let C.P =Rs 100. then , marked price =Rs100

S.P=75% of Rs 150=Rs112.50

Hence gain%=12.50%

Ex27 .A retailer buys 40 pens at the market price of 36 pens from a wholesaler ,if he sells these pens giving a discount of 1% ,what is the profit % ?

sol:

let the market price of each pen be Rs 1

then,C.P of 40 pens = Rs 36 S.P of 40 pens =99% of Rs 40=Rs 39.60

profit %=((3.60*100)/36) %=10%

Ex 28 . At what % above C.P must an article be marked so as to gain 33% after allowing a customer a discount of 5%?

Sol

Let C.P be Rs 100.then S.P be Rs 133

Let the market price be Rs x

Then 90% of x=133=>95x/100=133=>x=(133*100/95)=140

Market price = 40% above C.P

Ex .29 . When a producer allows 36% commission on retail price of his product, he earns a profit of 8.8%. what would be his profit % if the commision is reduced by 24%?

Sol:

Let the retail price =Rs 100.then, commission=Rs 36

S.P=Rs(100-36)=Rs 64

But, profit=8.8%

C.P=Rs(100/108.8*64)=Rs 1000/17

New commission =Rs12. New S.P=Rs(100-12)Rs 88

Gain=Rs(88-1000/17)=Rs 496/17

Gain%=(496/17*17/1000*100)%=49.6%

12. RATIO AND PROPORTION

IMPORTANT FACTS AND FORMULAE

I. RATIO: The ratio of two quantities a and b in the same units, is the fraction a/b and we write it as a:b.
In the ratio a:b, we call a as the **first term or antecedent** and b, the **second term or consequent.**

Ex. The ratio 5: 9 represents 5/9 with antecedent = 5, consequent = 9.
Rule: The multiplication or division of each term of a ratio by the same non-zero number does not affect the ratio.
Ex. 4: 5 = 8: 10 = 12: 15 etc. Also, 4: 6 = 2: 3.

2. **PROPORTION:** ***The equality of two ratios is called proportion.***
If *a:* b = c: d, we write, *a:* b:: c : d and we say that *a*, b, c, d are in proportion . Here *a* and d are called extremes, while b and c are called mean terms.
Product of means = Product of extremes.
Thus, a: b:: c : d <=> (b x c) = (a x d).

3. (i) Fourth Proportional: If *a* : b = c: d, then d is called the fourth proportional to *a*, b, c.
(ii) Third Proportional: If *a*: b = b: c, then c is called the third proportional to a and b.
(iii) Mean Proportional: Mean proportional between *a* and *b* is *square root of ab*

4. (i) COMPARISON OF RATIOS:
We say that *(a*: *b)* > (c: *d)* <=> (a/b)>(c /d).
(ii) COMPOUNDED RATIO:
The compounded ratio of the ratios (a: *b),* (c: *d),* (e : f) is *(ace*: bdf)

5. (i) *Duplicate ratio* of *(a* : b) is $(a^2 : b^2)$.
(ii) Sub-duplicate ratio of (a : *b)* is $(\sqrt{a} : \sqrt{b})$.
(iii)Triplicate ratio of (a : *b)* is $(a^3 : b^3)$.
(iv) Sub-triplicate ratio of (a : *b)* is $(a^{1/3} : b^{1/3})$.
(v) If (a/b)=(c/d), then ((a+b)/(a-b))=((c+d)/(c-d)) **(Componendo and dividendo)**

6. VARIATION:

(i) We say that x is directly proportional to y, if $x = ky$ for some constant k and we write, $x \propto y$.

(ii) We say that x is inversely proportional to y, if $xy = k$ for some constant k and we write, $x \propto (1/y)$

SOLVED PROBLEMS

Ex. 1. ***If*** **a : *b* = 5 : 9** ***and*** **b : c = 4: 7,** ***find*** **a : b : c.**

Sol. a:b=5:9 and b:c=4:7= (4X9/4): (7x9/4) = 9:63/4
a:b:c = 5:9:63/4 =20:36:63.

Ex. 2. ***Find:***
(i) ***the fourth proportional*** **to 4, 9, 12;**
(ii) ***the third proportional*** **to 16** ***and*** **36;**
iii) the **mean** ***proportional between 0.08 and 0.18.***

Sol.

i) Let the fourth proportional to 4, 9, 12 be x.

Then, 4 : 9 : : 12 : x ⇔4 x x=9x12 ⇔ X=(9 x 12)/14=27;
Fourth proportional to 4, 9, 12 is 27.

(ii) Let the third proportional to 16 and 36 be x.

Then, 16 : 36 : : 36 : x ⇔16 x *x* = 36 x 36 ⇔ x=(36 x 36)/16 =81
Third proportional to 16 and 36 is 81.

(iii) Mean proportional between 0.08 and 0.18
√0.08 x 0.18 =√8/100 x 18/100= √144/(100 x 100)=12/100=0.12

Ex. 3. ***If*** **x : *y* = 3 : 4,** ***find*** **(4x + *5y)* : (5x - *2y).***

Sol. X/Y=3/4 ⇔ (4x+5y)/(5x+2y)= (4(x/y)+5)/(5 (x/y)-2) =(4(3/4)+5)/(5(3/4)-2)

=(3+5)/(7/4)=32/7

Ex. 4. ***Divide Rs.*** **672** ***in the ratio*** **5 : 3**.

Sol. Sum of ratio terms = (5 + 3) = 8.

First part = Rs. (672 x (5/8)) = Rs. 420; Second part = Rs. (672 x (3/8)) = Rs. 252.

Ex. 5. ***Divide Rs.*** **1162 among** ***A, B,*** **C** ***in the ratio*** **35 : 28 :** ***20.***

Sol. Sum of ratio terms = (35 + 28 + 20) = 83.

A's share = Rs. (1162 x (35/83))= Rs. 490; B's share = Rs. (1162 x(28/83))= Rs. 392;

C's share = Rs. (1162 x (20/83))= Rs. 280.

Ex. 6. ***A bag contains*** **50** ***p,*** **25** ***P and*** **10** ***p coins in the ratio*** **5: 9: 4,** ***amounting*** **to** ***Rs. 206. Find the*** **number of** ***coins*** **of** ***each type.***

Sol. Let the number of 50 p, 25 P and 10 p coins be 5x, 9x and 4x respectively.
(5x/2)+(9x/ 4)+(4x/10)=206 ⇔ 50x + *45x* + 8x = 4120⇔1O3x = 4120 ⇔x=40.

Number of 50 p coins = (5 x 40) = 200; Number of 25 p coins = (9 x 40) = 360;
Number of 10 p coins = (4 x 40) = 160.

Ex. 7. ***A*** **mixture** ***contains alcohol*** **and** ***water*** **in** ***the ratio*** **4 : 3.** ***If*** **5 litres of water** ***is*** **added** ***to the mixture, the ratio becomes*** **4: 5.** ***Find the quantity of alcohol*** **in the given mixture**

Sol. Let the quantity of alcohol and water be 4x litres and 3x litres respectively

4x/(3x+5)=4/5 ⇔20x=4(3x+5)⇔8x=20 ⇔x=2.5
Quantity of alcohol = (4 x 2.5) litres = 10 litres.

13. PARTNERSHIP

!IMPORTANT FACTS AND FORMULAE ı

1. Partnership: When two or more than two persons run a business jointly, they are called partners and the deal is known as *partnership.*

2. Ratio of Division of Gains:

i) When investments of all the partners are for the same *time,* the gain or loss is distributed a among the partners in the ratio of their investments.

Suppose A and B invest Rs. x and Rs. y respectively for a year in a business, then at the end of the year:

(A's share of profit) : (B's share of profit) = x : y.

ii) ***When investments are for different time periods,*** then equivalent capitals are calculated for a unit of time by taking (capital x number of units of time). Now, gain or loss is divided in the ratio of these capitals.

Suppose A invests Rs. x for p months and B invests Rs. y for q months, then
(A's share of profit) : (B's share of profit) = xp : *yq.*

3. Working and Sleeping Partners: A partner who manages the business is known . as a

working partner and the one who simply invests the money is a *sleeping partner.*

SOLVED EXAMPLES

Ex. 1. A, B and C started a business by investing Rs. 1,20,000, Rs. 1,35,000 and ,Rs.1,50,000 respectively. Find the share of each, out of an annual profit of Rs. 56,700.

Sol. Ratio of shares of A, Band C = Ratio of their investments
= 120000 : 135000 : 150000 = 8 : 9 : 10.

A's share = Rs. (56700 x (8/27))= Rs. 16800.

B's share = Rs. (56700 x (9/27)) = Rs. 18900.

C's share = Rs. (56700 x (10/27))=Rs. 21000.

Ex. 2. Alfred started a business investing Rs. 45,000. After 3 months, Peter joined him with a capital of Rs. 60,000. After another 6 months, Ronald joined them with a capital of Rs. 90,000. At the end of the year, they made a profit of Rs. 16,500. Find the lire of each.

Sol. Clearly, Alfred invested his capital for 12 months, Peter for 9 months and Ronald for 3 months.

So, ratio of their capitals = (45000 x 12) : (60000 x 9) : (90000 x 3)
= 540000 : 540000 : 270000 = 2 : 2 : 1.

Alfred's share = Rs. (16500 x (2/5)) = Rs. 6600

Peter's share = Rs. (16500 x (2/5)) = Rs. 6600

Ronald's share = Rs. (16500 x (1/5)) = Rs. 3300.

Ex. 3. A, Band C start a business each investing Rs. 20,000. After 5 months A withdrew Rs.6000 B withdrew Rs. 4000 and C invests Rs. 6000 more. At the end of the year, a total profit of Rs. 69,900 was recorded. Find the share of each.

Sol. Ratio of the capitals of A, Band C
= 20000 x 5 + 15000 x 7 : 20000 x 5 + 16000 x 7 : 20000 x 5 + 26000 x 7
= 205000:212000 : 282000 = 205 : 212 : 282.

A's share = Rs. 69900 x (205/699) = Rs. 20500 I

B's share = Rs. 69900 x (212/699) = Rs. 21200;

C's share = Rs. 69900 x (282/699) = Rs. 28200.

Ex. 4. A, Band C enter into partnership. A invests 3 times as much as B and B invests two-third of what C invests. At the end of the year, the profit earned is Rs. 6600. What is the share of B ?

Sol. Let C's capital = Rs. x. Then, B's capital = Rs. (2/3)x

A's capital = Rs. (3 x (2/3).*x)* = Rs. *2x.*

Ratio of their capitals = *2x* : (2/3)x :x = 6 : 2 : 3.

Hence, B's share = Rs. (6600 x (2/11))= Rs. 1200.

Ex. 5. Four milkmen rented a pasture. A grazed 24 cows for 3 months; B 10 for 5 months; C 35 cows for 4 months and D 21 cows for 3 months. If A's share of rent is Rs. 720, find the total rent of the field.

Sol. Ratio of shares of A, B, C, D = (24 x 3) : (10 x 5) : (35 x 4) : (21 x 3) = 72 : 50 : 140 : 63.

Let total rent be Rs. x. Then, *A's* share = Rs. (72x)/325
(72x)/325=720 ⇔ x=(720 x 325)/72 = 3250

Hence, total rent of the field is Rs. 3250.

Ex.6. A invested Rs. 76,000 in a business. After few months, B joined him Rs. 57,000. At the end of the year, the total profit was divided between them in ratio 2 : 1. After bow many months did B join?

Sol. Suppose B joined after x months. Then, B's money was invested for (12 - x)
(76000 x 12)/(57000 x (12-x) =2/1 ⇔ 912000=114000(12-x)

114 (12 - x) = 912⇔12-x=8⇔x=4

Hence, B joined after 4 months.

Ex.7. A, Band C enter into a partnership by investing in the ratio of 3 : 2: 4. After 1 year, B invests another Rs. 2,70,000 and C, at the end of 2 years, also invests Rs.2,70,000. At the end of three years, profits are shared in the ratio of 3 : 4 : 5. Find initial investment of each.

Sol. Let the initial investments of A, Band C be Rs. *3x*, Rs. 2x and Rs. 4x respectively.
Then,
(3x x 36) : *[(2x* x 12) + *(2x* + 270000) x 24] : *[(4x* x 24) + *(4x* +270000) x 12]=3:4:5

1O8x : *(72x* + 6480000) : *(144x* + 3240000) = 3 : 4 : 5
108x /(72x+6480000)=3/4 ⇔ *432x = 216x* + 19440000
⇔*216x* = 19440000
x=90000

Hence, A's initial investment = 3x = Rs. 2,70,000;
B's initial investment = 2x = Rs. 1,80,000;
C's initial investment = 4x = Rs. 3,60,000.

14. CHAIN RULE

IMPORTANT FACTS AND FORMULAE

1. Direct Proportion: Two quantities are said to be directly proportional, if on the increase (or decrease) of the one, the other increases (or decreases) to the same
Ex. 1. Cost is directly proportional to the number of articles.
(More Articles, More Cost)

Ex. 2. Work done is directly proportional to the number of men working on it
(More Men, More Work)
2. Indirect Proportion: Two quantities are said to be indirectly proportional,if on the increase of the one, the other decreases to the same extent and vice-versa.
Ex. 1. The time taken by a car in covering a certain distance is inversely proportional to the speed of the car.
(More speed, Less is the time taken to cover a distance)

Ex. 2. Time taken to finish a work is inversely proportional to the num of persons working at it.
(More persons, Less is the time taken to finish a job)

Remark: In solving questions by chain rule, we compare every item with the term to be found out.

SOL VED EXAMPLES

Ex. 1. If 15 toys cost Rs, 234, what do 35 toys cost?

Sol. Let the required cost be Rs. x. Then,

More toys, More cost (Direct Proportion)

. 15 : 35 : : 234 : x ⇔ (15 x x) = (35 x 234) ⇔ x=(35 X 234)/15 =546

Hence, the cost of 35 toys is Rs. 546.

Ex. 2. If 36 men can do a piece of work in 25 hours, in how many hours will 15 men do it ?

Sol. Let the required number of hours be x. Then,

Less men, More hours (Indirect Proportion)

15 : 36 : : 25 : x ⇔(15 x x) = (36 x 25) ⇔(36 x 25)/15 = 60

Hence, 15 men can do it in 60 hours.

Ex. 3. If the wages of 6 men for 15 days be Rs.2100, then find the wages of for 12 days.

Sol. Let the required wages be Rs. x.

More men, More wages (Direct Proportion)

Less days, Less wages (Direct Proportion)

Men 6: 9 : :2100:x

Days 15:12

Therefore (6 x 15 x x)=(9 x 12 x 2100) ⇔ x=(9 x 12 x 2100)/(6 x 15)=2520

Hence the required wages are Rs. 2520.

Ex. 4. If 20 men can build a wall 66 metres long in 6 days, what length of a similar can be built by 86 men in 8 days?

Sol. Let the required length be x metres

More men, More length built (Direct Proportion)

Less days, Less length built (Direct Proportion)

Men 20: 35

Days 6: 3 : : 56 : x

Therefore (20 x 6 x x)=(35 x 3 x 56)⇔x=(35 x 3 x 56)/120=49

Hence, the required length is 49 m.

Ex. 5. If 15 men, working 9 hours a day, can reap a field in 16 days, in how many days will 18 men reap the field, working 8 hours a day?

Sol. Let the required number of days be x.
More men, Less days (indirect proportion)
Less hours per day, More days (indirect proportion)

Men 18 : 15
Hours per day 8: 9 } : :16 : x
(18 x 8 x x)=(15 x 9 x 16)⇔ x=(44 x 15)144 = 15

Hence, required number of days = 15.

Ex. 6. If 9 engines consume 24 metric tonnes of coal, when each is working 8 hours day, bow much coal will be required for 8 engines, each running 13hours a day, it being given that 3 engines of former type consume as much as 4 engines of latter type?

Sol. Let 3 engines of former type consume 1 unit in 1 hour.
Then, 4 engines of latter type consume 1 unit in 1 hour.

Therefore 1 engine of former type consumes(1/3) unit in 1 hour.

1 engine of latter type consumes(1/4) unit in 1 hour.

Let the required consumption of coal be x units.
Less engines, Less coal consumed (direct proportion)
More working hours, More coal consumed (direct proportion)
Less rate of consumption, Less coal consumed(direct prportion)

Number of engines 9: 8
Working hours 8 : 13 } :: 24 : x
Rate of consumption (1/3):(1/4)

[9 x 8 x (1/3) x x) = (8 x 13 x (1/4) x 24) ⇔ 24x = 624 ⇔ x = 26.

Hence, the required consumption of coal = 26 metric tonnes.

Ex. 7. A contract is to be completsd in 46 days sad 117 men were said to work 8 hours a day. After 33 days, (4/7) of the work is completed. How many additional men may be employed so that the work may be completed in time, each man now working 9 hours a day?

Sol. Remaining work = (1-(4/7) =(3/7)

Remaining period = (46 - 33) days = 13days

Let the total men working at it be x.

Less work, Less men	(Direct Proportion)
Less days, More men	(Indirect Proportion)
More Hours per Day, Less men	(Indirect Proportion)

Work (4/7): (3/7)
Days 13:33 } : : 117: x
Hrs/day 9 : 8
Therefore (4/7) x 13 x 9 x x =(3/7) x 33 x 8 x 117 or x=(3 x 33 x 8 x 117)/(4 x 13 x 9)=198

Additional men to be employed = (198 - 117) = 81.

Ex. 8. A garrison of 3300 men had provisions for 32 days, when given at the rate of 860 gns per head. At the end of 7 days, a reinforcement arrives and it was for that the provisions wi1l last 17 days more, when given at the rate of 826 gms per head, What is the strength of the reinforcement?

Sol. The problem becomes:
3300 men taking 850 gms per head have provisions for (32 - 7) or 25 days,
How many men taking 825 gms each have provisions for 17 days?

Less ration per head, more men	(Indirect Proportion)
Less days, More men	(Indirect Proportion)

Ration 825 : 850
Days 17: 25 } : : 3300 : x
(825 x 17 x x) = 850 x 25 x 3300 or x = (850 x 25 x 3300)/(825 x 17)=5000

Strength of reinforcement = (5500 - 3300) = 1700.

15. TIME AND WORK

IIMPORTANT FACTS AND FORMULAE

1. If A can do a piece of work in n days, then A's 1 day's work = (1/n).

2. If A's 1 day's work = (1/n),then A can finish the work in n days.

3. A is thrice as good a workman as B, then:
   Ratio of work done by A and B = 3 : 1.
   Ratio of times taken by A and B to finish a work = 1 : 3.

SOLVED EXAMPLES

Ex. 1. Worker A takes 8 hours to do a job. Worker B takes 10 hours to do the same Job.How long should it take both A and B, working together but independently, to do the same job? (IGNOU, 2003)

Sol. A's 1 hour's work = 1/8

B's 1 hour's work = 1/10

(A + B)'s 1 hour's work = (1/8) +(1/10)=9/40

Both A and B will finish the work in 40/9 days.

Ex. 2. A and B together can complete a piece of work in 4 days. If A alone can complete the same work in 12 days, in how many days can B alone complete that work? (Bank P.O. 2003)

Sol. (A + B)'s 1 day's work = (1/4). A's 1 day's work = (1/12).

B's 1 day's work =((1/4)-(1/12))=(1/6)

Hence, B alone can complete the work in 6 days.

Ex. 3. A can do a piece of work in 7 days of 9 hours each and B can do it in 6 days of 7 bours each. How long will they take to do it, working together 8 hours a day?

Sol. A can complete the work in (7 x 9) = 63 hours.

B can complete the work in (6 x 7) = 42 hours.

A’s 1 hour's work = (1/63) and B's 1 hour's work =(1/42)

(A + B)'s 1 hour's work =(1/63)+(1/42)=(5/126)

Both will finish the work in (126/5) hrs.
Number of days. of (42/5) hrs each =(126 x 5)/(5 x 42)=3 days

Ex. 4. A and B can do a piece of work in 18 days; Band C can do it in 24 days A and C can do it in 36 days. In how many days will A, Band C finish it together and separately?

Sol. (A + B)'s 1 day's work = (1/18) (B + C)'s 1 day's work = (1/24)
and (A + C)'s 1 day's work = (1/36)

Adding, we get: 2 (A + B + C)'s 1 day's work =(1/18 + 1/24 + 1/36)
=9/72 =1/8

(A +B + C)'s 1 day's work =1/16

Thus, A, Band C together can finish the work in 16 days.
Now, A’s 1 day's work = [(A + B + C)'s 1 day's work] - [(B + C)'s 1 day work:
=(1/16 – 1/24)= 1/48

A alone can finish the work in 48 days.

Similarly, B's 1 day's work =(1/16 – 1/36)=5/144

B alone can finish the work in 144/5=28 4/5 days

And C’s 1 day work =(1/16-1/18)=1/144

Hence C alone can finish the work in 144 days.

Ex. 6. A is twice as good a workman as B and together they finish a piece in 18 days. In how many days will A alone finish the work?

Sol. (A’s 1 day’s work):)(B’s 1 days work) = 2 : 1.

(A + B)'s 1 day's work = 1/18

Divide 1/18 in the ratio 2 : 1.

:. A’s 1 day's work =(1/18*2/3)=1/27

Hence, A alone can finish the work in 27 days.

Ex. 6. A can do a certain job in 12 days. B is 60% more efficient than A. How many days does B alone take to do the same job?

Sol. Ratio of times taken by A and B = 160 : 100 = 8 : 5.

Suppose B alone takes x days to do the job.

Then, 8 : 5 :: 12 : x = 8x = 5 x 12 =x = 7 1/2 days.

Ex. 7. A can do a piece of work in 80 days. He works at it for 10 days B alone finishes the remaining work in 42 days. In how much time will A and B working together, finish the work?

Sol. Work done by A in 10 days =(1/80*10)=1/8

Remaining work = (1- 1/8) =7/ 8

Now,7/ 8 work is done by B in 42 days.

Whole work will be done by B in (42 x 8/7) = 48 days.

A’s 1 day's work = 1/80 and B's 1 day's work = 1/48

(A+B)'s 1 day's work = (1/80+1/48)=8/240=1/30

Hence, both will finish the work in 30 days.

Ex. 8. A and B undertake to do a piece of work for Rs. 600. A alone can do it in 6 days while B alone can do it in 8 days. With the help of C, they finish it in 3 days. !find the share of each.

Sol :C's 1 day's work = 1/3-(1/6+1/8)=24

A : B : C = Ratio of their 1 day's work = 1/6:1/8:1/24= 4 : 3 : 1.

A’s share = Rs. (600 *4/8) = Rs.300, B's share = Rs. (600 *3/8) = Rs. 225.

C's share = Rs. [600 - (300 + 225») = Rs. 75.

Ex. 9. A and B working separately can do a piece of work in 9 and 12 days respectively, If they work for a day alternately, A beginning, in how many days, the work will be completed?

(A + B)'s 2 days' work =(1/9+1/12)=7/36

Work done in 5 pairs of days =(5*7/36)=35/36

Remaining work =(1-35/36)=1/36

On 11th day, it is A's turn. 1/9 work is done by him in 1 day.

1/36 work is done by him in(9*1/36)=1/4 day

Total time taken = (10 + 1/4) days = 10 1/4days.

Ex 10 .45 men can complete a work in 16 days. Six days after they started working, 30 more men joined them. How many days will they now take to complete the remaining work?

(45 x 16) men can complete the work in 1 day.

1 man's 1 day's work = 1/720

45 men's 6 days' work =(1/16*6)=3/8

Remaining work =(1-3/8)=5/8

75 men's 1 day's work = 75/720=5/48

Now,5/48 work is done by them in 1 day.

5/8work is done by them in (48/5 x 5/8)=6 days.

Ex:11. 2 men and 3 boys can do a piece of work in 10 days while 3 men and 2 boys can do the same work in 8 days.In how many days can 2 men and 1 boy do the work?

Soln: Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y.

Then, $2x+3y = \frac{1}{10}$ and $3x+2y = \frac{1}{8}$

Solving,we get: $x = \frac{7}{200}$ and $y = \frac{1}{100}$

(2 men + 1 boy)'s 1 day's work $= (2 \times \frac{7}{200} + 1 \times \frac{1}{100}) = \frac{16}{200} = \frac{2}{25}$

So, 2 men and 1 boy together can finish the work in $\frac{25}{2} = 12\frac{1}{2}$ days

16. PIPES AND CISTERNS

IMPORTANT FACTS AND FORMULAE

1. **Inlet:** A pipe connected with a tank or a cistern or a reservoir, that fills it, is known as an inlet.
Outlet: A pipe connected with a tank or a cistern or a reservoir, emptying it, is known as an outlet.

2. (i) If a pipe can fill a tank in x hours, then : part filled in 1 hour = 1/x

(ii) If a pipe can empty a full tank in *y* hours, then : part emptied in 1 hour = 1/y

(iii) If a pipe can .fill a tank in x hours and another pipe can empty the full tank in y hours (where *y> x),* then on opening both the pipes, the net part filled in 1 hour = (1/x)-(1/y)

(iv) If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where x > *y),* then on opening both the pipes, the net part emptied in 1 hour = (1/y)-(1/x)

SOLVED EXAMPLES

Ex. 1:Two pipes A and B can fill a tank in 36 bours and 46 bours respectively. If both the pipes are opened simultaneously, bow mucb time will be taken to fill the tank?

Sol: Part filled by A in 1 hour = (1/36);

Part filled by B in 1 hour = (1/45);

Part filled by (A + B) In 1 hour =(1/36)+(1/45)=(9/180)=(1/20)

Hence, both the pipes together will fill the tank in 20 hours.

Ex. 2: Two pipes can fill a tank in 10hours and 12 hours respectively while a third, pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time will the tank be filled?

Sol: Net part filled In 1 hour =(1/10)+(1/12)-(1/20)=(8/60)=(2/15).
The tank will be full in 15/2 hrs = 7 hrs 30 min.

Ex. 3: If two pipes function simultaneously, tbe reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than tbe otber. How many hours does it take the second pipe to fill the reservoir?

Sol:let the reservoir be filled by first pipe in x hours.

Then ,second pipe fill it in (x+10)hrs.

Therefore (1/x)+(1/x+10)=(1/12) ⇔(x+10+x)/(x(x+10))=(1/12).

⇔ x^2 –14x-120=0 ⇔ (x-20)(x+6)=0

⇔x=20 [neglecting the negative value of x]

so, the second pipe will take (20+10)hrs. (i.e) 30 hours to fill the reservoir

Ex. 4: A cistern has two taps which fill it in 12 minutes and 15minutes respectively. There is also a waste pipe in the cistern. When all the 3 are opened , the empty cistern is full in 20 minutes. How long will the waste pipe take to empty the full cistern?

Sol: Workdone by the waste pipe in 1min

=(1/20)-(1/12)+(1/15) = -1/10 [negative sign means emptying]

therefore the waste pipe will empty the full cistern in 10min

Ex. 5: An electric pump can fill a tank in 3 hours. Because of a leak in ,the tank it took 3(1/2) hours to fill the tank. If the tank is full, how much time will the leak take to empty it ?

Sol: work done by the leak in 1 hour=(1/3)-(1/(7/2))=(1/3)-(2/7)=(1/21).

The leak will empty .the tank in 21 hours.

Ex. 6. Two pipes can fill a cistern in 14 hours and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom it tooki 32 minutes more to fill the cistern.When the cistern is full, in what time will the leak empty it?

Sol: Work done by the two pipes in 1 hour =(1/14)+(1/16)=(15/112).

Time taken by these pipes to fill the tank = (112/15) hrs = 7 hrs 28 min.

Due to leakage, time taken = 7 hrs 28 min + 32 min = 8 hrs

Work done by (two pipes + leak) in 1 hour = (1/8).

Work done by the leak m 1 hour =(15/112)-(1/8)=(1/112).

Leak will empty the full cistern in 112 hours.

Ex. 7: Two pipes A and B can fill a tank in 36 min. and 45 min. respectively. A water pipe C can empty the tank in 30 min. First A and B are opened. after 7 min,C is also opened. In how much time, the tank is full?

Sol: Part filled in 7 min. = 7*((1/36)+(1/45))=(7/20).

Remaining part=(1-(7/20))=(13/20).

Net part filled in 1min. when A,B and C are opened=(1/36)+(1/45)-(1/30)=(1/60).

Now,(1/60) part is filled in one minute.

(13/20) part is filled in (60*(13/20))=39 minutes.

Ex.8: Two pipes A,B can fill a tank in 24 min. and 32 min. respectively. If both the pipes are opened simultaneously, after how much time B should be closed so that the tank is full in 18 min.?

Sol: let B be closed after x min. then ,

Part filled by (A+B) in x min. +part filled by A in (18-x)min.=1

Therefore x*((1/24)+(1/32))+(18-x)*(1/24)=1 ⇔ (7x/96) + ((18-x)/24)=1.

⇔ 7x +4*(18-x)=96.

Hence, be must be closed after 8 min.

17. TIME AND DISTANCE

IMPORTANT FACTS AND FORMULAE

1. Speed = $\left(\frac{\text{Distance}}{\text{Time}}\right)$, Time= $\left(\frac{\text{Distance}}{\text{Speed}}\right)$, Distance = (Speed * Time)

2. x km / hr = x * $\frac{5}{18}$

3. x m/sec = (x * 18/5) km /hr

4. If the ratio of the speeds of A and B is a:b , then the ratio of the times taken by them to cover the same distance is $\frac{1}{a} : \frac{1}{b}$

or b:a.

5. Suppose a man covers a certain distance at x km/ hr and an equal distance at y km / hr . Then , the average speed during the whole journey is $\frac{2xy}{x+y}$ km/ hr.

SOLVED EXAMPLES

Ex. 1. How many minutes does Aditya take to cover a distance of 400 m, if he runs at a speed of 20 km/hr?

Sol. Aditya's speed = 20 km/hr $= \{20 * \frac{5}{18}\}$ m/sec $= \frac{50}{9}$ m/sec

$\therefore$ Time taken to cover 400 m $= \{ 400 * \frac{9}{50} \}$ sec $= 72$ sec $= 1\frac{12}{60}$ min $1\frac{1}{5}$ min.

Ex. 2. A cyclist covers a distnce of 750 m in 2 min 30 sec. What is the speed in km/hr of the cyclist?

