Thoroughly Revised and [illegible]

Reasoning & Aptitude

for GATE 2019 and ESE Pre 2019

Comprehensive Theory with Examples
and Solved Questions of
GATE and ESE Prelims

Also useful for
UPSC (CSAT), MBA Entrance, Main SSC, Bank PO, IES, Railway [illegible]
Various Public Sector Units and other Competitive Exams conducted by Govt.

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Reasoning & Aptitude for GATE 2019 & ESE 2019 Prelims

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PREFACE

I have immense pleasure in placing this edition of "Reasoning & Aptitude" before the aspirants of Competitive Examinations. The book has been written to meet the growing requirements of candidates appearing for GATE, ESE Prelims, GRE, [illegible], SSC, various Public Sector Examinations, Bank (PO), MBA Entrance exams, Railways and Campus Placements of Software Companies etc.

The comprehensive volume would enable the readers to acquire complete and detailed understanding of "Reasoning & Aptitude". It covers all dimensions of Arithmetic, Algebra, Geometry, Reasoning and Data Interpretation. My first hand experience of teaching the students has been a great source of inspiration and has helped me immensely in writing this book. Preparation for Civil Services Examination taking Mathematics as optional subject also helped me sharpen the ideas and arguments developed here.

I am grateful to my parents and family members, who have been showering their blessings from the very beginning. I offer my sincere gratitude to my teachers, Principals of Navodaya Vidyalayas and Professors of IIT Kanpur for their blessings and guidance. I would like to acknowledge the encouragement and useful guidance provided by my colleagues and seniors serving in IAS, IFS, IPS and IRS etc. My publishers Mr. [illegible] & Mr. [illegible] Singh have been a constant source of support and encouragement. My special thanks to the entire MADE EASY team for bringing forth this book in time and [illegible] in the hands of readers.

Suggestions and constructive comments from the readers for the improvement of the book are welcome.

Neel Singh

(Indian Revenue Service)

Contents

[illegible]

Section-A: Arithmetic

Section-B: Algebra & Geometry

Section-C: Reasoning & Data Interpretation

Section-D: Previous GATE & ESE Solved Questions

A

Section

Arithmetic

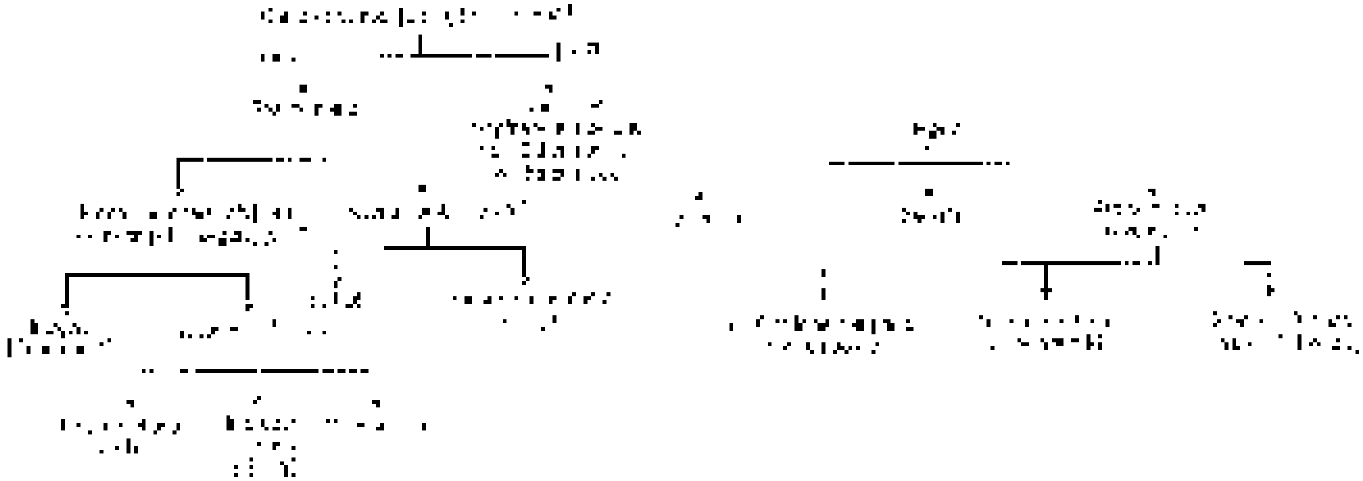
1.1

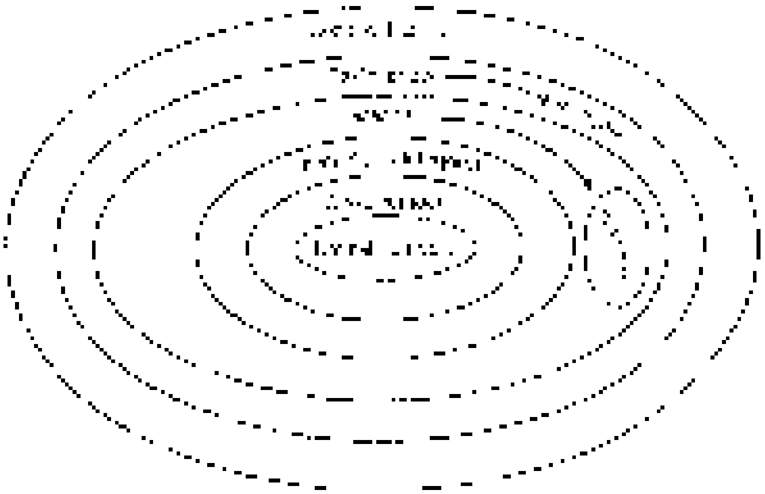
CHAPTER

Number System

[illegible]

Classifications of Numbers





[illegible]

Imaginary Numbers

[illegible]

Question: What is the value of expression

[illegible]

(a) 2 (b) 1

(c) [illegible] (d) None of these

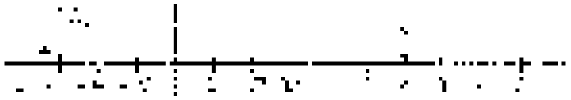
Ans. [illegible]

Solution:

[illegible]

Real Number System

[illegible]



Rational Number

[illegible]

Rational Numbers Follow

[illegible]

[illegible]

Fraction

[illegible]

Proper Fraction

[illegible]

Improper Fraction

[illegible]

Mixed Fraction

[illegible]

Integers

[illegible]

Negative Integers

[illegible]

Positive Integers

[illegible]

Negative numbers
Origin
Positive numbers

Natural Numbers

[illegible] considered as set of natural numbers. [illegible]

N = {1, 2, 3, 4, ...}

Whole Number

[illegible] whole numbers. [illegible]

W = {0, 1, 2, 3, ...}

Note: [illegible]

Even Numbers & Odd Numbers

1. Even Numbers

[illegible]

Note: [illegible]

2. Odd Number

[illegible]

Properties of numbers based on even & odd

Even + Even = Even

Odd + Odd = Even

Odd + Even = Odd

Odd × Odd = Odd

Odd × Even = Even

Even × Even = Even

[illegible]

[illegible]

$(Even)^n$ = Even

$(Odd)^n$ = Odd

These properties can be used extensively [illegible]

Example 1.

[illegible]

(a) [illegible] (b) 4

(c) [illegible] (d) 15

Ans. (c)

[illegible]

Example 2

[illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (d)

[illegible]

Prime Number & Composite Numbers

Prime Numbers

[illegible]

Composite Numbers

[illegible]

How to check whether given number is prime or not?

1. [illegible]
2. [illegible]

2. [illegible] is not divisible by any of these prime [illegible] the number is a prime number.

Learn it by examples:

Is [illegible] a prime number or not?

Square root of 629 is [illegible] 25. The primes less than 25 are 2, 3, 5, 7, 11, 13, 17, 19, 23

629 is not divisible by 2, 3, 5, 7, 11, 13 but is divisible by 17.

Hence 629 is not a prime number.

One more example: 179

Square root of 179 is less than 14. Hence we need to check divisibility by 2, 3, 5, 7, 11, 13.

179 is not divisible by any of these primes. Hence it is a prime number.

Test of Divisibility

1. Divisibility by 2
   A number is divisible by 2 if its unit digit is even or 0, it is divisible by 2.
   Eg. 22, 32, [illegible]

2. Divisibility by 3
   A number is divisible by 3 if the sum of digits of the number is divisible by 3.
   Eg. 2553
   Here 2 + 5 + 5 + 3 = 15 [illegible] 15 is divisible by 3 hence 2553 is divisible by 3.

3. Divisibility by 4
   A number is divisible by 4 if its last two digits is divisible by 4.
   Eg. 2352: here 52 is divisible by 4 so 2352 is divisible by 4.
   Eg. 3772, 604, 904 etc.

4. Divisibility by 5
   A number is divisible by 5 if the unit's place number is 0 or 5.
   Eg. 50, 515, 105 etc.

5. Divisibility by 6
   A number is divisible by 6 if the number is even and sum of digits is divisible by 3.
   Eg. 4554: here number is even and sum of digits 4 + 5 + 5 + 4 = 18 is divisible by 3.
   Eg. 72, 8448, 3852 etc.

6. Divisibility by 8
   A number is divisible by 8 if last three digits of it is divisible by 8.
   Eg. 37128 here 128 is divisible by 8 hence this number 37128 is divisible by 8.

7. Divisibility by 9
   A number is divisible by 9 if the sum of its digits is divisible by 9.
   Eg. 108936: here [illegible] is divisible by 9 and hence the number is divisible by 9.

8. Divisibility by 10
   A number is divisible by 10 if its unit digit is 0.
   Eg. 10, 20, 40, 3220 etc.

9. Divisibility by 11
   A number is divisible by 11 if the difference of sum of digits at odd places and sum of digits at even places is either 0 or divisible by 11.
   Eg. 1331: sum of digits at odd places is [illegible] and sum of digits at even places is [illegible] and the difference is [illegible] = 0 so 1331 is divisible by 11.

HCF and LCM of Numbers

H.C.F.

Highest common factor (H.C.F.) of two or more numbers is the greatest number that divides each of them exactly. For example 6 is the highest common factor of 18 and 24.

HCF is also called as greatest common divisor (G.C.D.)

L.C.M.

Least Common Multiple (L.C.M.) of two or more numbers is the least number which is exactly divisible by each of them.

For example, LCM of 6 and 8 is 24, because it is the least number which is multiple of both 6 and 8.

LCM and HCF of Fractions

Fractions are written in form of $\frac{\text{Numerator}}{\text{Denominator}}$, where denominator is never equal to 0.

$$\text{H.C.F. of Fractions} = \frac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}}$$

$$\text{L.C.M. of Fractions} = \frac{\text{L.C.M. of Numerators}}{\text{H.C.F. of Denominators}}$$

All fractions have to be in their simplest form.

Example: Find HCF & LCM of $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{4}{7}$

$$HCF = \frac{HCF\ of\ (1, 2, 4)}{LCM\ of\ (2, 3, 7)} = \frac{1}{42}$$

$$LCM = \frac{LCM\ of\ (1, 2, 4)}{HCF\ of\ (2, 3, 7)} = \frac{4}{1} = 4$$

Important Algebraic Formulae

1. $(a+b)^2 = a^2 + 2ab + b^2$
2. $(a-b)^2 = a^2 - 2ab + b^2$
3. $(a+b)(a-b) = a^2 - b^2$
4. $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$
5. $(a+b)^2 - (a-b)^2 = 4ab$
6. $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
   $= a^3 + b^3 + 3ab(a+b)$
7. $(a-b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$
   $= a^3 - b^3 - 3ab(a-b)$
8. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$
9. $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
10. $\frac{a^3 + b^3 + c^3 - 3abc}{a^2 + b^2 + c^2 - ab - bc - ca} = (a+b+c)$
11. $a^4 + b^4 + a^2b^2 = (a^2+b^2)^2 - (ab)^2$
    $= (a^2 + ab + b^2)(a^2 - ab + b^2)$

Conditions of Divisibility for Algebraic Function

1. $a^n + b^n$ is exactly divisible by $(a+b)$ only when n is odd.
   Ex. $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ is divisible by $(a+b)$ [illegible]
2. $a^n + b^n$ is never divisible by $(a-b)$ [illegible]
   Ex. [illegible]
   [illegible] is not divisible by $(a-b)$
3. $a^n - b^n$ is always divisible by $(a-b)$ [illegible] odd or even.
   Ex. $a^2 - b^2$ [illegible] exactly divisible by $(a-b)$ [illegible]
   [illegible] is exactly divisible by $(a-b)$
4. $a^n - b^n$ is divisible by $(a+b)$ only when n is even number.
   Ex. $a^4 - b^4 = (a^2 - b^2)(a^2 + b^2)$ [illegible]
   So, [illegible] $(a^n - b^n)$ is always divisible by $(a+b)$ if n is even number.

Factors of Composite Number

Composite numbers are those numbers which can be factorised into [illegible]

For eg. 8 is a composite number since it can be expressed as:

$8 = 2 \times 2 \times 2$

Similarly 4 is also a composite number as

$4 = 2 \times 2$

If composite number $N = a^x \times b^y$ [illegible]

[illegible] are [illegible] numbers and x, y [illegible]

[illegible] are their respective powers.

[illegible]

$N = 18$ [illegible]

[illegible] $18 = 2 \times 3 \times 3 = 2^1 \times 3^2$

Factors of $18 =$ [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Ex. 1 Find the number of [illegible]

Sol. $420 = 2 \times 2 \times 3 \times 5 \times 7$

$= 2^2 \times 3 \times 5 \times 7$

Factors $= (2 + 1)(1 + 1)(1 + 1)(1 + 1) = 24$

* * *

Counting Number of Trailing Zeros

Many times we come across a problem of [illegible] the number of zeros at the end of [illegible] number. For example

Number of zeros at the end of

$N = 10 \times 9 \times 8 \times \dots \times 3 \times 2 \times 1$

[illegible]

Short Cut:

[illegible]

[illegible]

[illegible]

Ex.1 [illegible]

Sol. [illegible]

Integral value [illegible]

Ex.2 [illegible]

Sol. [illegible]

Integral values [illegible]

[illegible]

* * *

Cyclicity

[illegible]

1. Cyclicity of 1
   [illegible]

2. Cyclicity of 2
   $2^1 = 2$
   $2^2 = 4$
   $2^3 = 8$
   $2^4 = 16$
   $2^5 = 32$
   $2^6 = 64$
   $2^7 = 128$
   $2^8 = 256$

[illegible]

Ex.1 [illegible]

Sol. [illegible]

Ex.2 [illegible]

Sol. [illegible]

3. Cyclicity of 3.
   $3^1 = 3$
   $3^2 = 9$
   $3^3 = 27$
   $3^4 = 81$
   $3^5 = 243$
   $3^6 = 729$
   $3^7 = 2187$
   $3^8 = 6561$

Alternately [illegible]

Ex. [illegible]

Sol. [illegible]

4. Cyclicity of 4.
   $4^1 = 4$
   $4^2 = 16$
   $4^3 = 64$
   $4^4 = 256$
   Cycle is 4, 6 [illegible]
   [illegible]
   [illegible]

Ex. [illegible]

Sol. [illegible]

Ex.2 [illegible]

Sol. [illegible]

5. Cyclicity of 5.
   $5^1 = 5$
   $5^2 = 25$
   $5^3 = 125$
   $5^4 = 625$
   Unit digit will always be 5

6. Cyclicity of 6.
   $6^1 = 6$
   $6^2 = 36$
   $6^3 = 216$
   $6^4 = 1296$
   Unit digit will always be 6

Ex.1 [illegible]

Sol. [illegible]

7. Cyclicity of 7.

$7^1 = 7$

$7^2 = 49$

$7^3 = 343$

$7^4 = 2401$

$7^5 = 16807$

$7^6 = 117649$

$7^7 = 823543$

$7^8 = 5764801$

Cycle of 7 is 7, 9, 3, 1

Ex.1 [illegible]

Sol. [illegible]

8. Cyclicity of 8

$8^1 = 8$

$8^2 = 64$

$8^3 = 512$

$8^4 = 4096$

$8^5 = 32768$

So cycle of 8 is 8, 4, 2, 6

Ex. [illegible]

Sol. [illegible]

9. Cyclicity of 9

$9^1 = 9$

$9^2 = 81$

$9^3 = 729$

$9^4 = 6561$

Cycle of 9 is 9, 1

[illegible]

Ex. [illegible] 13

Sol. [illegible]

[illegible]

Remember

Cyclicity table

1 : 1

2 : 2, 4, 8, 6

3 : 3, 9, 7, 1

4 : 4, 6

5 : 5

6 : 6

7 : 7, 9, 3, 1

8 : 8, 4, 2, 6

9 : 9, 1

0 : 0

[illegible]

Remainder Theorem

[illegible]

Ex.1 [illegible] by 7

Sol. [illegible]

[illegible]

Polynomial Theorem

[illegible] according to polynomial theorem [illegible]

[illegible] (1)

[illegible] (2)

[illegible] will [illegible] remainder of [illegible] because [illegible] term contains [illegible]

Ex. 1 [illegible]

Sol. [illegible]

Ex. 2 [illegible]

Sol. [illegible]

More on Remainders

Case [illegible]

[illegible] LCM of [illegible]

Sol. [illegible]

Remainders [illegible]

[illegible] LCM [illegible]

number.

Note: [illegible]

Ex. [illegible]

Sol. [illegible]

Remainders [illegible]

Note: [illegible]

Ex.2 [illegible]

Sol. [illegible]

Remainders [illegible]

Ex.3 [illegible]

Sol. [illegible]

Remainders [illegible]

Case II

[illegible] LCM [illegible]

Ex. [illegible]

Sol. [illegible]

Case-II

[illegible]

Ex. 1 [illegible]

Sol. [illegible]

Ex. 1 $65^2 = ?$

Sol. [illegible] $= 4225$

Ex. 2 [illegible]

Sol. [illegible]

Ex. 3 [illegible]

Sol. [illegible]

Squares of Numbers

[illegible]

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$

$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$
$16^2 = 256$
$17^2 = 289$
$18^2 = 324$
$19^2 = 361$
$20^2 = 400$

[illegible]

Observation

[illegible]

Base System

[illegible]

Examples

[illegible]

Conversion of a number from Decimal to other Base System

[illegible]

Example

[illegible]

5. [illegible]

[illegible]

Solved Examples

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

[illegible]

5. [illegible]

6. [illegible]

7. [illegible]

8. [illegible]

9. The LCM of [illegible] is
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) None of these
Ans: (c)

[illegible]

[illegible]

[illegible]

10. GCD of [illegible] is
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]
Ans: (b)

[illegible]

[illegible]

[illegible]

11. Convert the number 20 into two terms such that [illegible]
(a) [illegible] = 10
(b) [illegible] = 12
(c) [illegible] = 7.5
(d) None of these
Ans: (a)
[illegible] when [illegible]
Here [illegible] = 20
[illegible] = 10

12. [illegible] divisible by 88 [illegible]
(a) Divisible by 8 and 11
(b) [illegible] 11 and 8
(c) Divisible by 11 and three by 8
(d) None of these
Ans: (b)
[illegible] because 8 and 11 are co-prime numbers [illegible] 88.

15. Find the GCD of [illegible]
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]
(e) None of these

Ans: (d)
GCD = [illegible]

[illegible]

14. Find the LCM of [illegible]
[illegible]
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]
Ans: (a)

[illegible]

[illegible]

LCM = [illegible]

[illegible]

15. The product of three consecutive [illegible] numbers [illegible] is always divisible by
(a) 6
(b) 24
(c) 48
(d) All of these
Ans: (b)
[illegible]

16. Find the [illegible]
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]
Ans: (d)
[illegible] and GCD = 13
[illegible]

17. [illegible] divisible by 24
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) None of these
Ans: (d)
4536 is divisible by [illegible]
[illegible]

[illegible]

[illegible] divisible by 11 [illegible]

18. [illegible] which being divided by [illegible] 18 and 30 [illegible]

(a) 320 (b) 370

(c) 540 (d) None of these

Ans. (b)

LCM [illegible] 360 [illegible]

[illegible] 370

19. Find the greatest [illegible] less than 10000 which is divisible by 6, 30 and 64

(a) [illegible] (b) 9600

(c) [illegible] (d) None of these

Ans. (d)

[illegible]

[illegible]

So the largest four digit number will be [illegible]

20. Find the [illegible] number which when divided by [illegible]

(a) 1692 (b) 1697

(c) 1683 (d) None of these

Ans. (b)

The number [illegible]

[illegible]

So [illegible] divisible by 11 [illegible]

21. The LCM [illegible] 12 [illegible] The sum of HCF and LCM is 403 [illegible]

(a) 324 (b) 124

(c) 120 (d) None of these

Ans. (b)

It is given that LCM = 12 × HCF

also LCM + HCF = 403

So 13 HCF = 403 ⇒ HCF = 31

[illegible]

HCF × LCM = Number(1) × Number(2)

[illegible] = 124

22. [illegible]

[illegible]

[illegible]

[illegible]

(c) Rs. 200 (b) Rs. 1800

(c) Rs. 300 (d) None of these

Ans. (a)

[illegible]

Let [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

So [illegible]

23. A man [illegible]

[illegible]

[illegible]

[illegible] Rs. 5000

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) None of these

Ans. (b)

[illegible]

[illegible] Rs. [illegible]

[illegible]

[illegible] = Rs. [illegible]

[illegible]

Practice Exercise 1

1. [illegible]

(a) [illegible] (b) 3

(c) [illegible] (d) [illegible]

2. [illegible]

[illegible]?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

3. [illegible]

(a) 2 (b) [illegible]

(c) [illegible] (d) 9

4. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

5. [illegible]

(a) [illegible] (b) [illegible]

(c) 11 (d) [illegible]

6. [illegible]

(a) [illegible] (b) [illegible]

(c) 6 (d) [illegible]

7. [illegible]?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

8. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 3

9. [illegible]

(a) [illegible] (b) [illegible]

(c) 4 (d) [illegible]

10. [illegible]

(a) [illegible] (b) 0

(c) [illegible] (d) 3

11. [illegible]

(a) [illegible] (b) [illegible]

(c) 6 (d) [illegible]

12. [illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

(d) [illegible]

13. [illegible]

(a) [illegible] (b) 8

(c) [illegible] (d) 6

14. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

15. [illegible]

1. [illegible]
2. [illegible]
3. [illegible]

[illegible]

(a) [illegible] (b) 12

(c) [illegible] (d) [illegible]

16. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

17. [illegible] 3, 11, 19, 27, ..., 451, 459, 467 [illegible] 470 [illegible]?
    (a) 32 (b) 30
    (c) 29 (d) 31

18. [illegible] tickets, numbered from [illegible] Which of the following [illegible]?
    (a) [illegible] (b) 19
    (c) 27 (d) 28

19. [illegible] number [illegible] are possible [illegible] N [illegible]?
    (a) 5 (b) 7
    (c) 9 (d) 11

20. What is the unit digit of [illegible]?
    (a) 2 (b) 4
    (c) 3 (d) 7

21. How many [illegible] between [illegible] and 200?
    (a) 1 (b) 2
    (c) 3 (d) 4

22. [illegible] Which will be the 50th digit [illegible]?
    (a) 1 (b) 2
    (c) 3 (d) 4

23. N = (n + 1)(n − 2)(n [illegible])(n + [illegible]), where n is a [illegible]. Which of the following statements are true?
    1. Unit digit of N is 0
    2. N is perfectly divisible by 24
    3. N is a perfect square
    4. N is odd.
    (a) 1 only (b) 1 and 4 only
    (c) 3 only (d) 1 and 2 only

24. How many factors of [illegible] are multiples of [illegible]?
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) [illegible]

25. [illegible] then [illegible]
    (a) [illegible] (b) 1024
    (c) [illegible] (d) 1023

26. [illegible]?
    (a) [illegible] (b) 3
    (c) 1 (d) 2

ANSWER

Solutions

1. (a)

Method [illegible] $\frac{3}{9+4\sqrt{5}}$ [illegible]

$= [illegible] \frac{3}{9+4\sqrt{5}} \times \left(\frac{9-4\sqrt{5}}{9-4\sqrt{5}}\right)$

$= [illegible]$

$= \sqrt{27 - 12\sqrt{5}}$ [illegible]

Alternative Method

[illegible] $\frac{3}{9+4\sqrt{5}}$

[illegible]

and $\frac{3}{9+4\sqrt{5}} < 1$

Thus, [illegible] $\frac{3}{9+4\sqrt{5}}$ [illegible]

[illegible]

(a)

[illegible]

(b)

[illegible]

(b)

[illegible]

(b)

[illegible]

6. (b)

[illegible]

Alternative Method

[illegible]

7. (c)

[illegible]

8. (c)

[illegible]

9. (b)

[illegible]

10. (a)

[illegible]

11. (c)

[illegible]

12. (d)

[illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

(d) None statement is true.

13. (c)

[illegible]

14. (b)

[illegible]

15. (d)

[illegible]

16. (d)

[illegible]

17. (b)

[illegible]

18. (c)

[illegible]

19. (c)

[illegible]

20. (d)

[illegible]

21. (a)

[illegible]

22. (c)

[illegible]

23. (c)

[illegible]

24. (d)

[illegible]

25. (b)

[illegible]

26. (c)

[illegible]

12

CHAPTER

Percentage

The term per[illegible] [illegible] the value [illegible] [illegible] hundred. The concept of percentage is basically used for the comparison of two values by using the denominator value as 100.

The concept of percentage is very useful in reasoning [illegible] and especially for data interpretation section, where every calculation has to be [illegible] based on percentages.

Calculation of Percentage

As we know that percentage is the value out of hundred, the percentage is calculated as:

$$\frac{\text{Value}}{\text{Total value}} \times 100$$

[illegible]

Percentage & Fraction

[illegible] different form [illegible] calculations fast. Here are some common percentage values given in the form of fractions.

Percentage	Fraction	Decimal value
100%	1	1
50%	$\frac{1}{2}$	0.5
33.33%	$\frac{1}{3}$	0.33
25%	$\frac{1}{4}$	0.25
20%	$\frac{1}{5}$	0.20
16.66%	$\frac{1}{6}$	0.16

Multiplication Factor

Multiplication factor is the quantity which is multiplied to any quantity [illegible] after the change [illegible].

[illegible] quantity is 200 and 75% [illegible] $\frac{75}{100} = \frac{3}{4}$ times of 200. [illegible] multiplied [illegible] 200.

Multiplication factor [illegible] percentage [illegible] examples.

Example 1

A quantity 200 is increased by 75%, then what will be the new quantity?

Solution

[illegible] 75% of 200 i.e.

$$\frac{3}{4} \times 200 = 150$$

and then the new quantity will be 200 + 150 = 350

[illegible] was 100% [illegible] increased [illegible] 1.75 [illegible]

So the new quantity becomes

$$\left(1 + \frac{3}{4}\right) \times 200 = 350$$

or $(1 + 0.75) \times 200 = 350$

These $\left(1 + \frac{3}{4}\right)$ and $(1 + 0.75)$ are the multiplying factors [illegible]

Example 2

A quantity 200 when increased by some percentage becomes 350. Find out by what percentage it was increased?

Solution

Now we know that

200 × Multiplying Factor (MF) = 350

[illegible]

$$\text{So } MT = \frac{[illegible]}{[illegible]} [illegible] \frac{[illegible]}{5}$$

[illegible]

[illegible] $\frac{1}{5}$ [illegible]

[illegible]

Successive Percentage Change

[illegible]

Example 1.

A quantity 300 is increased by 20%. The [illegible] decreased by 10%. Find out the new quantity [illegible]

Solution.