Sol. Speed $= \{ \frac{750}{150} \}$ m/sec $= 5$ m/sec $= \{ 5 * \frac{18}{5} \}$ km/hr $= 18$km/hr

Ex. 3. A dog takes 4 leaps for every 5 leaps of a hare but 3 leaps of a dog are equal to 4 leaps of the hare. Compare their speeds.

Sol. Let the distance covered in 1 leap of the dog be x and that covered in 1 leap of the hare by y.

Then , $3x = 4y \Rightarrow x = \frac{4}{3}y \Rightarrow 4x = \frac{16}{3}y$.

$\therefore$ Ratio of speeds of dog and hare = Ratio of distances covered by them in the same time

$= 4x : 5y = \frac{16}{3}y : 5y = \frac{16}{3} : 5 = 16:15$

Ex. 4.While covering a distance of 24 km, a man noticed that after walking for 1 hour and 40 minutes, the distance covered by him was $\frac{5}{7}$ of the remaining distance. What was his speed in metres per second?

Sol. Let the speed be x km/hr.

Then, distance covered in 1 hr. 40 min. i.e., $1\frac{2}{3}$ hrs $= \frac{5x}{3}$ km

Remaining distance $= \{ 24 - \frac{5x}{3} \}$ km.

$\therefore \frac{5x}{3} = \frac{5}{7}\{ 24 - \frac{5x}{3} \} \Leftrightarrow \frac{5x}{3} = \frac{5}{7}\{ \frac{72-5x}{3} \} \Leftrightarrow 7x = 72 - 5x$

$\Leftrightarrow 12x = 72 \Leftrightarrow x=6$

Hence speed = 6 km/hr $=\{ 6 * \frac{5}{18} \}$ m/sec $= \frac{5}{3}$ m/sec $= 1\frac{2}{3}$

Ex. 5.Peter can cover a certain distance in 1 hr. 24 min. by covering two-third of the distance at 4 kmph and the rest at 5 kmph. Find the total distance.

Sol. Let the total distance be x km . Then,

$$\frac{\frac{2}{3}x}{4} + \frac{\frac{1}{3}x}{5} = \frac{7}{5} \Leftrightarrow \frac{x}{6} + \frac{x}{15} = \frac{7}{5} \Leftrightarrow 7x = 42 \Leftrightarrow x = 6$$

Ex. 6.A man traveled from the village to the post-office at the rate of 25 kmph and walked back at the rate of 4 kmph. If the whole journey took 5 hours 48 minutes, find the distance of the post-office from the village.

Sol. Average speed $= \{ \frac{2xy}{x+y} \}$ km/hr $=\{ \frac{2*25*4}{25+4} \}$ km/hr $= \frac{200}{29}$ km/hr

Distance traveled in 5 hours 48 minutes i.e., $5\frac{4}{5}$ hrs. $= \{ \frac{200}{29} * \frac{29}{5} \}$ km $= 40$ km

Distance of the post-office from the village $=\{ \frac{40}{2} \} = 20$ km

Ex. 7.An aeroplane files along the four sides of a square at the speeds of 200,400,600 and 800km/hr.Find the average speed of the plane around the field.

Sol. :

Let each side of the square be x km and let the average speed of the plane around the field by y km per hour then ,

$x/200+x/400+x/600+x/800=4x/y \Leftrightarrow 25x/2500 \Leftrightarrow 4x/y \Leftrightarrow y=(2400*4/25)=384$

hence average speed =384 km/hr

Ex. 8.Walking at $\frac{5}{7}$ of its usual speed, a train is 10 minutes too late. Find its usual time to cover the journey.

Sol. : New speed =5/6 of the usual speed

New time taken=6/5 of the usual time

So,(6/5 of the usual time)-(usual time)=10 minutes.

=>1/5 of the usual time=10 minutes.

$\Rightarrow$ usual time=10 minutes

Ex. 9.If a man walks at the rate of 5 kmph, he misses a train by 7 minutes. However, if he walks at the rate of 6 kmph, he reaches the station 5 minutes before the arrival of the train. Find the distance covered by him to reach the station.

Sol. Let the required distance be x km

Difference in the time taken at two speeds=1 min =1/2 hr

Hence x/5-x/6=1/5<=>6x-5x=6

$\Leftrightarrow x=6$

Hence, the required distance is 6 km

Ex. 10. A and B are two stations 390 km apart. A train starts from A at 10 a.m. and travels towards B at 65 kmph. Another train starts from B at 11 a.m. and travels towards A at 35 kmph. At what time do they meet?

Sol. Suppose they meet x hours after 10 a.m. Then,

(Distance moved by first in x hrs) + [Distance moved by second in (x-1) hrs]=390.

$65x + 35(x-1) = 390 \Rightarrow 100x = 425 \Rightarrow x = 17/4$

So, they meet 4 hrs.15 min. after 10 a.m i.e., at 2.15 p.m.

Ex. 11. A goods train leaves a station at a certain time and at a fixed speed. After ^hours, an express train leaves the same station and moves in the same direction at a uniform speed of 90 kmph. This train catches up the goods train in 4 hours. Find the speed of the goods train.

Sol. Let the speed of the goods train be x kmph.

Distance covered by goods train in 10 hours= Distance covered by express train in 4 hours

$10x = 4 \times 90$ or $x = 36$.

So, speed of goods train = 36kmph.

Ex. 12. A thief is spotted by a policeman from a distance of 100 metres. When the policeman starts the chase, the thief also starts running. If the speed of the thief be 8km/hr and that of the policeman 10 km/hr, how far the thief will have run before he is overtaken?

Sol. Relative speed of the policeman = (10-8) km/hr =2 km/hr.

Time taken by police man to cover 100m $\left(\frac{100}{1000} \times \frac{1}{2}\right)$ hr $= \frac{1}{20}$ hr.

In $\frac{1}{20}$ hrs, the thief covers a distance of $8 \times \frac{1}{20}$ km $= \frac{2}{5}$ km $= 400$ m

Ex.13. I walk a certain distance and ride back taking a total time of 37 minutes. I could walk both ways in 55 minutes. How long would it take me to ride both ways?

Sol. Let the distance be x km. Then,

(Time taken to walk x km) + (time taken to ride x km) =37 min.

(Time taken to walk 2x km) + (time taken to ride 2x km)= 74 min.

But, the time taken to walk 2x km = 55 min.

Time taken to ride 2x km = (74-55)min =19 min.

18. PROBLEMS ON TRAINS

IMPORTANT FACTS AND FORMULAE

1. *a km/hr* = *(a** 5/18) m/s.

2. a m / *s* = (a*18/5) km/hr.

3 Time taken by a train of length *1* metres to pass a pole or a standing man or a signal post is equal to the time taken by the train to cover *1* metres.

4. Time taken by a train of length *1* metres to pass a stationary object of length *b* metres is the time taken by the train to cover *(1 + b)* metres.

5. Suppose two trains or two bodies are moving in the same direction at u m / s and *v m/s*, where u > *v*, then their relatives speed = (u - *v)* m / s.

6. Suppose two trains or two bodies are moving in opposite directions at u m / s and *v m/s*, then their relative speed is = (u + *v)* m/s.

7. If two trains of length *a* metres and *b* metres are moving in opposite directions at u m / s and *v* m/s, then time taken by the trains to cross each other = *(a + b)/(u+v)* sec.

8.If two trains of length a metres and *b* metres are moving in the same direction
at u m / s and *v* m / s, then the time taken by the faster train to cross the slower train = (a+b)/(u-v) sec.

9. If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take *a* and *b* sec in reaching B and A respectively, then
(A's speet) : *(B's speed)* = $(b^{1/2}: a^{1/2})$.

SOLVED EXAMPLES

Ex.I. A train 100 m long is running at the speed of 30 km / hr. Find the time taken byit to pass a man standing near the railway line. (S.S.C. 2001)

Sol. Speed of the train = (30 x 5/18) m / sec = (25/3) m/ sec.

Distance moved in passing the standing man = 100 m.

Required time taken = *100/(25/3)* = (100 *(3/25)) sec = 12 sec

Ex. 2. A train is moving at a speed of 132 km/br. If the length of the train is 110 metres, how long will it take to cross a railway platform 165 metres long?

(Section Officers', 2003)

Sol. Speed of train = 132 *(5/18) m/sec = 110/3 m/sec.

Distance covered in passing the platform = (110 + 165) m = 275 m.

Time taken =275 *(3/110) sec =15/2 sec = 7 ½ sec

Ex. 3. A man is standing on a railway bridge which is 180 m long. He finds that a train crosses the bridge in 20 seconds but himself in 8 seconds. Find the length of the train and its speed?

Sol. Let the length of the train be x metres,

Then, the train covers x metres in 8 seconds and (x + 180) metres in 20 sec

$x/8=(x+180)/20 \Leftrightarrow 20x = 8(x + 180) \quad <=> \quad x = 120.$

Length of the train = 120 m.

Speed of the train = (120/8) m / sec = m / sec = (15 *18/5) kmph = 54 km

Ex. 4. A train 150 m long is running with a speed of 68 kmph. In what time will it pass a man who is running at 8 kmph in the same direction in which the train is going?

Sol: Speed of the train relative to man = (68 - 8) kmph

= (60* 5/18) m/sec = (50/3)m/sec

Time taken by the train to cross the man I

= Time taken by It to cover 150 m at 50/3 m / sec = 150 *3/ 50 sec = 9sec

Ex. 5. A train 220 m long is running with a speed of 59 kmph.. In what will

it pass a man who is running at 7 kmph in the direction opposite to that in which the train is going?

sol. Speed of the train relative to man = (59 + 7) kmph

= 66 *5/18 *m/sec* = 55/3 m/sec.

Time taken by the train to cross the man = Time taken by it to cover 220 m at (55/3) m / sec = (220 *3/55) sec = 12 sec

Ex. 6. Two trains 137 metres and 163 metres in length are running towards each other on parallel lines, one at the rate of 42 kmph and another at 48 kmpb. In what time will they be clear of each other from the moment they meet?

Sol. Relative speed of the trains = (42 + 48) kmph = 90 kmph

=(90*5/18) m / sec = 25 m /sec.

Time taken by the trains to'pass each other

= Time taken to *cover* (137 + 163) m at 25 m */sec* =(300/25) sec = 12 sec

Ex. 7. Two trains 100 metres and 120 metres long are running in the same direction with speeds of 72 km/hr,In howmuch time will the first train cross the second?

Sol: Relative speed of the trains = (72 - 54) km/hr = 18 *km/hr*

= (18 * 5/18) *m/sec* = 5 *m/sec.*

Time taken by the trains to cross each other

= Time taken to cover (100 + 120) m at 5 m /sec = (220/5) sec = 44 sec.

Ex. 8. A train 100 metres long takes 6 seconds to cross a man walking at 5 kmph in the direction opposite to that of the train. Find the speed of the train.?

Sol:Let the speed of the train be x kmph.

Speed of the train relative to man = (x + 5) kmph = *(x* + 5) *5/18 m/sec.

Therefore 100/((x+5)*5/18)=6 <=> 30 *(x* + 5) = 1800 <=> *x* = 55

Speed of the train is 55 kmph.

Ex9. A train running at 54 kmph takes 20 seconds to pass a platform. Next it takes.12 sec to pass a man walking at 6 kmph in the same direction in which the train is going . Find the length of the train and the length of the platform.

Sol: Let the length of train be x metres and length of platform be *y* metres.

Speed of the train relative to man = (54 - 6) kmph = 48 kmph

= 48*(5/18) m/sec = 40/3 m/sec.

In passing a man, the train covers its own length with relative speed.

Length of train = (Relative speed * Time) = (40/3)*12 m = 160 m.

Also, speed of the train = 54 *(5/18)m / sec = 15 m / sec.

(x+y)/15 = 20 <=> *x* + *y* = 300 <=> *Y* = (300 - 160) m = 140 m.

Ex10. A man sitting in a train which is traveling at 50 kmph observes that a goods train, traveling in opposite direction, takes 9 seconds to pass him. If the goods train is 280 m long, find its speed.?

Sol: Relative speed = 280/9 m / sec = ((280/9)*(18/5)) kmph = 112 kmph.

Speed of goods train = (112 - 50) kmph = 62 kmph.

19.BOATS AND STREAMS

IMPORTANT FACTS AND FORMULAE

1.In water ,the direction along the stream is called downstream and ,the direction against the stream is called upstream.

2.If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr,then:

speed downstream=(u+v)km/hr.
speed upstream=(u-v)km/hr.

3.If the speed downstream is a km/hr and the speed upstream is b km/hr,then :
speed in still water=1/2(a+b)km/hr
rate of stream=1/2(a-b)km/hr

SOLVED EXAMPLES

EX.1.A man can row upstream at 7 kmph and downstream at 10kmph.find man's rate in still water and the rate of current.

Sol. Rate in still water=1/2(10+7)km/hr=8.5 km/hr.
Rate of current=1/2(10-7)km/hr=1.5 km/hr.

EX.2. A man takes 3 hours 45 minutes to row a boat 15 km downstream of a river and 2hours30minutes to cover a distance of 5km upstream. find the speed of the river current in km/hr.

Sol. rate downstream=(15/3 ¾)km/hr=(15*4/15)km/hr=4km/hr.
Rate upstream=(5/2 ½)km/hr=(5*2/5)km/hr=2km/hr.
Speed of current=1/2(4-2)km/hr=1km/hr

EX.3. a man can row 18 kmph in still water.it takes him thrice as long to row up as to row down the river.find the rate of stream.

Sol. Let man's rate upstream be x kmph.then ,his rate downstream=3xkmph.
So,2x=18 or x=9.
Rate upstream=9 km/hr,rate downstream=27 km/hr.
Hence,rate of stream=1/2(27-9)km/hr=9 km/hr.

EX.4. there is a road beside a river.two friends started from a place A,moved to a temple situated at another place B and then returned to A again.one of them moves on a cycle at a speed of 12 km/hr,while the other sails on a boat at a speed of 10 km/hr.if the river flows at the speed of 4 km/hr,which of the two friends will return to placeA first?
Sol. Clearly the cyclist moves both ways at a speed of 12 km/hr.
The boat sailor moves downstream @ (10+4)i.e.,14 km/hr and upstream @ (10-4)i.e., 6km/hr.
So,average speed of the boat sailor=(2*14*6/14+6)km/hr
=42/5 km/hr=8.4 km/hr.
since the average speed of the cyclist is greater ,he will return ta A first.

EX.5. A man can row 7 ½ kmph in still water.if in a river running at 1.5 km/hr an hour,it takes him 50 minutes to row to a place and back,how far off is the place?

Sol. Speed downstream =(7.5+1.5)km/hr=9 km/hr;
Speed upstream=(7.5-1.5)kmph=6kmph.
Let the required distance be x km.then,
x/9+x/6=50/60.
2x+3x=(5/6*18)
5x=15
x=3.
Hence,the required distance is 3km.

EX.6. In a stream running at 2kmph,a motar boat goes 6km upstream and back again to the starting point in 33 minutes.find the speed of the motarboat in still water.

Sol.let the speed of the motarboat in still water be x kmph.then,
6/x+2 +6/x-2=33/60
$11x^2$-240x-44=0
$11x^2$-242x+2x-44=0
(x-22)(11x+2)=0
x=22.

EX.7.A man can row 40km upstream and 55km downstream in 13 hours also, he can row 30km upstream and 44km downstream in 10 hours.find the speed of the

man in still water and the speed of the current.

Sol.let rate upstream=x km/hr and rate downstream=y km/hr.
Then,40/x +55/y =13…(i) and 30/x +44/y =10
Multiplying (ii) by 4 and (i) by 3 and subtracting ,we get:11/y=1 or y=11.
Substituting y=11 in (i),we get:x=5.
Rate in still water =1/2(11+5)kmph=8kmph.
Rate of current=1/2(11-5)kmph=3kmph

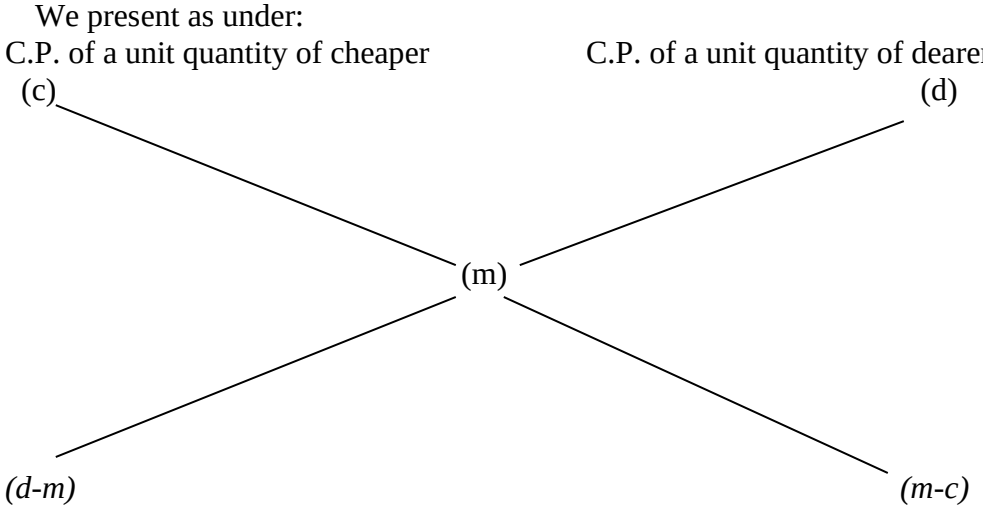
20. ALLIGATION OR MIXTURE

IMPORTANT FACTS AND FORMULAE

1. **Alligation**: It is the rule that enables us to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of a desired price.
2. **Mean Price**: The cost price of a unit quantity of the mixture is called the mean price.
3. **Rule of Alligation**: If two ingredients are mixed, then

$$\frac{\text{(Quantity of cheaper)}}{\text{(Quantity of dearer)}} = \frac{\text{(C.P. of dearer) - (Mean price)}}{\text{(Mean price) - (C.P. of cheaper)}}$$

We present as under:



∴ (Cheaper quantity) : (Dearer quantity) = (d - m) : (m - *c).*

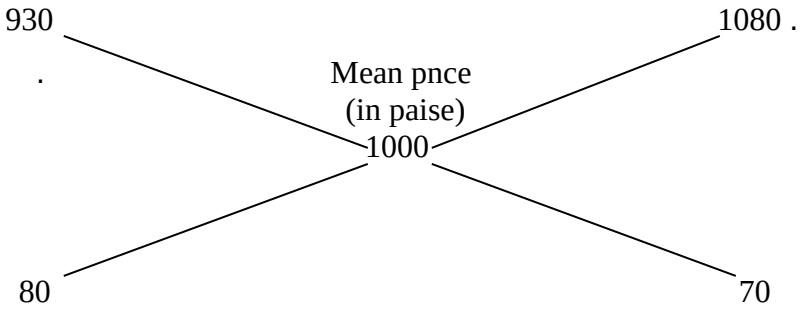
4. Suppose a container contains x units of liquid from which y units are taken out and replaced by water. After n operations the quantity of pure liquid=[x(1-y/x)^n]units.

SOLVED EXAMPLES

Ex. 1. In what ratio must rice at Rs. 9.30 per kg be mixed with rice at Rs. 10.80 per kg so that the mixture be worth Rs. 10 per kg ?

Sol. By the rule of alligation, we have:

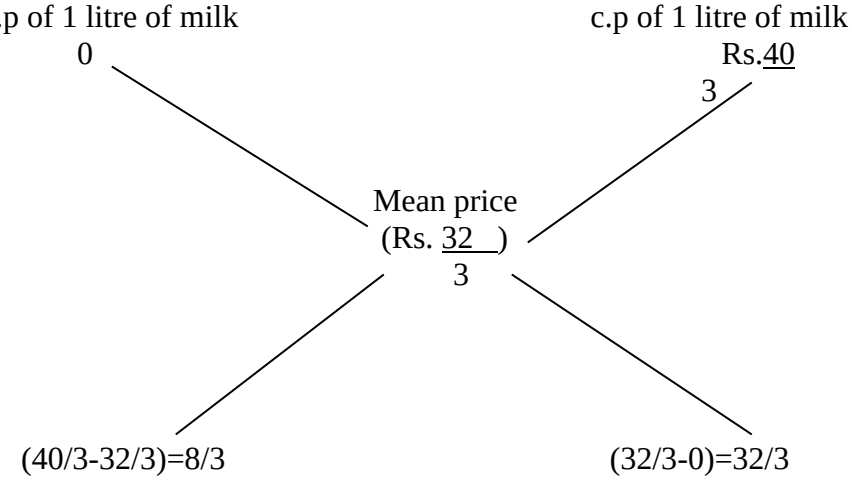
C.P. of 1 kg rice of 1st kind (in paise) C.P. of 1 kg rice of 2nd kind (in paise)



:.' Required ratio = 80 : 70 = 8 : 7.

Ex. 2. How much water must be added to 60 litres of milk at 1 ½ litres for Rs. 2 So as to have a mixture worth Rs.10 2/3 a litre ?

Sol. C.P. of 1 litre of milk = Rs. (20 x 2/3) = Rs. 40/3



∴ Ratio of water and milk = 8/3 : 32/3 = 8 : 32 = 1 : 4

∴ Quantity of water to be added to 60 litres of milk = [1/4 X 60] litres =15 litre

Ex. 3. In what ratio must water be mixed with milk to gain 20 % by selling the mixture at cost price?

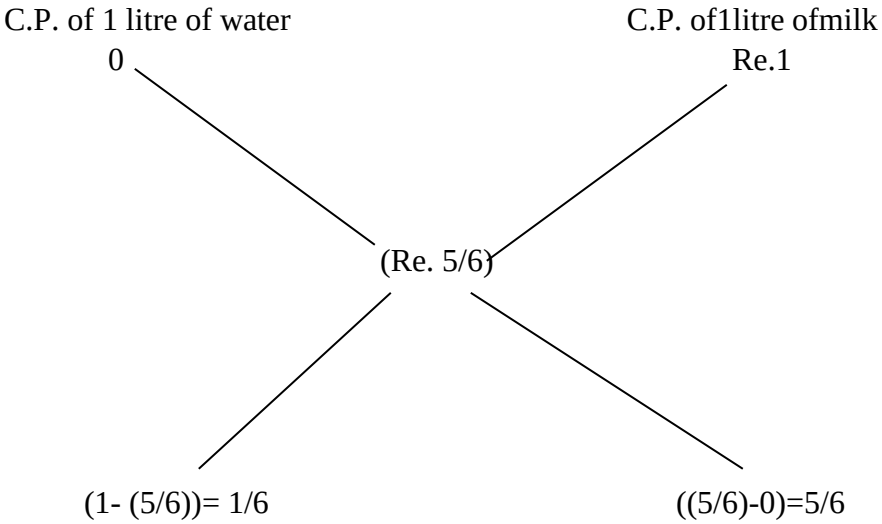
Sol. Let C.P. of milk be Re. 1 per litre.

Then, S.P. of 1 litre of mixture = Re. 1.

Gain obtained = 20%.

∴ C.P. of 1 litre of mixture = Rs. $\left[(100/120)* 1\right]$ =Rs.5/6

By the rule of alligation, we have:



∴Ratio of water and milk = 1/6 : 5/6 =

Ex. 4. .How many kgs. of wheat costing Rs. 8 per kg must be mixed with 86 kg of rice costing Rs. 6.40 per kg so that 20% gain may be obtained by Belling the mixture at Rs. 7.20 per kg ?

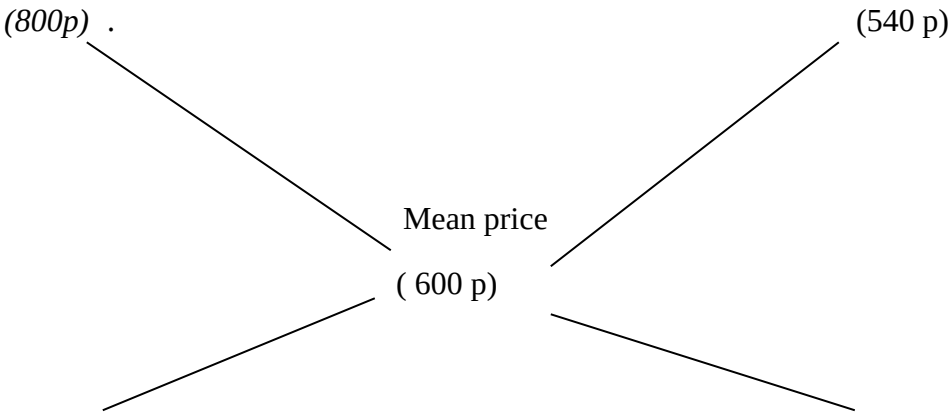
Sol. S.P. of 1 kg mixture = Rs. 7.20,Gain = 20%.

∴ C.P. of 1 kg mixture = Rs. $\left[(100/120)*7.20\right]$ =Rs. 6.

By the rule of alligation, we have:

C_P. of 1 kg wheat of 1st kind

C.P. of 1 kg wheat of 2nd kind



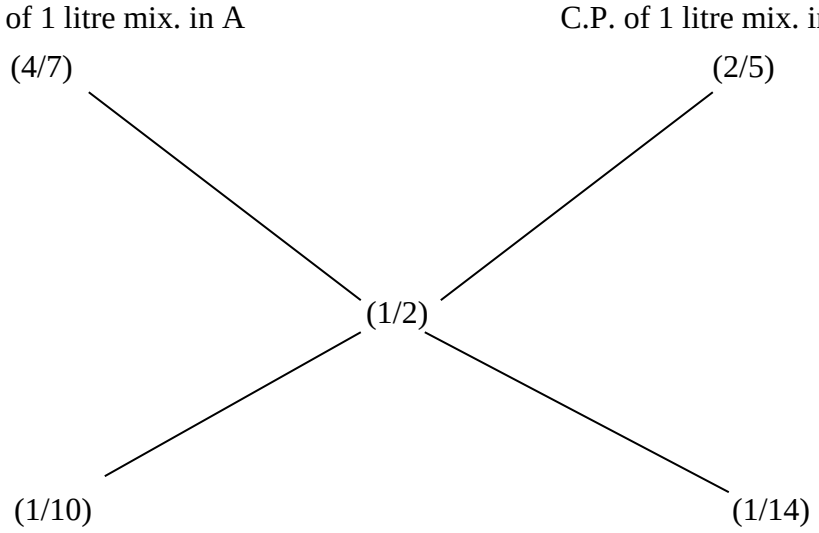
60 200

Wheat of 1st kind: Wheat of 2nd kind = 60 : 200 = 3 : 10.
Let x kg of wheat of 1st kind be mixed with 36 kg of wheat of 2nd kind.
Then, 3 : 10 = x : 36 or lOx = 3 * 36 or x = 10.8 kg.

Ex. 5. The milk and water in two vessels A and B are in the ratio 4 : 3 and 2: 3 respectively. In what ratio, the liquids in both the vessels be mixed to obtain a new mixture in vessel C containing half milk and half water?

Sol. *Let the C.P. of milk be Re. 1 per litre*

Milk in 1 litre mixture of A = 4/7litre; Milk in 1 litre mixture of B = 2/5 litre;
Milk in 1 litre mixture of C = ½ litre
C.P. of 1 litre mixture in A = Re .4/7*;* C.P. of 1 litre mixture in B = Re.2/5
Mean price = Re.1/2
By the rule of alligation, we have:



Required ratio = 1/10 : 1/14 = 7 : 5

21. SIMPLE INTEREST

IMPORTANT FACTS AND FORMULAE

1.. **Principal**: The money borrowed or lent out for a certain period is called the **principal** or the **sum.**
2**. Interest**: Extra money paid for using other's money is called **interest.**
3. **Simple Interest (S.I.)** : If the interest on a sum borrowed for a certain period is reckoned uniformly, then it is called **simple interest.**
Let Principal = P, Rate = R% per annum (p.a.) and Time = T years. Then,

(i) S.I. = (P*R*T)/100

(ii) P=(100*S.I)/(R*T) ;R=(100*S.I)/(P*T) and T=(100*S.I)/(P*R)

SOLVED EXAMPLES

Ex. 1. Find the simple interest on Rs. 68,000 at 16 2/3% per annum for 9 months.

Sol. P = Rs.68000,R = 50/3% p.a and T = 9/12 years = 3/4years.

$\therefore$ S.I. = (P*R*T)/100 = Rs.$\left(68{,}000*(50/3)*(3/4)*(1/100)\right)$= Rs.8500

Ex. 2. Find the simple interest on Rs. 3000 at 6 1/4% per annum for the period from 4th Feb., 2005 to 18th April, 2005.

Sol. Time = (24+31+18)days = 73 days = 73/365 years = 1/5 years.

P = Rs.3000 and R = 6 ¼ %p.a = 25/4%p.a

$\therefore$ S.I. = Rs.$\left(3{,}000*(25/4)*(1/5)*(1/100)\right)$= Rs.37.50.

Remark : The day on which money is deposited is not counted while the day on which money is withdrawn is counted .

Ex. 3. A sum at simple interests at 13 ½ % per annum amounts to Rs.2502.50 after 4 years find the sum.

Sol. Let sum be Rs. x then , S.I.=Rs.$\left(x*(27/2)*4*(1/100)\right)$ = Rs.27x/50

$\therefore$ amount = $\left(\text{Rs. } x+(27x/50)\right)$ = Rs.77x/50

$\therefore$ 77x/50 = 2502.50 $\Leftrightarrow$ x = $\frac{2502.50 * 50}{77}$ = 1625

Hence , sum = Rs.1625.

Ex. 4. A sum of Rs. 800 amounts to Rs. 920 in 8 years at simple intere interest rate is increased by 8%, it would amount to bow mucb ?

Sol. S.l. = Rs. (920 - 800) = Rs. 120; p = Rs. 800, T = 3 yrs. _

. R = $\left((100 \times 120)/(800*3)\right)$ % = 5%.

New rate = (5 + 3)% = 8%.

New S.l. = Rs. (800*8*3)/100 = Rs. 192.

: New amount = Rs.(800+192) = Rs. 992.

Ex. 5. Adam borrowed some money at the rate of 6% p.a. for the first two years , at the rate of 9% p.a. for the next three years , and at the rate of 14% p.a. for the period beyond five years. 1£ he pays a total interest of Rs. 11, 400 at the end of nine years how much money did he borrow ?

Sol. Let the sum borrowed be x. Then,

(x*2*6)/100 + (x*9*3)/100 + (x*14*4)/100 = 11400

$\Leftrightarrow$ $\left(3x/25 + 27x/100 + 14x / 25\right)$ = 11400 $\Leftrightarrow$ 95x/100 = 11400 $\Leftrightarrow$ x = (11400*100)/95 = 12000.

Hence , sum borrowed = Rs.12,000.

Ex. 6. A certain sum of money amounts to Rs. 1008 in 2 years and to Rs.1164 in 3 ½ years. Find the sum and rate of interests.

Sol.. S.I. for 1 ½ years = Rs.(1164-1008) = Rs.156.

S.l. for 2 years = Rs.(156*(2/3)*2)=Rs.208

Principal = Rs. (1008 - 208) = Rs. 800.

Now, P = 800, T = 2 and S.l. = 208.

Rate =(100* 208)/(800*2)% = 13%

Ex. 7. At what rate percent per annum will a sum of money double in 16 years.

Sol.. Let principal = P. Then, S.l. = P and T = 16 yrs.

$\therefore$ Rate = (100 x P)/(P*16)% = 6 ¼ % p.a.

Ex. 8. The simple interest on a sum of money is 4/9 of the principal .Find the rate percent and time, if both are numerically equal.

Sol. Let sum = Rs. x. Then, S.l. = Rs. 4x/9

Let rate = R% and time = R years.

Then, (x*R*R)/100=4x/9 or R^2 =400/9 or R = 20/3 = 6 2/3.

∴Rate = 6 2/3 % and Time = 6 2/3 years = 6 years 8 months.

Ex. 9. The simple interest on a certain sum of money for 2 l/2 years at 12% per annum is Rs. 40 less tban the simple interest on the same sum for 3 ½ years at 10% per annum. Find the sum.

Sol. Let the sum be Rs. *x* Then, $\left((x*10*7)/(100*2)\right) - \left((x*12*5)/(100*2)\right) = 40$

⇔ (7x/20)-(3x/10)=40

⇔*x* = (40 * 20) = 800.

Hence, the sum is Rs. 800.

Ex. 10. A sum was put at simple interest at a certain rate for 3 years. Had it been put at 2% higher rate, it would have fetched Rs. 360 more. Find the sum.

Sol. Let sum = P and original rate = R.

Then, $\left[\left(P*(R+2)*3\right)/100\right] - \left[\left(P*R*3\right)/100\right] = 360.$

⇔ 3PR + 6P - 3PR = 36000 ⇔ 6P=36000 ⇔ P=6000

Hence, sum = Rs. 6000.

Ex. 11. What annual instalment will discharge a debt of Rs. 1092 due in 3 years at 12% simple interest?

.

Sol .Let each Instalment be Rs. *x*

Then, $\left(x+\left((x*12*1)/100\right)\right) + \left(x+\left((x*12*2)/100\right)\right) + x = 1092$

⇔ (*(28x/25)* + (31x/25) + *x)* = 1092 ⇔ (28x+31x+25x)=(1092*25)

⇔ x= (1092*25)/84 = Rs.325.

∴Each instalment = Rs. 325.

Ex. 12. A sum of Rs. 1550 is lent out into two parts, one at 8% and another one at 6%. If the total annual income is Rs. 106, find the money lent at each rate.

Sol. Let the sum lent at 8% be Rs. x and that at 6% be Rs. (1550 - *x).*

$\therefore \left((x*8*1)/100\right) + \left((1550-x)*6*1\right)/100=106$

$\Leftrightarrow 8x + 9300 - 6x = 10600 \Leftrightarrow 2x = 1300 \Leftrightarrow x = 650.$

$\therefore$ Money lent at 8% = Rs. 650. Money lent at 6% = Rs. (1550 - 650) = Rs. 900.

22.COMPOUND INTEREST

Compound Interest: Sometimes it so happens that the borrower and the lender agree to fix up a certain unit of time, say *yearly* or *half-yearly* or *quarterly* to settle the previous account.

In such cases, the amount after first unit of time becomes the principal for the second unit,the amount after second unit becomes the principal for the third unit and so on.

After a specified period, ***the difference between the amount and the money borrowed is called the*** **Compound** ***Interest (abbreviated*** **as** ***C.I.) for that period.***

IMPORTANT FACTS AND FORMULAE

Let Principal = P, Rate = R% per annum, Time = n years.

I. When interest is compound Annually:

$$\text{Amount} = P(1+R/100)^n$$

II. When interest is compounded Half-yearly:

$$\text{Amount} = P[1+(R/2)/100]^{2n}$$

III. When interest is compounded Quarterly:

$$\text{Amount} = P[1+(R/4)/100]^{4n}$$

IV. When interest is compounded AnnuaI1y but time is in fraction, say 3(2/5) years.

$$\text{Amount} = P(1+R/100)^3 \times (1+(2R/5)/100)$$

V. When Rates are different for different years, say Rl%, R2%, R3% for 1st, 2nd and 3rd year respectively.

$$\text{Then, Amount} = P(1+R_1/100)(1+R_2/100)(1+R_3/100)$$

VI. Present worth of Rs.x due *n* years hence is given by :

Present Worth = $x/(1+(R/100))^n$

SOLVED EXAMPLES

Ex.1. *Find compound interest* on *Rs. 7500* at 4% *per* annum *for* 2 *years, compounded* annually.

Sol.

Amount = Rs $[7500*(1+(4/100)^2]$ = Rs (7500 * (26/25) * (26/25)) = Rs. 8112.

therefore, C.I. = Rs. (8112 - 7500) = Rs. 612.

Ex. 2. *Find compound interest* on *Rs. 8000* at 15% *per* annum *for* 2 *years* 4 *months, compounded annually*.

Sol. Time = 2 years 4 months = 2(4/12) years = 2(1/3) years.

Amount = Rs'. $[8000 \text{ X } (1+(15/100))^2 \text{ X } (1+((1/3)*15)/100)]$

=Rs. [8000 * (23/20) * (23/20) * (21/20)]

= Rs. 11109.

:. C.I. = Rs. (11109 - 8000) = Rs. 3109.

Ex. 3. *Find the compound interest* on *Rs. 10,000 in* 2 *years* at 4% *per* annum, *the interest being compounded half-yearly.* **(S.S.C. 2000)**

Sol.

Principal = Rs. 10000; Rate = 2% per half-year; Time = 2 years = 4 half-years.

Amount =

Rs $[10000 * (1+(2/100))^4]$ = Rs(10000 * (51/50) * (51/50) * (51/50) * (51/50))

= Rs. 10824.32.

:. C.I. = Rs. (10824.32 - 10000) = Rs. 824.32.

Ex. 4. *Find the compound interest* on *Rs. 16,000* at *20% per* annum *for* 9 *months, compounded quarterly.*

Sol. Principal = Rs. 16000; Time = 9 months =3 quarters;
Rate = 20% per annum = 5% per quarter.

Amount = Rs. $[16000 \times (1+(5/100))^3]$ = Rs. 18522.

CJ. = Rs. (18522 - 16000) = Rs. 2522.

Ex. 5. ***If the simple interest*** **on a** ***sum*** **of** ***money*** **at 5%** ***per*** **annum** ***for*** **3** ***years is Rs. 1200, find the compound interest*** **on** ***the same sum for the*** **same** ***period at the same rate.***

Sol.

Clearly, Rate = 5% p.a., Time = 3 years, S.I.= Rs. 1200. . .

So principal=RS [100*1200]/3*5=RS 8000

Amount = Rs. 8000 x [1 +5/100]^3 - = Rs. 9261.

.. C.I. = Rs. (9261 - 8000) = Rs. 1261.

Ex. 6. ***In what time will Rs. 1000 become Rs.*** **1331 at** ***10% per*** **annum** ***compounded annually?*** **(S.S.C. 2004)**

Sol.

Principal = Rs. 1000; Amount = Rs. 1331; Rate = 10% p.a. Let the time be n years. Then,
$[1000 (1+ (10/100))^n] = 1331$ or $(11/10)^n = (1331/1000) = (11/10)^3$
n = 3 years.

Ex. 7. ***If Rs. 600 amounts*** **to** ***Rs. 683.20 in*** **two years** ***compounded*** **annually, find the rate of** ***interest per*** **annum.**

Sol. Principal = Rs. 500; Amount = Rs. 583.20; Time = 2 years.
Let the rate be R% per annum.. 'Then,

$[500 (1+(R/100)^2] = 583.20$ or $[1+ (R/100)]^2 = 5832/5000 = 11664/10000$

$[1+ (R/100)]^2 = (108/100)^2$ or $1 + (R/100) = 108/100$ or $R = 8$

So, rate = 8% p.a.

Ex. 8. ***If the compound interest*** **on a** ***certain sum*** **at 16 (2/3)%** ***to*** **3** ***years is Rs.1270, find the simple interest*** **on** ***the same sum*** **at** ***the same*** **rate and** ***f or the*** **same period.**

Sol. Let the sum be Rs. x. Then,

C.I. = $[x * (1 + ((50/(3*100))^3 - x] = ((343x / 216) - x) = 127x / 216$

$127x /216 = 1270$ or $x = (1270 * 216) / 127 = 2160$.

Thus, the sum is Rs. 2160

S.I. = Rs (2160 * (50/3) * 3 * (1 /100)) = Rs. 1080.

Ex. 9. ***The difference*** **between** ***the compound interest*** **and** ***simple interest*** **on a** ***certain sum*** **at 10%** ***per*** **annum** ***for*** **2** ***years is Rs.*** **631.** ***Find the sum.***

Sol. Let the sum be Rs. x. Then,

C.I. = $x (1 + (10 /100))^2 - x = 21x / 100$,

S.I. = ((x * 10 * 2) / 100) = x / 5

(C.I) - (S.I) = ((21x / 100) - (x / 5)) = x / 100

(x / 100) = 632 □ x = 63100.

Hence, the sum is Rs.63,100.

Ex. 10. ***The difference*** **between** ***the compound interest*** **and** ***the simple*** **interest** ***accrued*** **on an amount** ***of Rs. 18,000 in*** **2** ***years was Rs. 405. What*** **was** ***the*** **rate** ***of interest p.c.p.a.*** **? (Bank P.O. 2003)**

Sol. Let the *rate* be R% p.a. then,

$[18000 (1 + (R / 100)^2) - 18000] - ((18000 * R * 2) / 100) = 405$

$18000 [(100 + (R / 100)^2 / 10000) - 1 - (2R / 100)] = 405$

$18000[((100 + R)^2 - 10000 - 200R) / 10000] = 405$

$9R^2 / 5 = 405$ □ $R^2 = ((405 * 5) / 9) = 225$

R = 15.

Rate = 15%.

Ex. 11. ***Divide Rs. 1301 between A and B, so that the amount*** **of** ***A after*** **7** ***years is equal to the amount*** **of** ***B after*** **9** ***years, the interest being compounded at*** **4%** ***per annum.***

Sol. Let the two parts be Rs. x and Rs. (1301 - *x).*

$x(1+4/100)^7 =(1301-x)(1+4/100)^9$

$x/(1301-x)=(1+4/100)^2=(26/25*26/25)$

625x=676(1301-x)

*1301x=676*1301*

x=676.

So,the parts are rs.676 and rs.(1301-676)i.e rs.676 and rs.625.

Ex.12. a certain sum amounts to rs.7350 in 2 years and to rs.8575 in 3 years.find the sum and rate percent.

S.I on rs.7350 for 1 year=rs.(8575-7350)=rs.1225.

*Rate=(100*1225/7350*1)%=16 2/3%*

Let the sum be rs.x.then,
$X(1+50/3*100)^2=7350$
*X*7/6*7/6=7350*
*X=(7350*36/49)=5400.*
Sum=rs.5400.

Ex.13.a sum of money amounts to rs.6690 after 3 years and to rs.10,035 after 6 years on compound interest.find the sum.
Sol. *Let the sum be rs.P.then*
$P(1+R/100)^3=6690…(i)$ *and* $P(1+R/100)^6=10035…(ii)$
On dividing,we get $(1+R/100)^3=10025/6690=3/2.$
Substituting this value in (i),we get:
*P*3/2=6690 or P=(6690*2/3)=4460*
Hence,the sum is rs.4460.

Ex.14. a sum of money doubles itself at compound interest in 15 years.in how many years will it beco,e eight times?
$P(1+R/100)^{15}=2P$
$(1+R/100)^{15}=2P/P=2$
LET $P(1+R/100)^n=8P$
$(1+R/100)^n=8=2^3=\{(1+R/100)^{15}\}^3$ *[USING (I)]*
$(1+R/100)^N=(1+R/100)^{45}$
n=45.
Thus,the required time=45 years.

Ex.15.What annual payment will discharge a debt of Rs.7620 due in 3years at 16 2/3% per annum interest?

Sol. Let each installment beRs.x.
Then,(P.W. of Rs.x due 1 year hence)+(P>W of Rs.x due 2 years hence)+(P.W of Rs. X due 3 years hence)=7620.

$\therefore$ $x/(1+(50/3*100))+ x/(1+(50/3*100))^2 + x/(1+(50/3*100))^3=7620$

$\Leftrightarrow(6x/7)+(936x/49)+(216x/343)=7620.$

$\Leftrightarrow 294x+252x+216x=7620*343.$
$\Leftrightarrow x=(7620*343/762)=3430.$
$\therefore$ Amount of each installment=Rs.3430.

23. LOGARITHMS

IMPORTANT FACTS AND FORMULAE

I. Logarithm: If a is a positive real number, other than 1 and a^m = X, then we write:
m = log_a x and we say that the value of log x to the base *a* is m.

Example:

(i) $10^3 = 1000 \Rightarrow \log_{10} 1000 = 3$

(ii) $2^{-3} = 1/8 \Rightarrow \log_2 1/8 = -3$

(iii) $3^4 = 81 \Rightarrow \log_3 81 = 4$

(iiii) $(.1)^2 = .01 \Rightarrow \log_{(.1)} .01 = 2.$

II. Properties of Logarithms:

1. $\log_a(xy) = \log_a x + \log_a y$

2. $\log_a (x/y) = \log_a x - \log_a y$

3. $\log_x x = 1$

4. $\log_a 1 = 0$

5. $\log_a(x^p) = p(\log_a x)$ 1

6. $\log_a x = 1/\log_x a$

7. $\log_a x = \log_b x/\log_b a = \log x/\log a.$

Remember: When base is not mentioned, it is taken as 10.

II. Common Logarithms:

Logarithms to the base 10 are known as common logarithms.

III. The logarithm of a number contains two parts, namely *characteristic* and *mantissa.*

Characteristic: The integral part of the logarithm of a number is called its ***characteristic.***

Case I: When the number is greater than 1.

In this case, the characteristic is one less than the number of digits in the left of the decimal point in the given number.

Case II: When the number is less than 1.

In this case, the characteristic is one more than the number of zeros between the decimal point and the first significant digit of the number and it is negative.
Instead of - 1, - 2, etc. we write, $\bar{1}$ (one bar), $\bar{2}$ (two bar), etc.

Example:

Number	*Characteristic*	*Number*	*Characteristic*
348.25	2	0.6173	$\bar{1}$
46.583	1	0.03125	$\bar{2}$
9.2193	0	0.00125	$\bar{3}$

Mantissa: The decimal part of the logarithm of a number is known is its ***mantissa.*** For mantissa, we look through log table.

SOLVED EXAMPLES

1.Evaluate:
(1)$\log_3 27$
(2)$\log_7 (1/343)$
(3)$\log_{100}(0.01)$

SOLUTION:

(1) let $\log_3 27=3^3$ or n=3.

ie, $\log_3 27 = 3$.

(2) Let $\log_7 (1\backslash 343) = n$.

Then ,$7^n = 1/343$
$= 1/7^3$
n = -3.

ie,
$\log_7(1\backslash 343)= -3$.

(3) let $\log_{100}(0.01) = n$.

Then,. $(100) = 0.01 = 1/100 = 100^{-1}$ 0r n=-1

EX.2. evaluate
(i) $\log_7 1=0$ (ii)$\log_{34} 34$ (iii)$36^{\log_6 4}$
solution:

i) we know that $\log_a 1=0$,so $\log_7 1=0$.
ii) we know that $\log_a a=1$,so $\log_{34} 34=0$.

iii) We know that $a^{\log_6 x} = x$.

. now $36^{\log_6 4} = (6^2)^{\log_6 4} = 6^{\log_6 (16)} = 16$.

Ex.3.if $\log_{\sqrt{8}} x = 3(1/3)$, find the value of x.

$\log_{\sqrt{8}} x = 10/3$, $x = (\sqrt{8})^{10/3} = (2^{3/2})^{10/3} = 2^{(3/2*10/3)} = 2^5 = 32$.

Ex.4:Evaluate: (i) $\log_5 3 * \log_{27} 25$ (ii) $\log 27 - \log_{27} 9$

(i)$\log_{5^3} * \log_{27} 25 = (\log 3/\log 5)*(\log 25/\log 27)$
$= (\log 3/\log 5)*(\log 5^2 * \log 3^3)$
$= (\log 3/\log 5)*(2\log 5/3\log 3)$
$= 2/3$

(ii)Let $\log_9 27 = n$
Then,
$9^n = 27 \Leftrightarrow 3^{2n} = 3^3 \Leftrightarrow 2n = 3 \Leftrightarrow n = 3/2$
Again, let $\log_{27} 9 = m$
Then,
$27^m = 9 \Leftrightarrow 3^{3m} = 3^2 \Leftrightarrow 3m = 2 \Leftrightarrow m = 2/3$

⇨ $\log_9 27 - \log_{27} 9 = (n-m) = (3/2 - 2/3) = 5/6$

Ex 5. Simplify :(log 75/16-2 log 5/9+log 32/243)
Sol: log 75/16-2 log 5/9+log 32/243
= log 75/16-log$(5/9)^2$+log32/243
= log 75/16-log25/81+log 32/243
= log(75/16*32/243*81/25)=log 2

Ex. 6.Find the value of x which satisfies the relation
$\log_{10} 3+\log_{10}(4x+1)=\log_{10}(x+1)+1$
Sol: $\log_{10} 3+\log_{10}(4x+1)=\log_{10}(x+1)+1$
$\log_{10} 3+\log_{10}(4x+1)=\log_{10}(x+1)+\log_{10}(x+1)+\log_{10} 10$
$\log_{10}(3(4x+1))=\log_{10}(10(x+1))$
$=3(4x+1)=10(x+1)=12x+3$
$=10x+10$
$=2x=7=x=7/2$

Ex. 7.Simplify:$[1/\log_{xy}(xyz)+1/\log_{yz}(xyz)+1/\log_{zx}(xyz)]$
Given expression: $\log_{xyz} xy+ \log_{xyz} yz+ \log_{xyz} zx$
$=\log_{xyz}(xy*yz*zx)=\log_{xyz}(xyz)^2$

$2\log_{xyz}(xyz)=2*1=2$

Ex.8.If $\log_{10} 2=0.30103$,find the value of $\log_{10} 50$.

Soln. $\log_{10} 50=\log_{10}(100/2)=\log_{10} 100-\log_{10} 2=2-0.30103=1.69897$.

Ex 9.If log 2=0.3010 and log 3=0.4771,find the values of:

i) log 25 ii)log 4.5

Soln.

i) log 25=log(100/4)=log 100-log 4=2-2log 2=(2-2*.3010)=1.398.

ii) log 4.5=log(9/2)=log 9-log 2=2log 3-log 2
=(2*0.4771-.3010)=.6532

Ex.10. If log 2=.30103,find the number of digits in 2^{56}.

Soln. log 2^{56} =56log2=(56*0.30103)=16.85768.

Its characteristics is 16.

Hence,the number of digits in 2^{56} is 17

24 .AREA

FUNDEMENTAL CONCEPTS

I.RESULTS ON TRIANGLES:
1.Sum of the angles of a triangle is 180 degrees.

2.Sum of any two sides of a triangle is greater than the third side.

3.Pythagoras theorem:
In a right angle triangle,
(Hypotenuse)^2 = (base)^2 + (Height)^2

4.The line joining the midpoint of a side of a triangle to the opposite vertex is called the

MEDIAN
5.The point where the three medians of a triangle meet is called **CENTROID**.

Centroid divides each of the medians in the ratio 2:1.

6.In an isosceles triangle, the altitude from the vertex bi-sects the base

7.The median of a triangle divides it into two triangles of the same area.

8.Area of a triangle formed by joining the midpoints of the sides of a given triangle is one-fourth of the area of the given triangle.

II.RESULTS ON QUADRILATERALS:

1. The diagonals of a parallelogram bisects each other .
2. Each diagonal of a parallelogram divides it into two triangles of the same area
3. The diagonals of a rectangle are equal and bisect each other.
4. The diagonals of a square are equal and bisect each other at right angles.
5. The diagonals of a rhombus are unequal and bisect each other at right angles.
6. A parallelogram and a rectangle on the same base and between the same parallels are equal in area.
7. Of all the parallelograms of a given sides , the parallelogram which is a rectangle has the greatest area.

IMPORTANT FORMULAE

I.1.Area of a rectangle=(length*breadth)
Therefore length = (area/breadth) and breadth=(area/length)
2.Perimeter of a rectangle = 2*(length+breadth)
II.Area of a square = (side)^2 =1/2(diagonal)^2
III Area of four walls of a room = 2*(length + breadth)*(height)
IV 1.Area of the triangle=1/2(base*height)
2. Area of a triangle = (s*(s-a)(s-b)(s-c))^(1/2), where a,b,c are the sides of a triangle and s= ½(a+b+c)
3.Area of the equilateral triangle =((3^1/2)/4)*(side)^2
4.Radius of incircle of an equilateral triangle of side a=a/2(3^1/2)
5.Radius of circumcircle of an equilateral triangle of side a=a/(3^1/2)
6.Radius of incircle of a triangle of area del and semiperimeter S=del/S
V.1.Area of the parellogram =(base *height)
2.Area of the rhombus=1/2(product of the diagonals)
3.Area of the trapezium=1/2(size of parallel sides)*distance between them
VI 1.Area of a circle =pi*r^2,where r is the radius
2. Circumference of a circle = 2∏R.
3. Length of an arc = 2∏Rθ/(360) where θ is the central angle
4. Area of a sector = (1/2) (arc x R) = pi*R^2*θ/360.
VII. 1. Area of a semi-circle = (pi)*R^2.
2. Circumference of a semi-circle = (pi)*R.

SOLVED EXAMPLES

Ex.1. One side of a rectangular field is 15 m and one of its diagonals is 17 m. Find the area of the field.

Sol. Other side = $((17)^{2} - (15)^{2)(1/2)}) = (289 - 225)^{(1/2)} = (64)^{(1/2)} = 8$ m.
Area = (15 x 8) m^2 = 120 m^2.

Ex. 2. A lawn is in the form of a rectangle having its sides in the ratio 2: 3. The area of the lawn is (1/6) hectares. Find the length and breadth of the lawn.

Sol. Let length = 2x metres and breadth = 3x metre.

Now, area = (1/6)x 1000 m^2 = 5000/3m^2

So, 2x * *3x* = 5000/3 <=> x^2 = 2500/9 <=> *x* = 50/3
therefore Length = 2x = (100/3) m = 33(1/3) m and Breadth = *3x* = 3(50/3) m = 50m.

Ex. 3. Find the cost of carpeting a room 13 m long and 9 m broad with a carpet 75 cm wide at the rate of Rs. 12.40 per square metre.
Sol. Area of the carpet = Area of the room = (13 * 9) m^2 = 117 m^2.
Length of the carpet = (area/width) = 117 *(4/3) m = 156 m.
Therefore Cost of carpeting = Rs. (156 * 12.40) = Rs. 1934.40.

Ex. 4. If the diagonal of a rectangle is 17 cm long and its perimeter is 46 cm, find the area of the rectangle. .

Sol. Let length = x and breadth = *y*. Then,
2 (x + *y)* = 46 or x + *y* = 23 and $x^2 + y^2 = (17)^2 = 289$.
Now, $(x + y)^2 = (23)^2$ <=> $(x^2 + y^2) + 2xy = 529$ <=> 289 + 2xy = 529 ⇔xy=120
Area = xy = 120 $cm^{2.}$

Ex. 5. The length of a rectangle is twice its breadth. If its length is decreased by 5 cm and breadth is increased by 5 cm, the area of the rectangle is increased by 75 sq. cm. Find the length of the rectangle.

Sol. Let breadth = x. Then, length = *2x*. Then,
(2x - 5) (x + 5) - 2x * x = 75 <=> 5x - 25 = 75 <=> x = 20.
:. Length of the rectangle = 20 cm.

Ex. 6. In measuring the sides of a rectangle, one side is taken 5% in excess, and the other 4% in deficit. Find the error percent in the area calculated from these

measurements. **(M.B.A. 2003)**

Sol. Let x and *y* be the sides of the rectangle. Then, Correct area = xy.
Calculated area = (105/100)*x * (96/100)*y = (504/500)(xy)
Error In measurement = (504/500)xy- *xy* = (4/500)xy
Error % = [(4/500)*xy* *(1/xy) *100] % = (4/5) % = 0.8%.

Ex. 7. A rectangular grassy plot 110 m. by 65 m has a gravel path 2.5 m wide all round it on the inside. Find the cost of gravelling the path at 80 paise per sq. metre.

Sol. Area of the plot = (110 x 65) m^2 = 7150 m^2
Area of the plot excluding the path = [(110 - 5) * (65 - 5)] m^2 = 6300 m^2.
Area of the path = (7150 - 6300) m^2 = 850 m^2.

Cost of gravelling the path = Rs.850 * (80/100)= Rs. 680

Ex. 8. The perimeters of two squares are 40 cm and 32 cm. Find the perimeter of a third square whose area is equal to the difference of the areas of the two squares. (S.S.C. 2003)

Sol. Side of first square = (40/4) = 10 cm;
Side of second square = (32/4)cm = 8 cm.
Area of third square = [$(10)^2$ - $(8)^2$] cm^2 = (100 - 64) cm^2 = 36 cm^2.
Side of third square = $(36)^{(1/2)}$ cm = 6 cm.
Required perimeter = (6 x 4) cm = 24 cm.

Ex. 9. A room 5m 55cm long and 3m 74 cm broad is to be paved with square tiles. Find the least number of square tiles required to cover the floor.

Sol. Area of the room = (544 x 374) cm^2.
Size of largest square tile = H.C.F. of 544 cm and 374 cm = 34 cm.
Area of 1 tile = (34 x 34) cm^2.
Number of tiles required =(544*374)/(34*34)=176

Ex. 10. Find the area of a square, one of whose diagonals is 3.8 m long.

Sol. Area of the square = (1/2)* $(diagonal)^2$ = [(1/2)*3.8*3.8]m^2 = 7.22 m^2.

Ex. 11. The diagonals of two squares are in the ratio of 2 : 5. Find the ratio of their areas. (Section Officers', 2003)

Sol. Let the diagonals of the squares be 2x and 5x respectively.

Ratio of their areas = (1/2)*$(2x)^2$:(1/2)*$(5x)^2$ = $4x^2$: $25x^2$ = 4 : 25.

Ex.12. If each side of a square is increased by 25%, find the percentage change in its area.

Sol. Let each side of the square be *a*. Then, area = a^2.

New side =(125a/100) =(5a/4). New area = $(5a/4)^2$ =$(25a^2)/16$.
Increase in area = $((25\ a^2)/16)$-a^2 =$(9a^2)/16$.
Increase% = [$((9a^2)/16)*(1/a^2)*100$] % = 56.25%.

Ex. 13. If the length of a certain rectangle is decreased by 4 cm and the width is increased by 3 cm, a square with the same area as the original rectangle would result. Find the perimeter of the original rectangle.

Sol. Let x and y be the length and breadth of the rectangle respectively.
Then, x - 4 = y + 3 or x - y = 7 ----(i)
Area of the rectangle =xy; Area of the square = (x - 4) *(y* + 3)
(x - 4) (y + 3) =xy <=> 3x - *4y* = 12 ----(ii)
Solving *(i)* and *(ii),* we get x = 16 and *y* = 9.
Perimeter of the rectangle = 2 (x + *y)* = [2 (16 + 9)] cm = 50 cm.

Ex. 14. A room is half as long again as it is broad. The cost of carpeting the at Rs. 5 per sq. m is Rs. 270 and the cost of papering the four walls at Rs. 10 per m^2 is Rs. 1720. If a door and 2 windows occupy 8 sq. m, find the dimensions of the room.

Sol. Let breadth = x metres, length = *3x* metres, height = H metres.

Area of the floor=(Total cost of carpeting)/(Rate/m^2)=$(270/5)m^2$=$54m^2$.
*x** (3x/2) = 54 <=> *x*^2 = (54*2/3) = 36 <=> *x* = 6.
So, breadth = 6 m and length =(3/2)*6 = 9 m.
Now, papered area = $(1720/10)m^2$ = 172 m^2.
Area of 1 door and 2 windows = 8 m^2.
Total area of 4 walls = (172 + 8) m^2 = 180 m^2

2*(9+ 6)* H = 180 <=> H = 180/30 = 6 m.

Ex. 15. Find the area of a triangle whose sides measure 13 cm, 14 cm and 15 cm.

Sol. Let a = 13, b = 14 and *c* = 15. Then, *S* = (1/2)*(a* + *b* + c) = 21.
(s- a) = 8, (s - b) = 7 and (s - *c)* = 6.
Area = $(s(s- a)\ (s - b)(s - c))^{(1/2)}$ = $(21 *8 * 7*6)^{(1/2)}$ = 84 cm^2.

Ex. 16. Find the area of a right-angled triangle whose base is 12 cm and hypotenuse is 13cm.

Sol. Height of the triangle = $[(13)^2 - (12)^2]^{(1/2)}$ cm = $(25)^{(1/2)}$ cm = 5 cm.

Its area = (1/2)* Base * Height = ((1/2)*12 * 5) cm^2 = 30 cm^2.

Ex. 17. The base of a triangular field is three times its altitude. If the cost of cultivating the field at Rs. 24.68 per hectare be Rs. 333.18, find its base and height.