[illegible]

$300\left(1+\frac{1}{[illegible]}\right)$ [illegible]

[illegible]

[illegible]

$$\frac{1}{50}$$

[illegible]

Comparison Leading to New Base Change

[illegible]

Example 1.

[illegible]

Solution

[illegible]

$$[illegible]\left(1+\frac{40}{100}\right)[illegible]$$

$$y = \left(1+\frac{[illegible]}{5}\right)x$$

$$y = \frac{7}{[illegible]}$$

$$x = \frac{5}{[illegible]}y$$

[illegible]

Example 2.

[illegible]

Solution

[illegible]

$$\left(1+\frac{[illegible]}{100}\right)$$

[illegible]

[illegible]

[illegible]

[illegible] $\frac{1}{11}$ [illegible] 100 [illegible]

Alternately: [illegible]

[illegible]

Example 3.

[illegible]

Solution:

[illegible]

[illegible]

Example 4.

[illegible]

Solution:

[illegible]

Example 5.

[illegible]

Solution:

[illegible]

Example 6.

[illegible]

Solution:

[illegible]

Example 7.

[illegible]

Solution:

[illegible]

[illegible]

[illegible]

Solved Examples

[illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

2. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

3. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

4. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

5. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

6. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

7. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. [illegible]

[illegible]

8. If the length, breadth and height of [illegible] are increased by 10%, 20% and 50% respectively. Find the percentage change in the volume of the cuboid.
   (a) 77% (b) [illegible]5%
   (c) 66% (d) 98%
   Ans. (d)
   Let l, b, h be length, breadth and height of the cuboid
   Volume = lbh
   Now l, b, h are increased by 10%, 20%, 50% respectively
   $$V' = l\left(1+\frac{10}{100}\right) \times b\left(1+\frac{20}{100}\right) \times h\left(1+\frac{50}{100}\right)$$
   $= 1.98\,lbh$
   % change = 98%

9. The price of sugar is increased by 25% [illegible] increase his expenditure [illegible] by 20%. What is the percentage change in his monthly consumption of sugar?
   (a) −4% (b) −10%
   (c) −33.33% (d) 5%
   Ans. (a)
   Let price of sugar be P and expenditure be E.
   Now price is increased by 25% so it becomes $\frac{5}{4}P$. Now [illegible] expenditure increased by 20% i.e.
   $1.2E = \frac{6}{5}E$
   So the amount of sugar that can be purchased
   $$= \frac{\frac{6}{5}E}{\frac{5}{4}P} = \frac{24E}{25P} = 0.96\left(\frac{E}{P}\right)$$
   Hence consumption [illegible] decreased by 4%.

10. 30% of a number [illegible] 91 [illegible]
    (a) 80 (b) 95
    (c) 70 (d) None of these
    Ans. (c)
    $\frac{30}{100}x = 30\%$ of the number
    $$\text{Now } 91 = \frac{130}{100}x$$
    $$x = \frac{100}{130} \times 91 = 70$$

11. The population [illegible] increases by 10% [illegible] the next year [illegible] migration, [illegible] the population decreases by 5%. [illegible] the population [illegible] increases by 2?%
    (a) 12330 (b) 12510
    (c) 1,27,510 (d) 12450
    Ans. (b)
    P = 10000, r_1 = [illegible]%, r_2 = −5%, r_3 = [illegible]
    Population at the end of third year
    $$P\left(1+\frac{r_1}{100}\right)\left(1+\frac{r_2}{100}\right)\left(1+\frac{r_3}{100}\right)$$
    $$= 10000\left(1+\frac{3?}{100}\right)\left(1-\frac{5}{100}\right)\left(1-\frac{2?}{?}\right)$$
    = 12510

12. In an examination, Manisha obtained 20% more marks than [illegible] Suresh [illegible] 10% [illegible] Rakesh [illegible] obtained by [illegible]. Then the percentage of marks obtained by Rakesh [illegible] maximum marks is 2000.
    (a) 68.6% (b) 72%
    (c) 79.2% (d) None of these
    Ans. (b)
    Marks obtained by Suresh [illegible] 1000
    $$\text{Manisha marks} = \frac{120}{100} \times 1000 = 1200$$
    $$\text{Rakesh Marks} = \frac{120}{100} \times [illegible] = 1440$$
    [illegible]
    $$\text{\% of Rakesh} = \frac{1440}{2000} \times 100 = 72\%$$

13. The population of a village is 5000. If the male population increases by 11% and [illegible] female [illegible] increases by 20%, then the population becomes [illegible]. Find the population of males [illegible]
    (a) 2500 (b) 4500
    (c) 3000 (d) 2000
    Ans. (a)
    Let population of male = x
    ∴ (5000 − x) = female population
    $$\frac{x \times 111}{100} + \frac{(5000 - x) \times 120}{100} = [illegible]$$
    On solving we get x = 2500
    Hence male population = 2500.

14. In [illegible] 40% [illegible] than [illegible]

(a) 93% (b) [illegible]
(c) 87% (d) [illegible]

Ans. (a)

Let Anil's salary = Rs. 100

Mukesh's salary = Rs. [illegible]

[illegible] increased by [illegible]

$= \frac{1[illegible]}{10[illegible]} \times 175 = \text{Rs. } [illegible]$

Anil's salary increased by 25% = 125

[illegible]

$\frac{120}{[illegible]} \times [illegible] = [illegible]\%$

15. [illegible] 100 [illegible]?

(a) [illegible] (b) [illegible]
(c) [illegible] (d) 40%

Ans. (a)

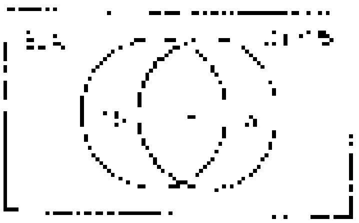
[illegible]

[illegible]

16. In an examination [illegible] students [illegible] in Physics, 70% in Chemistry [illegible] in both [illegible] subjects. Find the [illegible] number of students [illegible]

(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Ans. (c)



15% students failed in both subjects

% who passed = 85%

80 + 70 = 85 + x, x = 65%

[illegible] = [illegible]

[illegible]

17. 40% of [illegible] [illegible] of [illegible] is equivalent to

(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

Ans. (d)

$[illegible] \text{ of } 20\% = \frac{[illegible]}{100} \times \frac{[illegible]}{100} = \frac{[illegible]}{[illegible]} = [illegible]$

$20\% \text{ of } 25\% = \frac{20}{100} \times \frac{[illegible]}{[illegible]} = \frac{[illegible]}{[illegible]} = [illegible]$

$[illegible] = \frac{[illegible]}{100} \times \frac{[illegible]}{[illegible]}$

$= \frac{4}{100} = [illegible]$

∴ [illegible]

= [illegible] = [illegible]

18. A man's wages were decreased by 50%. The reduced wages were increased by 50%. [illegible]

(a) 25% (b) [illegible]
(c) 20% (d) None of these

Ans. (a)

[illegible]

∴ [illegible]

$= \left[[illegible] \right]\%$

$= \left[-50 + 50 - \frac{[illegible]}{100} \right]\% = -25\%$

Hence [illegible] 25%

19. [illegible] The [illegible]

(a) 21% (b) [illegible]
(c) [illegible] (d) None of these

Ans. (a)

[illegible]

∴ Net % change [illegible]

$= \left[[illegible] \frac{[illegible]}{100} \right]\%$

$= \left[[illegible] \frac{[illegible]}{100} \right]\% = [illegible]$

[illegible]

Percentage

Practice Exercise 1

1. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

2. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

3. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

4. [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) None of these

5. [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) None of these

6. [illegible]
(a) [illegible] increase (b) [illegible] increase
(c) [illegible] decrease (d) None of these

7. [illegible]
(a) [illegible]% (b) [illegible]%
(c) [illegible]% (d) None of these

8. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

9. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

10. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

11. [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) None of these

12. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

13. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

14. [illegible]

(a) [illegible]% (b) [illegible]%

(c) [illegible]% (d) [illegible]%

[illegible]

(a) $27\frac{?}{?}$% (c) [illegible]%

(b) 20% (d) [illegible]%

[illegible]

(a) [illegible]% (b) [illegible]%

(c) [illegible]% (d) [illegible]%

[illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) None of these

Solutions

1. Ans (?)

[illegible]

[illegible]

2. Ans. (b)

[illegible]

[illegible]

[illegible]

3. Ans. (b)

[illegible]

[illegible]

4. Ans. (c)

[illegible]

[illegible]

Amount of [illegible] = Rs [illegible]

5. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible] = Rs [illegible]

[illegible]

[illegible]

Difference in discount offered by the two shops [illegible] = Rs [illegible] = Rs 2.50.

6. Ans. (d)

[illegible]

$$\left(x - y - \frac{xy}{100}\right)\%$$

[illegible]

∴ The revenue decreases by 15%.

7. Ans. (c)

[illegible]

$$\left(x + y + \frac{xy}{100}\right)\%$$

[illegible]

∴ The area is increased by [illegible]%

8. Ans. (a)

[illegible]

9. Ans. (b)

[illegible]

$$\left(x - y - \frac{xy}{100}\right)\%$$

[illegible]

10. Ans. (b)

[illegible]

11. Ans. (c)

[illegible]

12. Ans. (d)

[illegible]

13. Ans. (c)

[illegible]

14. Ans. (b)

[illegible]

Ans. (3)

[illegible] $= \frac{[illegible]}{100+[illegible]} \times 100\% = [illegible]$

Ans. (3)

[illegible]

17. Ans. (4)

[illegible]

[illegible]

II Practice Exercise II

1. [illegible] total amount received by [illegible] was spent on [illegible] and 8% of the remaining on [illegible] Rs. 1500 [illegible]
(a) Rs. [illegible] (b) Rs. 2000
(c) Rs. [illegible] (d) Rs. 1500

2. The price of [illegible] has been reduced by [illegible]. If the reduced price is Rs. [illegible] the original [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) Rs. [illegible]

3. [illegible] 20% of the [illegible] the percentage of [illegible] population [illegible]
(a) 70% (b) [illegible]
(c) $[illegible]\frac{[illegible]}{[illegible]}\%$ (d) 70%

4. [illegible] three classes [illegible] 40 and [illegible] students respectively. [illegible] percentages of these classes are [illegible] and 10 respectively. The pass percentage of the whole [illegible]

(c) $13\frac{1}{3}$ (d) [illegible]
(b) [illegible] (d) $[illegible]\frac{2}{3}$

5. If A's [illegible] is [illegible] % [illegible], then [illegible]
(a) $\frac{[illegible]}{[illegible]}\%$ [illegible] (b) $\frac{[illegible]}{[illegible]}\%$ [illegible]
(c) $\frac{[illegible]}{[illegible]}\%$ [illegible] (d) None of these

6. From a container having [illegible] milk, [illegible] replaced by water [illegible]
(a) 40% pure (b) 50% pure
(c) [illegible]% pure (d) [illegible]% pure

7. The salaries of A and B together amount to Rs. 2000. A spends [illegible]% of his salary and B [illegible]% [illegible] savings [illegible] salary?
(a) Rs. [illegible] (b) Rs. 1250
(c) Rs. [illegible] (d) Rs. [illegible]

8. 300 grams of sugar [illegible] 40% [illegible] How much sugar should be added [illegible] 50% in the solution?
(a) 10 gms (b) [illegible] gms
(c) [illegible] gms (d) [illegible] gms

9. The examination [illegible] papers of [illegible] Mathematics [illegible]
(a) 80% (b) [illegible]%
(c) 75% (d) [illegible]%

10. [illegible] 20% and 25% [illegible]. How much percent is the [illegible] less than the first?
(a) [illegible]% (b) 7%
(c) 4% (d) [illegible]

11. In an examination A got [illegible] marks less than B, B got 25% more marks than C and C got 20% less [illegible]. If A [illegible] 360 marks [illegible], the percentage of marks obtained by D was
(a) 70 (b) [illegible]
(c) [illegible] (d) 85

12. If the numerator of a fraction be increased by 15% and its denominator be [illegible] by 8%, the value of the fraction is $\frac{15}{16}$. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

13. In an examination, [illegible] 35% [illegible] 15% [illegible] in both the subjects. [illegible] how many passed in either subject but not in both?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) None of these

14. In a school [illegible] 20% of the boys and 25% of the girls [illegible] The percentage of students [illegible]

(a) [illegible] (b) [illegible]

(c) 78% (d) [illegible]

15. [illegible] is increased by 20% [illegible] by 20% [illegible] expenditure of the family [illegible] decreased by

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 16%

16. A building worth [illegible] worth Rs. 72,900. After how many years will the value [illegible] 10% [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

17. A shopkeeper [illegible] 12.5% [illegible]

(a) Rs. 2 (b) Rs. 2.25

(c) Rs. 2.50 (d) Rs. 2.60

18. The length of a rectangle is increased by 60%. By what percent would the width have to be decreased to maintain the same area?

(a) $37\frac{1}{2}\%$ (b) 60%

(c) [illegible] (d) None

19. [illegible] 25% [illegible] How much percentage [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 10%

20. [illegible] Find the [illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

(d) [illegible]

21. [illegible] 25% [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) None of these

22. [illegible] 20% [illegible] Rs. 132 [illegible]

(a) [illegible] (b) 1500

(c) 2000 (d) None of these

23. [illegible] 25% [illegible] 20% [illegible]

(a) [illegible] (b) [illegible]

(c) 100 kg (d) [illegible] kg

24. [illegible] 25% [illegible] percentage [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) None of these

25. [illegible] 25% [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) None of these

26. [illegible]

[illegible] Rs. 75,000 [illegible]

(a) Rs. 67,500 (b) Rs. 75,000

(c) Rs. [illegible] (d) Rs. 72,000

Solutions

1. Ans. (c)

Purchases [illegible]

Balance [illegible]

[illegible] $\frac{5}{100}$ [illegible] $\frac{}{25}$

Balance [illegible] $\frac{}{25}$ [illegible] $\frac{}{25}$

[illegible] $\frac{}{25}$ [illegible] $\times 25$ [illegible]

2. Ans. (c)

90% [illegible] $\frac{90}{100}$ [illegible]

[illegible] $= 1000$

3. Ans. (c)

[illegible]

[illegible] $\frac{20}{100}$ [illegible]

[illegible]

[illegible]

[illegible]

4. Ans. (a)

[illegible]

$= [illegible] \frac{4}{100}$ [illegible]

[illegible]

[illegible] percentage [illegible] $\frac{20}{}$ [illegible] $\times 100$

$= \left(\frac{40}{120} \times 100 \right)\% = 33\frac{1}{3}\%$

5. Ans. (a)

[illegible] $\frac{x}{100}$ [illegible] $\frac{x}{100}$ [illegible]

[illegible] $\left(\frac{x}{y}\right)$ [illegible]

[illegible]

[illegible]

6. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

∴ [illegible]

7. Ans. (d)

[illegible] Rs. [illegible]

[illegible]

$\frac{5}{100}$ [illegible] $\frac{5}{100}$ [illegible] $= 1500$

8. Ans. (c)

[illegible] $\frac{}{100}$ [illegible]

[illegible]

[illegible]

[illegible] $\frac{}{100}$ [illegible]

[illegible]

9. Ans. (b)

[illegible] = $\frac{75}{100} \times$ [illegible] = [illegible]

10. Ans. (a)

Let [illegible] = 100

First number = 70% of x = $\frac{7x}{10}$

Second number = 80% of x = [illegible]

Required Percentage

$= \left(\frac{7x}{10} \times \frac{10}{[illegible]} \times 100 \right)\% = [illegible]$

11. Ans. (a)

A = $\frac{70}{100}$ B, B = $\frac{80}{100}$ C and C = $\frac{80}{[illegible]}$ D

∴ B = $\frac{10}{7}$ A, C = $\frac{4}{5}$ B and D = $\frac{5}{4}$ C

B = $\frac{10}{7} \times$ [illegible] = 400, C = $\frac{4}{5} \times 400$ = 320

and D = $\frac{5}{4} \times 320$ = 400

Percentage of D = $\left(\frac{[illegible]}{[illegible]} \times 100 \right)\%$ = [illegible]

12. Ans. (b)

Let the given fraction be [illegible]

Then [illegible] = $\frac{15}{16}$

⇒ [illegible] = $\left([illegible] \times \frac{32}{[illegible]} \right)$ = $\frac{3}{4}$

13. Ans. (a)

Failed in 1st subject = $\left(\frac{[illegible]}{100} \times 2500 \right)$ = [illegible]

Failed in 2nd subject = $\left(\frac{[illegible]}{100} \times 2500 \right)$ = [illegible]

Failed in both = $\left(\frac{[illegible]}{100} \times 2500 \right)$ = 375

Failed in 1st subject only = (875 − 375) = [illegible]

Failed in 2nd subject only = ([illegible] − 375) = [illegible]

Passed in both [illegible] = [illegible]

= [illegible] = 1125.

14. Ans. (a)

Suppose [illegible] = 2x

[illegible] = $\left(\frac{[illegible]}{[illegible]} \times [illegible] \right)$ + $\left(\frac{[illegible]}{100} \times 2x \right)$

= $\left(\frac{[illegible]}{[illegible]} + \frac{3x}{[illegible]} \right)$ = $\frac{[illegible]}{[illegible]}$

Required percentage

= $\left(\frac{[illegible]}{[illegible]} \times \frac{1}{[illegible]} \times 100 \right)\%$ = [illegible]%.

15. Ans. (a)

[illegible] 15

= Rs. [illegible]

Original expenditure = Rs. ([illegible] × 100)

= Rs. [illegible]

New expenditure = Rs. ([illegible] × 75) = Rs. [illegible]

∴ Decrease in expenditure

= $\left(\frac{1000}{[illegible]} \times 100 \right)\%$ = [illegible]%.

16. Ans. (d)

$7290 \left(1 + \frac{10}{100} \right)^{[illegible]} = [illegible] \left(1 + \frac{10}{100} \right)^{n}$

∴ $\left(\frac{11}{10} \right) \times [illegible] = \frac{[illegible]}{7290} = \frac{[illegible]}{729}$

∴ $\left(\frac{11}{[illegible]} \right) = \left(\frac{1[illegible]}{[illegible]} \right)^{3}$ ⇒ n = 3

17. Ans. (a)

Let original price = Rs. x/kg. Reduced price

= $\left(\frac{[illegible]}{100} x \right)$/kg

$\frac{100}{[illegible]} - \frac{[illegible]}{[illegible]}$ = 10.5 ⇒ $\frac{[illegible]}{[illegible]} - \frac{[illegible]}{[illegible]}$ = 10.5

[illegible] = 10.5 × [illegible]

∴ x = $\frac{[illegible]}{10.5 \times 75}$

∴ Reduced price

= Rs. $\left(\frac{75}{100} \times \frac{[illegible]}{10.5 \times 75} \right)$/kg = Rs. [illegible]/kg

18. Ans. (a)

[illegible] length = x and breadth = b

[illegible] the required [illegible]

$\frac{125}{100}x \times \frac{(100-y)}{100} \times b = xb$

⇒ 5 (100 − y) = 100 × 100

⇒ 100 − y = [illegible]

y = (100 − [illegible]) = 57 [illegible]

19. Ans. (d)

Let Shyam sells goods at Rs. 100

So Ram sells goods at Rs. 75

Now this Rs 75 is 25% dearer than Bhanu's

Bhanu × $\frac{125}{100}$ = 75

Bhanu's price = 60

Shyam's good is Rs 40 [illegible] than Bhanu i.e. %

then $\frac{40}{60}$ × 100 = [illegible]%

20. Ans. (d)

This cannot be determined because [illegible] adding or subtracting [illegible] results are [illegible]

21. Ans. (b)

Let Varun's salary is 100

Amit salary = 30% more than Varun's salary = 130

% salary of Varun less than Amit

= $\frac{30}{130}$ × 100 = 23.07%

22. Ans. (a)

Let the salary be P

x = −20, y = 40, z = [illegible]

$P\left[1 + \frac{x}{100}\right]\left[1 + \frac{y}{100}\right]\left[1 + \frac{z}{100}\right] = [illegible]$

P × [illegible] = [illegible]

P × 4[illegible] = [illegible] ⇒ P = [illegible]

23. Ans. (d)

Requirement of [illegible] is 100 kg

25% of 25 kg has 90% [illegible]

= $\frac{25 \times 90}{100}$ = 22.5 kg [illegible]

[illegible] kg has [illegible] = 0 kg

[illegible] 22.5 kg [illegible] required

So [illegible] 100 kg

$\frac{100}{22.5}$ × 100 = [illegible] kg

24. Ans. (a)

Let Ramya's sale price is Rs. 100

Amit sale price = Rs. 80

Amit sells at [illegible] 20% dearer than [illegible]

Chandrika's price = CP

CP × $\frac{120}{100}$ = 80, CP = 66.66

Now Chandrika's goods is Rs. 33.33 cheaper than Ramya's i.e.

= $\frac{33.34}{100}$ × 100 = 33.34%

25. Ans. (b)

Let x kg [illegible]

20% washed away [illegible]

80% i.e. 4/5x

out of $\frac{4}{5}$x [illegible] = $\frac{[illegible]}{[illegible]} \times \frac{4}{5}$ [illegible]

[illegible] kg [illegible] 1 kg is [illegible] 5 kg

∴ [illegible] kg [illegible]

5 × 9000 = [illegible] kg

26. Ans. (a)

Let total salary is Rs. x

$x\left[1 - \frac{[illegible]}{100}\right]\left[1 - \frac{[illegible]}{100}\right]\left[1 - \frac{[illegible]}{100}\right] = [illegible]$

$x\left[1 - \frac{50}{100}\right]\left[1 - \frac{30}{100}\right]\left[1 - \frac{24}{100}\right] = [illegible]$

(−ve sign because of spending)

$P\left[\frac{[illegible]}{100} \times \frac{[illegible]}{100}\right]\frac{76}{100}$ = [illegible]

P = Rs. [illegible]

1.3
CHAPTER

Profit and Loss

[illegible]

[illegible]

Terminologies in Profit & Loss

Cost price: Cost Price (CP) of an article is the [illegible]

Selling price: Selling price of an article is the [illegible]

[illegible]

[illegible]

Profit/Loss: [illegible]

Percent Profit/Loss: [illegible]

% Profit/Loss = $\frac{\text{Profit/Loss value}}{\text{[illegible]}} \times 100$

Margin: Margin is [illegible] used in terms of [illegible] selling price.

% Margin = $\frac{\text{Profit/Loss value}}{\text{Base [illegible]}} \times 100$

Marked Price: [illegible]

Discount: Discount is the rebate given [illegible]

Mark up: [illegible]

[illegible]

$$[illegible]\left(1 + \frac{P}{100}\right)$$

$$\text{So SP} = \text{CP}\left(1 - \frac{P}{100}\right)$$

[illegible] examples.

Example 1

[illegible]

Solution

[illegible]

$$= [illegible]\left(1 - \frac{[illegible]}{[illegible]}\right)$$

= [illegible]

[illegible] = [illegible]

[illegible]

[illegible]

$$= 95[illegible]\left(1 + \frac{10}{100}\right) = \text{Rs. [illegible]}$$

Example 2

[illegible] 20% [illegible] Find [illegible] profit [illegible]?

Solution

[illegible]

[illegible]

= x(CP) = x

[illegible]

Example 3

[illegible]

Solution

[illegible]

Example 4

[illegible]

Solution.

[illegible]

False Weight

[illegible]

Example 1

[illegible]

Solution

[illegible]

Example 2

[illegible]

Thus he incurred [illegible] loss.

Basic Formulae

1. [illegible]

[illegible]

2. [illegible]

[illegible]

3. [illegible]

[illegible]

4. When S.P. and Loss% are given, then

$$CP = \left[\frac{SP}{100 - Loss\%}\right] \times 100$$

5. If the cost price of 'x' items are same as the selling price of 'y' items, then

$$\% \text{ gain or loss} = \left[\frac{x - y}{y}\right] \times 100$$

If x > y, it is % gain and if x < y, it is % loss.

6. When two different articles are sold at the same S.P. getting a gain/loss of x% on the first and gain/loss of y% on the second, then overall % gain or % loss in the transaction is given by

$$\left[\frac{100(x + y) + 2xy}{(100 + x) + (100 + y)}\right]\%$$

The above expression represents overall gain or loss according to its sign (+ve/−ve).

7. When two articles are sold at the same selling price getting a gain of x% on the first and loss of x% on the second, then the overall % loss in the transaction is given by $\left(\frac{x}{10}\right)^2\%$

8. A merchant uses faulty measure and sells his goods at gain/loss of x%. The overall % gain or loss (g) is given by

$$\frac{100 + g}{100 + x} = \frac{\text{True measure}}{\text{Faulty measure}}$$

Note: If the merchant sells his goods at cost price then x = 0.

Example 1.

A dishonest dealer professes to sell his goods at the cost price but uses a faulty measure of 1 kg weight which measures 950 grams only. Find his gain percent.

Solution:

Here, True measure = 1000 gms

Faulty measure = 950 gms

Since the dealer sells his goods at cost price,

∴ x = 0,

∴ overall gain % is given by

$$\frac{100 + g}{100 + x} = \frac{\text{True measure}}{\text{Faulty measure}} = \frac{1000\,g}{950\,g}$$

$$\Rightarrow \frac{100 + g}{100} = \frac{1000\,kg}{950}$$

$$\Rightarrow 100 + g = \frac{1000 \times 100}{950} \Rightarrow g = 5\frac{5}{19}\%$$

* * *

Discount

9. Two successive discounts of x% and y% respectively are equivalent to a single discount of $\left(x + y - \frac{xy}{100}\right)$%

It can also be calculated as

$$\left[100 - 100 \times \frac{(100 - x)}{100} \times \frac{(100 - y)}{100}\right]\%$$

* * *

Ex.1 Find the single discount equivalent to two successive discounts of 50% and 40%.

Sol: Single discount equivalent to

$$\left(x + y - \frac{xy}{100}\right)\%$$

$$\Rightarrow \left(50 + 40 - \frac{50 \times 40}{100}\right)\%$$

$$\Rightarrow 70\%$$

Ex.2 Find the single discount which is equivalent to three successive discounts of 20%, 30% and 20%.

Sol: Single discount equivalent to 20% and 30%

$$\Rightarrow \left[20 + 30 - \frac{20 \times 30}{100}\right]\%$$

$$\Rightarrow 44\%$$

Now we will find single discount which is equivalent to two successive discounts of 44% and 20%

$$\Rightarrow \left[44 + 20 - \frac{44 \times 20}{100}\right]\%$$

$$\Rightarrow 55.2\%$$

Alternative:

∵ 0.8 × 0.7 × 0.8 = 0.448

So the final price is 44.8%

Which is reduced by 55.2%

* * *

Solved examples

1. [illegible] selling a watch for Rs. 495, a shopkeeper incurs a loss of 10%. Find the cost price of the watch [illegible] shopkeeper.
(a) Rs. 545 (b) Rs. 55[illegible]
(c) Rs. 5[illegible] (d) None of these

Ans. (b)

Here SP = 495

Loss = 10%

[illegible] CP = $\frac{SP}{(100 - Loss\%)} \times 100$

CP = $\frac{495}{90} \times 100$ = Rs. 550

2. A shopkeeper sold goods for Rs. 2400 and made a profit of 25% in the process. Find his profit percent if he had sold his goods at Rs. 2040.
(a) 6.25% (b) [illegible]%
(c) [illegible]% (d) [illegible]%

Ans. (a)

SP = 2400, P = 25%

CP = $\frac{SP}{(100 + P)} \times 100 = \frac{2400}{125} \times 100$ = 1920

If goods sold at Rs. 2040, profit = Rs. 120

Profit % = $\frac{120}{1920} \times 100$ = 6.25

3. [illegible] loss of 20%. What [illegible] profit [illegible] if it had been sold at Rs. 51?
(a) Rs. 4[illegible] (b) Rs. 4[illegible]
(c) Rs. 48 (d) Rs. 50

Ans. (b)

SP = [illegible]

CP = $\frac{[illegible]}{[illegible]} \times 100$ = [illegible]

[illegible] = Rs. [illegible]

4. A shopkeeper bought [illegible] at Rs. 9 per dozen [illegible]
(a) [illegible]% (b) [illegible]%
(c) [illegible]% (d) [illegible]%

Ans. (b)

CP of 12 oranges = Rs. 9

CP of 1 orange = $\frac{9}{12}$ = Rs. 0.75

Now SP [illegible] = Rs. 1.25 [illegible]

Profit % = $\frac{0.25}{0.75} \times 100 = 33\frac{1}{3}$%

5. A [illegible] 20% [illegible] 84 [illegible] Rs. 22.50 per quintal [illegible] percent [illegible] investment?
(a) 5% (b) [illegible]%
(c) 7.5% (d) 8%

Ans. (d)

[illegible]

CP = $\frac{25}{[illegible]} \times 100 = \frac{125}{6}$ [illegible]

Profit = [illegible]

= 22.50 − 20.83 = 1.667

Profit % = $\frac{1.667}{20.83} \times 100$ = 8%

[illegible]

6. The [illegible] Rs. [illegible] 12% [illegible] cost price [illegible]
(a) Rs. 125 (b) Rs. 150
(c) Rs. 175 (d) Rs. 200

Ans. (c)

Let CP [illegible] Rs. x

New CP [illegible] = Rs. $\frac{112x}{100}$

According to given condition, [illegible] $\frac{112}{100}$ [illegible]

[illegible]

x = Rs. 17[illegible]

7. The marked price [illegible] 20% [illegible] 10% [illegible]
(a) [illegible] (b) 8%
(c) [illegible] (d) [illegible]

Ans. (b)

SP = [illegible]

CP = $\frac{1200}{[illegible]} \times 100$ = [illegible]

If sold at [illegible]

SP = [illegible] × $\frac{90}{100}$ = [illegible]

Profit = [illegible] = Rs. [illegible]

Profit % = $\frac{[illegible]}{100}$ × 100 = [illegible]

8. A dozen pairs of gloves quoted at Rs. 80 are available at discount of 10%. Find how many pairs of gloves can be bought for Rs. 24?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

12 pairs of gloves are available at Rs. 80 with 10% discount.

80 × $\frac{90}{100}$ = Rs. 72

In Rs. 72, 12 pairs of gloves can be bought. In Re 1 = $\frac{12}{72}$ pairs

∴ In Rs. 24 = $\frac{12}{72}$ × 24 = 4

9. [illegible]

(a) 8.33% (b) [illegible]

(c) 20% (d) 25%

Ans. (c)

[illegible]

Hence [illegible]

= [illegible] × $\frac{[illegible]}{100}$

[illegible] = [illegible] × $\frac{[illegible]}{100}$ = [illegible] $\frac{5}{[illegible]}$

= [illegible] $\frac{[illegible]}{100}$ [illegible] $\frac{[illegible]}{100}$

[illegible]

Required percentage

= [illegible] × 100 = [illegible]

10. [illegible] 17% [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

Let the cost price be Rs. x and market price be Rs. y

[illegible] = x × $\frac{[illegible]}{[illegible]}$ [illegible] x × $\frac{17}{100}$

⇒ y × $\frac{90}{100}$ = x × $\frac{117}{100}$ ⇒ y = $\frac{117}{90}$ x

[illegible]

[illegible] percentage

= [illegible] × 100 = [illegible] × 100 = [illegible]

11. [illegible] Rs. [illegible] [illegible] material, labour and overheads in the ratio [illegible] 4 : [illegible]. [illegible] 20% profit. [illegible] price [illegible] of the set

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. 800 (d) [illegible]

Ans. (a)

[illegible]

= [illegible] × [illegible] = Rs. 400

Company [illegible] labour

= 400 + 20% [illegible] = Rs. [illegible]

Marked price of the set

= [illegible] + (300 − 400) = Rs. [illegible]

12. [illegible] 2005 [illegible]

[illegible]

(a) Rs. 1100 (b) Rs. [illegible]

(c) Rs. 1000 (d) Rs. [illegible]

Ans. (d)

In [illegible]

= [illegible] + [illegible] × $\frac{[illegible]}{[illegible]}$ = Rs. [illegible]

[illegible] = [illegible] + [illegible] × $\frac{[illegible]}{100}$ = Rs. [illegible]

[illegible] = 200 + 200 × $\frac{[illegible]}{100}$ = Rs. [illegible]

[illegible]

= 200 + 500 + [illegible] = Rs. [illegible]

[illegible] 275 [illegible]

(a) [illegible] (c) Rs [illegible]

(b) Rs [illegible] (d) None of these

Ans: (d)

[illegible]

Now rate = 275 [illegible]

[illegible]

Original quantity [illegible] Rs 275 [illegible]

New quantity [illegible]

[illegible]

Reduced Price [illegible] Rs 1.5 per kg

14. [illegible]

(a) Rs 500 (c) Rs 200

(b) Rs [illegible] (d) Rs 400

Ans. (d)

[illegible]

[illegible]

Selling [illegible] Rs 2 [illegible]

[illegible]

Given, [illegible]

[illegible]

15. [illegible]

(a) Rs 175 (c) Rs [illegible]

(b) Rs 225 (d) Rs [illegible]

Ans. (a)

[illegible]

[illegible]

Given, [illegible]

[illegible] Rs 175

16. [illegible]

(a) [illegible] (c) [illegible]

(b) [illegible] (d) None of these

Ans. (a)

[illegible]

[illegible]

[illegible]

Profit and Loss

Practice Exercise

1. [illegible]

(a) Rs 12 (c) Rs [illegible]

(b) Rs 16 (d) Rs [illegible]

2. [illegible]

(a) Rs. [illegible] (b) [illegible]

(c) Rs. [illegible] (d) [illegible]

3. [illegible]

(a) Rs. [illegible]

(b) Rs. [illegible]

(c) [illegible]

(d) [illegible]

4. [illegible] 21 [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

5. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

6. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

7. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

8. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

9. [illegible]

(a) [illegible] (b) [illegible]

(c) 1 (d) [illegible]

10. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

11. [illegible] Rs. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

12. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

13. [illegible] Rs. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

14. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

15. [illegible] Rs. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

16. [illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

(d) [illegible] Rs. 2000

17. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

18. [illegible]

[illegible] (c) 85%

[illegible] (d) None of these

[illegible] at a loss of 2% [illegible]

(a) 20000 (b) [illegible]

(c) 12000 (d) [illegible]

[illegible] kg [illegible]

(a) 6 kg (b) [illegible] kg

(c) 8.6 kg (d) 11.4 kg

[illegible] The C.P. of an article is [illegible] of the S.P. [illegible] the S.P. is of C.P. is

(a) 250 (b) 240

(c) [illegible] (d) 40

22. [illegible] 5% gain instead of 5% loss, the seller gets Rs 372 more. The C.P. of the article is

(a) Rs. 67.20 (b) Rs. [illegible]

(c) Rs. 100.40 (d) Rs. 540

23. A man [illegible] loss [illegible] The C.P. of the [illegible] was

(a) Rs. 100 (b) Rs. 150

(c) Rs. 200 (d) Rs. [illegible]

24. Raghu bought [illegible] oranges [illegible] Rs. 16 [illegible] did he sell the oranges?

(a) Rs. 14.40 (b) Rs. 15

(c) Rs. [illegible] (d) Rs. 19.20

25. [illegible] double [illegible] sold for Rs. 480 [illegible]

(a) Rs. [illegible] (b) Rs. 750

(c) Rs. 800 (d) Data inadequate

26. A man [illegible] Rs. 75 [illegible] Rs. 96 [illegible] The C.P. of [illegible] is

(a) Rs. [illegible] (b) Rs. 85

(c) Rs. 80 (d) Rs. [illegible]

27. [illegible] Rs. 300 [illegible] 5% [illegible] cash [illegible] is

(a) Rs. 250 (b) Rs. 248

(c) Rs. 240 (d) Rs. [illegible]

28. [illegible] $12\frac{1}{4}$% [illegible]

(a) $7\frac{1}{2}$% (b) 27%

(c) [illegible] (d) None

29. [illegible] Rs. 153 [illegible] 20% [illegible]

(a) Rs. 224 (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. 187

30. [illegible] Rs. 24 [illegible] 20% [illegible] 30% [illegible] price?

(a) Rs. 27 (b) Rs. [illegible]

(c) Rs. 29 (d) Rs. [illegible]

31. [illegible] 10% [illegible]

(a) [illegible] (b) 45 : 59

(c) 8 : 29 (d) 56 : 39

□□□

Solutions

1. Ans. (c)

[illegible]

[illegible]

[illegible]

∴ Cost of [illegible] = Rs. [illegible]

2. Ans. (d)

[illegible]

[illegible]

[illegible] = Rs. 14.40

3. Ans. (d)
[illegible]
[illegible]
[illegible]
= Rs. [illegible]

4. Ans. (a)
[illegible]
[illegible]
S.P. of [illegible] = Rs. [illegible]

$\therefore$ Gain% $= \left(\frac{[illegible]}{[illegible]} \times 100\right)\% = [illegible]\%$

5. Ans. (c)
Gain = [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
C.P. of [illegible] = Rs. 200
S.P. of 200 [illegible] = Rs. 250

Gain% $= \left(\frac{50}{200} \times 100\right)\% = 25\%$

6. Ans. (c)
Suppose [illegible]

C.P. of [illegible] = Rs. $\left(\frac{[illegible]}{[illegible]} \times [illegible]\right)$

= Rs. [illegible]

[illegible] = Rs. $\left(\frac{[illegible]}{[illegible]} \times [illegible]\right)$

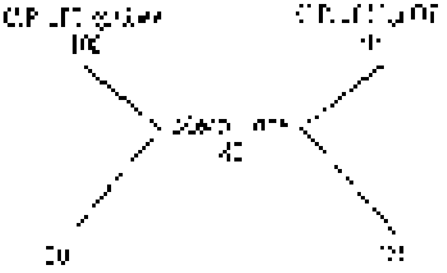
= Rs. [illegible] = [illegible]

7. Ans. (d)
[illegible]
= Rs. [illegible]
S.P. of 25 kg = Rs. (25 × 15) = Rs. 375.
$\therefore$ Gain = Rs. (375 − 337.50) = Rs. 37.50

8. Ans. (c)

[illegible] = Rs. $\left(\frac{100}{[illegible]} \times [illegible]\right)$ = Rs. [illegible]

By the Rule of Alligation:



$\therefore$ Required ratio = [illegible]

9. Ans. (d)

Gain % $= \left(\frac{[illegible]}{[illegible]} \times 100\right)\% = [illegible]\%$

10. Ans. (c)
C.P. of [illegible] = Re. 1
S.P. of [illegible] = [illegible]

For Rs. [illegible] = [illegible]

For Re. 1 = [illegible]

11. Ans. (b)
[illegible]

[illegible]

$\therefore$ [illegible]
For Rs. [illegible]
For Rs. [illegible]

[illegible] = [illegible]

12. Ans. (b)
[illegible]

[illegible]

$\therefore$ [illegible]

13. Ans. (b)
[illegible]

$\therefore$ [illegible]

$\therefore$ [illegible] $\left(1500 \times [illegible]\right)$ = [illegible]

14. Ans. (c)
[illegible]

$\therefore$ [illegible]

[illegible]

$\therefore$ P = [illegible] = Rs. [illegible]

Ans. (c)

[illegible]

Ans. (b)

[illegible] S.P. = Rs. 24000

[illegible]

Total C.P. = Rs. 25000

[illegible] = 24000 − 25000 = Rs. 1000

Ans. (a)

[illegible]

New C.P. = [illegible]

Gain = [illegible]

∴ Gain% = [illegible]

10. Ans. (c)

[illegible]

19. Ans. (c)

[illegible]

Total S.P. = [illegible]

[illegible]

20. Ans. (c)

[illegible]

Total C.P. = [illegible]

[illegible]

21. Ans. (c)

[illegible]

22. Ans. (a)

[illegible]

23. Ans. (c)

[illegible]

$$SP = \frac{105}{100}x = \frac{21x}{20}$$

$$\text{New CP} = \frac{95}{100}x = \frac{19x}{20}$$

Now, C.P. = [illegible]

[illegible]

24. Ans. (a)
Total C.P. = Rs. (12 × [illegible] + 16 × [illegible]) = Rs. [illegible]

S.P. of 8 [illegible] oranges

$= \text{Rs.}\left(\frac{120}{100} \times 80\right) = \text{Rs. } [illegible]$

S.P. per dozen = Rs. [illegible]

25. Ans. (b)
Let C.P. be Rs. x

900 − x = 2(x − 450)

⇒ 3x = 1800 ⇒ x = 600

C.P. = Rs. 600, gain required = 25%

$\therefore \text{S.P.} = \text{Rs.}\left(\frac{125}{100} \times 600\right) = \text{Rs. } 750$

26. Ans. (d)
Let C.P. be Rs. x

2x − 750 = 395 − x

⇒ 3x = [illegible]

x = [illegible]

27. Ans. (c)
Cost price = [illegible] of 90% of Rs. [illegible]

$= \left(\frac{105}{100} \times \frac{90}{100} \times \frac{[illegible]}{100} \times [illegible]\right) = \text{Rs. } [illegible]$

28. Ans. (c)
Let C.P. [illegible] Rs. 1000. Then [illegible]
Rs. [illegible]

S.P. = (100 − 30/4)% of Rs. [illegible]

$= \left(\frac{375}{400} \times 1000\right) = \text{Rs. } [illegible]$

∴ Profit% = [illegible] = [illegible]

29. Ans. (d)
C.P. = Rs. 150, Gain = 20%

$\therefore \text{S.P.} = \text{Rs.}\left(\frac{120}{100} \times 150\right) = \text{Rs. } 180.00$

Let the marked price be Rs. x

$\frac{90}{100}x = 180.00$

$\Rightarrow x = \frac{180 \times 100}{90} = 200$

30. Ans. (c)
Let the [illegible] be Rs. x

$\frac{90}{100} \times [illegible] = \frac{[illegible]}{90} \times [illegible]$

Required S.P. = [illegible] = Rs. [illegible]

31. Ans. (b)
Let the C.P. be Rs. 100
Then S.P. = Rs. 112
Let the marked price be Rs. x

Then 90% of x = 112 ⇒ $\frac{90}{100}x = 112$

$\therefore x = \left(\frac{112 \times 100}{90}\right) = \frac{1120}{9}$

∴ [illegible] = Rs. [illegible]

= [illegible]

1.4

CHAPTER

Simple Interest & Compound Interest

Simple Interest

[illegible]

$$SI = \frac{P \times R \times T}{100}$$

Where P = principal amount

R = Rate of interest

T = Time duration

Compound Interest

[illegible]

$$CI = P\left(1 + \frac{R}{100}\right)^T - P$$

Where P = principal amount

R = Rate of interest

T = Time duration

Case 1: When interest is compounded annually then

$$A = P\left(1 + \frac{R}{100}\right)^T$$

Case 2: When interest is compounded half-yearly then

$$A = P\left(1 + \frac{R/2}{100}\right)^{2T}$$

Case 3: When interest is compounded quarterly

$$A = P\left(1 + \frac{R/4}{100}\right)^{4T}$$

Case 4: When rates are different for different years [illegible]

R_1% for first year

R_2% for second year and

R_3% for third year then

$$\text{Amount} = P\left(1 + \frac{R_1}{100}\right) \times \left(1 + \frac{R_2}{100}\right)\left(1 + \frac{R_3}{100}\right)$$

Solved Examples

Example 1.

A sum of Rs 10000 [illegible] deposited [illegible] bank for [illegible] years. If the [illegible] 5% find the [illegible]

Solution

$$SI = \frac{PRT}{100}$$

$$SI = \frac{10000 \times [illegible]}{100} = \text{Rs } [illegible]$$

Amount = Principal + SI

10000 + [illegible]

Example 2.

[illegible]

Solution

[illegible]

Example 3.

A sum of money [illegible] 20 years [illegible] interest. Calculate the rate [illegible]

Solution

Principal = Rs x

Final Amount = Rs [illegible]

SI = Rs [illegible]

[illegible]

[illegible] = 20%

Example 4.

An amount of Rs 25000 is deposited in a [illegible] bank for 2 years. Calculate the [illegible] interest [illegible] at 10% per annum compounded annually.

Solution:

Here P = Rs 25000

R = 10%

n = 2 years

$$CI = P\left[1 + \frac{R}{100}\right]^n - P$$

$$= 25000\left[1 + \frac{10}{100}\right]^2 - 25000$$

= 30250 − 25000 = Rs. 5250

Solved Examples

1. Rs 1200 is lent out at 5% per annum simple interest for 3 years. Find the amount after 3 years.
   (a) Rs 1380 (b) Rs [illegible]
   (c) Rs [illegible] (d) Rs 1200
   Ans. (a)
   Here P = Rs 1200
   R = 5% T = 3 years

   $$SI = \frac{PRT}{100} = \frac{1200 \times 5 \times 3}{100} = Rs.\ 180$$

   Amount = P + SI = 1200 + 180 = 1380

2. Rs 2000 is lent at compound interest of 5% per annum for 2 years. Find the amount after 2 years.
   (a) Rs [illegible] (b) Rs 2016.25
   (c) Rs [illegible] (d) None of these
   Ans. (b)
   Here P = 2000, R = 5%, T = 2 years.

   $$A = P\left[1 + \frac{R}{100}\right]^T = 2000\left[1 + \frac{[illegible]}{100}\right]^2$$

   $$= 2000 \times \frac{2[illegible]}{20} \times \frac{21}{20} = Rs\ 2016.25$$

3. Find the difference between the simple and the compound interest at 5% per annum for 2 years on a principal of Rs 2000.
   (a) 5 (b) 10.5
   (c) 4.5 (d) None of these
   Ans. (a)
   Here P = Rs. 2000, R = 5%, n = 2 years

   $$CI - SI = P\left[\left(1 + \frac{R}{100}\right)^n - 1\right] - \frac{PRT}{100}$$

   $$= \left[2000 \times \frac{105}{100} \times \frac{105}{100} - 2000\right] - \frac{2000 \times 5 \times 2}{100}$$

   = 205 − 200 = Rs. 5

   Alternatively:

   Difference between CI and SI for two years

   $$CI - SI = P\left(\frac{R}{100}\right)^2 = (2000)\left(\frac{5}{100}\right)^2 = 5$$

4. What is the difference between the simple interest on a principal of Rs 500 being calculated at 5% per annum for 3 years and 4% per annum for 4 years?
   (a) Rs 5 (b) Rs 10
   (c) Rs 20 (d) Rs 40
   Ans. (a)
   P = Rs 500, R_1 = 5%, R_2 = 4%,
   T_1 = 3 years, T_2 = 4 years

   $$\text{Difference} = \frac{500 \times 5 \times 3}{100} - \frac{500 \times 4 \times 4}{100} = Rs.\ 5$$

5. What is the simple interest for two years on a sum of Rs 500 if the rate of interest for the 1st year is [illegible]% and for the 2nd year is [illegible]%?
   (a) 150 (b) [illegible]
   (c) [illegible] (d) 43
   Ans. (c)

   $$\frac{500 \times [illegible]}{100} + \frac{500 \times [illegible]}{100} = [illegible]$$

6. Find the compound interest on Rs 1000 at the rate of 20% per annum for 18 months when interest is compounded half yearly.
   (a) Rs 331 (b) Rs 1331
   (c) Rs 320 (d) None of these
   Ans. (a)
   Here P = Rs. 1000, R = 20%

   $$n = 18 \text{ months or } 1\frac{1}{2} \text{ years}$$

[illegible] compound interest [illegible] compounded [illegible]

$$[illegible]\left[\left(1+\frac{10}{100}\right)^{2}\right]$$

$$[illegible]\left(1+\frac{10}{100}\right)^{2} = \text{Rs. } [illegible]$$

[illegible] The interest [illegible] at the rate of 10% [illegible] Rs. 420.

(a) Rs. 2000 (c) Rs. [illegible]

(b) Rs. [illegible] (d) Rs. [illegible]

Ans. (a)

C.I. = Rs. 420, R = 10%, t = 2 years

$$C.I. = P\left[\left(1+\frac{R}{100}\right)^{t}-1\right]$$

$$420 = P\left[\left(1+\frac{10}{100}\right)^{2}-1\right]$$

$$420 = P\left[\frac{21}{100}\right]$$

$$\therefore P = \frac{420\times100}{21} = \text{Rs. } 2000$$

[illegible] rate of simple interest [illegible] 4 years [illegible] the sum of Rs. [illegible] for [illegible] years [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

P = Rs. [illegible], A = Rs. [illegible], T = [illegible]

$$SI = \frac{PRT}{100}$$

$$[illegible] = \frac{[illegible]\times R\times 4}{100}$$

$$72 = [illegible] \Rightarrow R = [illegible]$$

A person borrows Rs. [illegible] at the rate of 12% per annum [illegible] at the rate of [illegible] per annum [illegible] the compound interest [illegible] Rs. [illegible]

(a) Rs. [illegible] (c) Rs. [illegible]

(b) Rs. [illegible] (d) Rs. [illegible]

Ans. (a)

P = Rs. [illegible], R_1 = 12%, R_2 = [illegible], t = 1 year

SI = [illegible]

Let the sum be [illegible] invested at 12% [illegible]

$$\frac{x\times12\times1}{100}+\frac{(3000-x)\times[illegible]\times1}{[illegible]} = 168$$

$$[illegible] = [illegible] \Rightarrow x = [illegible]$$

10. The simple [illegible] interest [illegible] for 2 years [illegible] respectively [illegible] difference [illegible] Rs. 56. The sum [illegible]

(a) Rs. [illegible] (b) Rs. 700

(c) Rs. [illegible] (d) Rs. [illegible]

Ans. (b)

$$\frac{[illegible]}{100} - \frac{[illegible]}{100}$$

$$P\left[\frac{5\times3-8\times2}{100}\right] = 56,\ P = 700$$

11. If the difference between the simple interest and compound interest on a certain sum of money [illegible] for 3 years is Rs. [illegible] then the [illegible] amount [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

Ans. (a)

Here R = [illegible], t = [illegible] years

Difference [illegible]

$$[illegible] = P\left[\left(1+\frac{R}{100}\right)^{t}-1\right] - \frac{[illegible]}{100}$$

$$[illegible] = P\left[\left(1+\frac{[illegible]}{100}\right)^{[illegible]}-1\right] - \frac{[illegible]}{100}$$

On solving, P = [illegible]

12. A sum of Rs. 400 [illegible] for 2 years and Rs. 100 [illegible] for 4 years [illegible] Rs. 60 [illegible] the rate of interest, simple interest [illegible] equal [illegible]

(a) 5% (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

$$\frac{P_1R_1T_1}{100}+\frac{P_2R_2T_2}{100} = 60$$

$$\frac{400\times2\times R}{100}+\frac{100\times4\times R}{100} = 60$$

$$12R = 60 \Rightarrow R = 5\%$$

13. [illegible]

(a) 15 (c) [illegible]

(b) [illegible] (d) 12

Ans. (c)

[illegible]

Then [illegible]

[illegible]

⇒ T = 15 yrs.

14. A sum of money placed at compound interest doubles itself in 3 years. In [illegible] years will it amount to 8 times itself?

(a) [illegible] years (b) [illegible] years

(c) [illegible] years (d) [illegible] years

Ans. (c)

Let sum = x

Then $2x = x\left[1 + \frac{r}{100}\right]^3$

[illegible]

⇒ T = 9 yrs.

Alternative

If a certain sum of money becomes 2 times in 3 years, then it will become [illegible] years.

Hence [illegible] = 9 years

15. Divide Rs. [illegible] into two parts so that simple interest [illegible] for [illegible] years at [illegible] be equal to the simple interest on the second part for [illegible] years at 8% p.a.

(a) Rs. [illegible], Rs. [illegible]

(b) Rs. 3000, Rs. [illegible]

(c) Rs. [illegible], Rs. [illegible]

(d) None of these

Ans. (c)

[illegible]

$\frac{x \times [illegible]}{100} = \frac{(8000 - x) \times [illegible]}{100}$

[illegible]

x = [illegible]

16. A sum of money [illegible] in [illegible] years. At what rate [illegible] interest?

(a) 12% (b) 12.5%

(c) [illegible]% (d) 14%

Ans. (b)

[illegible]

A = [illegible]

T = 8 years R = [illegible]

$= \frac{S \times 100}{P \times T} = [illegible] = 12.5\%$

17. Sanjay borrowed Rs. [illegible] at [illegible] p.a. and Rs. [illegible] at 5% p.a. for the same duration. He had to pay Rs. 364 in all as interest. What is the time period?

(a) 5 years (b) 3 years

(c) 2 years (d) 4 years

Ans. (d)

$\frac{P \times R \times T}{100} + \frac{[illegible]}{100} = [illegible]$

$\left[\frac{900 \times 4T}{100} + \frac{1100 \times [illegible]}{100}\right] = [illegible]$

[illegible] = 364

T = [illegible] years

18. [illegible] years, [illegible]?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 14

Ans. (a)

$R = \frac{[illegible]}{100}$

$R = \frac{100}{[illegible]} = 6\frac{1}{3}$

18. A sum of Rs. 600 amounts to Rs. 720 in 4 years at simple interest. What will it amount to if the rate of interest is increased by 2%?

(a) Rs. 540 (b) Rs. 768

(c) Rs. [illegible] (d) Rs. 792

Ans. (b)

P = Rs. 600 A = Rs. 720

T = 4 years R = ?

$R = \frac{SI \times 100}{P \times T} = \frac{120 \times 100}{600 \times 4} = 5\%$

or 7% now

$SI = \frac{600 \times 7 \times 4}{100} = 168$

A = 600 + 168 = 768

□□□□

Simple Interest

I Practice Exercise I

1. Avinash borrowed Rs. 5000 from Sanjay at simple interest. After 3 years, Sanjay got Rs. [illegible] more than what he had given to Avinash. What was the rate of interest per annum?

(a) 2% (b) [illegible]

(c) 5% (d) [illegible]

2. Rs. 800 amounts to Rs. 920 in 3 years at simple interest. If the interest rate is increased by 3%, it would amount to how much?

(a) Rs. 992 (b) Rs. 1056

(c) Rs. [illegible] (d) Rs. 1182

3. The simple interest on a sum of money at 8% is Rs. 48 for 2 years. The simple interest on the same sum for 4 years at 4% will be

(a) Rs. 4[illegible] (b) Rs. 48

(c) Rs. [illegible] (d) Rs. 50

4. A sum of money at simple interest amounts to Rs. 2240 in 2 years and to Rs. 2600 in 5 years. What is the principal amount?

(a) Rs. 1520 (b) Rs. 1880

(c) Rs. 2120 (d) None

5. The simple interest on a certain sum of money at the rate of 5% p.a. for 8 years is Rs. 840. At what rate of interest the same amount of interest can be received on the same sum after 5 years?