Sol. Area of the field = Total cost/rate = (333.18/25.6)hectares = 13.5 hectares

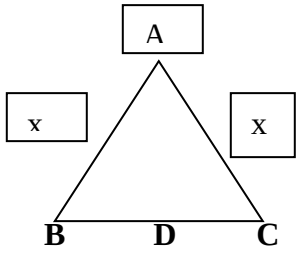
⇔ (13.5 x 10000) m^2 = 135000 m^2.

Let altitude = x metres and base = 3x metres.

Then, (1/2)* $3x * x = 135000 <=> x^2 = 90000 <=> x = 300$.

Base = 900 m and Altitude = 300 m.

Ex. 18. The altitude drawn to the base of an isosceles triangle is 8 cm and the perimeter is 32 cm. Find the area of the triangle.



Sol. Let ABC be the isosceles triangle and AD be the altitude.

Let AB = AC = x. Then, BC = (32 - *2x).*

Since, in an isosceles triangle, the altitude bisects the base,

so BD = DC = (16 - *x).*

In *triangle* ADC, $AC^2 = AD + DC^2 => x^2 = (8^2) + (16-x)^2$

$=> 32x = 320 => x = 10$.

BC = (32- *2x)* = (32 - 20) cm = 12 cm.

Hence, required area = ((1/2)x*BC * AD) = ((1/2)*12 *10)cm^2 = 60 cm^2.

Ex. 19. Find the length of the altitude of an equilateral triangle of side 3√3 cm.

Sol. Area of the triangle = (√3/4) x *(3 √3)2* = *27 √3.* Let the height be *h.*

Then, (1/2) x 3√3 x *h* = **(**27√3/4) X(2/√3) = 4.5 cm.

.

Ex. 20. In two triangles, the ratio of the areas is 4 : 3 and the ratio of their heights

is 3 : 4. Find the ratio of their bases.

Sol. Let the bases of the two triangles be x and y and their heights be *3h* and *4h* respectively.
Then,
((1/2) X x X 3h)/(1/2) X y X 4h) =4/3 ⇔ x/y =(4/3 X 4/3)=16/9
Required ratio = 16 : 9.

Ex.21. The base of a parallelogram is twice its height. If the area of the parallelogram is 72 sq. cm, find its height.

Sol. Let the height of the parallelogram be x. cm. Then, base = (2x*)* cm.

2x X x =72 ⇔ 2x^2 = 72 ⇔ X ^2=36 ⇔ x=6
Hence, height of the parallelogram = 6 cm.

Ex. 22. Find the area of a rhombus one side of which measures 20 cm and 01 diagonal 24 cm.
Sol. Let other diagonal = 2x cm.
Since diagonals of a rhombus bisect each other at right angles, we have:

(20)2 = (12)2 + (x)2 _ *x* = √(20)2 – (12)2= √256= 16 cm. _I
So, other diagonal = 32 cm.

Area of rhombus = (1/2) x (Product of diagonals) = *((1/2)x* 24 x 32) cm^2 = 384 cm^2

Ex. 23. The difference between two parallel sides of a trapezium is 4 cm. perpendicular distance between them is 19 cm. If the area of the trapezium is 475 find the lengths of the parallel sides. (R.R.B. 2002)
Sol. Let the two parallel sides of the trapezium be *a* em and b em.
Then, *a* - *b* = 4

And, (1/2) x *(a + b)* x 19 = 475 ⇔ *(a + b)* =((475 x 2)/19) ⇔ *a* + *b* = 50

Solving (i) and *(*ii*)*, we get: *a* = 27, *b* = 23.
So, the two parallel sides are 27 cm and 23 cm.

Ex. 24. Find the length of a rope by which a cow must be tethered in order tbat it may be able to graze an area of 9856 sq. metres. (M.A.T. 2003)
Sol. Clearly, the cow will graze a circular field of area 9856 sq. metres and radius equal to the length of the rope.
Let the length of the rope be R metres.

Then, ∏(R)^2 = (9856 X (7/22)) = 3136⇔ R = 56.

Length of the rope = 56 m.

Ex. 25. The area of a circular field is 13.86 hectares. Find the cost of fencing it at the rate of Rs. 4.40 per metre.

Sol. Area = (13.86 x 10000) m^2= 138600 m^2.

$\prod(R^2$= 138600 $\Leftrightarrow$(R)2 = (138600 x (7/22)) $\Leftrightarrow$ R = 210 m.

Circumference = 2$\prod$R = (2 x (22/7) x 210) m = 1320 m.
Cost of fencing = Rs. (1320 x 4.40) = Rs. 5808.

Ex. 26. The diameter of the driving wheel of a bus is 140 em. How many revolution, per minute must the wheel make in order to keep a speed of 66 kmph ?

Sol. Distance to be covered in 1 min. = (66 X_1000)/(60) m = 1100 m.

Circumference of the wheel = (2 x (22/7) x 0.70) m = 4.4 m.

Number of revolutions per min. =(1100/4.4) = 250.

Ex, 27. A wheel makes 1000 revolutions in covering a distance of 88 km. Find the radius of the wheel.

Sol. Distance covered in one revolution =((88 X 1000)/1000)= 88m.

2$\prod$R = 88 $\Leftrightarrow$ 2 x (22/7) x R = 88 $\Leftrightarrow$ R = 88 x (7/44) = 14 m.

Ex, 28. The inner circumference of a circular race track, 14 m wide, is 440 m. Find radius of the outer circle.

Sol . Let inner radius be *r* metres. Then, 2$\prod$r = 440 $\Leftrightarrow$ r = (440 x (7/44))= 70 m.

Radius of outer circle = (70 + 14) m = 84 m.

Ex, 29. Two concentric circles form a ring. The inner and outer circumferences of ring are (352/7) m and (518/7) m respectively. Find the width of the ring.

Sol.. Let the inner and outer radii be r and R metres.

Then *2*$\prod$*r* = (352/7) $\Leftrightarrow$ r =((352/7) X (7/22) X (1/2))=8m.

2$\prod$R=(528/7) $\Leftrightarrow$ R=((528/7) X (7/22) X (1/2))= 12m.

, ', Width of the ring = (R - *r)* = (12 - 8) m = 4 m.

Ex, 30. A sector of 120', cut out from a circle, has an area of (66/7) sq. cm. Find the radius of the circle.

Sol. Let the radius of the circle be *r* cm. Then,

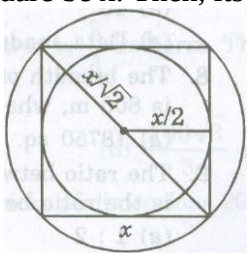
($\prod$(r)2 θ) /360=(66/7) $\Leftrightarrow$ (22/7) X (r) 2 X(120/360)= (66/7)

$\Leftrightarrow$ (r)2=((66/7) X (7/22) X 3) $\Leftrightarrow$ r=3.

Hence, radius = 3 cm.

Ex, 31. Find the ratio of the areas of the incircle and circumcircle of a square.

Sol. Let the side of the square be x. Then, its diagonal = $\sqrt{2}\,x$.



Radius of incircle = (x/2)
Radius of circum circle= ($\sqrt{2}$x/2) =(x/$\sqrt{2}$)

Required ratio = ((∏ (r)2)/4 : (∏(r)2) /2) = (1/4) : 1/2) = 1 : 2.

Ex. 32. If the radius of a circle is decreased by 50%, find the percentage decrease in its area.

Sol. Let original radius = R. New radius =(50/100) R = (R/2)

Original area=∏(R)2= and new area= ∏ ((R/2))2= (∏ (R)2)/4
Decrease in area =((3∏ (R)2)/4 X (1/∏(R)2) X 100) % = 75%

25.VOLUME AND SURFACE AREA

IMPORTANT FORMULAE

I. CUBOID

Let length = 1, breadth = b and height = h units. Then, 1. Volume = (1 x b x h) cubic units.

2. Surface area= 2(lb + bh + lh) sq.units.

3. Diagonal.=$\sqrt{l^2 + b^2 + h^2}$ units

II. CUBE

Let each edge of a cube be of length a. Then,

1. Volume = a^3 cubic units.

2. Surface area = $6a^2$ sq. units.
3. Diagonal = $\sqrt{3}$ a units.

III. CYLINDER

Let radius of base = r and Height (or length) = h. Then,

1. Volume = (Πr^2h) cubic units.
2. Curved surface area = (2Π rh). units.
3. Total surface area =$2\Pi r$ (h+r) sq. units

IV. CONE

Let radius of base = r and Height = h. Then,

1. Slant height, l = $\sqrt{h^2+r^2}$

2. Volume = (1/3) Πr^2h cubic units.

3. Curved surface area = (Πrl) sq. units.
4. Total surface area = (Πrl + Πr^2) sq. units.

V. SPHERE

Let the radius of the sphere be r. Then,

1. Volume = (4/3)Πr3 cubic units.

2. Surface area = ($4\Pi r^2$) sq. units.

VI. HEMISPHERE

Let the radius of a hemisphere be r. Then,

1. Volume = (2/3)Πr^3 cubic units.

2. Curved surface area = ($2\Pi r^2$) sq. units.

3. Total surface area = ($3\Pi r^2$) units.

Remember: 1 litre = 1000 cm3.

SOLVED EXAMPLES

Ex. 1. Find the volume and surface area of a cuboid 16 m long, 14 m broad and 7 m high.

Sol. Volume = (16 x 14 x 7) m3 = 1568 m3.

1 Surface area = [2 (16 x 14 + 14 x 7 + 16 x 7)] cm^2 = (2 x 434) cm^2 = 868 cm^2.

Ex. 2. Find the length of the longest pole that can be placed in a room 12 m long 8m broad and 9m high.

i

Sol. Length of longest pole = Length of the diagonal of the room

$= \sqrt{(12^2+8^2+9^2} = .\sqrt{(289)} = 17$ m.

Ex. 3. Tbe volume of a wall, 5 times as high as it is broad and 8 times as long as it is high, is 12.8 cu. metres. Find the breadth of the wall.

Sol. Let the breadth of the wall be x metres.

Then, Height = 5x metres and Length = 40x metres.

$\therefore x * 5x * 40x = 12.8 \Leftrightarrow x^3 = 12.8/200 = 128/2000 = 64/1000$

So, x = (4/10) m =((4/10)*100)cm = 40 cm

Ex. 4. Find the number of bricks, each measuring 24 cm x 12 cm x 8 cm, required to construct a wall 24 m long, 8m high and 60 cm thick, if 10% of the wall is filled with mortar?

Sol. Volume of the wall = (2400 x 800 x 60) cu. cm.

Volume of bricks = 90% of the volume of the wall

=((90/100)*2400 *800 * 60)cu.cm.

Volume of 1 brick = (24 x 12 x 8) cu. cm.

$\therefore$ Number of bricks=(90/100)*(2400*800*60)/(24*12*8)=45000.

Ex. 5. Water flows into a tank 200 m x 160 m througb a rectangular pipe of 1.5m x 1.25 m @ 20 kmph . In what time (in minutes) will the water rise by 2 metres?

Sol. Volume required in the tank = (200 x 150 x 2) m^3 = 60000 m^3.

. .

Length of water column flown in1 min =(20*1000)/60 m =1000/3 m

Volume flown per minute = 1.5 * 1.25 * (1000/3) m^3 = 625 m^3.

$\therefore$ Required time = (60000/625)min = 96min

Ex. 6. Tbe dimensions of an open box are 50 cm, 40 cm and 23 cm. Its thickness is 2 cm. If 1 cubic cm of metal used in the box weighs 0.5 gms, find the weight of the box.

Sol. Volume of the metal used in the box = External Volume - Internal Volume

$= [(50 * 40 * 23) - (44 * 34 * 20)]cm^3$

$= 16080\ cm^3$

$\therefore$ Weight of the metal =((16080*0.5)/1000) kg = 8.04 kg.

Ex. 7. The diagonal of a cube is 6√3cm. Find its volume and surface area.

Sol. Let the edge of the cube be a.

$\therefore \sqrt{3}a = 6../3 _ a = 6.$

So,Volume = a^3 = (6 x 6 x 6) cm^3 = 216 cm^3.

Surface area = $6a^2$ = (6 x 6 x 6) cm^2 == 216 cm^2.

Ex. 8. The surface area of a cube is 1734 sq. cm. Find its volume.

Sol. Let the edge of the cube bea. Then,

$6a^2 = 1734 \Rightarrow a^2 = 289 \Rightarrow a = 17$ cm.

$\therefore$ Volume = $a^3 = (17)^3$ cm^3 = 4913 cm^3.

Ex. 9. A rectangular block 6 cm by 12 cm by 15 cm is cut up into an exact number of equal cubes. Find the least possible number of cubes.

Sol. Volume of the block = (6 x 12 x 15) cm^3 = 1080 cm^3.

Side of the largest cube = H.C.F. of 6 cm, 12 cm, 15 cm = 3 cm.

Volume of this cube = (3 x 3 x 3) cm^3 = 27 cm^3.

Number of cubes = 1080/27 = 40.

Ex.l0. A cube of edge 15 cm is immersed completely in a rectangular vessel containing water . If the dimensions of the base of vessel are 20 cm x 15 cm, find the rise in water level.

Sol. Increase in volume = Volume of the cube = (15 x 15 x 15) cm^3.

$\therefore$ Rise in water level = volume/area = (15 x 15 x 15)/(20 x 15) cm = 11.25 cm.

Ex. 11. Three solid cubes of sides 1 cm, 6 cm and 8 cm are melted to form a new cube. Find the surface area of the cube so formed.

Sol. Volume of new cube = $(1^3 + 6^3 + 8^3)$ cm+ = 729 cm^3.

Edge of new cube = $\sqrt[3]{729}$ cm = 9 cm.

$\therefore$ Surface area of the new cube = (6 x 9 x 9) cm^2 = 486 cm^2.

Ex. 12. If each edge of a cube is increased by 50%, find the percentage increase in **Its surface area.** "

Sol. Let original length of each edge = a.

Then, original surface area = $6a^2$.

New edge = (150% of a) = (150a/100) = 3a/2

New surface area = $6x (3a/2)^2 = 27a^2/2$

Increase percent in surface area = $((\frac{15a^2}{2}) \times (\frac{1}{6a^2}) \times 100)\% = 125\%$

Ex. 13. Two cubes have their volumes in the ratio 1 : 27. Find the ratio of their surface areas.

Sol. Let their edges be a and b. Then,

$a^3/b^3 = 1/27$ (or) $(a/b)^3 = (1/3)^3$ (or) $(a/b) = (1/3)$.

$\therefore$ Ratio of their surface area = $6a^2/6b^2 = a^2/b^2 = (a/b)^2 = 1/9$, i.e. 1:9.

Ex.14.Find the volume , curved surface area and the total surface area of a cylinder with diameter of base 7 cm and height 40 cm.

Sol. Volume = $\prod r^2 h = ((22/7)x(7/2)x(7/2)x40) = 1540\ cm^{3.}$.

Curved surface area = $2\prod rh = (2x(22/7)x(7/2)x40) = 880\ cm^2$.

Total surface area = $2\prod rh + 2\prod r^2 = 2\prod r\ (h + r)$

$= (2 \times (22/7) \times (7/2) \times (40+3.5))\ cm^2$

$= 957\ cm^2$

Ex.15. If the capacity of a cylindrical tank is 1848 m^3 and the diameter of its base is 14 m, then find the depth of the tank.

Sol. Let the depth of the tank be h metres. Then,

$\prod \times 7^2 \times h = 1848 \Rightarrow h = (1848 \times (7/22) \times (1/49) = 12$ m

Ex.16. 2.2 cubic dm of lead is to be drawn into a cylindrical wire 0.50 cm **diameter. Find the length of the wire in metres.**

Sol. Let the length of the wire be h metres. Then,

$\prod (0.50/(2 \times 100))^2 \times h = 2.2/1000$

$\Rightarrow$ $h = ((2.2/1000) \times (100 \times 100)/(0.25 \times 0.25) \times (7/22)) = 112$ m.

Ex. 17. How many iron rods, each of length 7 m and diameter 2 cm can be made out of 0.88 cubic metre of iron?

Sol. Volume of 1 rod = $((22/7) \times (1/100) \times (1/100) \times 7)$ cu.m = 11/5000 cu.m

Volume of iron = 0.88 cu. m.

Number of rods = $(0.88 \times 5000/11) = 400$.

Ex. 18. The radii of two cylinders are in the ratio 3: 5 and their heights are in tbe ratio of 2 : 3. Find the ratio of their curved surface areas.

Sol. Let the radii of the cylinders be 3x, 5x and their heights be 2y, 3y respectively. Then

Ratio of their curved surface area = $\frac{2\prod \text{ X } 3x \text{ X } 2y}{2\prod \text{ X } 5x \text{ X } 3y} = 2/5 = 2.5$

Ex. 19. If 1 cubic cm of cast iron weighs 21 gms, then find the eight of a cast iron pipe of length 1 metre with a bore of 3 cm and in which thickness of the metal is 1 em.

Sol. Inner radius = (3/2) cm = 1.5 cm, Outer radius = (1.5 + 1) = 2.5 cm.

$\therefore$ Volume of iron = $[\prod \times (2.5)^2 \times 100 - \prod \times (1.5)^2 \times 100]$ cm^3

$= (22/7) \times 100 \times [(2.5)^2 - (1.5)^2]$ cm^3

$= (8800/7)$ cm^3

Weight of the pipe = $((8800/7) \times (21/1000))$kg = 26.4 kg.

Ex. 20. Find the slant height, volume, curved surface area and the whole surface area of a cone of radius 21 cm and height 28 cm.

Sol. Here, r = 21 cm and h = 28 cm.

$\therefore$ Slant height, $l = \sqrt{r^2 + h^2} = \sqrt{(21)^2 + (28)^2} = \sqrt{1225} = 35$cm

Ex. 21. Find the length of canvas 1.25 m wide required to build a conical tent of base radius 7 metres and height 24 metres**.**

Sol. Here, r = 7m and h = 24 m.

So,$l = \sqrt{(r^2 + h^2)} = \sqrt{(7^2 + 24^2)} = \sqrt{(625)} = 25$ m.
Area of canvas = $\pi rl = ((22/7)*7*25)m^2 = 550\ m^2$.
Length of canvas = (Area/Width) = (550/1.25) m = 440 m.

Ex. 22. The heights of two right circular cones are in the ratio 1 : 2 and the perimeters of their bases are in the ratio 3 : 4. Find the ratio of their volumes.

Sol. Let the radii of their bases be r and R and their heights be h and 2h respectively.
Then,$(2\pi r/2\pi R)=(3/4) \Rightarrow R=(4/3)r$.
$\therefore$ Ratio of volumes = $(((1/3)\pi r^2h)/((1/3)\pi(4/3r)^2(2h)))=9 : 32$.

Ex. 23. The radii of the bases of a cylinder and a cone are in the ratio of 3 : 4 and It heights are in the ratio 2 : 3. Find the ratio of their volumes.

Sol. Let the radii of the cylinder and the cone be 3r and 4r and their heights be 2h and 3h respectively.

:. Volume of cylinder = $\pi \times (3r)^2 * 2h = 9/8 = 9 : 8$.

Volume of cone $(1/3)\pi r^2 * 3h$

Ex. 24. A conical vessel, whose internal radius is 12 cm and height 50 cm, is full of liquid. The contents are emptied into a cylindrical vessel with internal radius 10 cm. Find the height to which the liquid rises in the cylindrical vessel.

Sol. Volume of the liquid in the cylindrical vessel
= Volume of the conical vessel
= $((1/3)* (22/7)* 12 * 12 * 50))cm^3 = (22 *4 *12 * 50)/7\ cm^3$.

Let the height of the liquid in the vessel be h.

Then (22/7)*10*10*h =(22*4*12*50)/7 or

h = (4*12*50)/100 = 24 cm

Ex. 25. Find the volume and surface area of a sphere of radius 10.5 cm.

3 3
Sol. Volume = $(4/3)\pi r^3 =(4/3)*(22/7)*(21/2)*(21/2)*(21/2)\ cm^3 = 4851\ cm^3$.
Surface area = $4\pi r^2 =(4*(22/7)*(21/2)*(21/2))\ cm^2 = 1386\ cm^2$

Ex. 26. If the radius of a sphere is increased by 50%, find the increase percent in volume and the increase percent in the surface area.

Sol. Let original radius = R. Then, new radius = (150/100)R=(3R/2)
Original volume = $(4/3)\prod R^3$, New volume = $(4/3)\prod(3R/2)^3 = (9\prod R^3/2)$
Increase % in volume=$((19/6)\prod R^3)*(3/4\prod R^3)*100))\% = 237.5\%$
Original surface area =$4\prod R^2$. New surface area = $4\prod(3R/2)^2=9\prod R^2$
Increase % in surface area =$(5\prod R^2/4\prod R^2) * 100)\% = 125\%$.

Ex. 27. Find the number of lead balls, each 1 cm in diameter that can be a sphere of diameter 12 cm.

Sol. Volume of larger sphere = $(4/3)\prod*6*6*6)\ cm^3 = 288\prod\ cm^3$.
Volume of 1 small lead ball = $((4/3)\prod*(1/2)*(1/2)*(1/2))\ cm^3 = \prod/6\ cm^3$.
$\therefore$ Number of lead balls = $(288\prod*(6/\prod)) = 1728$.

Ex.28.How many spherical bullets can be made out of a lead cylinder 28cm high and with radius 6 cm, each bullet being 1.5 cm in diameter ?

Sol. Volume of cylinder = $(\prod \text{ x } 6 \text{ x } 6 \text{ x } 28)\ cm^3 = (9\prod/16)\ cm^3$.
Number of bullet = $\frac{\text{Volume of cylinder}}{\text{Volume of each bullet}} = [(36 \text{ x } 28)\prod \text{ x } 16] /9\prod = 1792$.

Ex.29.A copper sphere of diameter 18cm is drawn into a wire of diameter 4 mm Find the length of the wire.

Sol. Volume of sphere = $((4\prod/3) \text{ x } 9 \text{ x } 9 \text{ x } 9)\ cm^3 = 972\prod\ cm^3$
Volume of sphere = $(\prod \text{ x } 0.2 \text{ x } 0.2 \text{ x } h)\ cm^3$
$\therefore\ 972\prod = \prod \text{ x } (2/10) \text{ x } (2/10) \text{ x } h \Rightarrow h = (972 \text{ x } 5 \text{ x } 5)cm = [(972 \text{ x } 5 \text{ x5})/100]\ m$
$= 243m$

Ex.30.Two metallic right circular cones having their heights 4.1 cm and 4.3 cm and the radii of their bases 2.1 cm each, have been melted together and recast into a sphere. Find the diameter of the sphere.

Sol. Volume of sphere = Volume of 2 cones
$= (\frac{1}{3}\prod \text{ x } (2.10^2) \text{ x } 4.1 + \frac{1}{3}\prod \text{ x } (2.1)^2 \text{ x } 4.3)$
Let the radius of sphere be R
$\therefore (4/3)\prod R^3 = (1/3)\prod(2.1)^3$ or R = 2.1cm
Hence , diameter of the sphere = 4.2.cm

Ex.31.A Cone and a sphere have equal radii and equal volumes. Find the ratio of the

sphere of the diameter of the sphere to the height of the cone.

Sol. Let radius of each be R and height of the cone be H.

Then, $(4/3) \prod R^3 = (1/3) \prod R^2H$ (or) $R/H = ¼$ (or) $2R/H = 2/4 = 1/2$

$\therefore$ Required ratio = 1:2.

Ex.32.Find the volume , curved surface area and the total surface area of a hemisphere of radius 10.5 cm.

Sol. Volume $= (2\prod r^3/3) = ((2/3) \times (22/7) \times (21/2) \times (21/2) \times (21/2))cm^3$

$= 2425.5\ cm^3$

Curved surface area $= 2\prod r^3 = (2 \times (22/7) \times (21/2) \times (21/2))cm^2$

$=693\ cm^2$

Total surface area $= 3\prod r^3 = (3 \times (22/7) \times (21/2) \times (21/2))cm^2$

$= 1039.5\ cm^{2.}$

Ex.33.Hemispherical bowl of internal radius 9 cm contains a liquid. This liquid is to be filled into cylindrical shaped small bottles of diameter 3 cm and height 4 cm. How many bottles will be needed to empty the bowl ?

Sol. Volume of bowl $= ((2\prod/3) \times 9 \times 9 \times 9)\ cm^3 = 486\prod\ cm^3$.

Volume of 1 bottle $= (\prod \times (3/2) \times (3/2) \times 4)\ cm^3 = 9\prod\ cm^3$

Number of bottles $= (486\prod/9\prod) = 54$.

Ex34.A Cone,a hemisphere and a cylinder stand on equal bases and have the same height.Find ratio of their volumes.

Sol. Let R be the radius of each

Height of the hemisphere = Its radius = R.

$\therefore$ Height of each = R.

Ratio of volumes $= (1/3)\prod R^2 \times R : (2/3)\prod R^3 : \prod R^2 \times R = 1:2:3$

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26. RACES AND GAMES

IMPORTANT FACTS

Races: A contest of speed in running, riding, driving, sailing or rowing is called race

Course: The ground or path on which contests are made is called a race course.

Starting Point: The point from which a race begins is known as a starting point.

Winning Point or Goal: The point set to bound a race is called a winning paint or a goal.

Winner: The person who first reaches the winning point is called a winner.

Dead Heat Race: If all the persons contesting a race reach the goal exactly at the same time, then the race is said to be a dead heat race.

Start: Suppose A and B are two contestants in a race. If before the start of the race, A is at the starting point and B is ahead of A by 12 metres, then we say that 'A gives B, a start of 12 metres. '
To cover a race of 100 metres in this case, A will have to cover 100 metres while B will

have to cover only (100 - 12) = 88 metres. i

In a 100 m race, 'A can give B 12 m' or 'A can give B a start of 12 m' or 'A beats 12 m' means that while A runs 100 m, B runs (100 - 12) = 88 m.

Games: 'A game of 100, means that the person among the contestants who scores 100m first is the winner.

If A scores 100 points while B scores only 80 points, then we say that 'A can give B 20 points.

SOLVED EXAMPLES :

Ex. 1. In a km race, A beats B by 28 metres or 7 seconds. Find A's time over the course.

Sol. Clearly, B covers 28 m in 7 seconds.

:. B's time over the course = (278 x 1000) sec = 250 seconds.

:. A's time over the course = (250 - 7-) sec = 243 sec = 4 min. 3 sec.

Ex. 2. A runs 1 ¾ times as fast as B. if A gives B a start of 84 m, bow far must winning post be so that A and B might reach it at the same time?

Sol. Ratio of the rates of A and B = 7/4 : 1 = 7 : 4.

So, in a race of 7 m, A gains 3m over B.

:. 3 m are gained by A in a race of 7 m.

:. 84 m are gained by A in a race of (7/3 x 84) m = 196 m.

:. Winning post must be 196 m away from the starting point.

Ex. 3. A can run 1 km in 3 min. 10 sec. and B can cover the same distance in 3 min. 20 sec. By what distance can A beat B ?

Soln:Clearly, A beats B by 10 sec.

Distance covered by B in 10 sec. = (1000 x 10)m = 50 m.

Therefore A beats B by 50 metres.

Ex .4 . In a 100 m race, A runs at 8km per hour. If A gives B a start of 4 m and still him by 15 seconds, what is the speed of B ?

Sol: Time taken by A to cover 100 m =(60 X 60 / 8000) x 100 sec = 45 sec.
B covers (100 - 4) m = 96 m in (45 + 15) sec = 60 sec.
B's speed = $\frac{96 \times 60 \times 60}{60 \times 1000}$ km/hr = 5.76 km/hr.

Ex. 5. A, Band C are three contestants in a km race. If A can give B a start of 40 m
and A can give C a start of 64m how many metre's start can B give C ?

Sol: While A covers 1000 m, B covers (1000 - 40) m = 960 m and
C covers (1000 - 64) m or 936 m.
When B covers 960 m, C covers 936 m.

Ex 6. In a game of 80 points; A can give B 5 points and C 15 points. Then how many points B can give C in a game of 60 ?

Sol. A: B = 80 : 75, A : C = 80 : 65.
B/C = (B/ A * A/C) = (75 / 80 * 80 / 65) = 15/13 = 60 /52 = 60: 5
Therfore ,In a game of 60, B can give C 8 points.

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27. CALENDAR

IMPORTANT FACTS AND FOAMULAE

Under this heading we mainly deal with finding the day of the week on a particular given date the process of finding it lies on obtaining the number of odd days.

Odd Days : Number of days more than the complete number of weeks in a given

Period ., is the number of odd days during that period.

LeapYear: Every year which is divisible by 4 is called a leap year.

Thus each one of the years 1992, 1996, 2004, 2008, 2012, etc. is a leap year.
Every 4th century is a leap year but no other century is a leap year.thus each one of 400, 800, 1200,' 1600, 2000, etc. is a leap year.
None of 1900, 2010, 2020, 2100, etc. is a leap year.

An year which is not a leap year is called an ordinary year.

(I)An ordinary year has 365 days. **(II) A leap year has 366 days.**

Counting of Odd Days:

i)1 ordinary year = 365 days = (52 weeks + 1 day).
:. An ordinary year has 1 odd day.
ii)1 leap year = 366 days = (52 weeks + 2 days).
:. A leap year has 2 odd days.
iii)100 years = 76 ordinary years + 24 leap years
= [(76 x 52) weeks + 76 days) + [(24 x 52) weeks + 48 days]
= 5200 weeks + 124 days = (5217 weeks + 5 days).
:. 100 years contain 5 odd days.
200 years contain 10 and therefore 3 odd days.
300 years contain 15 and therefore 1 odd day.
400 years contain (20 + 1) and therefore 0 odd day.
Similarly, each one of 800, 1200, 1600, 2000, etc. contains 0 odd days.
Remark: (7n + m) odd days, where m < 7 is equivalent to m odd days.
Thus, 8 odd days ≡ 1 odd day etc.

No of odd days	0	1	2	3	4	5	6
Day	Sun.	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.

SOLVED EXAMPLES

Ex: 1.Wbat was the day of the week on, 16th July, 1776?

Sol: 16th July, 1776 = (1775 years + Period from 1st Jan., 1776 to 16th July, 1776)
Counting of odd days :
1600 years have 0 odd day. 100 years have 5 odd days.
75 years = (18 leap years + 57 ordinary years)
= [(18 x 2) + (57 x 1)] odd days = 93 odd days
= (13 weeks + 2 days) = 2 odd days.