(a) 6% (b) 8%

(c) 7% (d) 10%

6. A sum of money was lent at simple interest at 11% p.a. for $3\frac{1}{2}$ years and $4\frac{1}{2}$ years respectively. If the difference in interests for two periods was Rs. 412.50, the sum is

(a) Rs. 3250 (b) Rs. 3500

(c) Rs. 3750 (d) Rs. 4250

7. [illegible] lent [illegible] at the rate of 6% [illegible] and gave the [illegible] at the rate of 10% [illegible]. At the end of 10 years he made a profit of Rs. [illegible]. The sum [illegible]

(a) Rs. 2000 (b) Rs. 3000

(c) Rs. 4000 (d) None of these

8. Raju borrowed Rs. 625 from Shri Lal at [illegible]% p.a. After 3 years, he then added some more money to the borrowed sum and lent it to Shubhash for the same period at [illegible]% rate of interest. If Raju gets Rs. 97.90 [illegible] in the deal, how much money did he add from his side?

(a) Rs. [illegible] (b) Rs. 35

(c) Rs. [illegible] (d) Rs. 100

9. Mr. Bhupal had invested in two schemes [illegible] rate of interest $7\frac{1}{2}$% and $8\frac{1}{2}$% per annum [illegible] yearly [illegible] Rs. 2[illegible]. The investment is

(a) Rs. [illegible] (b) Rs. 12,000

(c) Rs. [illegible] (d) Rs. 20,000

10. The rate at which a sum becomes four times of itself in 15 years at S.I. will be

(a) 15% (b) $17\frac{1}{2}$%

(c) 20% (d) 25%

11. [illegible] years is $\frac{4}{5}$ of the principal. What is the rate of interest per annum?
(a) 4% (b) [illegible]%
(c) 6% (d) Data inadequate

12. A sum of money [illegible] In how many years would it double itself?
(a) 8 years 8 months
(b) [illegible]
(c) 8 years [illegible]
(d) 8 years [illegible] months

13. A sum of Rs. [illegible] to be returned in [illegible] interest being simple. The rate of interest is
(a) [illegible]% (b) [illegible]%
(c) [illegible] (d) [illegible] $\frac{8}{11}$%

14. [illegible] 8% [illegible] for the first 3 years, [illegible] for the next [illegible] years and 10% p.a. for the period beyond [illegible] years. If the simple interest accrued [illegible] of 10 years is Rs. 1560, what is the sum?
(a) Rs. 1500 (b) Rs. 2000
(c) Rs. 2000 (d) Data inadequate

15. [illegible] Rs. 1[illegible] is required to be paid [illegible] interest [illegible] 20 [illegible] paid in 30 months, how [illegible]
(a) 90 (b) 100
(c) 240 (d) 360

16. A sum of Rs. [illegible] is lent out in two parts, one at 8% and another at 10%. The total annual income [illegible] is Rs. 1[illegible]. The money lent at 8% is
(a) Rs. [illegible] (b) Rs. 720
(c) Rs. 240 (d) Rs. [illegible]

17. A sum of Rs. 1550 was lent partly at 5% and partly at 8% p.a. simple interest. The total interest received after 3 years was Rs. 300. The ratio of the money lent at 5% to that at 8% is
(a) [illegible] (b) [illegible]
(c) 31 : 6 (d) 16 : 15

18. An amount of Rs. 1[illegible] divided among A, B and C [illegible] got the same amount after [illegible] 3 and [illegible] years respectively. If the rate of simple interest is [illegible] then the ratio of amounts invested among A, B and C will be:
(a) 10 : 15 : [illegible] (b) 22 : [illegible]
(c) 6 : 4 : 3 (d) [illegible]

◆◆◆

Solutions

1. Ans. (a)

$$\text{Rate} = \left(\frac{100 \times [\text{illegible}]}{500 \times [\text{illegible}]}\right)\% = [\text{illegible}]\%$$

2. Ans. (a)
Principal = Rs. 800, S.I. = Rs. 120,
Time = 3 years.

$$\therefore \text{Rate} = \left(\frac{100 \times 120}{800 \times 3}\right)\% = 5\%$$

New rate = 8%, Principal = Rs. 800
Time = 3 years

$$\text{S.I.} = \text{Rs.}\left(\frac{800 \times 8 \times 3}{100}\right) = \text{Rs. } 192$$

$\therefore$ New amount = Rs. (800 + 192) = Rs. 992

3. Ans. (b)

$$\text{Principal} = \text{Rs.}\left(\frac{100 \times 48}{[\text{illegible}]}\right) = \text{Rs. } 240$$

$$\text{S.I.} = \text{Rs.}\left(\frac{240 \times [\text{illegible}] \times 4}{100}\right) = \text{Rs. } [\text{illegible}]$$

4. Ans. (d)
S.I. for [illegible] = Rs. (2[illegible] − 2[illegible]) = Rs. 560
S.I. for 2 years = Rs. $\left(\frac{[\text{illegible}]}{[\text{illegible}]} \times 2\right)$ = Rs. [illegible]

$\therefore$ Principal = Rs. (2[illegible] − [illegible]) = Rs. [illegible]

5. Ans. (b)

$$\text{Sum} = \left(\frac{100 \times 240}{[\text{illegible}] \times 5}\right) = \text{Rs. } [\text{illegible}]$$

$$\text{Rate} = \left(\frac{100 \times 840}{[\text{illegible}]}\right)\% = [\text{illegible}]\%$$

6. Ans. (c)

Let the sum [illegible]. Then,

[illegible]

= [illegible] 2.50

[illegible]

7. Ans. (d)

Let the original amount [illegible] Rs. x. Then

[illegible]

8. Ans. (d)

[illegible]

∴ [illegible]

9. Ans. (a)

Let the money lent be Rs. x. Then

[illegible] = 25

10. Ans. (c)

Let sum = x, then [illegible]

[illegible]

11. Ans. (b)

[illegible]

12. Ans. (c)

[illegible]

Then [illegible]

[illegible]

Now, sum [illegible] Rate [illegible]

∴ Time = [illegible] years

= 7 years [illegible] months

13. Ans. (d)

[illegible] 11 months

[illegible]

14. Ans. (c)

Let the [illegible]

[illegible]

or 75x = [illegible]

or x = 2000

15. Ans. (c)

[illegible]

16. Ans. (a)

[illegible]

17. Ans. (a)

Let the [illegible]

[illegible] = 200

[illegible] = 500

[illegible]

5. Ans. (c)
Let the amounts invested be x, y, z respectively

Then $\frac{x \times 3 \times 5}{100} = \frac{y \times 5 \times 5}{100} = \frac{z \times 7 \times 5}{100} = k$

$\therefore x = 100k$, [illegible] $\frac{20}{3}k$ & [illegible] 5k

So x : y : z = 100 : $\frac{20}{3}$: 5k

[illegible]

[illegible]

Compound Interest

Practice Exercise I

1. The difference between compound interest and simple interest on a certain amount at 10% per annum at the end of the third year is Rs. 620. What is the principal amount?
(a) Rs. 10000 (b) Rs. 12000
(c) Rs. 18000 (d) Rs. 20000

2. The compound interest on a certain sum at $16\frac{2}{3}$% for 3 years is Rs. 1270. The simple interest on the same sum at the same rate and for the same period is
(a) Rs. 1200 (b) Rs. 1165
(c) Rs. 1080 (d) Rs. 1220

3. What is the principal amount which earns Rs. 132 as compound interest for the second year at 10% per annum?
(a) Rs. 1000 (b) Rs. 1200
(c) Rs. 1320 (d) Rs. 1195

4. A sum of money amounts to Rs. 4624 in 2 years and to Rs. 4913 in 3 years at compound interest. The sum is:
(a) Rs. 4260 (b) Rs. 4090
(c) Rs. 4335 (d) Rs. 4096

5. A sum of money at compound interest becomes three times of itself in 3 years. In how many years will it be nine times itself?
(a) 12 (b) 9
(c) 8 (d) 6

6. In how many years will a sum of Rs. 800 at 10% per annum compounded semi-annually become Rs. 926.10?
(a) $2\frac{1}{2}$ (b) [illegible]
(c) $4\frac{1}{2}$ (d) [illegible]

7. To find out the total compound interest accrued on a sum of money after 5 years, which of the following information given in the statements P and Q is/are sufficient?
P: The sum was Rs. 20000.
Q: The total amount of simple interest on the sum after 5 years was Rs. 4000.
(a) Only P is sufficient
(b) Only Q is sufficient
(c) Either P or Q is sufficient
(d) Both P & Q are needed

8. The least number of complete years in which a sum of money put out at 20% compound interest will be more than doubled is
(a) 3 (b) 4
(c) 5 (d) 6

9. A tree increases annually by $\frac{1}{8}$th of its height. By how much will it increase after 2 years, if it stands today 64 cm high?
(a) 72 cm (b) 74 cm
(c) 75 cm (d) 81 cm

10. The compound interest on a sum for 2 years is Rs. 832 and the simple interest on the same sum for the same period is Rs. 800. The difference between the compound interest and the simple interest for 3 years will be
(a) Rs. 48 (b) Rs. 66.56
(c) Rs. 98.56 (d) None of these

11. A sum of Rs. [illegible] was taken as a loan. This is to be repaid in two equal installments. If the rate of interest be 20% compounded annually, then the value of each installment is
(a) Rs. 842 (b) Rs. 600
(c) Rs. 720 (d) Rs. 700

15. What annual payment will discharge a debt of Rs. 7620 due in 3 years at $16\frac{2}{3}\%$ per annum compound interest?
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) Rs. [illegible]

* * *

Solutions

1. Ans. (d)

Let the sum be Rs. x. Then

[illegible]

$$= 620$$

$$x = 2000$$

Hence, the [illegible] is Rs. 2000

Alternative:

[illegible]

2. Ans. (c)

[illegible]

Thus, the sum is Rs. [illegible]

$$\therefore SI = Rs\left[\ldots \times \frac{50}{3} \times \ldots \times \frac{1}{100}\right]$$

$$= Rs.\ 1090.$$

3. Ans. (b)

[illegible]

$$\therefore P = [illegible] = Rs.\ [illegible]$$

4. Ans. (a)

[illegible]

$$[illegible]\left(1 + \frac{25}{100}\right)[illegible]$$

$$= Rs.\ [illegible]$$

5. Ans. (c)

[illegible]

Hence, n = 6 years

6. Ans. (b)

[illegible]

$$\therefore 2n = [illegible]\ \text{years}$$

7. Ans. [illegible]

[illegible]

[illegible]

Rate = $\left(\frac{100 \times 1000}{5 \times 2000}\right) = 4\%$

[illegible]

8. Ans. (b)

[illegible]

[illegible] = 2

[illegible] = 4 years.

9. Ans. (d)

[illegible] $\left(\frac{1}{2} \times 100\right)\% = 2\frac{1}{2}\%$

[illegible]

[illegible]

[illegible]

10. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Total difference = [illegible]

= Rs. [illegible]

11. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible] = Rs. 1100

[illegible]

[illegible]

[illegible] = Rs. 420

12. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

∴ [illegible]

1.5

CHAPTER

Ratio, Proportion & Variation

Ratio

[illegible]

[illegible]

[illegible]

[illegible]

Inequalities in the Ratio

[illegible]

$\Rightarrow$ [illegible] (i)

$\Rightarrow$ [illegible] (ii)

$\Rightarrow$ [illegible]

[illegible]

[illegible]

Ratio as a part of total value

[illegible]

$$\frac{A}{B} = [illegible]$$

[illegible]

$$\frac{A}{A-B} = [illegible]$$

$$A = [illegible](A-B)$$

[illegible]

[illegible] quantities.

Example 1.

[illegible]

Solution

$$2a = 3b \Rightarrow \frac{a}{b} = [illegible]$$

$\Rightarrow$ [illegible]

[illegible]

[illegible]

Example 2.

[illegible]

Solution

[illegible]

Example 3.

[illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Solution

[illegible]

$\Rightarrow \quad 10a^2 + ab = 30ab - 10b^2$

$\Rightarrow \quad \frac{10a^2 + ab}{b^2} = \frac{30ab - 10b^2}{b^2}$

$\Rightarrow \quad 10\left(\frac{a}{b}\right)^2 + \frac{a}{b} = 30 \times \left(\frac{a}{b}\right) - 10$

Assuming $\frac{a}{b} = x$

$\Rightarrow \quad 10x^2 + x = 30x - 10$

$\Rightarrow \quad 10x^2 - 29x + 10 = 0$

$\Rightarrow \quad x = \frac{10}{25} \text{ or } \frac{25}{10}$

$\Rightarrow \quad x = \frac{2}{5} \text{ or } \frac{5}{2}$

Hence ratio is 5 : 2

Types of Ratio

If two quantities A & B have their ratio A : B = p : q then

- Duplicate ratio of A : B is $p^2 : q^2$
- Triplicate ratio of A : B is $p^3 : q^3$
- Sub-duplicate ratio of A : B is $\sqrt{p} : \sqrt{q}$
- Sub-triplicate ratio of A : B is $\sqrt[3]{p} : \sqrt[3]{q}$

Example 1

The ratio of two quantities A & B is 4 : 9 what is the triplicate ratio of sub-duplicate ratio of A & B.

Solution

The sub-duplicate ratio of A & B is $\sqrt{4} : \sqrt{9}$
$= 2 : 3$

The triplicate ratio of 2 : 3 is $2^3 : 3^3$
$= 8 : 27$

Proportion

A proportion is comparison of two ratios. If the two ratios are equal then all the quantities are said to be in proportion i.e.

$\frac{a}{b} = \frac{c}{d}$ then a, b, c & d are in proportion & d is called as fourth proportional of a, b & c.

If three quantities are taken then

$\frac{a}{b} = \frac{b}{c}$ then c is called as third proportional of a & b. b is called as the mean proportional of a & c.

$\therefore \quad b^2 = ac$

or $\quad b = \sqrt{ac}$

So mean proportion is the geometric mean of the two quantities. Here the continued proportion is defined as follows: if quantities a, b, c & d are in continued proportion then

$\frac{a}{b} = \frac{b}{c} = \frac{c}{d}$

If there are 3 quantities in continued proportion, the middle term is GM then it is with both the other two quantities.

Example 1

Find the mean proportional of 3 & 27 and the third proportional of 3 & 27.

Solution

For mean proportion of 3 & 27 we have to find x

i.e. $\quad \frac{3}{x} = \frac{x}{27}$

$\Rightarrow \quad x^2 = 3 \times 27$ or $x = 9$

So mean proportion of 3 & 27 is 9

The third proportional of 3 & 27, say x, can be found

i.e. $\quad \frac{3}{27} = \frac{27}{x}$

$\Rightarrow \quad 3x = 27^2$

$\Rightarrow \quad x = 243$

So third proportion of 3 & 27 is 243.

Applications of Proportion

Proportion is very much useful in analysing the concepts of componendo & dividendo. So we are given the rules related to it as follows.

If a, b, c, d are in proportion

i.e. $\quad \frac{a}{b} = \frac{c}{d}$ then

- $\frac{a+b}{b} = \frac{c+d}{d}$ (componendo rule)
- $\frac{a-b}{b} = \frac{c-d}{d}$ (dividendo rule)
- $\frac{a+b}{a-b} = \frac{c+d}{c-d}$

(componendo & dividendo rule)

- $\frac{a}{c} = \frac{b}{d}$ (alternendo rule)
- $\frac{b}{a} = \frac{d}{c}$ (invertendo rule)

and if $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$

then $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \frac{a+c+e}{b+d+f}$

Variation

[illegible]

[illegible]

- [illegible]

[illegible]

Example 1.

[illegible]

Solution

Here $A \propto B$

[illegible]

[illegible]

$A \propto B$

or $A = Bk$

[illegible]

$\frac{A}{B} = \frac{A_2}{B_2}$

[illegible]

Inverse Variation

[illegible]

i.e. $A \propto \frac{1}{B}$

[illegible]

or $AB = K = \text{const.}$

i.e. $AB = A_2B_2 = [illegible]$

Example 1.

[illegible]

Solution.

[illegible]

Compound Ratio & Concept of Partnership

[illegible]

[illegible]

[illegible]

[illegible]

Case 1.

[illegible]

Example 1.

[illegible]

Solution.

[illegible]

[illegible] × 2

= 2 : 2 : 3 will be the profit ratio

Case 2

[illegible] profit will be shared in the ratio of their investment i.e. the ratio of profit will be

[illegible]

Example 1.

A, B & C invest rupees 10000, 15000 & 20000 respectively in a business for a year. In what will be the ratio of their profit?

Solution.

Since time period for all of them is same, profit will be shared in the ratio of their investment. So ratio of profit

= 10 K : 15 K : 20 K

= 2 : 3 : 4

Case 3.

When the investment is variable we have to look for the effective investment value for the profit sharing.

Example 1.

A, B, C invested rupees 10000, 15000 & 20000 respectively. Next year A & B invested 5000 more while C withdrew 10000 rupees. What will be the ratio of their profit after 2 years?

Solution.

For this we'll find the effective investment value of A, B & C respectively.

Effective Investment Value of A

= 10 K + [illegible] K

= 40 K

EIV of B = [illegible] = [illegible] K = 20 K

= 55 K

EIV of C = 20 K = 10 K + [illegible] K

= 45 K

So ratio of profit will be

40 K : [illegible] : [illegible] K

= 8 : 11 : 9

Example 2

A mixture contains alcohol and water in the ratio [illegible] By adding 10 litres of water the ratio becomes 2 : [illegible] Find out the amount of alcohol in the mixture.

(a) 20 (b) 30

(c) 40 (d) 50

Ans. (c)

The amount of alcohol = 4K

The amount of water = 3K

By adding water $\frac{4K}{3K+20} = \frac{2}{[illegible]}$

⇒ [illegible]K = [illegible]K + 20

⇒ 2K = 20 ⇒ K = 10

The amount of alcohol = 4 × 10 = 40 litres

Example 3.

The present ratio of ages of Ram & Raju is 5 : 4. 16 years ago the ratio of their ages was 16 : 11. The present sum of their ages is

(a) 90 years (b) 100 years

(c) 80 years (d) 110 years

Ans. (a)

Let the ages be 5K & 4K

$\frac{5K - 10}{4K - 10} = \frac{4}{[illegible]} \Rightarrow K = 10$

So sum of the ages = 50 + 40 = 90

Hence option (a)

Example 4

The income of Ram and Shyam are in the ratio [illegible] and their expenditures are in the ratio of [illegible] If each saves Rs. 1000 then Ram's income is

(a) 5000 (b) 6000

(c) 4000 (d) 7000

Ans. (c)

Let income be 5x, 4x

and expenditure be 3y, 2y

5x − 3y = 1000

4x − 2y = 1000

So x = 1000

So income is 5000

Hence option (c)

□□□□

Solved Examples

1. Divide Rs. 500 among A, B, C and D so that A and B together get [illegible] as much as C and D together, B gets [illegible] of what C gets and C gets [illegible] times as much as D. Then value of A is
(a) 300 (b) 75
(c) 125 (d) None of these

Ans. (c)

A + B + C + D = [illegible]

[illegible] = 3(C + D)

[illegible]

C + D = 125

A + B = 375

[illegible]

C = D = 125

[illegible]

[illegible]

[illegible]

2. [illegible] books in [illegible] days [illegible] 20 days.

(a) 9 (b) [illegible]

(c) 8 (d) [illegible]

Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible] 20 [illegible]

[illegible]

3. [illegible] 40 [illegible]

(a) 20 hrs (b) [illegible]

(c) 40 hrs (d) [illegible]

Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible] = 40 hrs

4. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 45, 60

5. [illegible] Rs. 1300 [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. 6000 (d) Rs. [illegible]

Ans. (c)

[illegible]

[illegible]

then

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] = 1000

[illegible] = 2000

[illegible] is 6000

6. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) [illegible]

Ans. (c)

[illegible] = A + B + C

[illegible]

[illegible]

[illegible]

[illegible]

7. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (c)

[illegible]

[illegible]

[illegible]

x = [illegible]

[illegible]

40 : 50 : 70

8. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (d)

Speed [illegible] 2 : 3 : 4

ratio of time taken will be $\frac{1}{2} : \frac{1}{3} : \frac{1}{4}$

$= \frac{6 : 4 : 3}{12} = 6 : 4 : 3$

5. After [illegible] in both [illegible] the ratio [illegible] Find the [illegible]

(a) 5/12 (c) [illegible]

(b) 3/5 (d) [illegible]

Ans. (b)

[illegible]

4x = 28 [illegible] 3y = 7 [illegible]

only [illegible] 3/5 [illegible] satisfies the above condition

6. Rs. 53 is [illegible] and [illegible] 50 paise [illegible] how many [illegible]?

(a) 92 (b) 64

(c) 85 (d) 6[illegible]

Ans. (a)

Let the number of girls and boys [illegible] then

[illegible] 53 (1)

also

[illegible] y = 80 (2)

from (1) and (2) we get

[illegible] = 16

[illegible] y = 64

So, [illegible]

7. [illegible] the ratio of milk [illegible] water [illegible] 2 [illegible] the quantity [illegible]

is:

(a) [illegible] lit (b) 25 lit

(c) 32.5 litres (d) [illegible] lit

Ans. (b)

Let [illegible]

now, $\frac{3x + 5}{[illegible]} = \frac{5}{?}$

[illegible]

[illegible] x = 5

[illegible]

8. [illegible] 50 p [illegible] 25 p [illegible] 25 p [illegible]

(a) [illegible] (b) 72

(c) 8? (d) None of these

Ans. (d)

[illegible]

[illegible] 12x [illegible] $\frac{?}{2}$ [illegible] $\frac{?}{4}$ [illegible]

[illegible]

[illegible] x = 4

13. A varies jointly [illegible] B and C [illegible] A = [illegible] B = [illegible]

(a) [illegible] (b) 35

(c) [illegible] (d) 105

Ans. (b)

[illegible] A = [illegible] then

[illegible]

So [illegible] then

A = [illegible]

= 1 × [illegible] = [illegible]

14. [illegible] x = 4 when y = 10 [illegible]

(a) 14[illegible]

(b) [illegible]

(c) [illegible]

(d) Cannot be determined

Ans. (d)

[illegible] $= \frac{k_2}{?}$

According to given [illegible]

[illegible]

So, $k_1 = \frac{?}{10} = \frac{7}{?}$

[illegible] $= \frac{k_2}{4}$

So [illegible]

[illegible] is [illegible]

[illegible] cannot be determined

15. [illegible] of [illegible] and water in the proportion [illegible] 2 [illegible] be 7 : 10?

(a) 35 (b) 8

(c) 7 (d) None of these

Ans. (b)

[illegible] 2x [illegible]

5x [illegible] 2x = 10

[illegible] 2x [illegible]

Now ⇒ $\frac{35}{14+x} = \frac{7}{[illegible]}$

98 = 7x [illegible] 42

7x = 42 ⇒ x = 6

[illegible]

Ratio & Proportion

Practice Exercise

1. Find the fourth proportional to the numbers [illegible], 48, [illegible].
   (a) 55 (b) 24
   (c) 49 (d) None of these

2. Find the third proportional to the numbers 4, 42.
   (a) 441 (b) 541
   (c) 241 (d) None of these

3. The prices of a scooter and a television set are in the ratio of 3 : 2. If the scooter costs Rs 600 more than the television set, then the price of television set is
   (a) Rs 1800 (b) Rs 1200
   (c) Rs 2400 (d) None of these

4. If A : B = 7 : 9 and B : C = 5 : 11, then A : B : C is equal to
   (a) 35:45:99 (b) [illegible]
   (c) 45:30:55 (d) None of these

5. The ratio of money with Anil and Sanjay is 4 : 5 and that with Sanjay and Manju is 6 : 7. If Anil has Rs. [illegible], then the amount of money Manju has is
   (a) Rs [illegible] (b) Rs 420
   (c) Rs [illegible] (d) None of these

6. The ratio of present ages of Suresh and Mahesh is 7 : 5. If after 6 years the ratio of their ages will be [illegible] : [illegible], the present age of Mahesh is
   (a) [illegible] years (b) 25 years
   (c) 20 years (d) None of these

7. Two numbers are in the ratio of 5 : 7. If 25 be subtracted from each, they are in the ratio of 35 : 59. Find the difference of the two numbers.
   (a) 24 (b) 6
   (c) 2[illegible] (d) None of these

8. The number that must be added to each of the numbers 8, 21, 13 and 31 to make the ratio of first two numbers equal to the ratio of last two numbers is
   (a) 5 (b) 7
   (c) 9 (d) None of these

9. A mixture contains alcohol and water in the ratio of 12 : 5. On adding 14 litres of water, the ratio of alcohol to water becomes 4 : 3. The quantity of alcohol in the mixture is
   (a) 16 litres (b) 42 litres
   (c) 20 litres (d) None of these

❑❑❑

Solutions

1. Ans. (b)
   Let x be the fourth proportional, then

   $$[illegible] : 45 : 33 : x \Rightarrow \frac{33}{45} = \frac{[illegible]}{x}$$

   $$\therefore x = \frac{[illegible] \times 33}{[illegible]} = 24$$

2. Ans. (a)
   Let x be the third proportional, then

   $$4 : 42 :: 42 : x \Rightarrow \frac{4}{42} = \frac{42}{x}$$

   $$\therefore x = \frac{42 \times 42}{4} = 441$$

3. Ans. (b)
   Here, a = 3, b = 2 and x = 600
   ∴ The price of television set

   $$= \frac{bx}{a-b} = \frac{2 \times 600}{3-2} = \text{Rs. } 1200$$

4. Ans. (a)
   Here $a_1 = 7$, $b_1 = 9$, $a_2 = 5$ and $b_2 = 11$
   ∴ A : B : C = $(a_1 \times a_2) : (b_1 \times a_2) : (b_1 \times b_2)$
   = (7 × 5) : (9 × 5) : (9 × 11)
   = 35 : 45 : 99

5. Ans. (b)
   We have, A : B = 4 : 5 and B : C = 6 : 7
   Here $a_1 = 4$, $b_1 = 5$, $a_2 = 6$ and $b_2 = 7$.
   ∴ A : B : C = $(a_1 \times a_2) : (b_1 \times a_2) : (b_1 \times b_2)$
   = (4 × 6) : (5 × 6) : (5 × 7)
   = 24 : 30 : 35

Thus, [illegible] Rs. 250 [illegible] money [illegible]

$= \frac{250}{2} \times 6 =$ Rs. [illegible]

6. Ans. (a)
We have, [illegible] = 7, [illegible] = 4, [illegible]

∴ The percentage of [illegible] $= \frac{[illegible]}{[illegible]}$

$= \frac{[illegible]}{[illegible] \times 3 \quad 5 \times 4} =$ [illegible]

7. Ans. (a)
We have [illegible] = 25 [illegible] and [illegible] = 59

∴ The first number $= \frac{[illegible]}{[illegible]}$

$= \frac{[illegible]\ 25 \times (59 \ [illegible])}{(5 \ [illegible]) \ [illegible]} =$ [illegible]

and the second number $= \frac{[illegible]}{[illegible]}$

$= \frac{[illegible] \times 25 \times (59 \ [illegible])}{(5 \ [illegible]) \ [illegible]} = 51$

∴ The difference of the numbers
= [illegible]

8. Ans. (a)
Here, a = 5, b = 3, [illegible] and d = [illegible]
∴ The required [illegible]

$= \frac{bc - ad}{(a+d) - (b+c)}$

$= \frac{[illegible] \times 13 - 5 \times 21}{(5 + 21) - (3 + 13)} =$ [illegible]

9. Ans. (c)
Ratio of [illegible] and water 12 : [illegible]
Let the quantities [illegible] be 12x and 5x respectively.
After adding [illegible]

$\frac{12x}{5x + [illegible]} = \frac{[illegible]}{[illegible]}$

$x = \frac{7}{2}$

Quantity of [illegible] $= 12 \times \frac{7}{2} = 42$ litres

□□□

Partnership

Practice Exercises

1. [illegible] and [illegible] partnership. [illegible] Rs. 12000 [illegible] Rs. 7 [illegible] 12 [illegible] Rs. 2[illegible]00. [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) None of these

2. [illegible] 18 [illegible] 2 [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) None of these

3. [illegible] in the ratio [illegible] distributed.
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

4. [illegible] A, B and C [illegible] ratio of [illegible] A, B and C is
(a) [illegible] (b) [illegible]
(c) 10 : 12 : [illegible] (d) None of these

5. [illegible] investments [illegible] in the ratio 1 : 2 [illegible]
(a) [illegible] (b) 2
(c) [illegible] (d) 4 months

6. [illegible] ratio $\frac{[illegible]}{[illegible]} : \frac{[illegible]}{[illegible]} : \frac{3}{[illegible]}$ [illegible] by [illegible] total profit [illegible] Rs. [illegible] profit [illegible]
(a) Rs. [illegible] (b) Rs. [illegible]
(c) Rs. [illegible] (d) Rs. [illegible]

7. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

8. [illegible]

(a) Rs. [illegible] (b) Rs. [illegible]

(c) Rs. [illegible] (d) Rs. [illegible]

[illegible]

Solutions

1. Ans. [illegible]

[illegible]

2. Ans. [illegible]

[illegible]

3. Ans. [illegible]

[illegible]

4. Ans. [illegible]

[illegible]

5. Ans. [illegible]

[illegible]

6. Ans. [illegible]

[illegible]

7. Ans. [illegible]

[illegible]

= 12.5% of Rs. 880 = Rs. 110

[illegible] profit = Rs. 770

[illegible]

[illegible] $\frac{5}{11}$ × Rs. 770 = Rs. 350

[illegible] = Rs. 350 + Rs. 110 = Rs. 460

8. Ans. [illegible]

[illegible]

∴ [illegible] = Rs. 2400

[illegible]

1.6

CHAPTER

Average Mixture & Alligation

Average

Average is a number which represents the general characteristics of a set of numbers. It is a very effective way of representing the entire group by a single value. Average of the group is defined as:

$$\text{Average} = \frac{\text{Sum of all the items in the group}}{\text{No. of items}}$$

Basic Points to mind with Average

- If the value of each item is increased by the same value P then the average of the group is increased also increased by P.