.. 1775 years have (0 + 5 + 2) odd days = 7 odd days = 0 odd day.
Jan. Feb. March April May June July
31 + 29 + 31 + 30 + 31 + 30 +16 = 198days
= (28 weeks + 2 days) =2days
:. . Total number of odd days = (0 + 2) = 2. Required day was 'Tuesday'.

Ex. 2. What was the day of the week on 16th August, 1947?

Sol. 15th August, 1947 = (1946 years + Period from 1st Jan., 1947 to 15th
Counting of odd days:
1600 years have 0 odd day. 300 years have 1 odd day.
47 years = (11 leap years + 36 ordinary years)
= [(11 x 2) + (36 x 1») odd days = 58 odd days = 2 odd days.
Jan. Feb. March April May June July Aug.
31 + 28 + 31 + 30 + 31 + 30 + 31 + 15
= 227 days = (32 weeks + 3 days) = 3,
Total number of odd days = (0 + 1 + 2 + 3) odd days = 6 odd days.
Hence, the required day was 'Saturday'.

Ex. 3. What was the day of the week on 16th April, 2000 ?

Sol. 16th April, 2000 = (1999 years + Period from 1st Jan., 2000 to 16thA'
Counting of odd days:
1600 years have 0 odd day. 300 years have 1 odd day.
99 years = (24 leap years + 75 ordinary years)

= [(24 x 2) + (75 x 1)] odd days = 123 odd days
= (17 weeks + 4 days) = 4 odd days.
Jan. Feb. March April
31 + 29 + 31 + 16 = 107 days = (15 weeks + 2 days) = 2 odd,
Total number of odd days = (0 + 1 + 4 + 2) odd days = 7 odd days = 0 odd day. Hence, the required day was 'Sunday'.

Ex. 4. On what dates of Jull.2004 did Monday fall?

Sol . Let us find the day on 1st July, 2004.
2000 years have 0 odd day. 3 ordinary years have 3 odd days.
Jan. Feb. March April May June July
31 + 29 + 31 + 30 + 31 + 30 + 1
= 183 days = (26 weeks + 1 day) = 1 t .
Total number of odd days = (0 + 3 + 1) odd days = 4 odd days.'
:. 1st July 2004 was 'Thursday',-,-
Thus, 1st Monday in July 2004 _as on 5th July.
Hence, during July 2004, Monday fell on 5th, 12th, 19th and 26th. .

Ex. 5. Prove that the calendar for the year 2008 will serve for the year 20ll

Sol. In order that the calendar for the year 2003 and 2014 be the same, 1st January of both the years must be on the same day of the week.
For this, the number of odd days between 31st Dec., 2002 and 31st Dec.,2013 must be the same.
We know that an ordinary year has 1 odd day and a leap year has 2 odd During this period, there are 3 leap years, namely 2004, 2008 and 2012 and 8 ordinary years.
Total number of odd days = (6 + 8) days = 0 odd day.
Hence, the calendar for 2003 will serve for the year 2014.

Ex. 6. Prove that any date in March of a year is the same day of the week corresponding date in November that year.

We will show that the number of odd days between last day of February and last day of October is zero. .
March April May June July Aug. Sept. Oct.
31 + 30 + 31 + 30 + 31 + 31 + 30 + 31

= 241 days = 35 weeks = 0 odd day.
,Number of odd days during this period = O.
Thus, 1st March of an year will be the same day as 1st November of that year. Hence, the result follows.

28. CLOCKS

IMPORTANT FACTS

The Face or dial of a watch is a circle whose circumference is divided into 60 equal parts, called ***minute spaces***.
A clock has two hands, the smaller one is called *the* ***hour hand*** **or** ***short hand*** while the larger one is called the ***minute hand*** **or** ***long hand..***
i) In 60 minutes, the minute hand gains 55 minutes on the hour hand.
ii) In every hour, both the hands coincide once.
iii) The hands are in the same straight line when they are coincident or opposite to each other.
iv) When the two hands are at right angles, they are 15 minute spaces apart.
v)When the hand's are in opposite directions, they are 30 minute spaces apart.
vi)Angle traced by hour hand in 12 hrs = 360°.
vii)Angle traced by minute hand in 60 min. = 360°.

Too Fast **and** ***Too Slow: If*** **a** ***watch or*** **a** ***clock indicates*** **8.15,** ***when the correct time*** **, 8 is said** ***to be*** **15** ***minutes too fast.***
On the other hand, if it indicates **7.45,** ***when the correct time is*** **8,** ***it is said to be 15 minutes too slow.***

SOLVED EXAMPLES

Ex 1:Find the angle between the hour hand and the minute hand of a clock when 3.25.

Solution:angle traced by the hour hand in 12 hours = 360°
Angle traced by it in three hours 25 min (ie) 41/12 hrs=(360*41/12*12)°

=102*1/2°
angle traced by minute hand in 60 min. = 360°.
Angle traced by it in 25 min. = (360 X 25)/60= 150°
Required angle = 1500 – 102*1/2°= 47*1/2°

Ex 2: At what time between 2 and 3 o'clock will the hands of a clock be together?

Solution: At 2 o'clock, the hour hand is at 2 and the minute hand is at 12, *i.e.* they are 10 min spaces apart.
To be together, the minute hand must gain 10 minutes over the hour hand.
Now, 55 minutes are gained by it in 60 min.

10 minutes will be gained in (60 x 10)/55 min. = 120/11 min.

The hands will coincide at 120/11 min. past 2.

Ex. 3. At what time between 4 and 5 o'clock will the hands of a clock be at right angle?

Sol: At 4 o'clock, the minute hand will be 20 min. spaces behind the hour hand, Now, when the two hands are at right angles, they are 15 min. spaces apart. So, they are at right angles in following two cases.
Case I. When minute hand is 15 min. spaces *behind the hour hand:*
In this case min. hand will have to gain (20 - 15) = 5 minute spaces. 55 min. spaces are gained by it in 60 min.

5 min spaces will be gained by it in 60*5/55 min=60/11min.

:. They are at right angles at 60/11min. past 4.

Case II. When the minute hand is 15 min. spaces *ahead* of the *hour* hand:
To be in this position, the minute hand will have to gain (20 + 15) = 35 minute spa' 55 min. spaces are gained in 60 min.

35 min spaces are gained in (60 x 35)/55 min =40/11

:. They are at right angles at 40/11 min. past 4.

Ex. 4. Find at what time between 8 and 9 o'clock will the hands of a clock being the same straight line but not together.

Sol: At 8 o'clock, the hour hand is at 8 and the minute hand is at 12, i.e. the two hands_ are 20 min. spaces apart.
To be in the same straight line but not together they will be 30 minute spaces apart. So, the minute hand will have to gain (30 - 20) = 10 minute spaces over the hour hand.
55 minute spaces are gained. in 60 min.

10 minute spaces will be gained in (60 x 10)/55 min. = 120/11min.

:. The hands will be in the same straight line but not together at 120/11 min.

Ex. 5. At what time between 5 and 6 o'clock are the hands of a clock 3minapart?

. Sol. At 5 o'clock, the minute hand is 25 min. spaces behind the hour hand.
Case I. Minute hand is 3 min. spaces *behind the hour hand.*
In this case, the minute hand has to gain' (25 - 3) = 22 minute spaces. 55 min. are gained in 60 min.

22 min. are gaineg in (60*22)/55min. = 24 min.

:. The hands will be 3 min. apart at 24 min. past 5.
Case II. Minute hand is 3 min. spaces *ahead* of *the hour hand.*
In this case, the minute hand has to gain (25 + 3) = 28 minute spaces. 55 min. are gained in 60 min.

28 min. are gained in (60 x 28_)/55=346/11

The hands will be 3 min. apart at 346/11 min. past 5.

Ex 6. Tbe minute hand of a clock overtakes the hour hand at intervals of 65 minutes of the correct time. How much a day does the clock gain or lose?

Sol: In a correct clock, the minute hand gains 55 min. spaces over the hour hand in 60 minutes.
To be together again, the minute hand must gain 60 minutes over the hour hand. 55 min. are gained in 60 min.

60 min are gained in 60 x 60 min =720/11 min.

But, they are together after 65 min.
Gain in 65 min =720/11-65 =5/11min.

Gain in 24 hours =(5/11 * (60*24)/65)min =440/43
The clock gains 440/43 minutes in 24 hours.

Ex. 7. A watch which gains uniformly, is 6 min. slow at 8 o'clock in the morning Sunday and it is 6 min. 48 sec. fast at 8 p.m. on following Sunday. When was it correct?

Sol. Time from 8 a.m. on Sunday to 8 p.m. on following Sunday = 7 days 12 hours = 180 hours

The watch gains (5 + 29/5) min. or 54/5 min. in 180 hrs.
Now 54/5 min. are gained in 180 hrs.

5 min. are gained in (180 x 5/54 x 5) hrs. = 83 hrs 20 min. = 3 days 11 hrs 20 min.

Watch is correct 3 days 11 hrs 20 min. after 8 a.m. of Sunday.
It will be correct at 20 min. past 7 p.m. on Wednesday.

Ex 8. A clock is set right at 6 a.m. The clock loses 16 minutes in 24 hours. What will be the true time when the clock indicates 10 p.m. on 4th day?

Sol. Time from 5 a.m. on a day to 10 p.m. on 4th day = 89 hours.
Now 23 hrs 44 min. of this clock = 24 hours of correct clock.

356/15 hrs of this clock = 24 hours of correct clock.

89 hrs of this clock = (24 x 31556 x 89) hrs of correct clock.

= 90 hrs of correct clock.

So, the correct time is 11 p.m.

Ex. 9. A clock is set right at 8 a.m. The clock gains 10 minutes in 24 hours will be the

true time when the clock indicates 1 p.m. on the following day?

Sol. Time from 8 a.m. on a day 1 p.m. on the following day = 29 hours.
24 hours 10 min. of this clock = 24 hours of the correct clock.

145 /6 hrs of this clock = 24 hrs of the correct clock

29 hrs of this clock = (24 x 6/145 x 29) hrs of the correct clock

= 28 hrs 48 min. of correct clock

The correct time is 28 hrs 48 min. after 8 a.m.
This is 48 min. past 12.

29. STOCKS AND SHARES

To start a big business or an industry, a large amount of money is needed. It is beyond the capacity of one or two persons to arrange such a huge amount. However, some persons associate together to form a company. They, then, draft a proposal, issue a prospectus(in the name of company), explaining the plan of the project and invite the public to invest money in this project. They, thus, pool up the funds from the public, by assigning them shares **of the company.**

IMPORTANT FACTS AND FORMULAE

1. Stock-capital: **The total amount needed to run the company is called the** stock-capital
2. Shares or stock: **The whole capital is divided into small units, called** shares **or** stock.
   For each investment, the company issues a share-certificate, showing the value of each share and the number of shares held by a person. The person who subscribers in shares or stock is called a share holder **or** stock holder.
3. Dividend: **The annual profit distributed among share holders is called** dividend.
   Dividend is paid annually as per share or as a percentage.
4. Face Value: **The value of a share or stock printed on the share-certificate is called its** Face Value **or** Nominal Value **or** Par Value.
5. Market Value: **The stocks of different companies are sold and bought in the open market through brokers at stock-exchanges. A share (or stock) is said to be:**
   - **(i)** At premium **or** Above par**, if its market value is more than its face value.**
   - **(ii)** At par**, if its market value is the same as its face value.**

(iii) At discount **or** Below par**, if its market value is less than its face value.**

Thus, if a Rs.100 stock is quoted at a premium of 16, then market value of the stock = Rs. (100+16) = Rs. 116.

Likewise, I f a Rs. 100 stock is quoted at a discount of 7, then market value of the stock = Rs. (100-7) = Rs. 93.

6. Brokerage: **The broker's charge is called** brokerage.
   - **(i) When stock is purchased, brokerage is added to the cost price.**
   - **(ii) When stock is sold, brokerage is subtracted from the selling price.**

Remember:

- **(i) The face value of a share always remains the same.**
- **(ii) The market value of a share changes form time to time.**
- **(iii) Dividend is always paid on the face value of a share.**
- **(iv) Number of shares held by a person**

$$= \frac{\text{Total Investment}}{\text{Investment in 1 share}} = \frac{\text{Total Income}}{\text{Income from 1 share}} = \frac{\text{Total Face Value}}{\text{face Value of 1 share}}$$

Thus, by a Rs. 100, 9% stock at 120, we mean that:

- **(i) Face Value (N>V) of stock = Rs. 100.**
- **(ii) Market Value (M>V) of stock = Rs. 120.**
- **(iii) Annual dividend on 1 share = 9% of face value = 9% of Rs. 100 = Rs. 9.**
- **(iv) An investment of Rs. 120 gives an annual income of Rs. 9.**
- **(v) Rate of interest p.a = Annual income from an investment of Rs. 100.**

$$= \left(\frac{9}{120} * 100\right)\% = 7\,(1/2)\,\%.$$

SOLVED EXAMPLES

Ex. 1. Find the cost of:

(i) Rs. 7200, 8% stock at 90;
(ii) Rs. 4500, 8.5% stock at 4 premium;
(iii) Rs. 6400, 10% stock at 15 discount.

Sol. (i) **Cost of Rs. 100 stock = Rs. 90**

Cost of Rs. 7200 stock = Rs. (90/100 * 7200) = Rs. 6480.

(ii) **Cost of Rs. 100 stock = Rs. (100+4)**

Cost of Rs. 4500 stock = Rs. (104/100 * 4500) = Rs. 4680

(iii) **Cost of Rs. 100 stock = Rs. (100-15)**
Cost of Rs. 6400 stock = Rs. (85/100 * 6400) = Rs. 5440.

Ex. 2. Find the cash required to purchase Rs. 3200, 7(1/2) % stock at 107 (brokerage (1/2) %)

Sol. **Cash required to purchase Rs. 100 stock = Rs (107+(1/2)) = Rs. (215/2).**
Cash required to purchase Rs. 100 stock = Rs [(215/2)*(1/100)*3200] = Rs. 3440.

Ex. 3. Find the cash realised by selling Rs. 2440, 9.5% stock at 4 discount (brokerage (1/4) %)

Sol. **By selling Rs. 100 stock , cash realised = Rs. [(100-4)-(1/4)] = Rs. (383/4).**
By selling Rs. 2400 stock, cash realised = Rs. [(383/4)*(1/100)*2400] = Rs 2298.

Ex. 4. Find the annual income derived from Rs. 2500, 8% stock at 106.

Sol. **Income from Rs. 100 stock = Rs. 8.**
Income from Rs. 2500 = Rs. [(8/1000*2500) =Rs. 200.

Ex. 5. Find the annual income derived by investing Rs. 6800 in 10% stock at 136.

Sol. **By investing Rs. 136, income obtained = Rs. 10.**
By investing Rs. 6800, income obtained = Rs. [(10/136)*6800] = Rs. 500.

Ex. 6. Which is better investment? 7(1/2) % stock at 105 or 6(1/2) % at 94.

Sol. **Let the investment in each case be Rs. (105*94).**

Case I : **7(1/2) 5 stock at 105:**
On investing Rs. 105, income = Rs. (15/2).
On investing Rs. (105*94), income = Rs. [(15/2)*(1/105)*105*94] = Rs 705.

Case II : **6(1/2) % stock at 94:**
On investing Rs. 94, income = Rs. (13/2).
On investing Rs. (105*94), income = Rs. [(13/2)*(1/94)*105*94] = Rs. 682.5.
Clearly, the income from 7(1/2) % stock at 105 is more.
Hence, the investment in 7(1/2) % stock at 105 is better.

Ex. 7. Find the cost of 96 shares of Rs. 10 each at (3/4) discount, brokerage being (1/4) per share.

Sol. **Cost of 1 share = Rs. [(10-(3/4)) + (1/4)] = Rs. (19/2).**
Cost of 96 shares = Rs. [(19/2)*96] = Rs. 912.

Ex. 8. Find the income derived from 88 shares of Rs. 25 each at 5 premium, brokerage being (1/4) per share and the rate of dividend being 7(1/2) % per annum. Also, find the rate of interest on the investment.

Sol. **Cost of 1 share = Rs. [25+5+1/4)] = Rs. (121/4).**
Cost of 88 shares = Rs.[(121/4)*88] = Rs. 2662.

∴ Investment made = Rs. 2662.
Face value of 88 shares = Rs. (88*25) = Rs. 2200.
Dividend on Rs. 100 = (15/2).
Dividend on Rs. 2200 = Rs. [(15/20*(1/100)*2200] = Rs. 165.

∴ Income derived = Rs. 165.
Rate of interest on investment = [(165/2662)*100] = 6.2 %.

Ex. 9. A man buys Rs. 25 shares in company which pays 9 % dividend. The money invested is such that it gives 10 % on investment. At what price did he buy the shares?

Sol. **Suppose he buys each share for Rs. x.**
Then, [25*(9/100)] = [x*(10/100)] or x = Rs. 22.50.
Cost of each share = Rs. 22.50.

Ex. 10. A man sells Rs.5000, 12 % stock at 156 and uinvests the proceeds parity in 8 % stock at 90 and 9 % stock at 108. He hereby increases his income by Rs. 70. How much of the proceeds were invested in each stock?

Sol. **S.P of Rs. 5000 stock = Rs. [(156/100)*5000] = Rs. 7800.**
Income from this stock = Rs. [(12/100)*5000] = Rs. 600.
Let investment in * % stock be x and that in 9 % stock = (7800-x).

∴ [x*(8/90)] + (7800-x) * (9/108) = (600+7)
⇔ (4x/45) + [(7800-x)/12] = 670 ⇔ 16x + 117000-15x = (670*180) ⇔ x = 3600.

∴ Money invested in 8 % stock at 90 = Rs. 3600.
Money invested in 9 % at 108 = Rs. (7800-3600) = Rs. 4200.

30. PERMUTATIONS AND COMBINATIONS

IMPORTANT FACTS AND FORMULAE

Factorial Notation: Let n be a positive integer. Then, factorial n, denoted by n! is defined as:

n! = n(n-1)(n-2).....3.2.1.

Examples: (i) 5! = (5x 4 x 3 x 2 x 1) = 120; (ii) 4! = (4x3x2x1) = 24 etc.
We define, 0! = 1.

Permutations: The different arrangements of a given number of things by taking some or all at a time, are called permutations.

Ex. 1. All permutations (or arrangements) made with the letters a, b, c by taking two at a time are: **(ab, ba, ac, bc, cb).**

Ex. 2. All permutations made with the letters a,b,c, taking all at a time are:
(abc, acb, bca, cab, cba).

Number of Permutations: Number of all permutations of n things, taken r at a time, given by:

^nP_r = n(n-1)(n-2).....(n-r+1) = n!/(n-r)!

Examples: (i) $^6p_2$ = (6x5) = 30. (ii) $^7p_3$ = (7x6x5) = 210.

Cor. Number of all permutations of n things, taken all at a time = n!

An Important Result: If there are n objects of which p_1 are alike of one kind; p_2 are alike of another kind; p_3 are alike of third kind and so on and p_r are alike of rth kind, such that (p_1+p_2+.....p_r) = n.

Then, number of permutations of these n objects is:

n! / (p_1!).p_2!).....(p_r!)

Combinations: Each of the different groups or selections which can be formed by taking some or all of a number of objects, is called a combination.

Ex. 1. Suppose we want to select two out of three boys A, B, C. Then, possible selections are AB, BC and CA.
Note that AB and BA represent the same selection.

Ex. 2. All the combinations formed by a, b, c, taking two at a time are **ab, bc, ca.**

Ex. 3. The only combination that can be formed of three letters a, b, c taken all at a time is **abc.**

Ex. 4. Various groups of 2 out of four presons A, B, C, D are:

AB, AC, AD, BC, BD, CD.

Ex. 5. Note that ab and ba are two different permutations but they represent the same combination.

Number of Combinations: The number of all combination of n things, taken r at a time is:

$^{n}C_{r}$ = n! / (r!)(n-r)! = n(n-1)(n-2).....to r factors / r!

Note that: $^{n}c_{r}$ = 1 and $^{n}c_{0}$ = 1.

An Important Result: $^{n}c_{r} = {}^{n}c_{(n-r)}$.

Example: (i) $^{11}c_{4}$ = (11x10x9x8)/(4x3x2x1) = 330.

(ii) $^{16}c_{13} = {}^{16}c_{(16-13)}$ = 16x15x14/3! = 16x15x14/3x2x1 = 560.

SOLVED EXAMPLES

Ex. 1. Evaluate: 30!/28!

Sol. We have, 30!/28! = 30x29x(28!)/28! = (30x29) = 870.

Ex. 2. Find the value of (i) $^{60}p_{3}$ (ii) $^{4}p_{4}$

Sol. (i) $^{60}p_{3}$ = 60!/(60-3)! = 60!/57! = 60x59x58x(57!)/57! = (60x59x58) = 205320.

(ii) $^{4}p_{4}$ = 4! = (4x3x2x1) = 24.

Ex. 3. Find the vale of (i) $^{10}c_{3}$ (ii) $^{100}c_{98}$ (iii) $^{50}c_{50}$

Sol. (i) $^{10}c_{3}$ = 10x9x8/3! = 120.

(ii) $^{100}c_{98} = {}^{100}c_{(100-98)}$ = 100x99/2! = 4950.

(iii) $^{50}c_{50}$ = 1. [$^{n}c_{n}$ = 1]

Ex. 4. How many words can be formed by using all letters of the word “BIHAR”

Sol. The word BIHAR contains 5 different letters.

Required number of words = $^{5}p_{5}$ = 5! = (5x4x3x2x1) = 120.

Ex. 5. How many words can be formed by using all letters of the word ‘DAUGHTER’ so that the vowels always come together?

Sol. Given word contains 8 different letters. When the vowels AUE are always together, we may suppose them to form an entity, treated as one letter.
Then, the letters to be arranged are DGNTR (AUE).

Then 6 letters to be arranged in ${}^{6}p_{6} = 6! = 720$ ways.

The vowels in the group (AUE) may be arranged in 3! = 6 ways.

Required number of words = (720x6) = 4320.

Ex. 6. How many words can be formed from the letters of the word 'EXTRA' so that the vowels are never together?

Sol. The given word contains 5 different letters.
Taking the vowels EA together, we treat them as one letter.
Then, the letters to be arranged are XTR (EA).
These letters can be arranged in 4! = 24 ways.
The vowels EA may be arranged amongst themselves in 2! = 2 ways.
Number of words, each having vowels together = (24x2) = 48 ways.
Total number of words formed by using all the letters of the given words
= 5! = (5x4x3x2x1) = 120.

Number of words, each having vowels never together = (120-48) = 72.

Ex. 7. How many words can be formed from the letters of the word 'DIRECTOR' So that the vowels are always together?

Sol. In the given word, we treat the vowels IEO as one letter.
Thus, we have DRCTR (IEO).
This group has 6 letters of which R occurs 2 times and others are different.
Number of ways of arranging these letters = 6!/2! = 360.
Now 3 vowels can be arranged among themselves in 3! = 6 ways.
Required number of ways = (360x6) = 2160.

Ex. 8. In how many ways can a cricket eleven be chosen out of a batch of 15 players ?

Sol. Required number of ways = ${}^{15}c_{11} = {}^{15}c_{(15-11)} = {}^{11}c_{4}$

$= 15x14x13x12/4x3x2x1 = 1365.$

Ex. 9. In how many ways, a committee of 5 members can be selected from 6 men and 5 ladies, consisting of 3 men and 2 ladies?

Sol. (3 men out 6) and (2 ladies out of 5) are to be chosen.

Required number of ways = $({}^{6}C_{3} \times {}^{5}C_{2}) = [6x5x4/3x2x1] \times [5x4/2x1] = 200$.

31. probability
important facts and formula

1.EXPERIMENT **:AN OPERATION WHICH CAN PRODUCE SOME WELL-DEFINED OUTCOME IS CALLED AN EXPERIMENT**

2.RANDOM EXPERIMENT: AN EXPERIMENT IN WHICH ALL POSSIBLE OUTCOME ARE KNOWN AND THE EXACT OUT PUT CANNOT BE PREDICTED IN ADVANCE IS CALLED AN RANDOM EXPERIMENT

EG OF PERFORMING RANDOM EXPERIMENT:

(I)ROLLING AN UNBIASED DICE

(II)TOSSING A FAIR COIN

(III)DRAWING A CARD FROM A PACK OF WELL SHUFFLED CARD

(IV)PICKING UP A BALL OF CERTAIN COLOR FROM A BAG CONTAINING BALL OF DIFFERENT COLORS

DETAILS:

(I)WHEN WE THROW A COIN. THEN EITHER A **HEAD(H)** OR A **TAIL (T)** APPEARS.

(II)A DICE IS A SOLID CUBE, HAVING 6 FACES ,MARKED 1,2,3,4,5,6 RESPECTIVELY WHEN WE THROW A DIE , THE OUTCOME IS THE NUMBER THAT APPEAR ON ITS TOP FACE .

(III)A PACK OF CARDS HAS 52 CARDS IT HAS 13 CARDS OF EACH SUIT ,NAMELY SPADES, CLUBS ,HEARTS AND DIAMONDS

CARDS OF SPADES AND CLUBS ARE BLACK CARDS

CARDS OF HEARTS AND DIAMONDS ARE RED CARDS

THERE ARE 4 HONORS OF EACH SUIT

THESE ARE **ACES ,KING ,QUEEN AND JACK**

THESE ARE CALLED FACE CARDS

3.**SAMPLE SPACE :W**HEN WE PERFORM AN EXPERIMENT ,THEN THE SET S OF ALL POSSIBLE OUTCOME IS CALLED THE SAMPLE SPACE

EG OF SAMPLE SPACE:

(I)IN TOSSING A COIN ,S={H,T}

(II)IF TWO COIN ARE TOSSED ,THEN S={HH,TT,HT,TH}.

(III)IN ROLLING A DIE WE HAVE,S={1,2,3,4,5,6}.

4.EVENT:ANY SUBSET OF A SAMPLE SPACE.

5.PROBABILITY OF OCCURRENCE OF AN EVENT.

LET S BE THE SAMPLE SPACE AND E BE THE EVENT .

THEN,$E \subseteq S$.

$P(E)=N(E)/N(S)$.

6.RESULTS ON PROBABILITY:

(I)$P(S) = 1$ (II)$0 \leq P(E) \leq 1$ (III)$P(\phi)=0$

(IV)FOR ANY EVENT A AND B, WE HAVE:

$P(A \cup B)=P(A)+P(B)-P(A \cup B)$

(V)IF $\overline{A}$ DENOTES (NOT-A),THEN $P(\overline{A})=1-P(A)$.

SOLVED EXAMPLES

EX 1. IN A THROW OF A COIN ,FIND THE PROBABILITY OF GETTING A HEAD.

SOL. HERE S={H,T} AND E={H}.

P(E)=N(E)/N(S)=1/2

EX2.TWO UNBIASED COIN ARE TOSSED .WHAT IS THE PROBABILITY OF GETTING ATMOST ONE HEAD?

SOL.HERE S={HH,HT,TH,TT}

LET EE=EVENT OF GETTING ONE HEAD

E={TT,HT,TH}

P(E)=N(E)/N(S)=3/4

EX3.AN UNBIASED DIE IS TOSSED .FIND THE PROBABILITY OF GETTING A MULTIPLE OF 3

SOL. HERE S={1,2,3,4,5,6}

LET E BE THE EVENT OF GETTING THE MULTIPLE OF 3

THEN ,E={3,6}

P(E)=N(E)/N(S)=2/6=1/3

E**X4. I**N A SIMULTANEOUS THROW OF PAIR OF DICE .FIND THE PROBABILITY OF GETTING THE TOTAL MORE THAN 7

SOL. HERE N(S)=(6*6)=36

LET E=EVENT OF GETTING A TOTAL MORE THAN 7

={(2,6),(3,5),(3,6),(4,4),(4,5),(4,6),(5,3),(5,4),(5,5),(5,6),(6,2),(6,3),(6,4),(6,5),(6,6)}

P(E)=N(E)/N(S)=15/36=5/12.

EX5. **A BAG CONTAINS 6 WHITE AND 4 BLACK BALLS .2 BALLS ARE DRAWN AT RANDOM. FIND THE PROBABILITY THAT THEY ARE OF SAME COLOUR.**

SOL .LET S BE THE SAMPLE SPACE

THEN N(S)=NO OF WAYS OF DRAWING 2 BALLS OUT OF (6+4)=10C2=(10*9)/(2*1)=45

LET E=EVENT OF GETTING BOTH BALLS OF SAME COLOUR

THEN N(E)=NO OF WAYS(2 BALLS OUT OF SIX) OR(2 BALLS OUT OF 4)

$=({}^{6}C2+{}^{4}C2)=(6*5)/(2*1)+(4*3)/(2*1)=15+6=21$

P(E)=N(E)/N(S)=21/45=7/15

EX6.TWO DICE ARE THROWN TOGETHER .WHAT IS THE PROBABILITY THAT THE SUM OF THE NUMBER ON THE TWO FACES IS DIVIDED BY 4 OR 6

SOL. CLEARLY N(S)=6*6=36

LET E BE THE EVENT THAT THE SUM OF THE NUMBERS ON THE TWO FACES IS DIVIDED BY 4 OR 6.THEN

E={(1,3),(1,5),(2,2),(2,4),(2,6),(3,1),(3,3),(3,5),(4,2),(4,4),(5,1),(5,3),(6,2),
(6,6)}

N(E)=14.

HENCE P(E)=N(E)/N(S)=14/36=7/18

EX7.TWO CARDS ARE DRAWN AT RANDOM FROM A PACK OF 52 CARDS.WHAT IS THE PROBABILITY THAT EITHER BOTH ARE BLACK OR BOTH ARE QUEEN?

SOL. WE HAVE N(S)=52C2=(52*51)/(2*1)=1326.