Example 1

Let us take a group of 5 numbers 25, 30, 15, 35, 40 and each number is increased by 3, then find out the new average.

Solution

$$\text{Initial Average} = \frac{25 + 30 + 15 + 35 + 40}{5}$$

$$= \frac{145}{5} = 29$$

$$\text{New Average} = \frac{28 + 33 + 18 + 38 + 43}{5}$$

$$= \frac{160}{5} = 32$$

So new Average = Initial average + 3.

- If the group items are decreased by the common value then the average will also decrease by same.
- If the group items are multiplied or divided by any constant value then the average value will also be multiplied or divided by the same.
- The average value will always be between the smallest value of the group and the largest value of the group.

Alternate Way of Calculation of Average

Let us say that a group contains numbers P_1, P_2, P_3 ... Then take a value which can be assumed as the assumed average, say A, and calculate the deviations of each value from the given values. The deviations are C_1, C_2, C_3 ... C_n. Then the average will be

$$A + \frac{C_1 + C_2 + C_3 \ldots + C_n}{n}$$

Example 1.

If weights of 6 persons are [illegible], 67 kg [illegible]. Find their average weight.

Solution:

Let us assume the [illegible] as 67 the average will be

$$67 + \frac{[illegible] - 4 + 2 + 7}{6}$$

$$= 67 + \frac{[illegible]}{6} = [illegible] \text{ kg}$$

Concept of Weighted Average

When we talk about the average of two different groups or more than two different groups, the average value of all groups taken together is not just equal to the average of averages of groups. For example if we have two different groups of average weights 60 & 70 kg, we cannot say that the average of all the groups when taken together is equal to

$$\frac{60 + 70}{2} = 65 \text{ kg, always}$$

It depends upon the number of elements in the groups. So in this case the number of group members plays a very important role. Let the first group has 20 people while the second group has 30 persons. Then the average will be

$$\frac{\text{Total weight}}{\text{Total numbers}} = \frac{20 \times 60 + 30 \times 70}{20 + 30}$$

$$= \frac{1200 + 2100}{50} = \frac{3300}{50} = 66 \text{ kg}$$

This kind of average is called as weighted average and weighted average is calculated as

$$\text{average} = \frac{n_1A_1 + n_2A_2 + n_3A_3 + \dots}{n_1 + n_2 + n_3 + \dots}$$

Where n_1, n_2, n_3 ... are the number of elements in the groups. While A_1, A_2, A_3 ... are the average of the groups.

Instead of exact value of number of elements we can also take the ratio of the number of elements.

Example 1.

The average marks of students of class A is 87 while that of class B is 73. If the number of students in class A and B are 42 & 63 respectively then find out the average marks of all the students taken together.

Solution

$$\text{Average} = \frac{2 \times 87 + 3 \times 73}{2 + 3}$$

(ratio is 42 : 63 = 2 : 3)

$$= \frac{174 + 219}{5} = \frac{393}{5} = 78.6$$

The weighted average has wide range of application. The weightage need not be necessarily the number of elements. It can be any characteristic of group that affect the groups standing in the result. We will see some examples here.

Example 2

Two alloys having the ratio of copper & zinc in the ratio 1 : 4 and 2 : 3 are mixed and the alloys are mixed in 2 : 3 by the weight. Find the ratio of copper & zinc in the mixture.

Solution:

Here weighted ratio is 2 : 3.

Now we have the weightage for the mixing.

Now if we talk about the quantity of copper in both the alloys.

It is $\frac{1}{5}$ and $\frac{2}{5}$.

So by weighted average technique

$$= \frac{2 \times \frac{1}{5} + 3 \times \frac{2}{5}}{2 + 3} = \frac{8}{25}$$

So the ratio of copper to copper is 8 : 17.

Mixture & Alligation technique

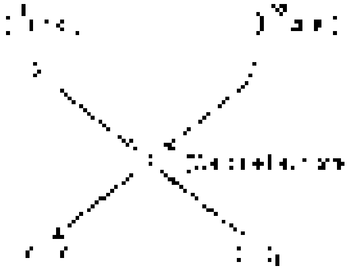
When it comes to the mixing of two different quantities, Weighted average comes into the picture. If two solutions of concentration c_1 and c_2 are mixed in the ratio $n : m$. Then the average concentration would be

$$c = \frac{nc_1 + mc_2}{n + m}$$

or we can rearrange the formula as

$$\frac{n}{m} = \frac{c_2 - c}{c - c_1}$$

This is famous as alligation formula. It can also be understood with the help of cross relation.



(Weightage of conc. c_1) : (Weightage of conc. c_2)

So it can be understood as the alligation technique provides us the ratio of mixing directly. Alligation technique has to be used when the weighted average is given & weighted average formula has to be used when weightage are given.

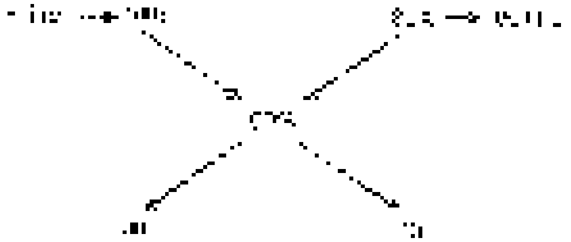
Let us understand it better with some examples.

Example 3.

How much water must be added in 30 litres of 70% milk solution to make it as 60% milk solution.

Solution

The concentration of water & solution are 0% and 70% respectively.



So the ratio of mixing is 1 : 6

$$\Rightarrow \frac{x}{30} = \frac{1}{6}$$

$\Rightarrow x = 5$ litres

Replacement

In case of replacement problems, where a [illegible] solution [illegible] is replaced with another ingredient. We have to look to the ingredient being consumed and the ingredient which is continuously increasing will keep on decreasing with the same percentage. Let us understand this with one example.

Example 1.

A vessel contains 100 litres of pure milk. After every 10 minutes 10 litres of the solution is taken out and is replaced with water. Find out what will be the amount of milk after 30 minutes in the solution.

Solution:

From the question, we see that 10 litres of milk is being replaced. [illegible] replaced [illegible] every 10 mins. Let us understand [illegible] with [illegible]

After 10 mins:

10 litres of milk will be replaced with water. So the solution will have

Milk = 90 litres

Water = 10 litres

After 20 minutes:

Now when the 10 litres solution will be taken out, it will be having milk and water in ratio 9 : 1.

So out of 10 litres solution milk taken out is = 9 litres remaining amount of milk = 90 − 9 = 81 litres

The remaining quantity will be water which is equal to = 100 − 81 = 19 litres

Now ratio of milk and water = 81 : 19

After 30 minutes:

Now the 10 litres solution which is taken out will have milk and water in ratio 81 : 19

So amount of milk taken out

$$= 10 \times \frac{81}{81+19} = 8.1 \text{ litres}$$

The amount of milk remaining

= 81 − 8.1 = 72.9 litres

The amount of water = 100 − 72.9 = 27.1 litres

Now let us take the amount of milk and water in [illegible] above example

Milk	Water	
100	0	
90	10	← After 1st replacement
81	19	← After 2nd replacement
72.9	27.1	← After 3rd replacement

Total volume of the solution = 100 litres

Volume replaced each time = 10 litres

Now we can observe that the percentage decrease in the milk [illegible] after each replacement.

This is because the amount of ingredient [illegible] constantly decreasing by being taken out [illegible] being [illegible] with [illegible] A [illegible] we [illegible] the [illegible] single [illegible] to [illegible] or multiplying by 90% successively

$90 = 100\left(1 - \frac{1}{10}\right)$

$81 = 100\left(1 - \frac{1}{10}\right)^2$

$72.9 = 100\left(1 - \frac{1}{10}\right)^3$

Thus, we can make a principle that

[illegible] percentage of [illegible] solution that is being replaced is [illegible]% of the total solution then [illegible] and having [illegible] replacement [illegible] will decrease by [illegible]% after every cycle.

This is the basic idea of replacement.

Example 2.

A person made a profit of 15% on 20% of the quantity sold while on the rest he makes a profit of 5%. Find out the overall percentage?

Solution:

Let us say the total quantity is x

20% of the quantity $= \frac{x}{5}$

80% of the quantity $= \frac{4x}{5}$

on $\frac{x}{5}$ the profit made $= \frac{15}{100} \times \frac{x}{5} = \frac{3x}{100}$

on $\frac{4x}{5}$ the profit made $= \frac{5}{100} \times \frac{4x}{5} = \frac{4x}{100}$

Net profit $= \frac{7x}{100} = 7\%$.

Alternate:

The same question can be solved using [illegible] the two parts are 20% & 80% [illegible] they [illegible] making [illegible] profit [illegible] overall [illegible]

= [illegible]

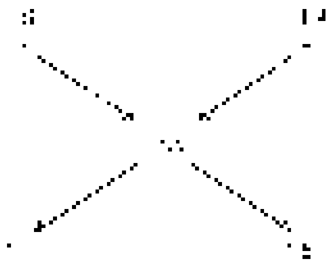
Example 3.

[illegible] deposits some amount in [illegible] bank at [illegible] and rest of the amount in [illegible] bank at [illegible] p.a. He gets [illegible] Rs. 10000 yearly. Find out the amount invested in [illegible] bank.

Solution:

[illegible] net interest rate

$= \frac{[illegible]}{10000} \times 100 = 8.5\%$



So the amount invested [illegible]

[illegible]

So the amount in [illegible] = [illegible] × [illegible]

= Rs. [illegible]

Example 4.

A [illegible] the ratio [illegible] 10 [illegible] is replaced with water [illegible] the amount of water after [illegible]

Solution:

[illegible]

Milk = $\frac{[illegible]}{5} \times 100$ = [illegible]

Water = $\frac{[illegible]}{5} \times 100$ = [illegible]

[illegible] will be [illegible]

$= \frac{[illegible]}{100} \times 100$ = [illegible]

[illegible]

= 80 × [illegible]

= [illegible]

[illegible] water

= [illegible]

Solved Examples

1. The average age of 24 students and the [illegible] is [illegible] years. When the [illegible] age is excluded, the average age is decreased by 1 year. What is the age of [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) Data inadequate
Ans. (a)
Average age of 24 students

$= \frac{\text{sum of ages of 24 students}}{24}$

$\Rightarrow [illegible] = \frac{\text{sum of ages of 24 students}}{24}$

∴ sum of ages of 24 students = [illegible]

= [illegible] years

Let the Age of principal be x years

Then, average age of the students and the principal

$= \frac{\text{sum of ages of 24 students \& principal}}{25}$

$\Rightarrow [illegible] = \frac{[illegible] + x}{25}$

⇒ x = 25 × [illegible] = [illegible]

2. The average weight of 3 [illegible] A, [illegible] is [illegible] kg. [illegible] joins [illegible] average becomes 80 kg. [illegible] whose weight is [illegible] kg more than [illegible] A, then the average weight of [illegible] becomes [illegible] kg. The weight of A is:
(a) [illegible] kg (b) 72 kg
(c) [illegible] kg (d) [illegible] kg
Ans. (c)
Sum of weights of A, B and C
= 3 × [illegible] = [illegible] kg
Sum of weights of A, B, C and D
= 4 × 80 = 320 kg
weight of D = 320 − [illegible] = [illegible] kg
∴ weight of E = [illegible] + 3 = [illegible] kg
[illegible] weight of [illegible] A
= [illegible] = [illegible] kg
Sum of weights of B, C, E and D
= [illegible] kg
∴ weight of A = 391 − [illegible] = [illegible] kg

3. Vijay Kumar has a certain average for 9 innings. In the tenth inning, he scores 100 runs thereby increasing his average by 8 runs. His new average is
(a) 20
(b) 24
(c) 28
(d) 32

Ans. (c)

Let the old average and new average be x and y respectively.

Then, y = x + 8 ...(i)

and $y = \frac{9x + 100}{10}$ ...(ii)

From (i) and (ii) we get

10 (x + 8) = 9x + 100

⇒ x = 20

∴ y = 20 + 8 = 28

4. The average age of 8 persons in a committee is increased by 2 years when two men aged 35 years and 45 years are substituted by two women. Find the average age of the two women.
(a) 48
(b) 45
(c) 51
(d) 42

Ans. (a)

Let the average age of 8 persons in the committee be x years.

Let the sum of ages of two women be y years.

Then sum of ages of 8 persons excluding two men aged 35 and 45 years

$= 8x - (35 + 45) = 8x - 80$

Again, $x + 2 = \frac{8x - 80 + y}{8}$

⇒ 8x + 16 = 8x − 80 + y

⇒ y = 96

∴ Average age of two women

$= \frac{96}{2} = 48$ years

5. The speed of the train going from Nagpur to Allahabad is 100 km/h while when coming back from Allahabad to Nagpur, its speed is 150 km/h. Find the average speed during the whole journey.
(a) 125
(b) 75
(c) 135
(d) 120

Ans. (d)

Let the distance between Allahabad and Nagpur be x km.

Total average speed $= \frac{2x}{\frac{x}{100} + \frac{x}{150}}$

$= \frac{2 \times 100 \times 150}{250} = 120$ km/hr

6. The ages of Mohan and Roop are in the ratio 1 : 3. After 5 years, the ratio of their ages will become 3 : 4. Find the average of their ages after 10 years.
(a) 15
(b) 12
(c) 17
(d) 20

Ans. (b)

Let their present ages of Mohan and Roop be 2x and 6x years respectively.

Also, 5 years, $\frac{2x + 5}{6x + 5} = \frac{3}{4}$

⇒ 8x + 20 = 18x + 15

⇒ 10x = 5

∴ $x = \frac{1}{2}$

Hence Present ages are 1 and 3 years.

After ten years their ages will be 11 and 13 years.

∴ Average of their ages

$= \frac{11 + 13}{2} = 12$ years

7. Find the average of the first 97 natural numbers.
(a) 47
(b) 37
(c) 49
(d) 48

Ans. (c)

Sum of the first 97 natural numbers

$= \frac{97 \times 98}{2} = 4753$

∴ The average $= \frac{4753}{97} = 49$

8. Find the average of all prime numbers between 30 and 50.
(a) 35.6
(b) 39.8
(c) 37.8
(d) 41.5

Ans. (b)

Prime numbers between 30 and 50 are 31, 37, 41, 43, 47

∴ Their average

$= \frac{31 + 37 + 41 + 43 + 47}{5} = 39.8$

9. The average of 5 consecutive numbers is n. If the next two numbers are also included, the average will

(a) Decreased by 1 (b) remain the same
(c) increased by 1.4 (d) increased by 2
Ans. (a)
Let the five consecutive numbers be x, x – 1, x – 2, x – 3 and x – 4.

$$\text{Given: } n = \frac{x + x - 1 + x - 2 + x - 3 + x - 4}{5}$$

$\Rightarrow n = x - 2$
The average after including the next two numbers

$$= \frac{x + x - 1 + x - 2 + x - 3 + x - 4 + x - 5 + x - 6}{7}$$

$= x - 3 = n + 2 - 3$
$= n - 1$
Hence the average decreases by 1.

10. The average of 50 numbers is 38. If two numbers, namely, 45 and 55 are discarded, the average of the remaining numbers is
(a) 36.5 (b) 37
(c) 37.52 (d) 37.5
Ans. (d)
Sum of 50 numbers
$= 38 \times 50 = 1900$
Sum of remaining numbers
$= 1900 - (45 + 55) = 1800$
average of remaining numbers

$$= \frac{1800}{48} = 37.5$$

11. The average weight of [illegible] is increased by 2 kg when one of the men weighing [illegible] kg is replaced by another person. Find the weight of the new person?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]
Ans. (b)
Let the average weight of [illegible] before replacement be x kg.
Also, let the weight of new person be y kg.

$$\text{Then, } x + 2 = \frac{5x - 50 + y}{5}$$

$\Rightarrow$ [illegible]
$\therefore y =$ [illegible] kg

12. The average age of the Indian cricket team playing the Nagpur test is 30. The average age of 5 of the players is 27 and that of another set of 5 players totally different from the first five, is 29. If it is the captain who was not included in either of these two groups, then find the age of the captain.
(a) 75
(b) 55
(c) 50
(d) Cannot be determined
Ans. (c)
Let the age of the captain be y years

$$\text{Then, } 30 = \frac{27 \times 5 + 29 \times 5 + y}{11}$$

$\Rightarrow 330 = 135 + 145 + y$
$\therefore y = 330 - 280 = 50$ years

13. Out of three numbers, the first is twice the second and is thrice the third. The average of the three numbers is 88. The smallest number is
(a) 72 (b) [illegible]
(c) 42 (d) 48
Ans. (d)
Let x be the first number then the other two numbers

will be $\frac{x}{2}$ and $\frac{x}{3}$

$$\text{Again } 88 = \frac{x + \frac{x}{2} + \frac{x}{3}}{3}$$

$$\Rightarrow 88 = \frac{x}{3}\left[1 + \frac{1}{2} + \frac{1}{3}\right]$$

$$\Rightarrow 88 = \frac{x}{3} \times \frac{11}{6}$$

$$\therefore \text{The smallest number} = \frac{x}{3} = \frac{144}{3} = 48$$

14. The average of first five multiples of 3 is
(a) 3 (b) 9
(c) 12 (d) 15
Ans. (b)

$$\text{Average} = \frac{3(1 + 2 + 3 + 4 + 5)}{5} = \frac{3 \times 15}{5} = 9$$

15. The average temperature on 1st, 2nd and 3rd December was 24.4°C. The average temperature of the first two days was 24°C. The temperature on the 3rd of December was
(a) 20°C (b) 24°C
(c) 25.2°C (d) None of these
Ans. (c)
Let the temperature on 3rd of December be x°C. Then

$$24.4 = \frac{2 \times 24 + x}{3} \Rightarrow x = 25.2°C$$

16. The average of 20 results is [illegible] and that of 30 more results is 20. For all the results taken together the average is:
(a) 2[illegible]
(b) 5[illegible]
(c) 24
(d) [illegible]4
Ans. (c)
Required average
$= \frac{20 \times 30 + 30 \times 20}{50} = \frac{1200}{50} = 24$

17. The average temperature on Monday, Tuesday and Wednesday was 41°C and on Tuesday, Wednesday and Thursday it was 40°C. If on Thursday it was exactly 39°C, then on Monday the temperature was:
(a) [illegible]°C
(b) 4[illegible]°C
(c) [illegible]°C
(d) 2[illegible]°C
Ans. (a)
Sum of temperatures on Tuesday and Wednesday
$= 3 \times 40 - 39 = 81$
The sum of temperatures on Monday, Tuesday and Wednesday $= 3 \times 41 - 81 = 42$

❑❑❑

Average

1 Practice Exercise

1. There are 35 students in a hostel. If the number of students is increased by 7, the expenses of the mess were increased by Rs. 42 per day while the average expenditure per head diminished by Re 1. Find the original expenditure of the mess.
(a) Rs. 450
(b) Rs. 410
(c) Rs. 3[illegible]
(d) Rs. 420

2. An aeroplane travels distances 2500 km, 1200 km and 500 km at the rate of 500 km/hr, 400 km/hr and 250 km/hr respectively. The average speed is:
(a) 420 km/hr
(b) 410 km/hr
(c) 4[illegible] km/hr
(d) 575 km/hr

3. The average weight of 16 boys of section A of a class is [illegible] kg whereas the average weight of [illegible] students of section B of the same class is [illegible] kg. Find the average weight of all the students in the class.
(a) [illegible] kg
(b) [illegible] kg
(c) [illegible] kg
(d) [illegible] kg

4. The average monthly salary of a staff of 12 persons is Rs. 2450. One member of the staff whose monthly salary is Rs. 2650, [illegible]. Find the average salary of the remaining 11 persons of the staff.
(a) Rs. 2420
(b) Rs. 2[illegible]
(c) Rs. [illegible]
(d) Rs. 2432

5. 3 years ago, the average age of a family of 5 members was 17 years. With the birth of a new baby, the average remains the same even today. The age of the baby is:
(a) 1 year
(b) 2 years
(c) $1\frac{1}{2}$ years
(d) 3 years

6. A batsman in his 17th innings makes a score of 85, and thereby increases his average by 3. What is his average after the 17th innings? He had never been 'not out'.
(a) 47
(b) 37
(c) 39
(d) 43

7. The average of [illegible]
(a) 30
(b) 2[illegible]
(c) 4[illegible]
(d) [illegible]

8. A [illegible] 10 [illegible] average is [illegible]. How many [illegible] the average of [illegible] value of [illegible]
(a) 1[illegible]
(b) [illegible]3
(c) 1[illegible]
(d) None of these

9. The average age of [illegible] their ages are 20 years and [illegible] years respectively [illegible]. What is the average age of the [illegible]?
(a) 2[illegible] years
(b) 3[illegible] years
(c) 4[illegible] years
(d) [illegible] years

10. The average speed of a train in the onward journey is 2[illegible]% more than that in the return journey. The train halts for one hour on reaching the destination. The total time taken for the complete to and fro journey is [illegible] hours, covering a distance of 800 km. The speed of the train in the onward journey is:
(a) [illegible] km/hr
(b) [illegible] km/hr
(c) 100 km/hr
(d) [illegible] km/hr

11. The average weight of 3 men A, B and C is 84 kg. Another man D joins the group and the average now becomes 80 kg. If another man E, whose weight is 3 kg more than that of D, replaces

[illegible] D, replaces A, then average weight of B, C, [illegible] kg. [illegible] weight of A?

(a) [illegible] kg (b) [illegible] kg
(c) [illegible] kg (d) 80 kg

12. The average of marks obtained by [illegible] candidates was 35. If the average of marks of passed candidates was [illegible] and that of failed candidates was [illegible], then the number of those candidates who passed the examination is

(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

13. [illegible] is decreased by 3 months when [illegible] was replaced by a new boy. The age of the new boy is

(a) [illegible] yrs 8 months
(b) 15 years
(c) [illegible] yrs 4 months
(d) 17 yrs 10 months

14. The average daily wages of A, B and C is [illegible]. If B earns Rs 40 more than C per day and A earns double of what C earns per day, the wages of A per day is

(a) Rs [illegible] (b) Rs [illegible]
(c) Rs [illegible] (d) Rs [illegible]

15. With an average speed of 40 km/hr, a train reaches its destination in time. If it goes with an average speed of [illegible] km/hr, it is late by [illegible] minutes. The total journey is

(a) [illegible] km (b) [illegible] km
(c) [illegible] km (d) [illegible] km

16. In a competitive examination, the average marks [illegible] was 45. [illegible] 50 [illegible] the average [illegible] 40 marks. The number of students who appeared in the examination [illegible]

(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

17. A man whose bowling average is 12.4, takes 5 wickets for 26 runs and thereby decreases his average by 0.4. The number of wickets taken by him before his last match is

(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

18. The average age of a committee of 8 members is 40 years. A member aged 55 years retired and he was replaced by a member aged 39 years. The average age of the present committee is

(a) 39 years (b) 38 years
(c) 36 years (d) 35 years

□□□□

Solutions

1. Ans. (c)

Let the original expenditure = Rs x

Original average expenditure = $\frac{x}{35}$

New average expenditure = $\frac{x+42}{42}$

$\Rightarrow \frac{x}{35} - \frac{x+42}{42} = 1 \Rightarrow x = 420$

∴ Original expenditure = [illegible]

2. Ans. (a)

The total time taken can be calculated as shown below:

Distance	Speed	Time
[illegible] km	[illegible] km/hr	[illegible]
[illegible] km	[illegible] km/hr	[illegible]
[illegible] km	[illegible] km/hr	[illegible]
Total [illegible] km		10 hrs

Average speed = $\frac{\text{Total distance}}{\text{Total time}}$ = [illegible]

Average speed = [illegible] km/hr

3. Ans. (c)

Average weight of 24 students of section A = [illegible] kg

Total weight of [illegible] = [illegible] kg

Total weight of [illegible] students of section B = [illegible] kg

Total weight of [illegible] = ([illegible] + 575) kg = 2868 kg

Average weight of [illegible] the class

= $\frac{2868}{[illegible]}$ = [illegible] kg

4. Ans. (a)

Average salary of 9 persons = Rs. 2450

Total salary of 9 persons

= Rs. 2450 × 9 = Rs. 22050

Salary of the person who is transferred

= Rs. 4050

Thus, the total salary of remaining 8 persons

= Rs 22050 − 4050 = Rs 18000

The average salary of the remaining 8 persons

= Rs. $\frac{18000}{8}$ = Rs. 2250

5. Ans. (c)

Present age of 5 members

= 5 × 17 + 3 × 5 years

= 100 years

Present age of 6 members with the baby

= 6 × 17 = 102 years

∴ Age of the baby = (102 − 100) years = 2 years.

6. Ans. (b)

Average score before 17th innings

= 85 − 3 × 17 = 34

∴ Average score after 17th innings

= 34 + 3 = 37

7. Ans. (a)

Let the numbers be x, y and z. Then

$x + y + z = 98$, $\frac{x}{y} = \frac{2}{3}$ and $\frac{y}{z} = \frac{5}{8}$

∴ $x = \frac{2y}{3}$ and $z = \frac{8y}{5}$

So, $\frac{2y}{3} + y + \frac{8y}{5} = 98$

or, $\frac{49y}{15} = 98$ or $y = 30$

8. Ans. (c)

Average of 5, 7, 14 and x = $\frac{5 + 7 + 14 + x}{4}$ [illegible]

The [illegible]

[illegible]

⇒ x = [illegible] ...(i)

Also, $\frac{x + y}{2} = 24$ ...(ii)

From (i) and (ii) we get:

$48 - y = $ [illegible] $\Rightarrow y = 39$

9. Ans. (b)

Let the average age of 8 men be x years.