LET A=EVENT OF GETTING BOTH BLACK CARDS

B=EVENT OF GETTING BOTH QUEENS

A∩B=EVENT OF GETTING QUEEN OF BLACK CARDS

N(A)=^{26}C2=(26*25)/(2*1)=325,

N(B)=^{4}C2=(4*3)/(2*1)=6 AND

N(A∩B)=2C2=1

P(A)=N(A)/N(S)=325/1326;

P(B)=N(B)/N(S)=6/1326 AND

P(A∩B)=N(A∩B)/N(S)=1/1326

P(A∪B)=P(A)+P(B)-P(A∩B)=(325+6-1/1326)=330/1326=55/221

32. TRUE DISCOUNT

IMPORTANT CONCEPTS

Suppose a man has to pay Rs. 156 after 4 years and the rate of interest is 14% per annum. Clearly, Rs. 100 at 14% will amount to Rs. 156 in 4 years. So, the payment of Rs. 100 now will clear off the debt of Rs. 156 due 4 years hence. We say that:
Sum due = Rs. 156 due 4 years hence;

Present Worth (P.W.) = Rs. 100;

True Discount (T.D.) = Rs. (156 - 100) = Rs. 56

(Sum due) - (P.W.).

We define : T.D. = Interest on P.W.

Amount = (P.W.) + (T.D.).

Interest is reckoned on P.W. and true discount is reckoned on the amount.

IMPORTANT FORMULAE

Let rate = R% per annum and Time = T years. Then,

1. P.W.=[100 x Amount /100 + (R x T)
   =100 x T.D./ RxT
2. T.D.=[(P.W.) x R x T /100]
   = [Amount x RxT/100 + (R x T)]
3.(S.I.)*(T.D.) /(S.I.)-(T.D.)
4. (S.I.) - (T.D.) - S.I. on T.D.

5. When the sum is put at compound interest, then
P.W. = Amount/[1 +R/100]^T

SOLVED EXAMPLES

Ex. 1. Find the present worth of Rs. 930 due 3 years hence at 8% per annum. Also find the discount.

Sol.

P.W=100 x Amount /[100 + (R x T)]

=Rs.100 x 930/100+ (8x3)
= (100x930)/124
= Rs. 750,
T.D. = (Amount) - (P.W.) = Rs. (930 - 750) = Rs. 180.

Ex. 2. The true discount on a bill due 9 months hence at 12% per annum is Rs. Find the amount of the bill and its present worth.

Sol. Let amount be Rs. x. Then,
x*R*T/100 + (R x T)
=T.D.
=>x * 12*3/ 4/[100+[12*3/4]]
=540
x= 540x109 = Rs.6540
Amount - Rs. 6540. P.W. = Rs. (6540 - 540) - Rs. 6000.

Ex. 3. The true discount on a certain sum of money due 3 years hence is Rb. 250 and the simple interest on the same sum for the same time and at the same rate is Rs. 375. Find the sum and the rate percent.

Sol. T.D. = Rs. 250 and S.I. = Rs. 375.
Sum due =S.I. xT.D./ S.I. -T.D.

=375x250/375- 250
=Rs.750.
Rate=[100*375/750*3]%=16 2/3%

Ex. 4. The difference between the simple interest and true discount on a certain sum
of money for 6 months at 12—% per annum is Rs. 25. Find the sum.

Sol. Let the sum be Rs. x. Then,
T.D. = (x*25/2*1/2)/(100+(25/2*1/2))=x*25/4*4/425=x/17
S.I=x*25/2*1/2*1/100=x/16
x/16-x/17=25
=>17x-16x=25*16*17
=>x=6800
Hence, sum due = Rs. 6800.

Ex. 5. A bill falls due in 1 year. The creditor agrees to accept immediate payment of the half and to defer the payment of the other half for 2 years. By this arrangement
ins Rb. 40. What is the amount of the bill, if the money be worth 12-z% ?
Sol. Let the sum be Rs. x. Then,
[x/2+(x/2*100)/100+(25/2*2)]-[(x*100)/(100+25/2*1]

=40
=>x/2+2x/5-8x/9=40
=>x=3600
Amount of the bill - Rs. 3600.

33. BANKER'S DISCOUNT

IMPORTANT CONCEPTS

Banker's Discount : Suppose a merchant A buys goods worth, say Rs. 10,000 from another merchant B at a credit of say 5 months. Then, B prepares a bill, called the bill of exchange. A signs this bill and allows B to withdraw the amount from his bank account after exactly 5 months.

The date exactly after 5 months is called nominally due date. Three days (known as grace days) are added to it to get a date, known as legally due date.

Suppose B wants to have the money before the legally due date. Then he can have the money from the banker or a broker, who deducts S.I. on the face value (i.e., Rs. 10,000 in this case) for the period from the date on which the bill was discounted (i.e., paid by the banker) and the legally due date. This amount is known as Banker's Discount (B.D.) Thus, B.D. is the S.I. on the face value for the period from the date on which the bill was discounted and the legally due date.

Banker's Gain (B.G.) = (B.D.) - (T.D.) for the unexpired time.

Note : When the date of the bill is not given, grace days are not to be added.

IMPORTANT FORMULAE

1. B.D. = S.I. on bill for unexpired time.
2. B.G. = (B.D.)-(T.D.) = S.I. on T.D. $=(T.D)^2/P.W$.

3. T.D. = $\sqrt{(P.W.xB.G.)}$

4. B.D. =[(Amount *Rate *Time)/100]
5. Amount=[(B.D. x T.D.)/(B.D.-T.D.)]
6. T.D.= [(Amount x Rate x Time)/(100+(Rate*Time))]
7. T.D.=[(B.G. x 100)/(Rate x Time)]

SOLVED EXAMPLES

Ex. 1. A bill for Rs. 6000 is drawn on July 14 at 5 months. It is discounted on 5th October at 10%. Find the banker's discount, true discount, banker's gain and the money that the holder of the bill receives.

Sol.

Face value of the bill = Rs. 6000.

Date on which the bill was drawn = July 14 at 5 months. Nominally due date = December 14.

Legally due date = December 17.

Date on which the bill was discounted = October 5.

Unexpired time : Oct. Nov. Dec.
26 + 30 + 17 = 73 days =1/ 5Years
B.D. = S.I. on Rs. 6000 for 1/5 year
= Rs. (6000 x 10 x1/5 x1/100)= Rs. 120.

T.D. = Rs.[(6000 x 10 x1/5)/(100+(10*1/5))]
=Rs.(12000/102)=Rs. 117.64.

B.G. = (B.D.) - (T.D.) = Rs. (120 - 117.64) = Rs. 2.36.

Money received by the holder of the bill = Rs. (6000 - 120)
= Rs. 5880.

Ex. 2. If the true discount on a certain sum due 6 months hence at 15% is Rs. 120, what is the banker's discount on the same sum for the same time and at the same rate?

Sol. B.G. = S.I. on T.D.
= Rs.(120 x 15 x 1/2 x 1/100)
= Rs. 9.
(B.D.) - (T.D.) = Rs. 9.
B.D. = Rs. (120 + 9) = Rs. 129.

Ex. 3. The banker's discount on Rs. 1800 at 12% per annum is equal to the true discount on Rs. 1872 for the same time at the same rate. Find the time.
Sol.
S.I. on Rs. 1800 = T.D. on Rs. 1872.
P.W. of Rs. 1872 is Rs. 1800.
Rs. 72 is S.I. on Rs. 1800 at 12%.
Time =[(100 x 72)/ (12x1800)]year
1/3year = 4 months.

Ex. 4. The banker's discount and the true discount on a sum of money due 8 months hence are Rs. 120 and Rs. 110 respectively. Find the sum and the rate percent.
Sol.
Sum =[(B.D.*T.D.)/(B.D.-T.D.)]
= Rs.[(120x110)/(120-110)]
= Rs. 1320.
Since B.D. is S.I. on sum due, so S.I. on Rs. 1320 for 8 months is Rs. 120.
Rate =[(100 x120)/(1320 x 2/3)%
= 13 7/11%.

Ex. 5. The present worth of a bill due sometime hence is Rs. 1100 and the true discount on the bill is Rs. 110. Find the banker's discount and the banker's gain.
Sol. T.D. =√(P.W.*B.G)
B.G. =(T.D.)2/ P.W.

= Rs.[(110x110)/ 1100]
= Rs. 11.
B.D.= (T.D. + B.G.) = Rs. (110 + 11) = Rs. 121.

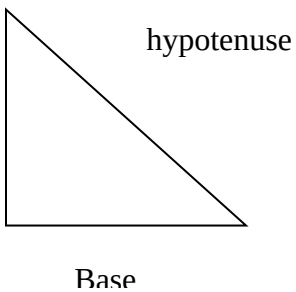
Ex. 6. The banker's discount on Rs. 1650 due a certain time hence is Rs. 165. Find the true discount and the banker's gain.
Sol.
Sum = [(B.D.xT.D.)/ (B.D.-T.D.)]
= [(B.D.xT.D.)/B.G.]
T.D./B.G. = Sum/ B.D.
=1650/165
=10/1
Thus, if B.G. is Re 1, T.D. = Rs. 10.
If B.D.is Rs. ll, T.D.=Rs. 10.
If B.D. is Rs. 165, T.D. = Rs. [(10/11)xl65]
=Rs.150
And, B.G. = Rs. (165 - 150) = Rs, 15.

Ex. 7. What rate percent does a man get for his money when in discounting a bill due 10 months hence, he deducts 10% of the amount of the bill?
Solution: Let amount of the bill = Rs.100
Money deducted =Rs.10
Money received by the holder of the bill = Rs.100-10 = Rs.90
SI on Rs.90 for 10 months = Rs.10
Rate =[(100*10)/(90*10/12)%=13 1/3%

34. HEIGHTS AND DISTANCES

IMPORTANT FACTS AND FORMULAE

1.We already know that:
In a rt.angled ΔOAB, where $\angle BOA = \theta$,
i)$\sin\theta$ = Perpendicular/Hypotenuse = AB/OB;
ii)$\cos\theta$ = Base/Hypotenuse = OA/OB;
iii)$\tan\theta$ = Perpendicular/Base = AB/OA;
iv)$\text{cosec}\,\theta = 1/\sin\theta$ = OB/AB;
v)$\sec\theta = 1/\cos\theta$ = OB/OA;
vi)$\cot\theta = 1/\tan\theta$ = OA/AB.



2. **Trigonometrical identities:**

i)$\sin^2\theta + \cos^2\theta = 1$.
ii)$1+\tan^2\theta = \sec^2\theta$
iii)$1+\cot^2\theta = \operatorname{cosec}^2\theta$

3. **Values of T-ratios:-**

θ	0	30°	45°	60°	90°
Sin θ	0	½	$1/\sqrt{2}$	$\sqrt{3}/2$	1
Cos θ	1	$\sqrt{3}/2$	$1/\sqrt{2}$	½	0
Tan θ	0	$1/\sqrt{3}$	1	$\sqrt{3}$	Not defined

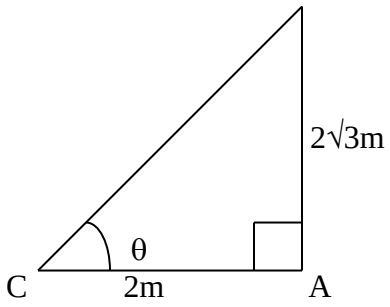
4. **Angle of Elevation:** Suppose a man from a point O looks up an object P, placed above the level of his eye. Then, the angle which the line of sight makes with the horizontal through O, is called the angle of elevation of P as seen from O.

$\therefore$ Angle of elevation of P from O = $\angle$AOP.

5. **Angle of Depression**: Suppose a man from a point O looks down at an object P, placed below the level of his eye, then the angle which the line of sight makes with the horizontal through O, is called the angle of depression of P as seen from O.

SOLVED EXAMPLES

Ex.1.If the height of a pole is $2\sqrt{3}$ metres and the length of its shadow is 2 metres, find the angle of elevation of the sun.



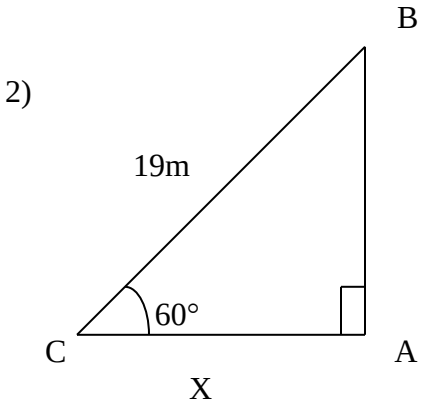
Sol. Let AB be the pole and AC be its shadow.
Let angle of elevation, $\angle ACB=\theta$.

Then, AB = $2\sqrt{3}$ m AC = 2 m.

Tan θ = AB/AC = $2\sqrt{3}/2 = \sqrt{3} \Rightarrow \theta = 60°$

So, the angle of elevation is 60°

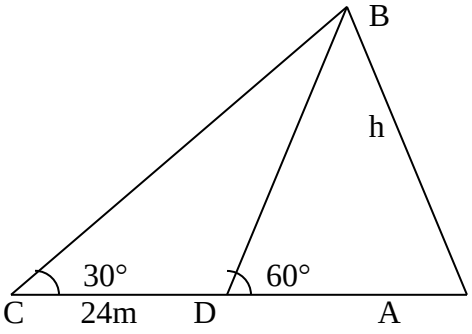
Ex.2. A ladder leaning against a wall makes an angle of 60° with the ground. If the length of the ladder is 19 m, find the distance of the foot of the ladder from the wall.



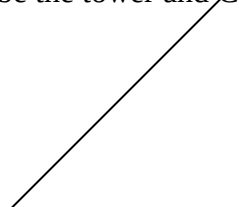
Sol. Let AB be the wall and BC be the ladder.
Then, $\angle ACB = 60°$ and BC = 19 m.
Let AC = x metres
AC/BC = cos 60° $\Rightarrow$ x/19 = ½ $\Rightarrow$ x=19/2 = 9.5

$\therefore$ Distance of the foot of the ladder from the wall = 9.5 m

Ex.3. The angle of elevation of the top of a tower at a point on the ground is 30°. On walking 24 m towards the tower, the angle of elevation becomes 60°. Find the height of the tower.



Sol. Let AB be the tower and C and D be the points of observation. Then,



$AB/AD = \tan 60° = \sqrt{3}$ => $AD = AB/\sqrt{3} = h/\sqrt{3}$

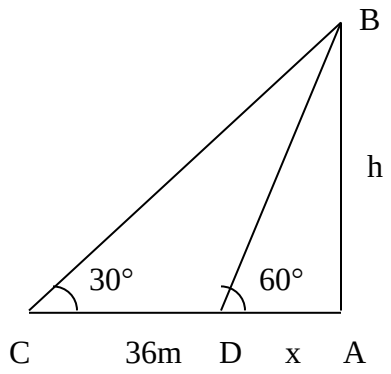
$AB/AC = \tan 30° = 1/\sqrt{3}$ $AC = AB \times \sqrt{3} = h\sqrt{3}$

$CD = (AC-AD) = (h\sqrt{3} - h/\sqrt{3})$

$h\sqrt{3} - h/\sqrt{3} = 24$ => $h = 12\sqrt{3} = (12 \times 1.73) = 20.76$

Hence, the height of the tower is 20.76 m.

Ex.4. A man standing on the bank of a river observes that the angle subtended by a tree on the opposite bank is 60°. When he retires 36 m from the bank, he finds the angle to be 30°. Find the breadth of the river.



Sol. Let AB be the tree and AC be the river. Let C and D be the two positions of the man. Then,
$\angle ACB = 60°$, $\angle ADB = 30°$ and CD=36 m.
Let AB=h metres and AC=x metres.
Then, AD=(36+x)metres.

$AB/AD = \tan 30° = 1/\sqrt{3}$ => $h/(36+x) = 1/\sqrt{3}$

$h = (36+x)/\sqrt{3}$ .....(1)

$AB/AC = \tan 60° = \sqrt{3}$ => $h/x = \sqrt{3}$

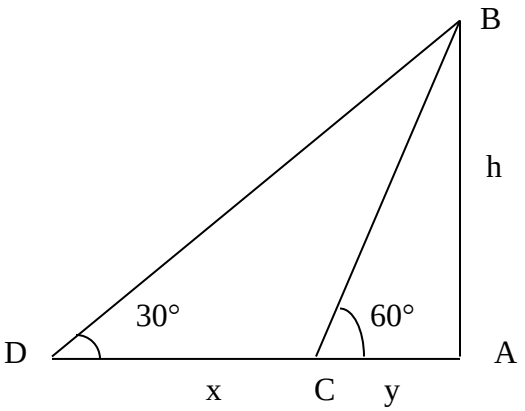
$h = \sqrt{3}x$ .....(2)

From (i) and (ii), we get:

$(36+x)/\sqrt{3} = \sqrt{3}x$ => $x = 18$ m.

So, the breadth of the river = 18 m.

Ex.5. A man on the top of a tower, standing on the seashore finds that a boat coming towards him takes 10 minutes for the angle of depression to change from 30° to 60°. Find the time taken by the boat to reach the shore from this position.



Sol. Let AB be the tower and C and D be the two positions of the boat.

Let AB=h, CD=x and AD=y.

$h/y=\tan 60°=\sqrt{3} \quad \Rightarrow \quad y=h/\sqrt{3}$

$h/(x+y)=\tan 30° = 1/\sqrt{3} \quad \Rightarrow \quad x+y=\sqrt{3}h$

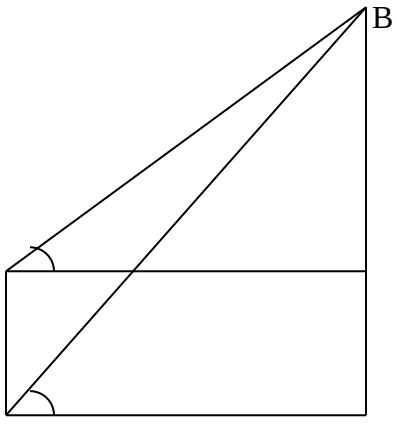
$x=(x+y)-y = (\sqrt{3}h-h/\sqrt{3})=2h/\sqrt{3}$

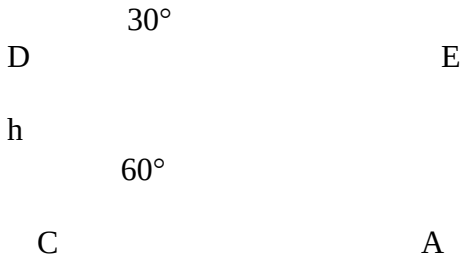
Now, $2h/\sqrt{3}$ is covered in 10 min.

$h/\sqrt{3}$ will be covered in $(10\times(\sqrt{3}/2h)\times(h/\sqrt{3}))=5$ min

Hence, required time = 5 minutes.

Ex 6. There are two temples, one on each bank of a river, just opposite to each other. One temple is 54 m high. From the top of this temple, the angles of depression of the top and the foot of the other temple are 30° and 60° respectively. Find the width of the river and the height of the other temple.





Sol. Let AB and CD be the two temples and AC be the river.
Then, AB = 54 m.
Let AC = x metres and CD=h metres.

$\angle ACB=60°$, $\angle EDB=30°$
$AB/AC=\tan 60°=\sqrt{3}$
$AC=AB/\sqrt{3}=54/\sqrt{3}=(54/\sqrt{3}\times\sqrt{3}/\sqrt{3})=18m$
$DE=AC=18\sqrt{3}$
$BE/DE=\tan 30°=1/\sqrt{3}$
$BE=(18\sqrt{3}\times1/\sqrt{3})=18$ m
CD=AE=AB-BE=(54-18) m = 36 m.
So, Width of the river = AC = $18\sqrt{3}$ m=18×1.73 m=31.14m
Height of the other temple = CD= 18 m.

36. TABULATION

This section comprises of questions in which certain data regarding common disciplines as production over a period of a few years: imports, exports, incomes of employees in a factory, students applying for and qualifying a certain field of study etc. are given in the form of a table. The candidate is required to understand the given information and thereafter answer the given questions on the basis of comparative analysis of the data.
Thus, here the data collected by the investigator are arranged in a systematic form in a table called the *tabular form.* In order to avoid some heads again and again, tables are made consisting of horizontal lines called *rows* and vertical lines called *columns* with distinctive heads, known as *captions.* Units of measurements are given with the captions.

SOLVED EXAMPLES

The following table gives the sales of batteries manufactured by a *company* lit *the years.* Study *the table and answer the questions that follow:*

(S.B.I.P.O. 1998)

NUMBER OF DIFFERENT TYPES OF BATTERIES SOLD BY A COMPANY OVER THE YEARS (NUMBERS _N THOUSANDS)

TYPES OF BATTERIES

Year	4AH	7AH	32AH	35AH	55AH	T0TAL
1992	75	144	114	102	108	543
1993	90	126	102	84	426	528
1994	96	114	75	105	135	525
1995	105	90	150	90	75	510
1996	90	75	135	75	90	465
1997	105	60	165	45	120	495
1998	115	85	160	100	145	605

1. The total sales of all the seven years is the maximum for which battery ?

(a) 4AH *(b)* 7AH *(c)* 32AH *(d)* 35AH *(e)* 55AH

2. What is the difference in the number of 35AH batteries sold in 1993 and 1997 ?

(a) 24000 *(b)* 28000 *(c)* 35000 (d) 39000 *(e)* 42000

3. The percentage of 4AH batteries sold to the total number of batteries sold was maximum in the year:

(a) 1994 . *(b)* 1995 *(c)* 1996 *(d)* 1997 *(e)* 1998

4. In the case of which battery there was a continuous decrease in sales from 1992 to 1997 ?

(8) 4AH *(b)* 7 AH *(c)* 32AH (d) 35AH *(e)* 55AH

5. What was the approximate percentage increase in the sales of 55AH batteries in 1998 compared to that in 1992 ?

(a) 28% *(b)* 31% (c) 33% (d)34% (e)37%

Sol. 1. *(c)* : The total sales (in thousands) of all the seven years for various

batteries are:
For 4AH = 75 + 90 + 96 + 105 + 90 + 105 + 115 = 676
For 7AH = 144 + 126 + 114 + 90 + 75 + 60 + 85 = 694
For 32AH = 114 + 102 + 75 + 150 + 135 + 165 + 160 = 901
For 35 AH= 102 + 84 + 105 + 90 + 75 + 45 + 100 = 601
For 55 AH= 108 + 126 + 135 + 75 + 90 + 120 + 145 = 799.
Clearly, sales are maximum in case of *32AH* batteries.
2. *(d* : Required difference = [(84 - 45) x 1000] = 39000.
3. *(d)* : The percentages of sales of 4AH batteries to the total sales in different years are:

For 1992 =(75*100/543)%=13.81%

For 1993=(90*100)/528%=17.05%

For 1994=(96*100/465)%=19.35%

For 1995=(105*100/495)%=20.59%

For 1996=(96*100/465)%=19.35%

For 1997=(105*100/495)%=21.21%

For 1998=(115*100/605)%=19.01%

Clearly, the percentage is maximum in 1997.

4. (b) : From the table it is clear that the sales of 7AH batteries have been decreasing continuously from 1992 to 1997.

5. (d) : Required Percentage =(145-108)/108)*100 %=34.26%=34%.

Ex 2: Study the following table carefully and answer these questions:

NUMBER OF CANDIDATES APPEARED AND QUALIFIED IN A COMPETITIVE EXAMINATION FROM DIFFERENT STATES OVER THE YEAR

	1997		1998		1999		2000		2001	
	App.	Qual.	App.	Qal.	App.	Qual.	App.	Qual.	App.	Qual
M	5200	720	8500	980	7400	850	6800	775	9500	1125
N	7500	840	9200	1050	8450	920	9200	980	8800	1020
P	6400	780	8800	1020	7800	890	8750	1010	9750	1250
Q	8100	950	9500	1240	8700	980	9700	1200	8950	995
R	7800	870	7600	940	9800	1350	7600	945	7990	885

1. Combining the states P and Q, together in 1998, what is the percentage of the candidates qualified to that of the canditates appeared?

(8) 10.87% *(b)* 11.49% *(c)* 12.35% (d) 12.54% *(e)* 13.50%

2.The percentage of the total number of qualified candidates to the total number appeared candidates among all the five states in 1999 is :

(a) 11.49%*(b)* 11.84% *(c)*- 12.21% (d) 12.57%*(e)* 12.7a1

3. What is the percentage of candidates qualified from State N for all the years together, over the candidates appeared from State N during all the years together?

(a) 12.36% *(b)* 12.16% *(c)* 11.47% (d) 11.15%(e)None of these

4. What is the average of candidates who appeared from State Q during the given yeas?

(8) 8700 *(b)* 8760 *(c)* 8810 (d) 8920 *(e)* 8990

5 . In which of the given years the number of candidates appeared from State P has maximum percentage of qualified candidates?

(8) 1997 *(b)* 1998 *(c)* 1999 (d) 2000 (e) 2001

6. Total number of candidates qualified from all the states together in 1997 is approximately what percentage of the total number of candidates qualified from all the states together in 1998 ?

(8) 72% *(b)* 77% *(c)* 80% (d) 83% *(e)* 86%

Sol.1.(c)Required Percentage=(1020+1240) *100%=(2260*100)/18300%

(8800+9500)

=12.35%

Required Percentage= (850+920+890+980+1350) *100%

(7400+8450+7800+8700+9800)

=(4990*100)/42150%

=11.84%

(e) : Required Percentage=(84-

+1050+920+980+1020)/(7500+9200+8450+9200+8800)*100%

=(4810*100)/43150* %

=11.15%

4. (e) Required average =(8100+9500+8700+9700+8950)/5

=44950/5

=8990

5. (e) : The percentages of candidates qualified to candidates appeared from State P during different years are:

For 1997= $\frac{780}{6400}$ * 100% =12.19%

for 1998 = $\frac{1020*100}{8800}$ %=11.59%

For 1999 = $\frac{890*100}{7800}$ %=11.41%;

For 2000 = $\frac{1010*100}{8\,750}$ % = 11.54%.

For 2001=$\frac{1250*100}{9750}$ %= 12.82%

:. Maximum percentage is for the year 2001.

6. *(c)* : Required Percentage =$\frac{(720 + 840 + 780 + 950 + 870)}{980+1050+1020+1240+940}$ x 100

=80%

Ex. 3. *The following table gives the percentage of marks obtained by* seven *students* in six , *different subjects* in an *examination. Study the table* and answer *the questions based* on *it. The numbers* in *the brackets give the maximum marks* in *each subject.*
(Bank P.O. 2003)

\ (Max. marks) Student	Maths (160)	Chemistry (130)	Physics (120)	Geography (100)	History (60)	Computer Science (40)
Ayush	90	50	90	60	70	80

Aman	100	80	80	40	80	70
Sajal	90	60	70	70	90	70
Rohit	80	65	80	80	60	60
Muskan	80	65	85	95	50	90
Tanvi	70	75	65	85	40	60
Tharun	65	35	50	77	80	80

1. What was the aggregate of marks obtained by Sajal in all the six subjects?
(a) 409 *(b)* 419 *(c)* 429 (d) 439 *(e)* 449
2. What is the overall percentage of Thrun?
(a) 52.5% *(b)* 55% *(c)* 60% (d) 63% *(e)* 64.5%
3. What are the average marks obtained by all the seven students in Physics? (rounded off to two digits after decimal)
(a) 77.26 *(b)* 89.14 *(c)* 91.37 (d) 96.11 *(e)* 103.21
4. The number of students who obtained 60% and above marks in all the subjects is :
(a) 1 *(b)* 2 *(c)* 3 (d) None *(e)* None of these
6. In which subject is the overall percentage the best?
(a) History *(b)* Maths *(c)* Physics (d) Chemistry *(e)* Geography

Sol. 1.. *(e)* : Aggregate marks obtained by Sajal
= [(90% of 150) + (60% of 130) + (70% of 120) + (70% of 100) + (90% of 60) + (70% of 40)] = 135 + 78 + 84 + 70 + 54 + 28 = 449.

2. *(c)* : Aggregate marks obtained by Tarun .
= [(65% of 150) + (35% of 130) + (50% of 120) + (77% of 100) + (80% of 60) + (80% of 40)] = 97.5 + 45.5 + 60 + 77 + 48 + 32 = 360.
Total maximum marks (of all the six subjects)
= (150 + 130 + 120 + 100 + 60 + 40) = 600.

Overall percentage of Tarun = $\frac{360 \times 100}{600}$ % = 60%.

3. *(b)* : Average marks obtained in Physics by all the seven students

$= \frac{1}{7}$ [(90% of 120) + (80% of 120) + (70% of 120) + (80% of 120) + (85% of 120) + (65% of 120) + (50% of 120)]

$= \frac{1}{7}$ [(90 + 80 + 70 +80 + 85 + 65 + 50)% of 120]

$= \frac{1}{7}$ [520% of 120] = 89.14.

4. *(b)* : From the table it is clear that Sajal and Rohit have 60% or more marks in each of the six subjects.

6. *(b)* : We shall find the overall percentage (for all the seven students) with respect to each subject.

The overall percentage for any subject is equal to the average of percentages obtained by all the seven students since the maximum marks for any subject is the same for all the students.

Therefore, overall percentage for:

(i) Maths = $\frac{1}{7}$(90+100+90+80+80+70+65)]%

= $\frac{1}{7}$(575)]% = 82.14%.

(ii) Chemistry = $\frac{1}{7}$(50 + 80 + 60 + 65 + 65 + 75 + 35)]%

= $\frac{1}{7}$(430)]% = 61.43%.

(iii) Physics = $\frac{1}{7}$(90 + 80 + 70 + 80 + 85 + 65 + 50)]%

= $\frac{1}{7}$ (520)]% = 74.29%.

(iv) Geography = $\frac{1}{7}$(60 + 40 + 70 + 80 + 95 + 85 + 77)]%

= [$\frac{1}{7}$ (507)}_ = 72.43%.

(v) History = $\frac{1}{7}$ (70 + 80 + 90+ 60 + 50 + 40 + 80)]%

= $\frac{1}{7}$ [(470)]% = 67.14%.

(vi*)* Computer Science = [$\frac{1}{7}$ (80 + 70 + 70 + 60 + 90 + 60 + 80)]%

= $\frac{1}{7}$ (510)]% = 72.86%.

Clearly; this. percentage is highest for Maths.

ex.4. *Study the following table carefully and answer tbe questions given below:*(Bank P.O. 2001)

CLASSIFICATION OF 100 STUDENTS BASED ON THE MARKS OBTAINED BY THEM IN PHYSICS AND CHEMISTRY IN AN EXAMINATION

Marks out Of 50 Subject	40 and above	30 and Above	20 and above	10 and above	0 and above
physics	9	32	80	92	100
chemistry	4	,21	66	,. 81,	100
(aggregate Average)	7	27	73	87	100

1. The number of students scoring less than 40% marks in aggregate is :
(a) 13 *(b)* 19 *(c)* 20 *(d)* 27 *(e)* 34

2. If at least 60% marks in Physics are required for pursuing higher studies in Physics,how many students will be eligible to pursue higher studies in Physics?
(a) 27 *(b)* 32 *(c)* 34 *(d)41* *(e)* 68

3. What is the difference between the number of students passed with 30 as cut-off marks in Chemistry and those passed with :JUas cut-off marks in aggregate?
(a) 3 *(b)* 4 *(c)* 5 *(d)* 6 *(e)* 7

4. The percentage of the number of students getting at least 60% marks in Chemistry over those getting at least 40% marks in aggregate, is approximately:
(a) 21% *(b)* 27% *(c)* 29% (d) 31% (e) 34%

5. If it is known that at least 23 students were eligible for a Symposium on Chemistry the minimum qualifying marks in Chemistry for eligibility to Symposium would lie in the range:
(a) 40-50 *(b)* 30-40 *(c)* 20-30 (d) Below 20

Sol. 1. (d) : We have 40% of 50 $=\left(\frac{40}{100} \times 50\right)= 20.$

:. Required number = Number of students scoring less than 20 marks in aggregate
= 100 - number of students scoring 20 and above marks in aggregate = 100 - 73 = 27.

2. *(b)* : We have 60% of 50 $=\left(\frac{60}{100} \times 50\right) = 30.$

:. Required number = Number of students scoring 30 and above mark in Physics = 32.

3. (d) : Required difference = (Number of students scoring 30 and above in mark in Chemistry) (Number of students scoring 30 and above marks in aggregate) = 27 - 21 = 6.

4. *(c)* : Number of students getting at least 60% marks in Chemistry = Number of students getting 30 and above marks in Chemistry = 21. Number of students getting at least 40% marks in aggregate = Number of students getting 20 and above marks in aggregate = 73.
:. Required Percentage = $\frac{21}{73} \times 100\% = 28.77\% \approx 29\%$.

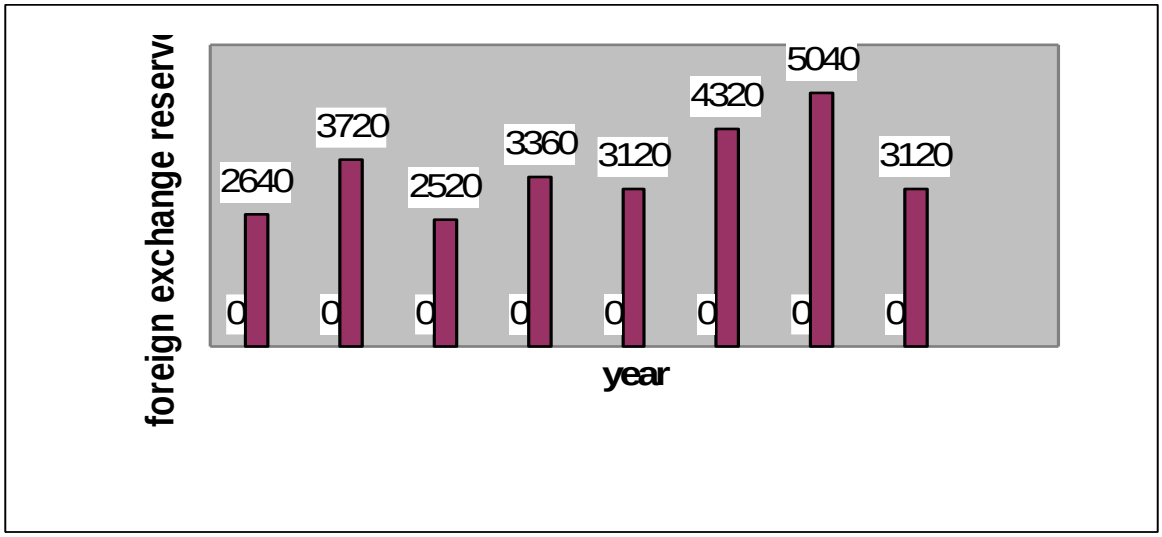
6. *(c)* : Since 66 students get 20 and above marks in Chemistry and out of these 21 students get 30 and above marks, therefore to select top 35 students in Chemistry, the qualifying marks should lie in the range 20-30.

37.BAR GRAPHS

this section comprises of questions in which the data collected in a particular discipline are represented in the form of vertical or horizontal bars drawn by selecting a particular scale.one of the parameters is plotted on the horizontal axis and the other on the vertical axis . the candidate is required to understand the given information and thereafetr answer the given questions on the basis of data analysis.

1.The bar graph given below shows the foreign exchange reserves of a country (in million us$)
from 1991-92 to 1998-99 .answer the questions based on this graph.

FOREIGN EXCHANGE RESERVES OF A COUNTRY
(IN MILLION US $)



1.The foreign exchange reserves in 1997-98 was how ,any times that in 1994-95?
(a)0.7 (b) 1.2 (c) 1.4 (d) 1.5 (e) 1.8
2.what was the percentage increase in the foreign exchange reserves in 1997-98 over 1993-94?
(a)100 (b)150 (c)200 (d)620 (e)2520

3.for which year,the percent increase of foreign exchange reserves over the previous year,is the highest?
(a)1992-93 (b)1993-94 (c)1994-95 (d)1996-97 (e)1997-98

4.the foreign exchange reserves in 1996-97 werw approximately what percent of the average foreign exchange reserves over the period under review?
(a)95% (b)110% (c)115% (d)125% (e)140%

5.the ratio of the number of years,in which the foreign exchange reserves are above the average reserves ,to those in which the reserves are below the average reserves is :
(a)2:6 (b)3:4 (c)3:5 (d)4:4 (e)5:3

Solutions
1 (d) : required ratio = 5040/3360 = 1.5
2 (a) : foreign exchange reserve in 1997-98=5040 million us $
foreign exchange reserves in 1993-94=2520 million us$
therefore increase=(5040-2520)=2520 million us $

therefore percentage increase=((2520/2520)*100)%=100%

3(a): there is an increase in foreign exchange reserves during the years 1992-93,1994-951996-97,1997-98 as compared to previous year (as shown by bar graph)

the percentage increase in reserves during these years compared to previous year are

(1) for 1992-93 =[(3720-2640)/2640*100]% =40.91%
(2) for 1994-95=[(3360-2520)/2520*100]%=33.33%
(3) for 1996-97=[(4320-3120)/3120*100]%=38.46%
(4) for 1997-98=[(5040-4320)/4320*100]%=16.67%

Clearly, the percentage increase over previous year is highest for 1992-93.

4. (d) : Average foreign exchange reserves over the given period
= [_x (2640 + 3720 + 2520 + 3360 + 3120 + 4320 + 5040 + 3120)] million US $

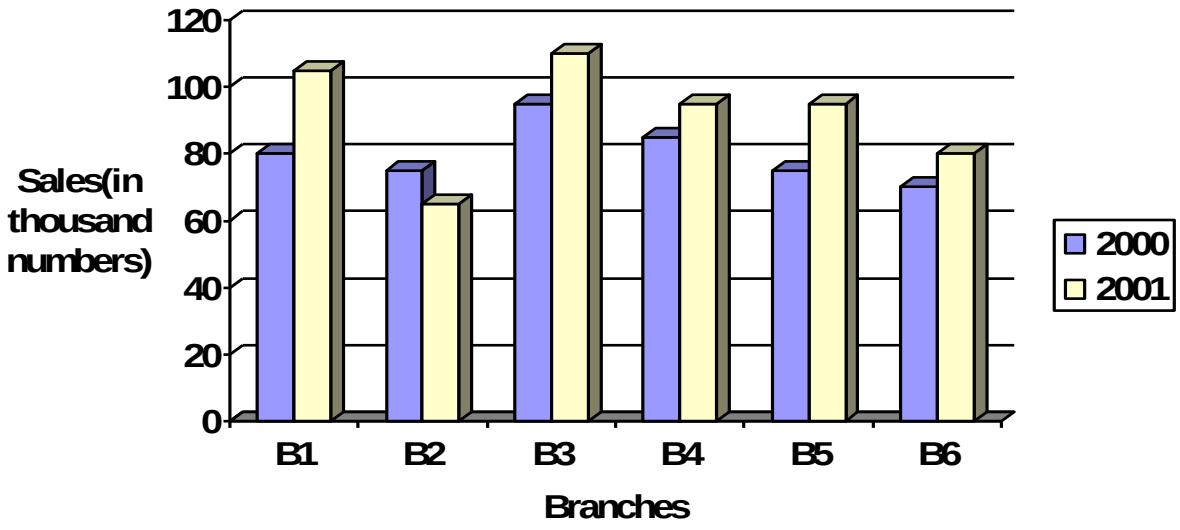
= 3480 million US $.
Foreign exchange reserves in 1996-97 = 4320 million US $. . .
Required Percentage = x 100 % = 124.14% .. 125%.
3480 .

5. *(c)* : Average foreign exchange reserves over the given period = 3480 million US $.

The country had reserves above 3480 million US $ during the years 199293, 1996-97 and 1997-98 *i.e.,* for 3 years and below 3480 million US $ during the years 1991-92, 1993-94, 1994-95, 1995-96 and 1998-99 *i.e.,* for 5 years.
Hence, required ratio = 3 : 5.

Ex. 2. The bar-graph provided on next page gives the sales of books (in thousand numbers) from six branches of a publishing company during two consecutive years 2000 and 2001. Answer the questions based on this bar-graph:

Sales of books (in thousand numbers) from six branches-B1,B2,B3,B4,B5 and B6 of a publishing company in 2000 and 2001



1.total sales of branches b1,b3 and b5 together for both the years (in thousand numbers) is:
(a)250 (b) 310 (c) 435 (d)560 (e)585

2.total sales of branch b6 for both the years is what percent of the total sales of branch b3 for both the years?
(a) 68.54% (b)71.11% (c) 73.17% (d)75.55% (e)77.26%

3.what is the average sale of all the branches (in thousand numbers) for the year 2000?
(a)73 (b)80 (c)83 (d)88 (e)96

4.what is the ratio of the total sales of branch b2 for both years to the total sales of branch b4 for both years ?
(a)2:3 (b)3:5 (c)4:5 (d)5:7 (e)7:9

5.what percent of the average sales of branchesn b1,b2 and b3 in 2001 is the average sales of branches b1,b3 and b6 in 2000?
(a)75%(b)77.5% (c)82.5% (d)85% (e)87.5%

SOLN……..
1.(d) total sales of branches B1,B3 and B5 for both the years (in thousand numbers)=(80+105)+(95+110)+(75+95)=560

2(c) required percentage=[(70+80)/(95+110)*100]%=(150/205*100)%=73.17%

3(b)average sales of all the six branches (in thousand numbers) for the year 2000=1/6*(80+75+95+85+75+70)=80

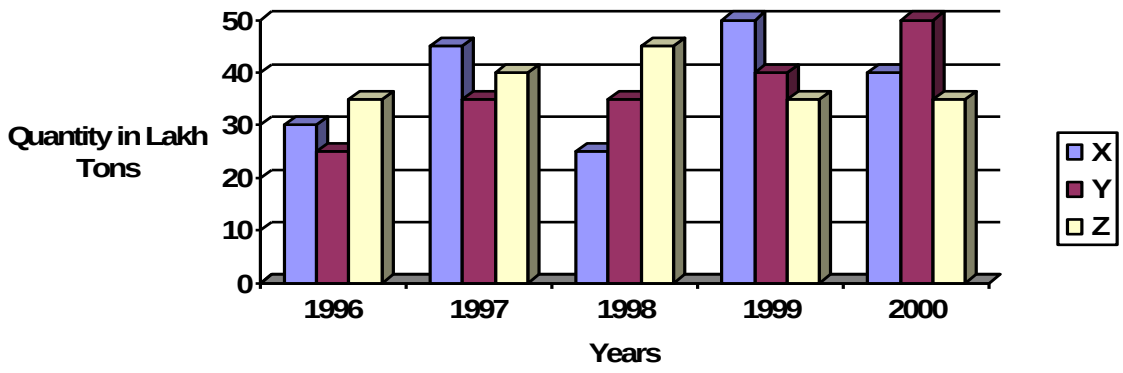
4(e) required ratio=(75+65)/(85+95)=140/180=7/9

5(e)average sales(in thousand numbers of branches B1,B3,and B6 in 2000= 1/3*(80+95+70)=245/3

average sales(in thousand numbers of branches B1,B2,and B3 in 2001=1/3*(105+65+110)=280/3

therefore required percentage=[((245/3)/(280/3))*100]%=(245/280*100)%=87.5%

Ex.3. The bar graph provided below gives the data of the production of paper (in thousand tonnes) by three different companies x,y and z over the years .study the graph and answer the questions that follow
production of paper(in laks tonnes) by three companys x,yand z over the years



1.What is the difference between the production of the company Z in 1998 and company y in 1996?
a.2 ,00,000 tons
b.20,00,000 tons
c.20,000 tons
d.2,00,00,000 tons
e.none of these

2.what is the ratio of the average production of company x in the period 1998 to

2000 to the average production of company y in the same period?
a.1:1
b.15:27
c.23:25
d.27:29
e.none of these

3.what is the percentage increase in the production of company y from1996 to 1999?
a.30%
b.45%
c.50%
d.60%
e.75%

4.the avreage production of five years was maximum for which company?
a.x
b.y
c.z
d.x & y both
e.x and z both

5.for which of thw follolwing years the percentage rise / fall in production from previous year is the maximum for company y?
a.1997
b.1998
c.1999
d.2000
e.1997 & 2000

6.in which year was the percentage of production of company z to the production of company y the maximum?
a.1996
b.1997
c.1998
d.1999
e.2000
Sol: 1(b):required difference =
[(45-25)*i,00,000]tons=20,00,000 tons

2(c):average production of company x in the period 1998-2000=[1/3*(25+50+40)]=(115/3) lakh tons

average production of company y in the period 1998-2000 [1/3*(35+40+50)]=(125/3) lakh tons

therefore req ratio=(115/3)/(125/3)=115/125=23/25

3(d):percentage increase in the production y from 1996-1999=[(40-25)/25*100]%=(15/25*100)%=60%

4(e):average production (in lakh tons)in five years for the three company's are:
for company x=[1/5*(30+45+25+50+40)]=190/5=38
for company y=[1/5*(25+35+35+40+50)]=185/5=37
for company z=[1/5*(35+40+45+35+35)]=190/5=38
therefore the average production of maximum for both the company's x and z

5(a) : Percentage change (rise/fall)in the production of Company Y in comparison to the previous year, for different years are:

For 1997 = $\left[\left((32-25)/25\right)*100\right]\%$ = 40%

For 1998 = $\left[\left((35-35)/25\right)*100\right]\%$ = 0%

For 1999 = $\left[\left((40-35)/35\right)*100\right]\%$ = 14.29%

For 2000 = $\left[\left((50-40)/40\right)*100\right]\%$ = 25%

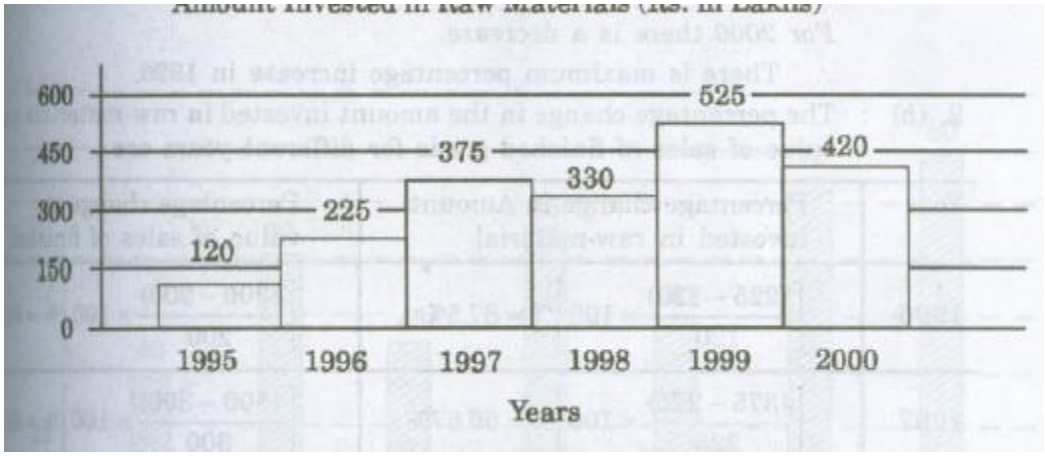
Hence, the maximum percentage rise/fall in the production of company Y is for 1997.

6(a) : The percentages of production of company z to the production of company z for various years are:
For 1996 = ((35/25)*100)%=140%; For 1997 = ((40/35)*100)% = 114.29%
For 1998 = ((45/35)*100)%=128.57%; For 1999 = ((35/40)*100)%=87.5%
For 2000 = ((35/50)*100)%=70%

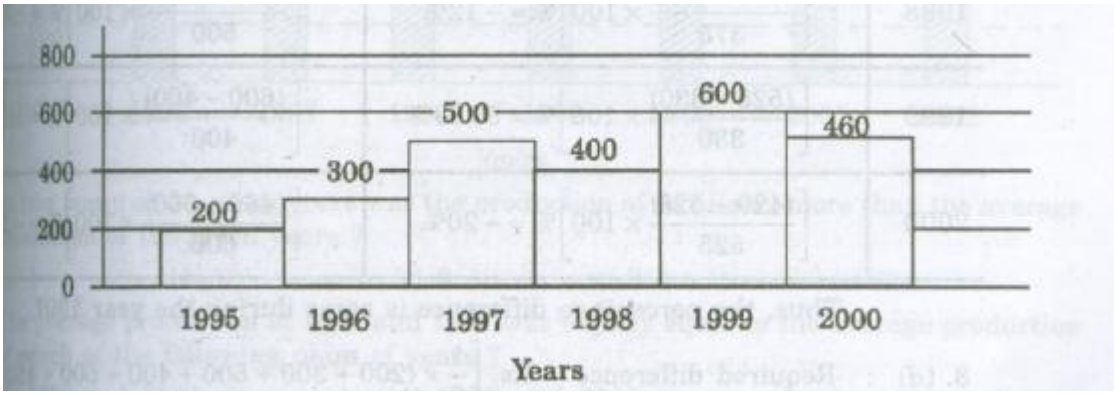
Clearly, this percentage is highest for 1996.

Ex.4.**Outof the two bar graphs provided below, one shows the amounts (in Lakh Rs) invested by a Company in purchasing raw materials over the years and the other shows the values(in Lakh Rs.) of finished goods sold by the Company over the years. Study the two bar graphs and answer the questions based on them.**
Amount Invested in Raw Materials and the Value of Sales of Finished Goods for a Company over the Years

Amount Invested in Raw Materials (Rs. in Lakhs)



Value of Sales of Finished Goods(Rs.in Lakhs)



1.Inwhichyear,there has been a maximum percentage increase in the amount invested inRawMaterials as compared to the previous year?
*(a)*1996 (b) 1997 *(c)* 1998 (d) 1999 *(e)* 2000
2. Inwhichyear, the percentage change (compared to the previous year) in the investment onRaw Materials is the same as that in the value of sales of finished goods?
*(a)*1996 *(b)* 1997 *(c)* 1998 (d) 1999 *(e)* 2000
3.Whatwas the difference between the average amount invested in Raw Materials during the given period and the average value of sales of finished goods during this period?
*(a)*Rs. 62.5 lakhs *(b)* Rs. 68.5 lakhs *(c)* Rs. 71.5 lakhs
(d)Rs.77.51akhs *(e)* Rs. 83.5 lakhs

4. The value of sales of finished goods in 1999 was approximately what percent of the average amount invested in Raw Materials in the years 1997,1998 and 1999?
(a) 33% (b) 37% (c) 45% (d) 49% (e) 53%

5. The maximum difference between the amount invested in Raw Materials and the value of sales of finished goods was during the year:
(a) 1995 (b) 1996 (c) 1997 (d) 1998 (e) 1999

Sol. 1. (a) : The percentage increase in the amount invested in raw-materials as compared to the previous year, for different years are:

For 1996 = [((225-120)/120)*100]% = 87.5%
For 1997 = [((375-225)/225)*100]% = 66.67%
For 1998 = [((525-330)/330)*100]% = 59.09%
For 2000 there is a decrease.

2.(b)The percentage change in the amount invested in raw-materials and in the value of sales of finished goods for different years are:

year	Percentage change in amount invested in raw-materials	Percentage change in value of sales of finished goods
1996	[((225-120)/120)*100]% = 87.5%	[((300-200)/200)*100]% = 50%
1997	[((375-225)/225)*100]% = 66.7%	[((500-300)/300)*100]% = 66.67%
1998	[((525-330)/330)*100]% = -12%	[((400-500)/500)*100]% = -20%
1999	[((525-330)/330)*100]% = 59.09%	[((600-400)/400)*100]% = 50%
2000	[((420-525)/525)*100]% = -20%	[((460-600)/600)*100]% = -23.33%

Thus the percentage difference is same during the year 1997.

3. (d) : Required difference = Rs. [(1/6)*(200+300+500+400+600+460)
- (1/6)*(120+225+375+330+525+420)] lakhs
= Rs. [(2460/6)-(1995/6)] lakhs = Rs.(410-332.5)lakhs = 77.5 lakhs.

4. (d) : Required percentage = [(600/(375+300+525))*100]% = 48.78% ≈ 49%

5. (c) : The difference between the amount invested in raw-material and the value of sales of finished goods for various years are :

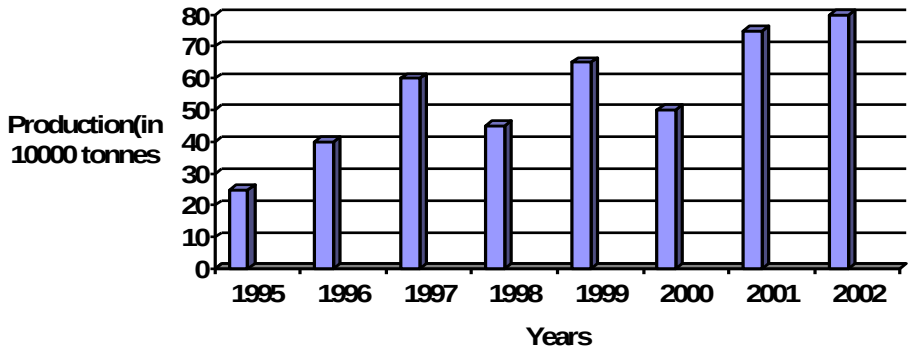
For 1995 = Rs.(200-120)lakhs = Rs. 80 lakhs
For 1996 = Rs.(200-225)lakhs = Rs. 75 lakhs
For 1997 = Rs. (500-375)lakhs = Rs. 125 lakhs
For 1998 = Rs. (400-330)lakhs = Rs. 70 lakhs.
For 1999 = Rs. (600-525)lakhs = Rs. 75 lakhs
For 2000 = Rs. (460-420)lakhs = Rs. 40 lakhs.

Clearly, maximum difference was during 1997

EXERCISE 37

Directions(questions 1 to 5) : study the following bar-graph and answer the questions given below.
Production of fertilizers by a Company (in 10000 tonnes) over the Years

X axis=years
Y axis=Production (in 10000 tonnes)



1. In how many of the given years was the production of fertilizers more than the average production of the given years?

   (a)1 (b)2 (c)3 (d)4 (e)5

2. The average production of 1996 and 1997 was exactly equal to the average production of which of the following pairs of years?

   (a)2000 and 2001 (b)1999 and 2000 (c)1998 and 2000
   (d)1995 and 1999 (e)1995 and 2001

3. What was the percentage decline in the production of fertilizers from 1997 to 1998?

   (a) $33\frac{1}{3}\%$ (b) 30% (c) 25% (d) 21% (e) 20%

4. In which year the percentage increase in production as compared to the previous year the maximum?

   (a) 2002 (b) 2001 (c) 1999 (d) 1997 (e) 1996

38. PIE-CHARTS

IMPORTANT FACTS AND FORMULAE

The **pie-chart** or a **pie-graph** is a method of representing a given numerical data in the form of sectors of a circle.

The sectors of the circle are constructed in such a way that the area of each sector is proportional to the corresponding value of the component of the data.

From geometry, we know that the area of a circle is proportional to the central angle.

So, the central angle of each sector must be proportional to the corresponding value of the component.

Since the sum of all the central angle is 360°, we have

$$\left|\ \text{Value of the component}\ \right| \propto \left|\ \ \right|^{\circ}$$

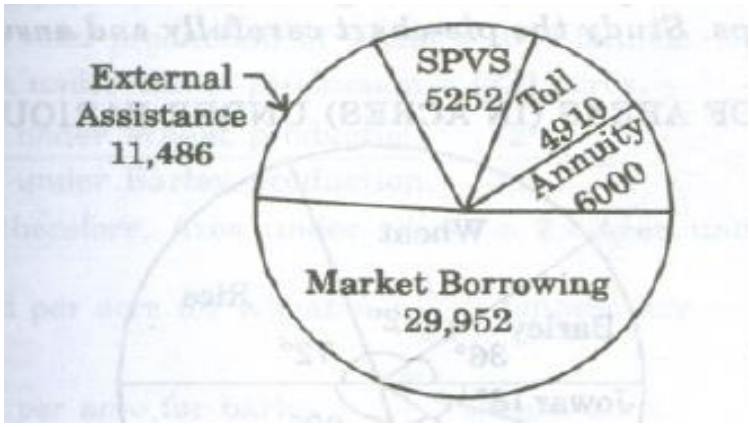
Central angle of the component = ---------- * 360
Total value

SOLVED EXAMPLES

The procedure of solving problems based on pie-charts will be clear from the following solved examples.

Example 1. The following pie-chart shows the sources of funds to be collected by the National Highways Authority of India (NHAI) for its Phase II projects. Study the pie-chart and answer the questions that follow.

SOURCES OF FUNDS TO BE ARRANGED BY NHAI FOR PHASE II PROJECTS (IN CRORES RS.)



Total funds to be arranged for Projects (Phase II) =Rs.57,600 crores.

1. Near about 20% of the funds are to be arranged through:
(a) SPVS (b) External Assistance
(c) Annuity (d) Market Borrowing

2. The central angle corresponding to Market Borrowing is:
(a) 52° (b) 137.8°
(c) 187.2° (d) 192.4°

3. The approximate ratio of the funds to be arranged through Toll and that through Market Borrowing is:
(a) 2:9 (b) 1:6
(c) 3:11 (d) 2:5

4. If NHAI could receive a total of Rs. 9695 crores as External Assistance, by what percent (approximately) should it increase the Market Borrowings to arrange for the shortage of funds ?

(a) 4.5% (b) 7.5%
(c) 6% (d) 8%

5.If the toll is to be collected through an outsourced agency by allowing a maximum 10% commission, how much amount should be permitted to be collected by the outsourced agency, so that the project is supported with Rs. 4910 crores ?

(a) Rs.6213 crores (b) Rs. 5827 crores
(c) Rs. 5401 crores (d) Rs. 5216 crores

SOLUTION

1. (b): 20% of the total funds to be arranged = Rs.(20% of 57600) crores
= Rs.11520 crores Rs.11486 crores.

2. (c):Central angle corresponding to Market Borrowing = $\frac{29952}{57600} * 360°$
$= 187.2°$

3. (b): Required ratio = $\frac{4910}{29952} = \frac{1}{6.1} = \frac{1}{6}$

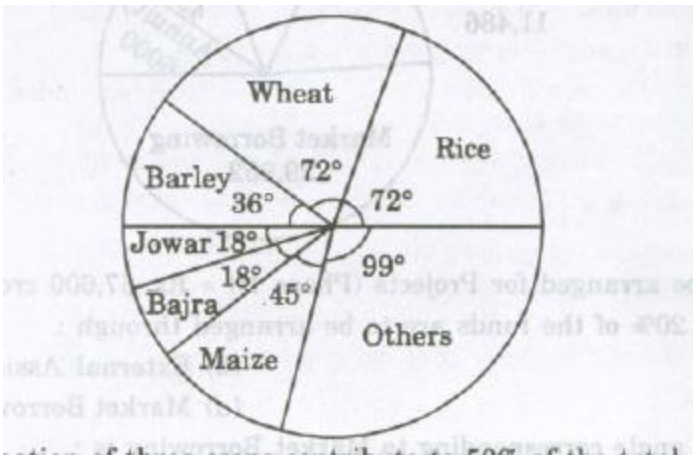
4. (c):Shortage of funds arranged through External Assistance
=Rs.(11486-9695) crores =Rs. 1791 crores.
therefore, Increase required in Market Borrowings =Rs. 1791 crores.

Percentage increase required = $\left| \frac{1791}{29952} * 100 \right| \% = 5.98 \% = 6\%$

5. (c):Amount permitted = (Funds required from Toll for projects of Phase II) + (10 % of these funds)
=Rs. 4910 crores + Rs. (10% of 4910) crores
=Rs. (4910 + 491) crores = Rs. 5401 crores.

Example 2. The pie-chart provided below gives the distribution of land (in a village) under various food crops. Study the pie-chart carefully and answer the questions that follow.

DISTRIBUTION OF AREAS (IN ACRES) UNDER VARIOUS FOOD CROPS



1.Which combination of three crops contribute to 50% of the total area under the food crops ?

(a) Wheat, Barley and Jowar (b)Rice, Wheat and Jowar

(c) Rice, Wheat and Barley (d)Bajra, Maize and Rice

2.If the total area under jowar was 1.5 million acres, then what was the area (in million acres) under rice?

(a)6 (b)7.5 (c)9 (d)4.5

3.If the production of wheat is 6 times that of barley, then what is the ratio between the yield per acre of wheat and barley ?

(a) 3:2 (b) 3:1 (c) 12:1 (d) 2:3

4.If the yield per acre of rice was 50% more than that of barley, then the production of barley is what percent of that of rice ?

(a)30% (b)33 % (c)35% (d)36%

5.If the total area goes up by 5%, and the area under wheat production goes up by 12% , then what will be the angle for wheat in the new pie-chart ?