∴ Sum of the ages of 8 men = 8x years

Now, according to the condition of the question

Average age of (6 men + 2 women)

= (x + 2) years

∴ Sum of the ages of (6 men + 2 women)

= 8 (x + 2) = 8x + 16 years

Hence, it is clear that on replacing two men by two women, sum of their ages increased by 16 years.

Therefore, sum of the ages of two women

= (21 + 23) + 16 = 60 years

∴ Average age of two women = $\frac{60}{2}$ = 30 yrs

10. Ans. (b)

Time taken to cover first 100 km distance

$= \frac{100}{30} = 3\frac{1}{3}$ hrs

Time taken to cover second 100 km distance

$= \frac{100}{40} = 2\frac{1}{2}$ hrs

Time taken to cover last 100 km distance

$= \frac{100}{50} = 2$ hrs

Total time taken

$3\frac{1}{3} + 2\frac{1}{2} + 2 = \frac{10}{3} + \frac{5}{2} + 2 = \frac{47}{6}$ hrs

Total distance travelled = 300 km

∴ Average speed $= \frac{300}{47/6}$

$= \frac{300 \times 6}{47} = 38.3$ km/hr

11. Ans. (c)

Weight of D = (80 × 4 − 84 × 3) kg = 68 kg

Weight of E = (68 + 3) kg = 71 kg

(B + C + D + E)'s

Weight = (79 × 4) kg = 316 kg

∴ (B + C)'s weight = [316 − (68 + 71)] kg

= 177 kg

Hence A's weight = [(84 × 3) − 177] kg = 75 kg

12. Ans. (a)

Let [illegible]

Then, 21 × x + 5 × (120 − x) = 12[illegible] × 25

∴ [illegible] = 4200 − [illegible]

Or, x = $\frac{3400}{34}$ [illegible] = [illegible]

13. Ans. (c)

Total decrease = (2[illegible] × 2) [illegible]

= [illegible] years [illegible]

∴ Age of the new boy = 18 years [illegible]

= 14 years 8 [illegible]

14. Ans. (a)

Let [illegible] of C = x

Then, daily wages of A = [illegible]

and daily wages of B = [illegible]

Hence, average daily wages of A, B and C

$= \frac{x + 2x [illegible]}{3} = \frac{[illegible] x + [illegible]}{3}$

[illegible] = [illegible] 40 = [illegible]

⇒ [illegible] = [illegible]

∴ Wages of A per day = [illegible] × 80 = [illegible]

15. Ans. (a)

[illegible] $\frac{15}{[illegible]}$ [illegible] $= \frac{1}{4}$

[illegible] $= \frac{35 \times 40}{[illegible] \times 4} =$ [illegible]

16. Ans. (c)

[illegible] = [illegible]

[illegible]

= [illegible] × 50 = 2700

[illegible] = [illegible] − 2700

Reduced average = $\frac{[illegible] − 2700}{x}$

∴ 40 = $\frac{[illegible] − 2700}{x}$

or, 40x = [illegible] − 2700

⇒ [illegible] 2700 [illegible] = [illegible]

17. Ans. (a)

Let [illegible]

[illegible]

Then $\frac{[illegible]}{x + 5}$ = [illegible]

18. Ans. (b)

[illegible]

$= \frac{8 \times [illegible]}{8}$ [illegible] $= \frac{[illegible]}{[illegible]} = \frac{[illegible]}{[illegible]}$

= [illegible] years.

[illegible]

1.7 CHAPTER

Time & Work

[illegible] the class of questions where a problem is solved by comparing the given input to process and one output. Since efficiency of different persons is different, the [illegible] [illegible]. We discuss all such problems under the heading "Time & Work".

In Time & Work, [illegible] distribute the work between two or more persons based on their capacities.

The basic understanding of these problems comes by quantifying work. We will start understanding this quantification with the following example.

Let us assume a person finishes 2 units of the work in one day and takes total time of [illegible] days. So to find out the total work we should know the capacity of the person and the total amount of work to be finished.

All the Time & Work problems are based upon the following formula:

$$\text{Capacity} = \frac{\text{Work}}{\text{Time}}$$

So to find out the two variables we need to know the other two. [illegible]

Example 1.

5 persons finish a piece of work in 7 days. In how many days 7 persons will finish the same amount of work?

Solution

Here we don't know how much work is involved. [illegible] capacity of the individuals. So we will assume the capacity.

Let us assume that 1 person finishes 1 unit in 1 day

=> 5 persons will finish 5 units in 1 day

=> 5 persons will finish 35 units in 7 days

=> The total work is 35 units.

Now taking 7 persons

They will finish 7 units in 1 day

So time taken by 7 persons = 35/7 = 5 days

Example 2

A can finish a work in 10 days. B can finish the same work in 12 days. How many days will they take to finish the work working together?

Solution

Given

A takes 10 days

B takes 12 days

Since we don't know the amount of work [illegible]. So we will assume the work. Let us assume the work is 60 units.

So capacity of A $= \frac{60}{10} = 6$ units/day

Capacity of B $= \frac{60}{12} = 5$ units/day

Combined capacity of A & B = 11 units/day

So time taken by A & B $= \frac{60}{11} = 5\frac{5}{11}$ days

Example 3.

A finishes a work in [illegible] days. With the help of B, he finishes the same work in [illegible] days. How much time B alone will take to finish the work?

Solution.

Let the work be 80 units.

[illegible]

[illegible]

[illegible]

So time taken by B $= \frac{80}{1} = 80$ days

Alternate Work

Sometimes the condition of the question is that [illegible] work in a particular [illegible] can be understood by following example.

Example 1.

A can finish the work in 15 days and B [illegible] in [illegible] days. In how many days will the work be finished if [illegible]

Solution.

[illegible]

Concept of Negative Work

[illegible]

Example 3.

[illegible]

Solution.

[illegible]

Concept of Wages

[illegible]

Ratio of wages = Ratio of work finished

[illegible]

Example 4

[illegible]

Solution.

[illegible]

Tips & Cautions

[illegible]

The inlet pipe always does the positive work while the outlet pipe always does the negative work. Let us see some problems.

Example 1.

Pipe A can fill a tank in 10 hours while pipe B can empty a completely filled tank in 15 hours. How much time it will take to fill a 2/3rd filled tank completely by both of the pipes?

Solution.

Tank capacity = 30 ltrs

A → [illegible] = 3 l/hours

B → [illegible] = −2 l/hours

Capacity of (A + B) = 3 − 2 = 1 l/hr

Amount of water to be filled

$= \left(\frac{2}{3}\right) \times 30 = 20$ ltrs

So the time taken $= \frac{20}{1} = 20$ hrs.

Efficiency Comparison

When two person's efficiencies are compared then in that case, the basic work and time calculations become much easier. In this sort of case we will be able to assume the capacities directly. For example:

Example 1.

A is 3 times efficient than B and can finish the work 10 days earlier as compared to B. How much time will A and B take to finish the same amount of work?

Solution.

If A is 3 times efficient than B

Then B will take 3 times the no. of days that A takes

$\text{Speed} \propto \frac{1}{\text{Time}}$

So, if A takes x days then B takes 3x then given that

$x + 10 = 3x \Rightarrow x = 5$

A → [illegible] = 5 days

B → 3 × 5 = 15 days

Work = 15 unit

(A + B)'s capacity = 4 unit/day

Time taken $= \frac{15}{4} = 3\frac{3}{4}$ days

Example 2.

A tank can be filled completely in 6 hours but because of the leak it takes 2 hours more to get filled. In how much time the leak can empty a full tank?

Solution

Time [illegible] = 8 hrs

A + Leak → [illegible] = 3 l/hrs

A = 4 l/hr

Leak capacity = 1 litre/hour

Time $= \frac{24}{1} = 24$ hrs

Example 3.

A monkey climbs on a greasy pole. In 1 minute he goes up 3 m, but in the next minute he slips down 2 m. If the length of the pole is 50 m, then how much time will he take to reach the top?

Solution.

When monkey will cross the height of 47 m, in the next minute he will reach the top. So we will find the time in which monkey takes to reach the height of 47 m.

In first minute monkey moves = 3 m

In second minute monkey moves = −2 m

So in 2 minutes monkey effectively moves = 1 m.

So he will take 47 × 2 min to move 47 m.

So total time taken = 47 × 2 + 1 min = 95 mins.

Example 4.

In a hostel there was food for 120 persons for 36 days. After 12 days 80 more persons joined the hostel. In how many days the food will last?

Solution.

After 12 days the food will be sufficient for

120 persons for remaining 24 days. If 80 more persons come, total persons in the hostel = 200

If 120 persons take 24 days

Then 200 persons will take $\frac{24 \times 120}{200}$ = [illegible] days

Example 5.

Raman can finish a work in 15 days while Shyam can finish the same work in 10 days. How many days they will take to finish the work together?

Solution

Raman finishes the work in 15 days

Shyam finishes the work in 10 days

Shyam makes 1/4 work in 5 days
Ravi finishes 1/4 work in [illegible] days
Let work 75 units

So, Ravi $\xrightarrow{75\text{ units}}$ 15 days

Shyam $\xrightarrow{75\text{ units}}$ [illegible] days

Capacity of Ravi & Shyam = [illegible] units/day

Time taken = [illegible] days

Example 6.

Ramu is thrice as efficient as Rakesh. Working together they finish the same work in 20 days. How many days Rakesh alone takes to finish the work?

Solution.

Let us assume the capacity of Ramu & Rakesh, their capacity is 3 units & 1 unit/day.
Total capacity of Ramu & Rakesh = 4 units/day
Hence total work = 20 × 4 = 80 units

So, time taken by Rakesh $= \frac{80}{1} = 80$ days

Example 7.

Suresh can finish a task in 54 days. Working with Mohan, Suresh [illegible] 108 & 162 respectively. How many days they would take to finish the work together?

Solution.

They are working [illegible]
Ratio of days = inverse ratio of capacities
So Mohan : Suresh = [illegible]
[illegible]
Mohan's capacity = 2 units/day
Suresh's capacity = 3 units/day
Total work = 2 × [illegible] = [illegible] units
[illegible]

[illegible] = 4 [illegible] days

Example 8.

A man & a woman can finish a work in [illegible] days. [illegible] can finish the work in [illegible] days. How many days [illegible] will take to finish the work?

Solution.

Let the capacities of a man be m & a woman be w.

1m + 2w $\xrightarrow{[illegible]}$ 12 days

1m + 3w $\xrightarrow{[illegible]}$ 10 days

Work = 60 units
⇒ 1m + 2w = 5
1m + 3w = 6
So, m = 3, w = 1
Total capacity of 4 men and 2 women
= 4 × 3 + 2 × 1
= 14 units/day

Time taken $= \frac{[illegible]}{[illegible]} = [illegible]$ days

◆

Conceptual Man-Day

If 100 workers can finish the task in 50 days, then 1 worker can finish the task in 100 × 50 = 5000 days.

This is represented in terms of man-day.

Man-day is nothing but the total man required to finish the task by 1 person.

Three Cases:

Case I

If 100 workers can finish the task in 50 days, then how many days it would take to finish the work by 25 workers?

Solution:

Here Man-Day = 100 × 50 = 5000
Now according to question only 25 workers are available.

25 × days = 5000

Days $= \frac{5000}{25} = 200$ days it requires to finish the task by 25 workers.

Case II

If 100 workers can finish the task in 50 days. 100 workers started working the task and working for [illegible] days. [illegible] workers [illegible] days. How much [illegible] the task [illegible]

Solution:

Total Man × Day = constant

[illegible] = 5000

In first 10 [illegible] are working for 10 days. So they can finish

100 × 10 = 1000 Man Days

Now [illegible] Man-Day [illegible]

[illegible]

$\text{Day} = \frac{1000}{200}$ [illegible] days

[illegible] days to complete the task.

Case-II

[illegible] 50 days. [illegible] days [illegible] of days [illegible] the task

Solution:

Total Man × Day = constant

[illegible] = 5000

[illegible] workers [illegible] so they can finish

100 × 20 = 2000 (Man × Day)

Now 3000 (Man × Day) is still remaining [illegible] be finished by [illegible] workers

Man × Day = 3000

200 × Day = 3000

$\text{Day} = \frac{3000}{200} = 15$ days

[illegible] the task.

Man × Day × Hour

$M_1 \times D_1 \times H_1$ = work [illegible]

$M_2 \times D_2 \times H_2$ = work

Work may be [illegible]

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

[illegible] length and height respectively [illegible]

$$\frac{M_1 D_1 H_1}{L_1 B_1 H_1} = \frac{M_2 D_2 H_2}{L_2 B_2 H_2}$$

$$= \frac{M_1 D_1 H_1}{[illegible]} = \frac{M_2 D_2 H_2}{[illegible]}$$

Concept of Efficiency

Efficiency of [illegible]

[illegible] concept of efficiency.

Ex. 1 A is three times as efficient as B and [illegible] days [illegible]

Sol: [illegible] days

[illegible] days

$2x = 32$

$x = 16$ days

$3x = 48$ [illegible] days

[illegible]

$\frac{1}{16} + \frac{1}{48} = [illegible] = \frac{1}{12}$ part

[illegible] required to complete the task.

Ex. 2 [illegible] days [illegible] to finish the task [illegible]

Sol: [illegible]

[illegible]

$\frac{1}{15} + \frac{1}{60} = \frac{5}{60} = \frac{1}{12}$ [illegible]

So they require 12 days with [illegible] together.

SOLVED EXAMPLES

1. [illegible] A [illegible] 10 days [illegible] 12 days [illegible] days [illegible]?
(a) [illegible] days (b) [illegible] days
(c) [illegible] days (d) [illegible] days
Ans. (a)

One day work of [illegible] = $\frac{1}{10}$

and [illegible] one day work = $\frac{1}{12}$

[illegible]

$\frac{1}{[illegible]} + \frac{1}{12} = \frac{[illegible]}{[illegible]} = \frac{[illegible]}{[illegible]}$

[illegible] days required [illegible] work by A and [illegible]

2. [illegible] men and [illegible] women [illegible] in [illegible] days. And [illegible] men and 7 women [illegible] in 4 days. [illegible] 1 man and 1 woman [illegible] the work?
(a) $24\left(\frac{[illegible]}{7}\right)$ days (b) $[illegible]\left(\frac{1}{[illegible]}\right)$ days
(c) $[illegible]\left(\frac{1}{7}\right)$ days (d) $12\left(\frac{[illegible]}{[illegible]}\right)$ days
Ans. (a)
Let man complete [illegible] in [illegible] days and woman [illegible] together

[illegible] $\frac{1}{[illegible]}$ [illegible] ...(i)

[illegible] ...(ii)

After simplifying [illegible]

$20[illegible] = [illegible]$

$[illegible] = 1$

$[illegible] = \frac{1}{[illegible]}$

$[illegible] = \frac{1}{[illegible]}$ ...(iii)

[illegible]

$[illegible] = \frac{[illegible]}{1[illegible]}$

$[illegible] = \frac{1}{[illegible]} + \frac{[illegible]}{[illegible]} = \frac{[illegible]}{15[illegible]}$

[illegible] require $\frac{[illegible]}{[illegible]}$ days $= [illegible]\frac{[illegible]}{7}$

3. A [illegible] 10 days [illegible] 20 days [illegible]?
(a) [illegible] days (b) [illegible] days
(c) [illegible] days (d) [illegible] days
Ans. (b)

$\frac{[illegible]}{[illegible]} - \frac{1}{10} [illegible] \frac{1}{20} = \frac{1}{[illegible]}$

[illegible] 20 days [illegible] work

4. A [illegible] 20 days. [illegible] days [illegible] A and B [illegible] the work?
(a) [illegible] days (b) [illegible] days
(c) [illegible] days (d) [illegible] days
Ans. (d)

A [illegible] = $\frac{1}{2[illegible]}$

[illegible] $\frac{[illegible]}{20} \times [illegible] = \frac{1}{4}$ [illegible]

Remaining work = $\frac{[illegible]}{[illegible]}$ [illegible]

∴ B [illegible] $\frac{[illegible]}{[illegible]}$ [illegible] days

∴ [illegible] $\frac{1[illegible]}{[illegible]4} = \frac{40}{[illegible]}$ days

[illegible]

$\frac{1}{2[illegible]} + \frac{[illegible]}{40} = \frac{[illegible]}{[illegible]}$ [illegible] days

5. [illegible] days. After [illegible] days [illegible]?
(a) [illegible] days (b) [illegible] days
(c) [illegible] days (d) [illegible] days
Ans. (a)
[illegible] = [illegible]
[illegible] = [illegible]
[illegible]
$[illegible] = [illegible]$
$[illegible] = [illegible]$
$[illegible] = [illegible]$

6. [illegible] hours [illegible] pages [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Ans. (b)

∴ [illegible] hours can copy [illegible] pages

∴ [illegible] $\frac{50}{10}$ [illegible]

Both [illegible] 300 pages [illegible] hours

So [illegible] $\frac{300}{40}$ [illegible]

[illegible] 50

[illegible] $\frac{}{25}$ [illegible] = [illegible]

7. [illegible] and [illegible] 20 days. [illegible]

[illegible]

(a) 10 days (b) [illegible]

(c) 14 days (d) None of these

Ans. (d)

[illegible] $\frac{1}{25}$

[illegible] = $\frac{1}{20}$

[illegible] $\frac{1}{25}+\frac{1}{20}$

$=\frac{9}{100}$ [illegible]

[illegible] $\frac{9}{100}$ [illegible] $\frac{45}{100}$ [illegible]

[illegible] $\left(\frac{55}{100}\right)$ [illegible] $\left(\frac{1}{20}\right)$

= 11 days

8. [illegible]

[illegible]

[illegible]

(a) $\frac{66}{17}$ days (b) $\frac{144}{17}$ days

(c) $\frac{72}{17}$ days (d) 6 days

Ans. (b)

[illegible] $\frac{1}{2}$ [illegible]

[illegible]

[illegible] = [illegible]

Together they work [illegible]

$\frac{1}{\frac{1}{16}+\frac{1}{18}} = \frac{144}{17}$ days

9. [illegible]

[illegible]

[illegible]

[illegible]

(a) 6 days (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

[illegible]

[illegible]

[illegible]

[illegible] $\frac{1}{}$ [illegible] $\frac{1}{}$ [illegible]

[illegible]

[illegible]

10. [illegible]

[illegible]

[illegible] 51 [illegible] 31 [illegible]

[illegible]

(a) 4 days (b) [illegible]

(c) 4 [illegible] (d) [illegible] days

Ans. (c)

[illegible] = 51 [illegible]

[illegible] = [illegible] $\frac{1}{}$

51 [illegible]

51 × $\frac{1}{}$ [illegible] $\frac{1}{}$

[illegible] $\frac{24 \times 12}{51}$ [illegible] days

[illegible] 12 [illegible] days

11. [illegible]

[illegible]

[illegible]

(a) [illegible] days (b) 21 days

(c) 32 days (d) 42 days

Ans. (d)

[illegible]

days

Together they can complete in

$$\frac{x \times 2x}{3x} = 14 \text{ days}$$

x = 21 days, 2x = 42 days

12. If 12 men and 16 boys can do a piece of work in 5 days and 13 men and 24 boys can do it in 4 days, [illegible] the daily work done by a man with that done by a boy?
(a) 2 : 1 (b) 1 : 3
(c) [illegible] (d) 3 : 1
Ans. (a)

$$12\,M + 16\,B = \frac{1}{5} \quad \ldots(i)$$

$$13\,M + 24\,B = \frac{1}{4} \quad \ldots(ii)$$

$$\text{Also} \quad 36\,M + 48\,B = \frac{3}{5}$$

$$26\,M + 48\,B = \frac{2}{4}$$

$$10\,M = \frac{1}{10} \Rightarrow M = \frac{1}{100}$$

$$\text{Similarly } B = \frac{1}{200}, \; M : B = 2 : 1$$

13. A can do a work in 10 days and B can do the same work in 20 days. They work together for 5 days and then A goes away. In how many more days will B finish the work?
(a) 5 days (b) 8.5 days
(c) 10 days (d) $3\frac{1}{2}$ days
Ans. (a)
In 5 days they can complete

$$\left[\frac{1}{10} + \frac{1}{20}\right] \times 5 = \frac{3}{4} \text{ part}$$

$$\text{Remaining} = \frac{1}{4} \text{ part}$$

$$\text{B will finish in } \frac{\frac{1}{4}}{\frac{1}{20}} = 5 \text{ days}$$

14. 15 men are employed to do a piece of work in 210 days. But at the end of 100 days, 15 additional men are employed. In how many more days will the work be completed?
(a) 35 days (b) 50 days
(c) 55 days (d) 60 days
Ans. (c)
Man × Day = Man × Day
15 × 210 = 3150 work for 210 days
15 × 100 = 1500 work completed
remaining work = 1650 Man × Day
Man × Day = 1650
30 Day = 1650
Day = 55

15. If a garrison of 200 soldiers has food for 31 days. After 27 days, 150 soldiers left the fort. For how many more days will the remaining food last for the remaining soldiers?
(a) 16 days (b) 10 days
(c) 8 days (d) 6 days
Ans. (a)
Man × Day = Man × Day
200 × 31 = 6200
After 27 days
200 × 27 = 5400 Man × Day is finished
Remaining = 800
Man × Day = 800
50 × Day = 800
Day = 16

16. A cistern is normally filled in 8 hours. However, it takes 2 hours more to fill because of a leak in its bottom. If the cistern is full, in what time will the leak empty it?
(a) 40 h (b) 16 h
(c) 30 h (d) 15 h
Ans. (a)

In one hour $\frac{1}{8}$ part is filled but due to leak in one hour only $\frac{1}{10}$ part is filled

$$\frac{1}{8} - \frac{1}{x} = \frac{1}{10}$$

$$\Rightarrow \frac{1}{8} - \frac{1}{10} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{40} = \frac{1}{x}, \; x = 40 \text{ hours}$$

17. Pipes A and B running together can fill a cistern in 6 minutes. If B takes 5 minutes more than A to fill the cistern, then the time in which A and B will fill the cistern separately are respectively
(a) 15 min, 20 min (b) 15 min, 10 min
(c) 10 min, 15 min (d) 25 min, 20 min

Ans. (b)
Let pipe A can fill in x hrs and pipe B in x – 5 minutes

$$\frac{1}{x}+\frac{1}{x-5}=\frac{1}{6}$$

or $\frac{x(x-5)}{2x-5}=6$

x = 10, x + 5 = 15

18. Two pipes are connected to a tank. Pipe A is filling the tank & Pipe B is for emptying the tank. If A can fill the tank in 10 hours and B can empty the tank in 15 hours then find how many hours will it take to completely fill a half empty tank?
(a) 30 hours (b) 15 hours
(c) 20 hours (d) 33.33 hours
Ans. (b)

$$\frac{1}{10}-\frac{1}{15}=\frac{1}{30}$$

So it takes 30 hours to fill the tank and 15 hours to fill half the tank.

19. There are three Taps A, B and C in a tank. They can fill the tank in 10 hrs, 20 hrs and 25 hrs respectively. At first, all of them are opened simultaneously. Then after 2 hours tap C is closed and A and B are kept running. After the 4th hour, tap B is also closed. The remaining work is done by tap A alone. Find the percentage of the work done by Tap A itself.
(a) 32 % (b) 52 %
(c) 72 % (d) None of these
Ans. (d)

	A	B	C		
1st hour	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	
2nd hour	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	
3rd hour	$\frac{1}{10}$	$\frac{1}{20}$	×	$\frac{3}{20}$	$\frac{15}{100}$ part
4th hour	$\frac{1}{10}$	$\frac{1}{20}$	×	$\frac{3}{20}$	$\frac{15}{100}$ part

So remaining part must be filled by A is

$$\frac{\frac{32}{100}}{\frac{1}{10}}=3.2 \text{ hours}$$

% of work done by A

$= \frac{40+32}{100} = 0.72$ i.e. 72%

Time & Work

Practice Exercise

1. 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days. If all the 10 men and 15 women work together, in how many days will the work get completed?
(a) $6\frac{2}{3}$ days (b) $8\frac{1}{3}$ days
(c) $7\frac{2}{3}$ days (d) None of these

2. A is thrice as good a workman as B and is therefore able to finish a piece of work in 60 days less than B. Find the time in which they can do it working together.
(a) $22\frac{1}{2}$ days (b) $22\frac{1}{4}$ days
(c) 25 days (d) None of these

3. Ganesh takes twice as much time as Mahesh and thrice as much time as Suresh to complete a piece of work. Working together, they can complete the work in 4 days. Find the time taken by each of them separately to complete the whole.
(a) 36, 24 and 18 days
(b) 20, 10 and 7 days
(c) 24, 12 and 8 days
(d) None of these

4. A man can complete a work in 6 days. A woman can complete the same work in 12 days and a boy can do it in 24 days. In how many days can all working together complete the work?
(a) 3 days (b) 4 days
(c) 2 days (d) None of these

5. Ajay and Sunil can complete a work in 12 days, Sunil and Sanjay in 15 days and Sanjay and Ajay in 20 days. They together worked for 6 days and then Ajay leaves and Sanjay and Sunil work together for 4 days more. Then Sunil leaves. How long will Sanjay take to complete the work?
(a) 12 days (b) 10 days
(c) 16 days (d) None of these

6. Seema, Gupta and Tripti together can complete the work in 4 days. If Gupta and Tripti together [illegible]

complete the work in $\frac{4}{5}$ days. [illegible]

[illegible] days. [illegible] can complete the work in

(a) [illegible] days (b) [illegible] days

(c) 20 days (d) None of these

7. Working 7 hours daily [illegible] in 24 days. In how many days would [illegible] working [illegible] hours daily?

(a) 30 days (b) 20 days

(c) 35 days (d) None of these

8. [illegible] days. In how many days can [illegible] men and [illegible] women finish the same work?

(a) 6 days (b) 5 days

(c) 7 days (d) None of these

9. [illegible] the time [illegible] 24 days [illegible] 16 days [illegible] B take alone?

(a) 30 days (b) 32 days

(c) 40 days (d) 38 days

10. Two men undertake to do a piece of work for Rs. 600. One alone can do it in 6 days and the other in 8 days. With [illegible] they finish it in 3 days. Boy's share should be

(a) Rs. 300 (b) Rs. 225

(c) Rs. 75 (d) Rs. [illegible]

11. [illegible] 2 days [illegible] together [illegible]

(a) 1 : [illegible] (b) 2 : 1

(c) 1 : 3 (d) 4 : 1

12. A and B can [illegible] in 9 and 12 days respectively. If they work [illegible] how many days will the work be completed?

(a) $10\frac{1}{2}$ days (b) [illegible] $\frac{1}{4}$ days

(c) [illegible] days (d) [illegible] days

13. A and B can [illegible] in 15 and 20 days respectively. They began the work together [illegible] A leaves after some days [illegible] remaining work in [illegible] days. After how many days did A leave?

(a) 6 days (b) 5 days

(c) 2 days (d) 10 days

14. A can do a piece of work in 20 days, B in 30 days and C in 40 days. If A is assisted by B on one day and by C on the next day alternately, work would be completed in

(a) $17\frac{32}{37}$ days (b) [illegible] days

(c) $16\frac{8}{37}$ days (d) [illegible] days

◆

Solutions

1. Ans. (a)

[illegible]

∴ Working together [illegible] complete the work in

$$= \frac{xy}{x+y} \text{ days}$$

$$= \frac{[illegible]}{[illegible]+12} \text{ [illegible] days}$$

2. Ans. (c)

Let B take x days to do the work. Then, A takes (x − 60) days to complete the work.

Since ratio of work done by A and B is [illegible], ratio of time taken by A and B is [illegible].

$$\text{So we have, } \frac{x-60}{x} = \frac{1}{[illegible]}$$

$$\Rightarrow (x-60) [illegible] = 90$$

∴ Time taken by B [illegible] = 90 days and time taken by A [illegible] = $\frac{90}{3}$ = 30 days

∴ A and B working together will complete the work in $\frac{xy}{x+y}$ days

$$= \frac{90 \times 30}{90+30} \text{ days} = \frac{45}{2}$$

$= 22\frac{1}{2}$ days

3. Ans. (d)

[illegible] takes [illegible] days to finish the work.

Thus, [illegible] takes $\frac{x}{2}$ and Suresh takes $\frac{x}{3}$ days to finish the same work.

∴ [illegible] working together will complete the work in

$$= \frac{xyz}{xy+yz+zx} \text{ days}$$

$$= [illegible] \text{ days}$$

$$= [illegible] \text{ or } \frac{x}{6} \text{ days}$$

Given $\frac{x}{6} = 4$, [illegible]

∴ [illegible] takes 24 days, [illegible] takes $\frac{24}{2}$ or 12 days and Suresh takes $\frac{24}{3} = 8$ days to finish the work.

4. Ans. (c)

Manish can complete the work in [illegible] = 10 days

[illegible] can complete the work in [illegible] = 12 days

And [illegible] can complete the work in [illegible] = 15 days.

∴ [illegible] working together can complete the work in

$$= \frac{xyz}{xy+yz+zx} \text{ days}$$

$$= \frac{10 \times 12 \times 15}{10 \times 12 + 12 \times 15 + 15 \times 10} = 4 \text{ days}$$

5. Ans. (c)

Ankit, [illegible] and Sanjay working together can complete the work in

$$= \left(\frac{xyz}{xy+yz+zx}\right) \text{ days}$$

$$= \left(\frac{12 \times 15 \times 20}{12 \times 15 + 15 \times 20 + 20 \times 12}\right)$$

$$= \frac{3600}{[illegible]}, \text{ i.e. } \frac{[illegible]}{[illegible]} \text{ days}$$

∴ Work done by all of them together in [illegible] days

$$= [illegible] = \frac{13}{[illegible]}$$

Also, work done by Sunil and Sanjay in [illegible] days

$$= \frac{4}{15}$$

Remaining work

$$= 1 - \left(\frac{[illegible]}{[illegible]} + \frac{[illegible]}{[illegible]}\right) = \frac{[illegible]}{2}$$

Which is to be done by Sanjay.

Now, since Sunil and Sanjay can complete the work in $\frac{120}{[illegible]}$ days and [illegible] can complete the work in [illegible] days.

∴ Sanjay alone can complete the work in

$$[illegible] = 120 \text{ days}$$

∴ $\frac{[illegible]}{[illegible]}$ of the work is done by Sanjay in $\frac{120}{[illegible]}$ [illegible] days.

6. Ans. (c)

Suresh, Gupta and Singh together can finish the work in 4 days.

Suresh and Gupta together can do it in $\frac{[illegible]}{[illegible]}$ days.

Gupta and Singh together can do it in 8 days.

Therefore, Suresh alone can complete the work in

$$= \left(\frac{xy}{y-x}\right) \text{ days} = \left(\frac{8 \times 4}{[illegible]}\right) \text{ days}$$

[Here $x = 4$ and $y = 8$ days]

Also, Singh alone can complete the work in

$$= \left(\frac{xy}{y-x}\right) \text{ days} = \left(\frac{\frac{24}{5} \times 4}{\frac{24}{5} - 4}\right) \text{ days}$$

[Here $x = 4$ and $y = \frac{24}{5}$] = 24 days

∴ [illegible] and Singh can complete the work in

$$= \left(\frac{xy}{x+y}\right) \text{ days} = \left(\frac{[illegible]}{[illegible]}\right) \text{ days}$$

[Here [illegible] and [illegible]] = 6 days

[illegible] $\frac{6 \times [illegible]}{[illegible]} = 12$

7. Ans. (a)

We have $M_1 = 24$, $D_1 =$ [illegible], $W_1 =$ [illegible]

$M_2 =$ [illegible], $D_2 = ?$, $W_2 =$ [illegible], $T_2 = 8$

$M_1D_1T_1W_2 = M_2D_2T_2W_1$

$\Rightarrow 24 \times$ [illegible] $\times D_2 \times 8 \times 1$

$\Rightarrow D_2 =$ [illegible] days.

8. Ans. (b)

Here a = [illegible], b = [illegible], c = [illegible] and d = [illegible]

∴ Required number of days

$= \left(\frac{\text{[illegible]}}{bc - ad}\right)$ days

$= \left(\frac{\text{[illegible]}}{\text{[illegible]}}\right)$ days = [illegible]

9. Ans. (d)

B does a rate of work [illegible] hour

Then A does [illegible] part in [illegible] hour

Now A does [illegible] work in [illegible]

[illegible] $+ \frac{\text{[illegible]}}{6} = \frac{\text{[illegible]}}{16}$

[illegible] $= \frac{\text{[illegible]}}{\text{[illegible]}}$

[illegible] days and [illegible] days

10. Ans. (a)

[illegible] $= \frac{3}{\text{[illegible]}}$ [illegible]

[illegible] day [illegible] $= \frac{3}{\text{[illegible]}}$

[illegible] days' work $= \left(\frac{1}{\text{[illegible]}} - \frac{3}{\text{[illegible]}}\right)$ [illegible]

∴ [illegible]

$\frac{1}{\text{[illegible]}}$ [illegible] $\frac{3}{\text{[illegible]}}$ [illegible]

∴ [illegible] = Rs [illegible] = Rs 75

11. Ans. (b)

[illegible]

[illegible] = [illegible] B

∴ [illegible]

∴ Work done by [illegible] the [illegible]
[illegible]

12. Ans. (b)

(A + B)'s [illegible] days' work $\frac{1}{\text{[illegible]}} + \frac{1}{\text{[illegible]}} = \frac{7}{\text{[illegible]}}$

work done by A and B during [illegible] days

$= \frac{7}{\text{[illegible]}} = \frac{35}{\text{[illegible]}}$

Remaining work $= 1 - \frac{\text{[illegible]}}{\text{[illegible]}} = \frac{1}{\text{[illegible]}}$

Now, [illegible] work is done by A in 1 day

∴ [illegible] work will be done by A in

[illegible] $\frac{\text{[illegible]}}{\text{[illegible]}} = \frac{1}{4}$ [illegible]

So, total time taken = [illegible] days

13. Ans. (c)

A's [illegible] days' work = $\frac{\text{[illegible]}}{\text{[illegible]}}$

Remaining work $= 1 - \frac{\text{[illegible]}}{\text{[illegible]}} = \frac{\text{[illegible]}}{\text{[illegible]}}$

Now (A + B)'s 1 day's work

$= \frac{1}{45} + \frac{1}{\text{[illegible]}} = \frac{\text{[illegible]}}{\text{[illegible]}}$

$\frac{\text{[illegible]}}{\text{[illegible]}}$ work is done by A and B in 1 day

∴ $\frac{\text{[illegible]}}{\text{[illegible]}}$ work is done by A and B in

$\frac{\text{[illegible]}}{\text{[illegible]}} =$ [illegible] days

[illegible] days

14. Ans. (a)

(A + [illegible])'s 1 day's work $= \frac{\text{[illegible]}}{\text{[illegible]}}$

∴ [illegible] days' work

$\frac{1}{\text{[illegible]}} + \frac{\text{[illegible]}}{\text{[illegible]}} = \frac{\text{[illegible]}}{\text{[illegible]}}$

∴ Work done in first [illegible] days

$= \frac{\text{[illegible]}}{\text{[illegible]}} + \frac{7}{\text{[illegible]}} = \frac{\text{[illegible]}}{\text{[illegible]}}$

[illegible]

Pipes & Cisterns

1 Practice Exercise

1. [illegible]
(a) [illegible] (b) 7 hours
(c) [illegible] (d) None of these

2. [illegible] will be filled up [illegible]
(a) [illegible] minutes
(b) [illegible] minutes
(c) [illegible] minutes
(d) [illegible]

3. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

4. [illegible] hours and 12 hours, [illegible] 20 hours. [illegible] filled?
(a) [illegible] (b) 6 hours 40 minutes
(c) [illegible] (d) None of these

5. [illegible] 2 hours [illegible]
(a) [illegible] (c) [illegible]
(b) 40 hours (d) None of these

6. [illegible] 12 hours. [illegible]
(a) [illegible] (c) [illegible]
(b) 40 hours (d) None of these

7. [illegible] together?
(a) [illegible] minutes (c) 12 minutes
(b) [illegible] minutes (d) data inadequate

8. [illegible] minutes, [illegible]
(a) 4 min [illegible] sec (c) [illegible] min [illegible] sec
(b) 4 min [illegible] sec (d) [illegible] min [illegible] sec

9. [illegible]
(a) [illegible] minutes (b) [illegible] minutes
(c) [illegible] minutes (d) [illegible] minutes

10. [illegible] 30 minutes. [illegible]
(a) [illegible] minutes (b) 10 minutes
(c) 12 minutes (d) 18 minutes

Solutions

1. Ans. (a)

Here, x = 2 and y = 3

∴ Part of the cistern filled in 1 hour

$$\frac{1}{x}-\frac{1}{y}=\frac{1}{2}-\frac{1}{3}=\frac{1}{6}$$

∴ Total time taken to fill the cistern = 6 hrs.

2. Ans. (a)

Here x = 25 and y = 50

∴ Part of the tank filled or emptied in 1 minutes

$$=\frac{1}{x}-\frac{1}{y}=\frac{1}{25}-\frac{1}{50}=\frac{1}{50}$$

Which is positive, this means the tank is filled. Total time taken to fill the tank = 50 minutes

3. Ans. (c)

Here, x = 10 and y = 15

∴ Tank will be filled in

$$=\left(\frac{xy}{y-x}\right)\text{ hours}$$

$$=\left(\frac{10\times15}{15-10}\right)\text{ hours} = 30\text{ hours.}$$

4. Ans. (a)

Here, x = 10, y = 12 and z = 20

∴ The tank will be full in

$$=\left(\frac{x\times y\times z}{xy+yz-zx}\right)\text{ hours}$$

$$=\left(\frac{10\times12\times20}{10\times12+12\times20-20\times10}\right)\text{ hours}$$

$$=\left(\frac{15}{2}\right)\text{ hours or 7 hours 30 minutes}$$

5. Ans. (c)

Here, x = 8 and y = 8 + 2 = 10

∴ The tank will be empty in

$$=\left(\frac{xy}{y-x}\right)\text{ hours}$$

$$=\left(\frac{8\times10}{10-8}\right)\text{ hours} = 40\text{ hours}$$

6. Ans. (c)

Let one pipe fills the cistern in x hours, then the second pipe takes (x − 10) hours

$$\therefore\quad \frac{1}{x}+\frac{1}{x-10}=\frac{1}{12}$$

⇒ 12(x − 10) + 12x = x(x − 10)

⇒ x² − 34x + 120 = 0

⇒ (x − 30)(x − 4) = 0

∴ x = 30 or x = 4

∴ Slower pipe takes 30 hours to fill the cistern.

7. Ans. (b)

[illegible] pipe A [illegible] times faster than pipe [illegible] takes 120 minutes to fill the tank. According to question [illegible]

[illegible] $\frac{4}{3}$ [illegible]

Both pipe together can fill the tank in

$$\frac{1}{T}=\frac{1}{40}\ \text{[illegible]}$$

8. Ans. (a)

As the pipes are operating alternately, in the first 2 minutes part $=\frac{1}{4}+\frac{1}{6}=\frac{5}{12}$

In the next 2 minutes the cistern will be filled $\frac{5}{12}$ part of cistern. Therefore in 4 minutes the two pipes which are operating alternately will fill

$$\frac{5}{12}+\frac{5}{12}=\frac{10}{12}=\frac{5}{6}\text{ part}$$

The part of the cistern unfilled $=1-\frac{5}{6}=\frac{1}{6}$

Pipe A can fill $\frac{1}{4}$ of the cistern in 1 minutes.

Pipe A can fill $\frac{1}{6}$ of the cistern in

$$4\times\frac{1}{6}=\frac{2}{3}\text{ minutes}$$

Total time taken to fill the cistern

$$4\frac{2}{3}=\frac{14}{3}\text{ min}$$

Or, 4 minutes 40 seconds.

9. Ans. (a)

Part filled in 1 minute $=\frac{1}{20}-\frac{1}{25}=\frac{1}{100}$

Part filled in 6 minutes $=\frac{6}{100}\times1=\frac{3}{50}$

Unfilled part $= 1 - \frac{9}{20} = \frac{11}{20}$

This is to be filled by A alone and hence will be filled in $20 \times \frac{11}{20} = 11$ minutes.

10. Ans. (b)

Work done by waste pipe in 1 minute

$$= \left(\frac{1}{12} + \frac{1}{15}\right) - \frac{1}{20} = \left(\frac{3}{20} - \frac{1}{20}\right) = \frac{1}{10}$$

∴ Waste pipe can empty the cistern in 10 minutes.

❑❑❑

Pipes & Cisterns

17 Practice Exercise: 1

1. Two pipes can fill a tank in 10 hours 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 the tank will be filled?
(a) 7 hrs (b) 8 hrs
(c) 7 hrs 30 min (d) 8 hrs 30 min

2. An electric pump can fill a tank in 3 hours. Because of a leak in the tank it took $3\frac{1}{2}$ hours to fill the tank. The leak can drain out all the water of the tank in
(a) 10.50 hrs (b) 12 hrs
(c) 21 hrs (d) 24 hrs

3. If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours does it take the second pipe to fill the reservoir?
(a) 25 hrs (b) 28 hrs
(c) 30 hrs (d) 35 hrs

4. 12 buckets of water fill a tank when the capacity of each bucket is 13.5 litres. How many buckets will be needed to fill the same tank, if the capacity of each bucket is 9 litres?
(a) 8 (b) 16
(c) 18 (d) 15

5. Bucket P has thrice the capacity as bucket Q. It takes 60 turns for bucket P to fill the empty drum. How many turns it will take for both the buckets P and Q, having each turn together to fill the empty drum?
(a) 30 (b) 40
(c) 45 (d) 90

6. Two pipes A and B can fill a tank in [illegible] minutes respectively. [illegible] A and B [illegible] at the beginning and then C [illegible]
(a) [illegible] min (b) 30 min
(c) $30\frac{1}{2}$ min (d) [illegible] min

7. Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is
(a) 10 (b) 12
(c) 14 (d) 16

8. A leak in the bottom of a tank can empty the full tank in 6 hours. An inlet pipe fills water at the rate of 4 litres a minute. When the tank is full, the inlet is opened and due to the leak, the tank is empty in 8 hours. How many litres does the cistern hold?
(a) 7580 (b) 7960
(c) 8290 (d) 8640

9. A cistern has two taps which fill it in 12 min and 15 min respectively. There is also a waste pipe in the cistern. When all the three are opened, the empty cistern is full in 20 minutes. How long will the waste pipe take to empty the full cistern?
(a) 10 min (b) [illegible]
(c) [illegible] min (d) [illegible]

10. Two pipes A and B can fill a tank in 12 min and 16 min respectively. [illegible] A and B [illegible] fill the tank [illegible] minutes?
(a) $6\frac{1}{2}$ min (b) [illegible]
(c) $4\frac{1}{2}$ min (d) $4\frac{1}{4}$ min

❑❑❑

Solutions

1. Ans. (c)

[illegible]

$$\left(\frac{1}{[illegible]}+\frac{[illegible]}{[illegible]}-\frac{1}{[illegible]}\right)=\frac{6}{[illegible]}=\frac{2}{[illegible]}$$

∴ [illegible] hrs

= [illegible]

2. Ans. [illegible]

Work done by [illegible]

$$=\left(\frac{1}{[illegible]}-\frac{[illegible]}{[illegible]}\right)=\frac{1}{21}$$

∴ [illegible] 21 [illegible]

3. Ans. (c)

[illegible] first [illegible]

[illegible] (x + 10) [illegible]

$$\frac{1}{x}+\frac{1}{x+10}=\frac{1}{[illegible]}\Rightarrow\frac{x+10+x}{[illegible]}=[illegible]$$

$\Rightarrow x^2 - [illegible]x - 120 = 0$

⇒ [illegible] ⇒ x = [illegible]

∴ [illegible]

4. Ans. (d)

Capacity of the tank = (12 [illegible]) [illegible]

= 162 [illegible]

[illegible]

[illegible] $=\left(\frac{162}{[illegible]}\right)=$ [illegible]

5. Ans. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

$$=\frac{[illegible]}{[illegible]}=\left([illegible]\right)=15$$

6. Ans. (d)

[illegible]

$$=[illegible]\left(\frac{1}{[illegible]}\right)=\left([illegible]\right)=\frac{3}{[illegible]}$$

[illegible]

$$=\frac{1}{[illegible]}\left(\frac{1}{12}+\frac{1}{[illegible]}\right)=\left(\frac{1}{[illegible]}\right)=\frac{1}{[illegible]}$$

Now $\frac{[illegible]}{60}$ [illegible]

∴ [illegible] $\left(30\times\frac{3}{4}\right)$

= [illegible]

7. Ans. [illegible]

[illegible] $=\frac{[illegible]}{[illegible]}=\frac{1}{[illegible]}$

[illegible] $=\left(1-\frac{1}{[illegible]}\right)=\frac{[illegible]}{[illegible]}$

∴ [illegible]

∴ [illegible]

∴ [illegible]

= [illegible] (A + B) [illegible]

$$[illegible]=\left(\frac{1}{[illegible]}-\frac{[illegible]}{[illegible]}\right)=\frac{[illegible]}{12}$$

∴ [illegible] 14 [illegible]

8. Ans. [illegible]

Work done by [illegible]

$$\left(\frac{[illegible]}{[illegible]}-\frac{1}{[illegible]}\right)=\frac{[illegible]}{[illegible]}$$

Work done by [illegible]

$$=\left(\frac{1}{[illegible]}+\frac{[illegible]}{[illegible]}\right)=\frac{1}{[illegible]}$$

∴ [illegible]

∴ [illegible]

= [illegible]

9. Ans. (b)

Work done [illegible]

$$[illegible]\left(\frac{1}{[illegible]}-\frac{1}{[illegible]}\right)=\frac{1}{[illegible]}$$

[illegible]

∴ [illegible]

10. Ans. [illegible]

[illegible]

[illegible] (A + B) [illegible]

[illegible]

$$[illegible]\left(\frac{1}{[illegible]}\right)=\frac{1}{[illegible]}$$

[illegible]

[illegible]

[illegible]

1.8
CHAPTER

Time, Speed & Distance

Time, Speed & Distance is a very important chapter to understand. [illegible] speed, distance [illegible] question [illegible] problem [illegible].

In this chapter we will study:

- Relative speed
- Average speed
- Races
- Circular races
- Applications [illegible]

Time, distance and speed are related as:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

The units of speed & distance have to be kept same. If speed has to be converted we can use:

$$1 \text{ km/hr} = \frac{5}{18} \text{ m/s}$$

$$\text{or} \quad 1 \text{ m/s} = \frac{18}{5} \text{ km/hr}$$

Example 1

A train covers 200 m at the speed 72 km/hr. Find the time taken to travel the distance.

Solution

$$\text{Train speed} = 72 \text{ km/hr} = 72 \times \frac{5}{18} = 20 \text{ m/s}$$

$$\text{Time} = \frac{200}{20} = 10 \text{ sec.}$$

Average Speed

In calculating the average speed the first thing that has to be wiped out from the mind is that the average speed is not the average value of different speeds. It is [illegible] of total time taken [illegible] speed [illegible] distance.

$$\text{Average speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

Example 2

A car covers first 400 meters with the speed 72 km/hr and next 300 meters with the speed 36 km/hr. Find the average speed of the car.

Solution

Time taken to cover first 400 m

$$400 \text{ m} = \frac{400}{72 \times \frac{5}{18}} = 20 \text{ s}$$

Time taken to cover next 300 m

$$300 \text{ m} = \frac{300}{36 \times \frac{5}{18}} = 30 \text{ s}$$

Total time = 50 s

Total distance = 700 m

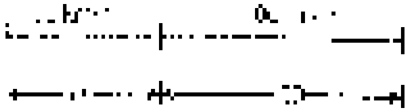
$$\text{Average speed} = \frac{700}{50} = 14 \text{ m/s}$$

Where equal distances are covered with different uniform speeds, the value of distance does not matter while calculating the average speed.

Example 3

A man covers a distance with the speed 40 km/hr and then travels double of the previous distance with the speed 60 km/hr. Find the average speed.

Solution



$$\text{Time taken for first distance} = \frac{D}{40}$$

$$\text{Time taken for second distance} = \frac{2D}{60} = \frac{D}{30}$$

Total distance = D + 2D = 3D

∴ Average speed = [illegible]

[illegible] km/hr

Relative Speed

[illegible]

- [illegible]
  - [illegible]
  - [illegible]
- [illegible]
  - [illegible]
  - [illegible]
  - [illegible]

[illegible]

Problems on Trains

[illegible]

[illegible]

[illegible]

Example 1

[illegible]

Solution

Here L = 200 m [illegible]

[illegible]

Rivers & Boats

[illegible]

- [illegible]
- [illegible]

[illegible]

Example [illegible]

[illegible]

Solution

[illegible]

$u_B = 20$ [illegible]

Circular Tracks

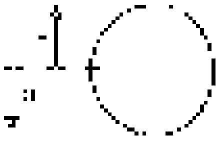
[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

Case 1

[illegible]



[illegible]

$$T_A = \text{LCM of } \left\{\frac{D}{a}, \frac{D}{b}\right\}$$

$$n = \frac{T_A}{T_1}$$

Case 2.

When the [illegible] are moving in opposite direction then

$$T_A = \text{LCM of } \left\{\frac{D}{[illegible]}, \frac{D}{[illegible]}, \ldots\right\}$$

$$T_A = \text{LCM of } \left\{\frac{D}{a}, \frac{D}{b}, \ldots\right\}$$

$$n = \frac{T_A}{[illegible]}$$

Example 3.

Two persons [illegible] running on a circular track with speed [illegible] & 30 m/s in opposite direction [illegible] of the track is 100 m [illegible] find [illegible] how many times [illegible] they will meet.

Solution

For opposite direction $T_1 = \frac{100}{20+30} = 2$ s

$$T_A = \text{LCM of } \left(\frac{100}{20}, \frac{100}{30}\right) = \frac{100}{[illegible]} = 10 \text{ s}$$

So $n = \frac{T_A}{T_1} = \frac{10}{2} = 5$

Application of variation

[illegible] different [illegible] of [illegible] in TSD

- When distance [illegible] constant

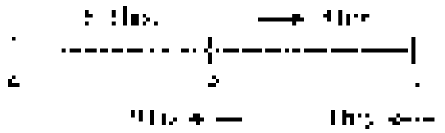
$$\text{Speed} \propto \frac{1}{\text{Time}} \text{ (Inverse variation)}$$

An inverse variation [illegible] speed becomes [illegible] of previous speed then time [illegible] of previous time.

Example 4.

Two trains start [illegible] at [illegible] towards each other [illegible] at same time [illegible] point P [illegible] both trains take [illegible] & [illegible] to reach their destination. Find out the ratio of their speeds.

Solution



[illegible] meet at P then

$$\text{The ratio of speeds} = \frac{[illegible]}{[illegible]}$$

$$\frac{A}{B} = \frac{1}{[illegible]} \qquad (i)$$

Similarly for [illegible]

$$\frac{A}{B} = \frac{[illegible]}{[illegible]} \qquad (ii)$$

[illegible]

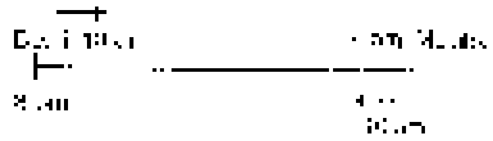
$$\frac{[illegible]}{[illegible]} = [illegible]$$

$$\text{So } \frac{A}{B} = \frac{[illegible]}{[illegible]} = \frac{3}{2}$$

Example 5

Two trains start from Delhi & Mumbai towards each other [illegible] & [illegible] [illegible] they reach their destination at same [illegible] & [illegible] respectively. Find out at what time they cross each other.

Solution



So, Time taken by Delhi [illegible] hrs

Time taken by Mumbai [illegible] hrs

So speed ratio $\frac{D}{M} = \frac{[illegible]}{[illegible]}$ (inverse variation)

$$= \frac{[illegible]}{[illegible]}$$

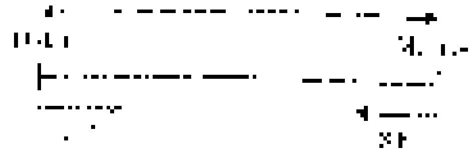
Let speed of D = 2k

M = 3k

The distance between Delhi & Mumbai

= [illegible] × 8 = [illegible] Km

or [illegible] = 24 Km



We take the product of two speeds [illegible] 30 km/h [illegible] moving towards each other

So time taken to meet = $\frac{30 \times [illegible]}{[illegible] + 3[illegible]} = \frac{[illegible]}{1}$ hrs

= 2 hr, 4 min

So they meet at [illegible]

Races

In races there are basically two concepts which are generally carried out.

- Comparison of distance & speed.
- Comparison of speed & time.

Let us see some examples.

Example 1.

In a 100 meter race A beats B by 20 m & B beats C by 20 m. Find by how much does A beat C.

Solution

A beats B by 20 m ⇒

when A covers 100 m, B covers 80 m, so ratio of speeds of A : B = 10 : 8

So ratio of speeds A : B = 5 : 4

Similarly B : C = 5 : 4

So A : C = 25 : 16

So when A covers 25 m, C covers 16 m, [illegible]

So when A will cover 100 m, C will cover 16 × 4 = 64 m

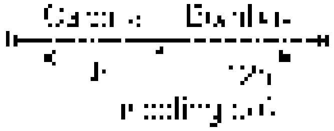
So A beats C by 36 metres.