(a) 62.4° (b) 76.8° (c) 80.6° (d) 84.2°

SOLUTIONS

1.(c):The total of the central angles corresponding to the three crops which cover 50% of the total area ,should be 180°.Now, the total of the central angles for the given combinations are:

(i) Wheat,Barley and jowar = (72°+36°+18°)=126°

(ii) Rice,Wheat and Jowar = (72°+72°+18°)=162°

(iii) Rice,Wheat and Barley = (72°+72°+36°)=180°

(iv)Bajra,Maize and Rice = (18°+45°+72°) = 135°

Clearly:(iii) is the required combination.

2.(a): The area under any of the food crops is proportional to the angle corresponding to that crop.

Let the area under the rice production be x million acres.

Then, 18:72 = 1.5:x $\Rightarrow$ x=(72*15/18)=6

Thus, the area under rice production be = 6 million acres.

3.(b): Let the total production of barley be T tones and let Z acres of land be put under barley production.

Then, the total production of wheat =(6T) tones.

Also,area under wheat production = (2Z) acres.

$$\therefore \frac{\text{Area Under Wheat Production}}{\text{Area Under Barley Production}} = \frac{72^\circ}{36^\circ} = 2$$

And therefore,Area under wheat = 2*Area under Barley = (2Z)acres

Now, yield per acre for wheat = (6T/2Z) tones/acre = (3T/Z) tones/acre

And yield per acre for barley = (T/Z) tones/acre.

$$\therefore \text{Required ratio} = \frac{3T/Z}{T/Z} = 3:1.$$

4. (b):Let Z acres of land be put under barley production.

$$\text{Then,} \quad \frac{\text{Area Under Rice Production}}{\text{Area Under Barley Production}} = \frac{72^\circ}{36^\circ} = 2.$$

$\therefore$Area under rice production = 2 * area under barley production = (2Z) acres.

Now,if p tones be the yield per acre of barley then ,yield per acre of rice

=(p+50% of p) tones =(3/2 p) tones.

$\therefore$Total production of rice = (yield per acre) * (area under production)

= (3/2 p)*2Z=(3pZ) tones.

And,Total production of barley = (pz) tones.

∴Percentage production of barley to that rice = (pZ/3pZ *100)%= 33 1/3% .

5.(b): Initially,let t be the total area under considerations.

The area under wheat production initially was =(72/360 * t)acres = (t/5)acres.

Now,if the total area under consideration be increased by 5%,

then the new value of the total area= (105/100 t) acres.

Also,if the area under wheat production be increased by 12%,

then the new value of area under wheat = $\frac{t}{5}$ +(12% of $\frac{t}{5}$) acres = (112t/500)acres.

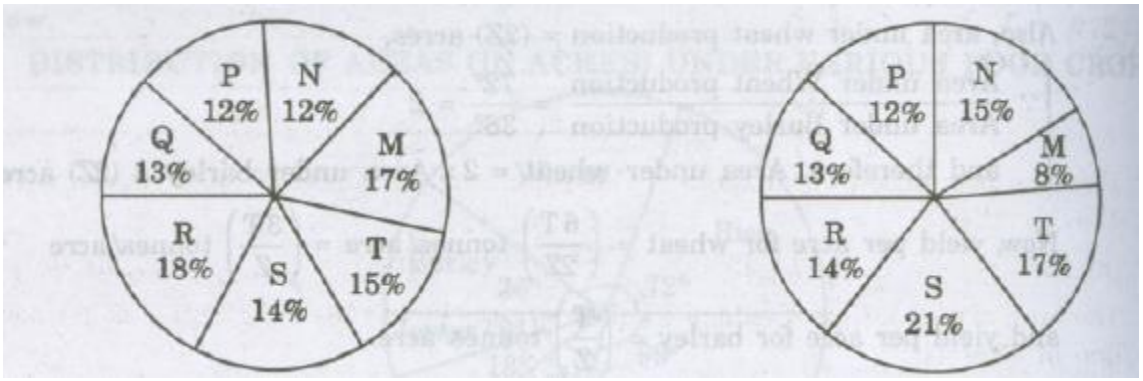
∴Central angle corresponding to wheat in the pie-chart

$$= \frac{\text{Area Under Wheat (new)}}{\text{Total area (new)}} * 360 = \frac{(112t/500)}{(105t/100)} * 360 = 76.8°$$

Example 3.The following pie-charts show the distribution of students of graduate and post graduate levels in seven different institute-M,N,P,Q,R,S and T in a town.

DISTRIBUTION OF STUDENTS AT GRADUATE AND POST-GRADUATE LEVELS IN SEVEN INSTITUTES-M,N,P,Q,R,S AND T.

Total	Number of students of graduate level	Total	Number of students of post graduate level



1.How many students of institutes M and S are studying at graduate level?
(a) 7516 (b) 8463 (c) 9127 (d) 9404

2.Total number of students studying at post -graduate level from institutes N and P is:
(a) 5601 (b) 5944 (c) 6669 (d) 7004

3.What is the total number of graduate and post-graduate level students in institute R?
(a) 8320 (b) 7916 (c) 9116 (d) 8372

4 .What is the ratio between the number of students studying at post graduate and graduate levels respectively from institute S?
(a) 14:19 (b) 19:21 (c) 17:21 (d) 19:14

5.What is the ratio between the number of students studying post graduate level from institute S and the number of students studying at graduate level from institute Q?
(a) 13:19 (b) 21:13 (c) 13:8 (d)19:13

SOLUTION

1.(b):Students of institute M at graduate level = 17% of 27300 = 4641.
Students of institute S at graduate level = 14% of 27300 = 3822
∴Total number students at graduate level in institutes M and S = 4641+3822=8463

2.(c):Required number = (15% of 24700) + (12% of 24700) = 3705 + 2964 = 6669.

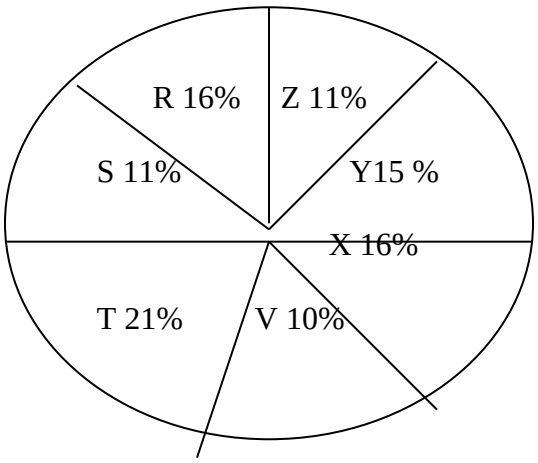
3.(d):Required number = (18% of 27300) + (14% of 24700) = 4914 + 3458 = 8372.

4.(d):Required ratio = (21% of 24700) = 21 * 24700 = 19
(14% of 27300) 14 * 27300 14

5.(d):Required ratio = (21% of 24700) = 21 * 24700 = 19
(13% of 27300) 13 * 27300 13

*Example 4.Study the following pie-chart and the table and the answer the questions based on them***.**

PROPORTION OF POPULATION OF SEVEN VILLAGES IN 1997



village	% population below poverty
X	38
Y	52
Z	42
R	51
S	49
T	46
V	58

1.Find the population of villages S if the population of village X below poverty line in 1997 is 12160.

(a). 18500 (b) 20500 (c) 22000 (d) 26000

2.The ratio of the population of the village T below poverty line to that of village Z below poverty line in 1997 is:
(a) 11:23 (b) 13:11 (c) 23:11 (d) 11:13

3.If the population of village R in 1997 is 32000,then what will be the population of village Y below poverty line in that year?
(a) 14100 (b)15600 (c) 16500 (d) 17000

4.If in 1998, the population of villages Y and V increases by 10% each and the percentage of population below poverty line remains unchanged for all the villages, then find the population of village V below poverty line in 1998,given that the population of village Y in 1997 was 30000.
(a) 11250 (b) 12760 (c) 13140 (d) 13780

5.If in 1998,the population of village R increases by 10% while that of village Z reduces by 5% compared that in 1997 and the percentage of population below poverty line remains unchanged for all the village,then find the approximate ratio of population of village R below poverty line for the year 1999.
(a) 2:1 (b) 3:2 (c) 4:3 (d) 5:4

SOLUTION

1.(c):Let the population of village X be x

Then,38% of x=12160 $\Rightarrow x = \frac{12160 * 100}{38} = 3200$

Now ,if s be the population village S,then

16:11 = 32000 : s $\Rightarrow s = \frac{11 * 32000}{16} = 22000.$

2.(c): Let N be the total population of all the seven villages.

Then ,population of village T below poverty line = 46% of (21% of N) and population of village Z below poverty line = 42% of (11% of N)

$\therefore$ **Required ratio** $= \frac{46\% \text{ of } (21\% \text{ of } N)}{42\% \text{ of } (11\% \text{ of } N)} = \frac{46 * 21}{42 * 11} = \frac{23}{11}$

3.(b): Population of village R = 32000(given)

Let the population of village Y be y.

Then, 16:15 = 32000 : y $\Rightarrow$ y = 15 * 32000 =30000
16

4.(b): Population of village Y in 1997 = 30000(given) .
Let the population village V in 1997 be v.
Then, 15:10 = 30000:v $\Rightarrow$ v = 30000 * 10 = 20000.
15
Now population of village V in 1998 = 20000 + (10% 0f 20000) = 20000.
∴Population of village V below poverty line in 1998 = 58% of 22000 = 12760.

5.(a) : Let the total population of all the seven villages in 1997 be N.
Then,population of village R in 1997 = 16% of N = 16/ 100 N
And population of village Z in 1997 = 11% of N =11/100 N

∴Population of village R in 1999 = {16/100N+(10% of 16/100 N)}=1760/10000 N
and population of village Z in 1999 = {11/100 N-(5% of 11/100 N)} = 1045/10000 N.
Now,population of village R below poverty line for 1999 = 51% of(1760/10000 N)
And population of village Z below poverty line 1999 = 42% of (1045/10000 n)

51% of (1760/10000 N) 51 * 1760 2
---------- = ---------- = ------
42% of (1045/10000 N) 42 * 1045 1.

39.LINE-GRAPHS

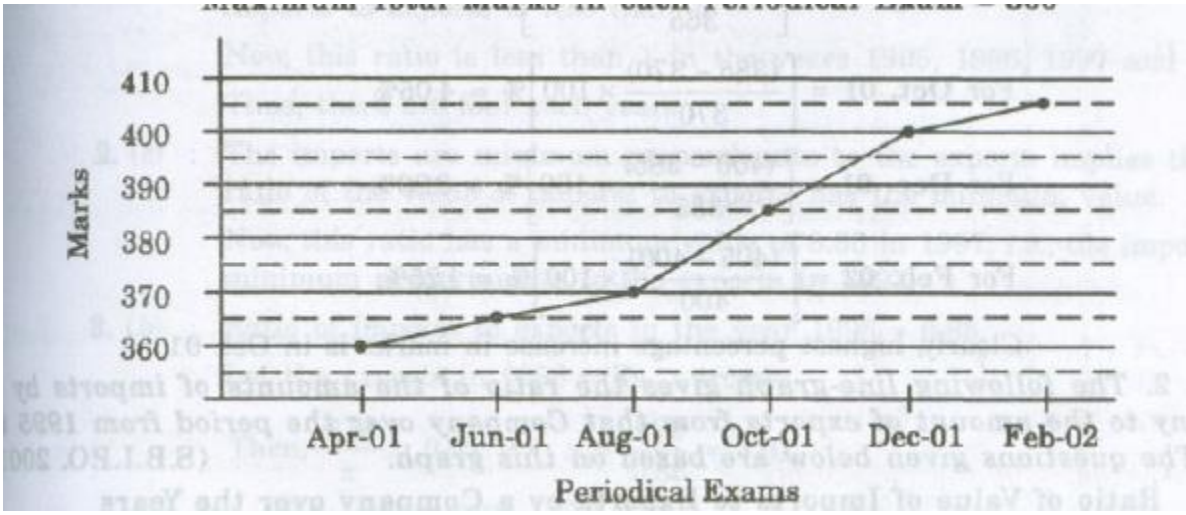
This section comprises of question in which the data collected in a particular discipline are represented by specific points together by straight lines. The points are plotted on a two-dimensional plane taking one parameter on the horizontal axis and the other on the vertical axis. The candidate is required to analyse the given information and thereafter answer the given questions on the basis of the analysis of data.

SOLVED EXAMPLES

Ex. 1. In a school the periodical examination are held every second month. In a session during Apr. 2001 – Mar. 2002, a student of Class IX appeared for each of the periodical exams. The aggregate marks obtained by him in each periodical exam are represented in the line-graph given below. Study the graph and answer the questions based on it. (S.B.I.P.O 2003)

MARKS OBTAINED BY A STUDENT IN SIX PERIODICAL EXAMS HELD IN
EVERY TWO MONTHS DURING THE YEAR IN THE SESSION 2001-02

Maximum Total Marks In each Periodical Exam = 500



1. **The total number of marks obtained in Feb. 02 is what percent of the total marks obtained in Apr. 01?**
   (a) 110% (b) 112.5% (c) 115% (d) 116.5% (e) 117.5%
2. **What are the average marks obtained by the student in all the periodical exams of during the session.**
   (a) 373 (b) 379 (c) 381 (d) 385 (e) 389
3. **what is the percentage of marks obtained by the student in the periodical exams of Aug. 01 and Oct. 01 taken together?**
   (a) 73.25% (b) 75.5% (c) 77% (d) 78.75% (e) 79.5%
4. **In which periodical exams there is a fall in percentage of marks as compared to the previous periodical exams?**
   (a) None (b) Jun. 01 (c) Oct. 01 (d) Feb. 01 (e) None of these
5. **In which periodical exams did the student obtain the highest percentage increase in marks over the previous periodical exams?**
   (a) Jun. 01 (b) Aug. 01 (c) Oct. 01 (d) Dec. 01 (e) Feb. 02

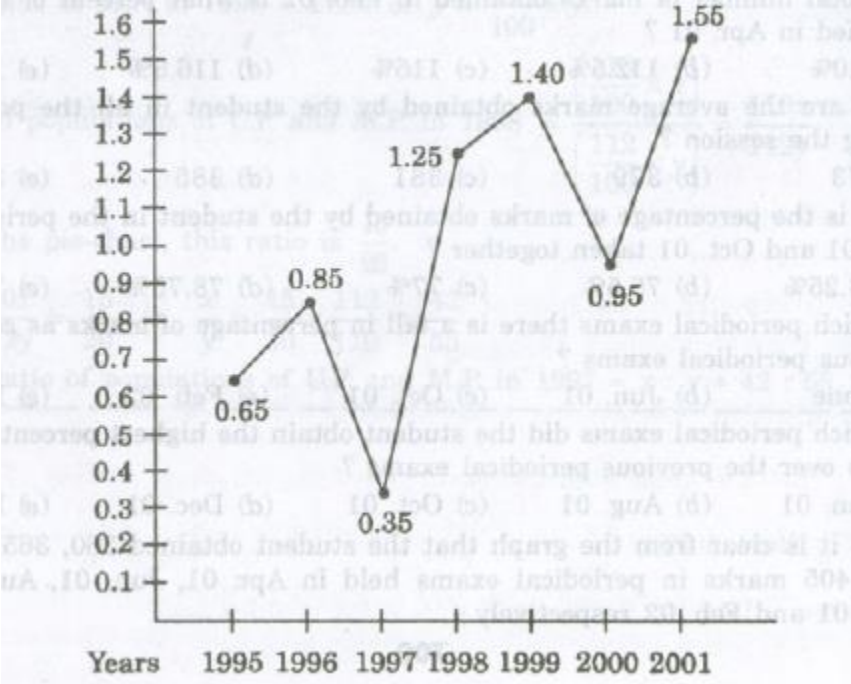
Sol. Here it is clear from the graph that the student obtained 360, 365, 370, 385, 400 and 405 marks in periodical exams held in Apr. 01, Jun. 01, Aug. 01, Oct. 01, Dec.

01 and Feb. 02 respectively.

1. (b) : Required percentage = [(405/360)*100] % = 112.5 %
2. (c) : Average marks obtained in all the periodical exams.
   = (1/6)*[360+370+385+400+404] = 380.83 ≈ 381.
3. (d) : Required percentage = [(370+385)/(500+500) * 100] % = [(755/1000)*100]% =75.5%
4. (a) : As is clear from graph, the total marks obtained in periodical exams, go on increasing. Since, the maximum marks for all the periodical exams are same , it implies that the percentage of marks also goes on increasing. Thus, in none of the periodical exams, there is a fall in percentage of marks compared to the previous exam.
5. (c) : Percentage increases in marks in various periodical exams compared to the previous exams are:
   For **Jun. 01** = [(365-360)/360 * 100] % = 1.39 %
   For **Aug. 01** = [(370-365)/365 * 100] % = 1.37 %
   For **Oct. 01** = [(385-370)/370 * 100] % = 4.05%
   For **Dec. 01** = [(400-385)/385 * 100] % = 3.90 %
   For **Feb. 02** = [(405-400)/400 * 100] % = 1.25 %

Ex. 2. The following line- graph the ratio of the amounts of imports by a Company to the amount of exports from that Company over the period from 1995 to 2001. The questions given below are based on this graph. (S.B.I.P.O 2001)

Ratio of value of Import to Export by a Company over the Years



1. **In how many of the given years were the exports more than the imports?**
   a. 1 b. 2 c. 3 d. 4

2.The imports were minimum proportionate to the exports of the Company in the year:
a..1995 b.1996 c.1997 d.2001

3.If the imports of the Company in 1996 was Rs.272 crores, the exports from the Company in 1996 was:
a. Rs.370 crores b.Rs.320 crores c.Rs.280 crores
d.Rs.275 crores e.Rs.264 crores

4.What was the percentage increase in imports from 1997 to 1998?
a. 72 b.56 c.28 d.None of these e.Data inadequate

5.If the imports in 1998 was Rs.250 crores and the total exports in the years 1998 and 1999 together was Rs.500 crores, then the imports in 1999 was:
a.Rs.250 crores b.Rs.300 crores c.Rs 357 crores
d.Rs 420 crores e.None of these

Sol: 1. d : The exports are more than the imports implies that the ratio of value of imports to exports is less than 1.
Now, this ratio is less than 1 in the years 1995,1996,1997 and 2000.
Thus, there are four such years.

2. c: The imports are minimum proportionate to the exports implies that the ratio of the value of imports to exports has the minimum value.
Now, this ratio has a minimum value of 0.35 in 1997, i.e., the imports are minimum proportionate to the exports in 1997.

3. b: Ratio of imports to exports in the years 1996=0.85.
Let the exports in 1996=Rs.320 crores.
Then,272/x =0.85 implies x=272/.85 = 320.

Exports in 1996 = Rs.320 crores.

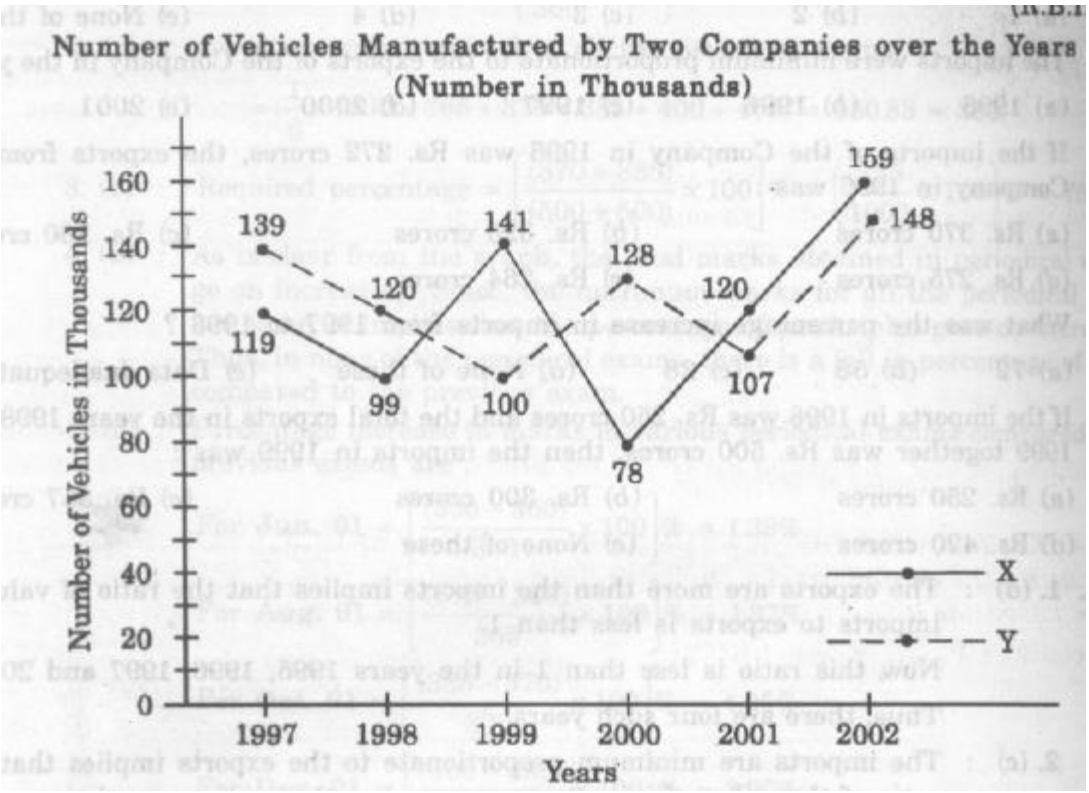
4. e: The graph gives only the ratio of imports to exports for different years. To find the percentage increase in imports from 1997 to 1998, we require more details such as the value of imports or exports during these years. Hence, the data is inadequate to answer this question.

5. d: The ratio of imports to exports for the years 1998 and 1999 are 1.25 and 1.40 respectively.
Let the exports in the year 1998 = Rs. x crores
Then, the exports in the year 1999=Rs(500-x) crores.
1.25=250/x implies x=250/1.25=200
Thus the exports in the year 1999=Rs. (500-200)crores=Rs.300 crores
Let the imports in the year 1999=Rs. y crores
Then, 1.4=y/300 implies y=(300*1.4)=420.
Imports in the year 1999=Rs.420 crores.

Ex.3.Study the following line-graph and answer the question based on it.

Number of vehicle Manufactured by Two Companies over the Years

(Numbers in thousands)



1.What is the difference between the total productions of the two Companies in the given years?

a. 19000 b. 22000 c.26000 d.28000 e.29000

2.What is the difference between the numbers of vehicles manufactured by Company Y in 2000 and 2001?

a.50000 b.42000 c.33000 d.21000 e.13000

3.What is the average number of vehicles manufactured by Company X over the given period? (rounded off to the nearest integer)

a.119333 b.113666 c.112778 d.111223 e. None of these

4.In which of the following years, the difference between the productions of Companies X and Y was the maximum among the given years?

a.1997 b.1998 c.1999 d.2000 e.2001

5.The production of Company Y in 2000 was approximately what percent of the production of Company X in the same year?

a.173. b.164 c.132 d.97 e.61

Sol: From the line-graph it is clear that the productions of Company X in the years 1997,1998,1999,2000,2001 and 2002 are 119000,99000,141000,78000,120000and 159000 respectively and those of Company Y are 139000,120000,100000,128000,107000 and 148000 respectively.

1. (c) : Total production of Company X from 1997 to 2002
= 119000+99000+141000+78000+120000+159000 = 716000
and total production of Company Y from 1997 to 2002
=139000+120000+100000+128000+107000+148000=742000
Difference=742000-716000=26000.

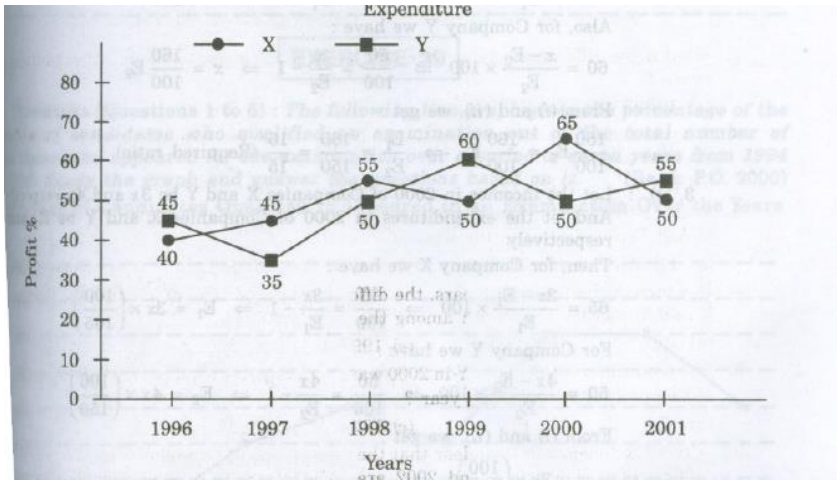
2. (d) : Require difference = 128000-107000 = 21000.
3. (a) : Average number of vehicles manufactured by Company X
= (91/6)* (119000 + 99000 + 141000 + 78000 + 120000 + 159000) = 119333.

4. (d) : The difference between the production of Companies X and Y in various years are.
For 1997 = (139000 – 119000) = 20000;
For 1998 = (120000 – 99000) = 21000;
For 1999 = (141000 – 100000) = 41000;
For 2000 = (128000 – 78000) = 50000;
For 2001 = (120000 – 107000) = 13000;
For 2003 = (159000 – 148000) = 11000;
Clearly, maximum difference was in 2000.

5. (b) : Required percentage = [(128000/78000)* 100] % = 164 %.

Ex. 4. The following line-graph gives the percent profit earned by two Companies X and Y during the period 1996 – 2001. Study the line – graph and answer the questions that are based on on it.

Percentage Profit Earned by Two Companies X and Y over the Given years
% profit/ loss = [(Income – Expenditure) / Expenditure] * 100



1. If the expenditure of Company Y in 1997 was Rs. 220 crores, what was its income in 1997?

(a). Rs. 312 crores (b). Rs. 297 crores (c) Rs. 283 crores (d) Rs. 275 crores (e)Rs.261 crores

2.If the incomes of the two companies were equal in 1999,then what was the ratio of expenditure of Company X to that of company Y in 1999 ?

(a) 6:5 (b) 5:6 (c) 11:6 (d) 16:15 (e) 15:16

3.The incomes of the companies X and Y in 2000 were in the ratio of 3:4 respectively.What was the respective ratio of their expenditures in 2000?

(a) 7:22 (b) 14:19 (c) 15:22 (d)27:35 (e) 33:40

4.If the expenditure ofcompanies X and Y in 1996 were equal and the total income of the two companies in 1996 was Rs.342 crores, what was the total profit of the twocompanies together in 1996 ? (Profit = Income – Expenditure)

(a) Rs.240crores (b) Rs.171crores (c) Rs.120crores (d) Rs.102crores (e)None of these.

5.The expenditure ofcompany X in the year 1998 was Rs.200 crores and the income Company X in 1998 was the same as its expenditure in 2001 was:

(a) Rs.465crores (b)Rs.385crores (c)Rs.295crores (d)Rs.255crores

Sol.1.(b) : Profit percent ofcompany Y in 1997=35.

Let the income of company Y in 1997 be Rs.x crores

Then,$35 = \frac{x-220}{220} \times 100 \Rightarrow x = 297$

$\therefore$ Income of company Yin 1997 = Rs.297crores

2.(d): Let the incomes of the twocompanies X and Yin 1999 be Rs.x and let the Expenditures of companies X and Y in 1999 be E_1 and E_2 respectively

Then, for Company X we have:

$$50 = \frac{x-E1}{E1} \times 100 \Rightarrow \frac{50}{100} = \frac{x}{E1} - 1 \Rightarrow x = \frac{150}{100} E1$$

Also, for the Company Y we have:

$$60 = \frac{x-E2}{E2} * 100 \Rightarrow \frac{60}{100} = \frac{x}{E2} - 1 \Rightarrow x = \frac{160}{100} E2$$

From (i) and (ii),we get

$$\frac{150}{100} E1 = \frac{160}{100} E2 \Rightarrow \frac{E1}{E2} = \frac{160}{150} = \frac{16}{15} \text{(Required ratio)}$$

3.(c):Let the incomes in 2000 of companies X and Y be 3x and 4x respectively.And let the expenditure in 2000 of companies X and Y be E1 and E2 respectively.

Then, for company X we have:

$65=\frac{3x-E1}{E1} *100 \Rightarrow \frac{65}{100} = \frac{3x}{E1} -1 \Rightarrow E1=3x *(\frac{100}{165})$

For company Y we have:

$50 =\frac{4x-E2}{E2} *100 \Rightarrow \frac{50}{100} = \frac{4x}{E2} -1 \Rightarrow E2 = 4x* (\frac{100}{150})$

From (i)and(ii) we get:

$\frac{E1}{E2} = \frac{3x*(100/165)}{4x*(100/150)} = \frac{3* 150}{4*165} = \frac{15}{22}$(Required ratio)

4.(d):Let the expenditures of each of the Companies X and Y in 1996 be Rs.xcrores.And let the income of Company X in 1996 be Rs.zcrores so that the income of Company Y in 1996 =Rs.(342-z)crores.

Then,for company X we have:

$40= \frac{z-x}{x} *100 \Rightarrow \frac{40}{100} = \frac{z}{x} -1 \Rightarrow x = \frac{100z}{140}$

Also for company Y we have:

$45= \frac{(342-z)-x}{x} *100 \Rightarrow \frac{45}{100} = \frac{(342-z)}{x} -1 \Rightarrow x = \frac{(342 -z)* 100}{145}$

From(i)and (ii) we get:

$\frac{100z}{140} = \frac{(342-z) *100}{145} \Rightarrow z = 168$

Substituting z=168 in (i),we get: x=120

$\therefore$ Total expenditure of companies X and Y in 1996=2x=Rs.240crores.

Total income of companies X and Y in 1996=Rs.342 crores.

$\therefore$Total profit =Rs.(342-240)crores =Rs.102 crores

5.(a): Let the income of company X in 1998 be Rs.x crores.

Then,$55= \frac{x-200}{x} *100 \Rightarrow x = 310.$

$\therefore$ Expenditure of Company X in 2001= Income of company X in 1998 = Rs.310crores

Let the income of company X in 2001 be Rs.z crores

Then, $50 = \frac{z-310}{310} * 100 \Rightarrow z = 465.$

$\therefore$ Income of company X in 2001 = Rs.465 crores.