□□□□

Solved Example

1. Walking at 3/4 of his normal speed, Abhishek is 16 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is
(a) 48 minutes (b) 60 minutes
(c) 42 minutes (d) 62 minutes
Ans. (a)
Speed × Time = Distance
S × T = D
New S′ = $\frac{3}{4}$ S, so T′ must be $\frac{4}{3}$ T to keep D constant
i.e. $\frac{3}{4}S \times \frac{4}{3}T = D$
Now $\frac{4}{3}T - T = 16$
So $\frac{1}{3}T = 16 \Rightarrow T = 48$

2. Two trains, Calcutta Mail and Bombay Mail, start at the same time from stations Calcutta and Bombay respectively towards each other. After passing each other, they take 12 hours and 3 hours to reach Bombay and Calcutta respectively. If the Calcutta Mail is moving at the speed of 48 km/h, the speed of the Bombay Mail is
(a) 24 km/h (b) 22 km/h
(c) 36 km/h (d) 96 km/h
Ans. (d)



In this case $\frac{S_1}{S_2} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$

$\frac{48}{S_2} = \frac{\sqrt{3}}{\sqrt{12}} = \frac{1}{2}$ ⇒ $S_2 = 96$ km/h

3. Rajdhani Express travels [illegible] km in [illegible] h and another [illegible] km in [illegible] h. What is the average speed of train?
(a) 1590 km/h (b) 80 km/h
(c) 130 km/h (d) 134 km/h
Ans. (d)
Average speed = $\frac{\text{Total Distance Travelled}}{\text{Total Time Taken}}$
$= \frac{[illegible] + [illegible]}{[illegible]} = [illegible]$ km/h

4. A man travels from A to B at a speed of v_1 km/h and returns from B to A at a speed of v_2 km/h. His average speed of the journey is
(a) $\frac{2v_1v_2}{v_1 + 2v_2}$ (b) $\frac{2v_1v_2}{v_1 + v_2}$
(c) $\frac{v_1v_2}{v_2 + 2v_1}$ (d) $\frac{2v_1v_2}{v_1 + 2v_2}$

Ans. (b)

Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

$$= \frac{2D}{\frac{D}{V_1}+\frac{D}{V_2}} = \frac{2}{\frac{1}{V_1}+\frac{1}{V_2}} = \frac{2V_1V_2}{V_1+V_2}$$

5. Ravi, by walking at a speed of 25 km/h reaches his college 10 minutes late. Next time he increases his speed by 5 km/h but finds that he is still late by 4 minutes. What is the distance of his college from his house?
(a) 15 km (b) 8 km
(c) 12 km (d) None of these
Ans. (a)
Let distance be D km

$$\frac{D}{25} = t + \frac{10}{60} \quad \ldots(i)$$

$$\text{Also } \frac{D}{30} = t + \frac{4}{60} \quad \ldots(ii)$$

From (i) and (ii) we get

$$D \times \frac{1}{150} = \frac{1}{10}$$

$$D = \frac{150}{10} = 15 \text{ km}$$

6. A motorcar does a journey in 17.5 hours, covering the first half at 30 km/h and the second half at 40 km/h. Find the distance of the journey.
(a) 650 km (b) 600 km
(c) 1200 km (d) 575 km
Ans. (b)
Hint: Total time = 17.5 hours
let total Distance be 2D km

$$\text{then } \frac{D}{30}+\frac{D}{40} = 17.5$$

$$D\left[\frac{1}{30}+\frac{1}{40}\right] = 17.5$$

$$D \times \frac{7}{120} = 17.5$$

$$D = \frac{17.5 \times 120}{7}$$

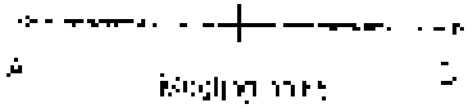
D = 300 km
Total Distance = 2D = 600 km

7. Manish travels a certain distance by car at the rate of 12 km/h and walks back at the rate of 3 km/h. The whole journey took 5 hours. What is the distance he covered on the car?
(a) 12 km (b) 30 km
(c) 15 km (d) 8 km
Ans. (a)
Let distance be D km

$$\frac{D}{12}+\frac{D}{3} = 5 \qquad \therefore D\left(\frac{1}{12}+\frac{1}{3}\right) = 5$$

$$D = \frac{5 \times 12}{5} = 12 \text{ km}$$

8. Two trains A and B start simultaneously in the opposite direction from two points A and B and arrive at their destinations 9 and 4 hours respectively after their meeting each other. At what rate does the second train B travel if the first train travels at 80 km per hour?
(a) 60 km/h (b) 100 km/h
(c) 120 km/h (d) None of these
Ans. (c)



$$\text{Here } \frac{S_A}{S_B} = \frac{\sqrt{t_B}}{\sqrt{t_A}}$$

$$\frac{80}{S_B} = \frac{\sqrt{4}}{\sqrt{9}} \qquad \frac{80}{S_B} = \frac{2}{3}$$

S_B = 120 km/hour

9. A journey of 192 km takes 2 hours less by a fast train than by a slow train. If the average speed of the slow train be 16 km/h less than that of fast train, what is the average speed of the faster train?
(a) 32 km/h (b) 16 km/h
(c) 12.8 km/h (d) 48 km/h
Ans. (d)
Let speed of fast train be S km/h then

$$\frac{192}{S-16} - \frac{192}{S} = 2 \quad \ldots(i)$$

This type of question can be directly solved by going through option.
Here using equation (i) and putting options
we get S = 48 km/hour

10. A passenger train takes 2 hours less for a journey of [illegible] km if its speed is increased by 5 km/h over its usual speed. Find the usual speed.

(a) 12 kmph (c) 15 kmph
(b) 20 kmph (d) 25 kmph
Ans. (d)

$$\frac{300}{S} - \frac{300}{S+5} = 2 \qquad \ldots(i)$$

Using the options for speed and using equation (i) we get
S = 25 km/hour

11. A plane left 30 minutes later than the scheduled time and in order to reach its destination 1500 kilometres away in time, it had to increase its speed by 250 km/hr from its usual speed. Find its usual speed.
(a) 250 km/hr (b) 1000 km/hr
(c) 750 km/hr (d) None of these
Ans. (c)

30 mins = $\frac{1}{2}$ hr, usual speed

$$\frac{D}{S} - \frac{D}{S+\frac{1}{3}S} = \frac{1}{2}$$

$$\frac{1500}{(4S/3)} - \frac{1125}{S} = \frac{1}{2} \qquad \ldots(i)$$

Going through options and (i) we get,
S = 750 km/hour

12. A car travels 1/3 of the distance on a straight road with a velocity of 10 km/h, the next 1/3 with a velocity of 20 km/h and the last 1/3 with a velocity of 60 km/h. What is the average velocity of the car for the whole journey?
(a) 18 km/h (b) 10 km/h
(c) 20 km/h (d) 35 km/h
Ans. (a)

$$\text{Average speed} = \frac{\text{Distance covered}}{\text{Time taken}}$$

$$= \frac{D}{\frac{D}{3}\times\frac{1}{10}+\frac{D}{3}\times\frac{1}{20}+\frac{D}{3}\times\frac{1}{60}} = \frac{3}{\frac{1}{10}+\frac{1}{20}+\frac{1}{60}}$$

= 18 km/hour

13. Walking at 3/4 of his usual speed, a man is 16 minutes late for his office. The usual time taken by him to cover that distance is
(a) 48 minutes (b) 60 minutes
(c) 42 minutes (d) 62 minutes
Ans. (a)

S × T = Distance (constant)

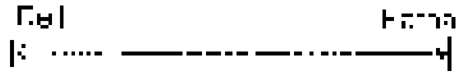
$$\frac{3}{4}S \times \frac{4}{3}T = D$$

Time has become $\frac{4}{3}$.

Now $\frac{1}{3}T = 16$ minutes

T = 48 minutes

14. Two trains for Bombay leave Delhi at 6 am and 6:45 am and travel at 98 km/h and 136 km/h respectively. How many kilometres from Delhi will the two trains meet?
(a) 262.4 km (b) 260 km
(c) 200 km (d) None of these
Ans. (a)



Distance travelled by 1st train in 45 minutes

$$= 98 \times \frac{45}{60} = 73.5 \text{ km} = \frac{147}{2} \text{ km}$$

Relative speed = $S_2 - S_1$ = 136 − 98 = 38 km/h

Time taken to cover 73.5 km is

$$\frac{73.5}{38} = \frac{147}{2\times38} = \frac{147}{76} \text{ hour}$$

$$\text{Distance} = \frac{147}{76} \times 98 = 188.55$$

Total distance = 73.5 + 188.55
= 262 km approx.

15. A motorboat went downstream for 28 km and immediately returned. It took the boat twice as long to make the return trip. If the speed of the river flow were twice as high, the trip downstream and back would take 672 minutes. Find the speed of the boat in still water and the speed of the river flow.
(a) 9 km/h, 3 km/h (b) 9 km/h, 6 km/h
(c) 8 km/h, 2 km/h (d) 12 km/h, 3 km/h
Ans. (a)
Let speed of boat be S_1
Speed of stream = S_2

$$\text{Then } \frac{28}{S_1 - S_2} = 2 \times \frac{28}{S_1 + S_2}$$

$$\text{Also } \frac{28}{S_2 + S_1} + \frac{28}{S_1 - 2S_2} = 672 \text{ minutes}$$

Solving above two equations

S_b = [illegible] km

S_s = 5 km

16. A train requires 7 seconds to pass a pole while it requires 25 seconds to cross a stationary train which is 378 metres long. Find the speed of the train.
(a) 75.6 km/h
(b) 75.4 km/h
(c) 76.2 km/h
(d) 21 km/h

Ans. (a)

To cross a pole:

$$t = \frac{L}{S_T} = \frac{\text{Length of train}}{\text{Speed of train}}$$

$$7 = \frac{L}{S_T} \quad \ldots(i)$$

Also, to cross a stationary train, $t = \frac{L + 378}{S_T}$

L = length of stationary train

$$25 = \frac{L + 378}{S_T} \quad \ldots(ii)$$

From (i) and (ii)

$L = 7S_T$

$25\,S_T = 7\,S_T + 378$

$18\,S_T = 378$

$$S_T = 21 \text{ m/s} = 21 \times \frac{18}{5} = 75.6 \text{ km/h}$$

17. A boat goes downstream for 10 km and then upstream for 6 km. The speed of the river flow is 1 km/h. What should be the minimum speed of the boat for the trip to be completed in a maximum of 4 hours?
(a) 2 km/h
(b) 3 km/h
(c) 4 km/h
(d) 5 km/h

Ans. (c)

$$\frac{D}{S_B + S_R} + \frac{D}{S_B - S_R} = 4 \text{ hour}$$

$$\frac{10}{S_B + 1} + \frac{6}{S_B - 1} = 4 \text{ hour} \quad \ldots(i)$$

Solving by option method, we get

$S_B = 4$ km/hour

18. Two trains are running on parallel lines in the same direction at speeds of 40 km/h and 20 km/h respectively. The faster train crosses a man in the slower train in 36 seconds. The length of the faster train is
(a) 200 metres
(b) [illegible] metres
(c) 22[illegible] metres
(d) 2[illegible] metres

Ans. (a)

L = [illegible]

$$\frac{L_F}{S_F - S_S} = t \quad \ldots(i)$$

$$S_F - S_S = 40 - 20 = 20 \text{ km/h}$$

$$= 20 \times \frac{5}{18} = \frac{50}{9} \text{ m/s}$$

$$\text{Now, } t = \frac{L_F}{50/9} \Rightarrow 36 = \frac{L_F}{50/9}$$

So, $L_F = 200$ m

19. The speed of the boat in still water is 15 km/h and speed of the stream is 5 km/h. A distance of 8 km going upstream, is covered in
(a) 1 h
(b) 1 h 15 min
(c) 1 h 12 min
(d) None of these

Ans. (d)

$$t = \frac{D}{S_B - S_S} \text{ (upstream)}$$

$$= \frac{8}{15 - 5} = \frac{8}{10} = \frac{4}{5} \text{ (h} = 48 \text{ min)}$$

20. A boat goes 15 km upstream in 80 minutes. The speed of the stream is 5 km/h. The speed of the boat in still water is
(a) 16.25 km/h
(b) [illegible] km/h
(c) [illegible] km/h
(d) 1[illegible] km/h

Ans. (a)

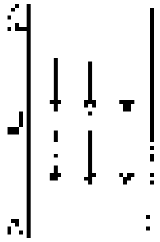
$$t = \frac{D}{S_B - S_S} \text{ (upstream)}$$

$$\frac{80}{60} = \frac{15}{S_B - 5} \Rightarrow \frac{4}{3} = \frac{15}{S_B - 5}$$

$S_B = 16.25$ km/h

21. The distance between A and C is [illegible], B lies between A and C. A boat can go from A to B and back in 6 h 30 minutes, while it goes from A to C in 9 h. How long would it take to go from C to A?
(a) 3.75 h
(b) 4 h
(c) 4.25 h
(d) [illegible] h

Ans. (b)



Let AB = L km then

BC = 7 km

AC = 20 km

$$\frac{D}{S_A+S_B}+\frac{[illegible]}{S_A+S_B}=\frac{[illegible]}{[illegible]} \quad ...(i)$$

$$\frac{[illegible]}{S_A-S_B}=8 \quad ...(ii)$$

So $\frac{L}{S_A-S_B}=\frac{9}{2}$ ...(iii)

from (i) and (iii) we get,

$$\frac{[illegible]}{2}\frac{D}{S_A+S_B}=\frac{[illegible]}{[illegible]}$$

$$\frac{D}{S_A+S_B}=[illegible]$$

[illegible] minutes

$$\frac{20}{S_A+S_B}=[illegible]$$

22. Two trains are travelling in the same direction at 50 km/h and 40 km/h respectively. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.

(a) 0.1 km (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

$$T=\frac{L}{S_A-S_B}$$

RS = 50 − 40 = 10 km/hr = [illegible]

$$[illegible]=\frac{L}{[illegible]} \Rightarrow [illegible]$$

23. Without stoppages a train travels certain distance with an average speed of 75 km/h and with stoppages it covers the same distance with an average speed of 60 km/h. How many minutes per hour does the train stop?

(a) 10 minutes (b) 12 minutes

(c) 14 minutes (d) 15 minutes

Ans. (b)

Speed of train [illegible] 75 km/h and 60 km/h [illegible] of 30 [illegible] 60 [illegible] stoppage [illegible]

stoppage [illegible] $\frac{[illegible]}{[illegible]}$ = [illegible]

So stoppage = 12 minutes

24. A man rows [illegible] km up the stream and [illegible] km down stream [illegible] 5 hours each time. The velocity of the current is

(a) 1 km/h (b) 1.5 km/h

(c) [illegible] (d) [illegible]

Ans. (b)

$$\frac{[illegible]}{S_B-S_C}=[illegible]$$

$$\frac{[illegible]}{S_B-S_C}=5 \text{ hour}$$

15 = 5S_B − 5S_C ...(i)

30 = 5S_B + 5S_C ...(ii)

15 = 10 S_C

S_C = 1.5 km/hr

25. A man can row 30 km upstream and 44 km downstream in 10 hours. It is also known that he can row 40 km upstream and 55 km downstream in 13 hours. Find the speed of the man in still water.

(a) 4 km/h (b) 6 km/h

(c) 8 km/h (d) [illegible] km/h

Ans. (c)

$$\frac{30}{S_B-S_S}+\frac{44}{S_B+S_S}=10 \text{ hr}$$

$$\frac{40}{S_B-S_S}+\frac{55}{S_B+S_S}=13$$

Let $S_B - S_S$ [illegible] and $S_B + S_S = y$

Then

30x + 44y = 10 ...(i)

40x + 55y = 13 ...(ii)

By solving, we get

S_B = 8 km/h

26. In a stream that is running at 2 km/h, a man goes 10 km upstream and comes back to the starting point in 55 minutes. Find the speed of the man in still water.
(a) 20 km/h (b) 22 km/h
(c) 24 km/h (d) 28 km/h
Ans.(b)

$$\frac{10}{S_M-2}+\frac{10}{S_M+2}=\frac{55}{60}=\frac{11}{12} \quad \ldots(i)$$

On solving eq. (i) we get,
$S_M = 22$ km/h

27. A motorboat went downstream for 14 km and then upstream for 9 km. It took a total of 5 hours for the entire journey. Find the speed of the river flow if the speed of the boat in still water is 5 km/h.
(a) 1 km/h (b) 1.5 km/h
(c) 2 km/h (d) 3 km/h
Ans.(c)

$$\frac{14}{S_B+S_R}+\frac{9}{S_B-S_R}=5$$

$$\frac{14}{5+S_R}+\frac{9}{5-S_R}=5$$

Using [illegible] options we get,
$S_R = 2$ km/h

28. A motorboat, whose speed in still water is 10 km/h, went 91 km downstream and then returned to its starting point. Calculate the speed of the river flow if the round trip took a total of 20 hours.
(a) 3 km/h (b) 4 km/h
(c) 2 km/h (d) 6 km/h
Ans.(a)

$$\frac{91}{S_B+S_R}+\frac{91}{S_B-S_R}=20$$

$$\frac{91}{10+S_R}+\frac{91}{10-S_R}=20$$

$S_R = 3$ km/h

Time, Speed & Distance

1 Practice Exercise: I

1. A train passes a railway bridge 1 km long in [illegible] seconds. If the train is running at a speed of [illegible] km/h, the length of the train in metres is
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

2. Sound travels at 330 metres a second. [illegible] seconds. [illegible] distance of
(a) [illegible] km (b) [illegible] km
(c) [illegible] km (d) None of these

3. The [illegible] is $3\frac{3}{4}$ [illegible] seconds [illegible]. The speed of the train is
(a) [illegible] km/h (b) [illegible] km/h
(c) [illegible] km/h (d) None of these

4. On a journey a man travels at the rate of [illegible] km per hour for the first 100 km. Then he travels the next 150 km at the rate of [illegible] km an hour. The average speed in km per hour for the first 250 km of journey is
(a) [illegible] km/h (b) [illegible] km/h
(c) [illegible] km/h (d) None of these

5. Rakesh travels [illegible] Both of them start at the same time [illegible] from Meerut to Delhi. After [illegible] they complete their journey in [illegible] hours, respectively. At what speed does Suresh travel if Rakesh cycles at [illegible]?
(a) [illegible] km/h (b) [illegible] km/h
(c) [illegible] km/h (d) None of these

6. A car completes a journey [illegible] at a speed of [illegible] km/h, and [illegible] hours at a speed of 70 km/h. The average speed of the car is
(a) 63 km/h (b) 65 km/h
(c) [illegible] km/h (d) None of these

7. By walking at $\frac{3}{4}$ of his usual speed, a man reaches [illegible]

(a) 35 minutes (b) 31 minutes
(c) 30 minutes (d) None of these

8. A car starts from A for B travelling 20 km an hour. $1\frac{1}{2}$ hours later another car starts from A and travelling at the rate of 30 km an hour reaches B $2\frac{1}{2}$ hours before the first. Find the distance from A to B.
(a) 250 km (b) 260 km
(c) 240 km (d) None of these

9. A train does a journey without stopping in 8 hours, if it had travelled 5 km an hour faster, it would have done the journey in 6 hours 40 min. What is its slower speed?
(a) 25 km/hr (b) 30 km/hr
(c) 40 km/hr (d) None of these

10. Without any stoppage a person travels a certain distance at an average speed of 42 km/hr and with stoppages he covers the same distance at an average speed of 28 km/hr. How many minutes per hour does he stop?
(a) 24 minutes (b) 30 minutes
(c) 20 minutes (d) None of these

11. A train 300 metres long is running at a speed of 90 km/hr. How many seconds will it take to pass a 240 metres long train running in the same direction at a speed of 60 km/hr?
(a) 70 sec (b) 8 sec
(c) 12 sec (d) None of these

12. Two trains are running in opposite directions with the same speed. If the length of each train is 135 metres and they cross each other in 18 seconds, the speed of each train is
(a) 23 km/hr (b) 30 km/hr
(c) 27 km/hr (d) None of these

13. Two trains are moving in the same direction at 50 km/hr and 30 km/hr. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.
(a) 120 m (b) 110 m
(c) 100 m (d) None of these

14. Two trains 130 m and 150 m long are moving in the same direction. The faster train takes one minute to pass the other completely. If they are moving in opposite direction, they pass each other completely in 3 seconds. Find the speed of each train.
(a) 42 m/sec, 38 m/sec
(b) 50 m/sec, 44 m/sec
(c) 48 m/sec, 42 m/sec
(d) None of these

15. Two stations A and B are 110 km apart on a straight line. One train starts from A at 7 A.M. and travels towards B at 20 km/h speed. Another train starts from B at 8 A.M. and travels towards A at 25 km/h speed. At what time will they meet?
(a) 10.30 A.M. (b) 11 A.M.
(c) 10 A.M. (d) None of these

16. Two trains start at the same time from Mumbai and Pune and proceed towards each other at the rate of 60 km and 40 km per hour respectively. When they meet, it is found that one train has travelled 20 km more than the other. Find the distance between Mumbai and Pune.
(a) 150 km (b) 100 km
(c) 120 km (d) None of these

17. A and B are two stations. A train goes from A to B at 64 km/hr and returns to A at a slower speed. If its average speed for the whole journey is 56 km/hr, at what speed did it return?
(a) 46 km/hr (b) 49.77 km/hr
(c) 50 km/hr (d) 47.42 km/hr

18. [illegible] The length of the train is half that of the bridge. If the train passes the bridge in 2 minutes, the speed of the train is
(a) 45 km/hr (b) 45 km/hr
(c) 27.5 km/hr (d) None of these

19. A motorcyclist goes from Bombay to Pune, a distance of 192 km, at an average speed of 32 km per hour. Another man starts from Bombay by car $2\frac{1}{2}$ hours after the first and reaches Pune half an hour earlier. What is the ratio of the speed of the motorcycle and the car?
(a) 1 : 2 (b) 1 : 3
(c) 10 : 27 (d) 5 : 4

20. A man covers a distance of 12 km in 42 minutes. If he covers $\frac{3}{4}$ of the distance in $\frac{2}{3}$ of time,

what should be his speed to cover the remaining distance in the remaining time?

(a) 36 km/hr (b) [illegible] km/hr

(c) [illegible] km/hr (d) 14 km/hr

21. A train 110 metre in length passes a man walking at the speed of 6 km/hr against it in 6 seconds. The speed of the train in km per hour is

(a) 60 km/hr (b) 48 km/hr

(c) [illegible] km/hr (d) 66 km/hr

❑❑❑❑

Solutions

1. Ans. (b)

Let the length of the train be x m.

∴ Total distance covered by the train = (x + 150) m

Speed of the train = 60 km/h

$$= 60 \times \frac{5}{18} = \frac{50}{3} \text{ m/sec}$$

Since Distance = Speed × time

$$\therefore \quad x + 150 = \frac{50}{3} \times 18 = 300$$

or x = 300 − 150 = 150 m.

∴ Length of the train = 150 m.

2. Ans. (c)

[illegible]

[illegible] = (225 × 10) metres

= 2.25 km

3. Ans. (a)

Distance covered in 2 seconds

$$= \frac{1}{4} \times 4 = 1 \text{ [illegible]}$$

$$\therefore \quad \text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{1}{2} \text{ [illegible]}$$

$$= \left(\frac{1}{2} \times \frac{18}{5}\right) \text{ km/hr} = \text{[illegible] km/hr}$$

4. Ans. (c)

Let the speed of the return journey be x km/h.

$$\text{Then, } 56 = \left(\frac{2x_1x_2}{x_1 + x_2}\right) = \frac{2 \times 64 \times x}{64 + x}$$

∴ [illegible] = [illegible] = [illegible]

$$\therefore \quad x = \frac{448}{9} = 49.78 \text{ km/hr}$$

5. Ans. (a)

$$\frac{\text{Increased speed}}{\text{Original speed}} = \text{[illegible]} = \frac{4}{3}$$

∴ Increased speed = [illegible] × Original speed

= [illegible] km/hr

6. Ans. (a)

Here [illegible]

[illegible]

The average speed is [illegible]

[illegible]

= 60 km/h

7. Ans. (c)

[illegible]

[illegible]

= [illegible] × original time

⇒ Original time = [illegible]

= [illegible] minutes

8. Ans. (c)

Here difference of speed = 40 − 20 = [illegible]

Difference in time = [illegible]

And product of speed = 30 × 20 = 600 [illegible]

Product of speed ÷ difference of speed [illegible] distance covered [illegible]

[illegible] product [illegible] ÷ ([illegible] / diff. of speed) [illegible]

[illegible]

9. Ans. (c)

Let the speed of boat [illegible] = x km/h.

Since the distance travelled [illegible] same [illegible] Therefore

[illegible]

⇒ [illegible]

⇒ [illegible]

∴ x = [illegible] km/h

10. Ans. (c)

Here S₁ = [illegible] km/h, S₂ = [illegible]

∴ Overtaking time = [illegible]

= [illegible] hour = 20 minutes

11. Ans. (b)

Here L₁ = [illegible] m, L₂ = [illegible] m,

S₁ = [illegible] km/h and S₂ = [illegible] km/h

∴ Relative speed = 90 − 60 = [illegible] km/h = [illegible] × $\frac{5}{18}$ m/s

∴ Time taken = $\frac{[illegible]}{S_1 - S_2}$ = [illegible]

= [illegible] = [illegible] sec

12. Ans. (c)

Let the speed of each train be x m/sec

We have L₁ + L₂ = [illegible] m

and S₁ + S₂ = [illegible] m/sec

∴ Time taken [illegible] = [illegible]

⇒ [illegible]

or x = [illegible] m/s

= [illegible] km/hr = [illegible] km/hr

13. Ans. (c)

Relative speed = ([illegible] − [illegible]) km/hr = [illegible] km/hr

= ([illegible] × $\frac{5}{18}$) m/sec

Distance covered in [illegible] at this speed

= ([illegible]) m = [illegible] m

∴ Length of faster train = [illegible] m

14. Ans. (a)

Speed of the [illegible]

= [illegible]

= [illegible] m/sec

Speed of the slower train

[illegible]

= [illegible]

15. Ans. (d)

Time from 7 A.M. to 8 A.M. = 1 hour

Thus the time of their meeting

= [illegible] hr = [illegible] hr

= 2 hrs [illegible]

16. Ans. (b)

Distance between Mumbai and Pune

= [illegible] km

= [illegible] km = [illegible] km

17. Ans. (b)

Let the normal speed be x km/hr

Then [illegible] = [illegible]

∴ $126x = 34 \times 58 \times$ [illegible]

∴ $x = \frac{34 \times [illegible]}{72} = 40.77$ km/hr

18. Ans. (a)

Distance covered in 2 minutes

$= \left(1 + \frac{1}{2}\right)$ km i.e. $\frac{3}{2}$ kms.

Distance covered in 1 hr. $= \left(\frac{3}{2} \times \frac{60}{2}\right)$ km

= 45 km

∴ Speed of the train = 45 km/hr

19. Ans. (a)

Speed of the first man = 32 km/hr

Time taken = [illegible] = 8 hr

Second man covers 32 km in 8 hr

∴ Speed of the second man

= 32 ÷ 8 = 4 km/hr

Ratio = 32 : 8 or 1 : 2

20. Ans. (a)

Distance already covered $= \frac{3}{4} \times 12 = 9$ km

Time spent $= \frac{2}{3} \times 45$ min = 30 min

Distance left = (12 − 9) km = 3 km

Time left = (45 − 30) min = 15 min

∴ Required speed $= \frac{3}{15/60}$ km/hr

= 12 km/hr

21. Ans. (a)

Let the speed of the train in km/hr be x

Then, relative speed = (x + 6) km/hr

$= (x + 6) \times \frac{5}{18}$ m/sec

∴ $(x + 6) \times \frac{5}{18} \times 6 = 110$

∴ x = 60

∴ Speed of the train = 60 km/hr

* * *

Boats & Streams

1 Practice Exercise 1

1. If a man can swim downstream at 6 km/hr and upstream at 2 km/hr, his speed in still water is:
(a) 4 km/hr (b) 2 km/hr
(c) 3 km/hr (d) 2.5 km/hr

2. A man rows [illegible] km upstream and [illegible] km downstream taking [illegible] hours each, then the speed of the stream is:
(a) [illegible] (b) 15 km/hr
(c) 2 km/hr (d) 12 km/hr

3. If a boat goes 7 km upstream in 42 minutes and the speed of the stream is 3 kmph, then the speed of the boat in still water is:
(a) 4.2 km/hr (b) 9 km/hr
(c) 13 km/hr (d) 21 km/hr

4. A man can row $9\frac{1}{3}$ kmph in still water and finds that it takes him thrice as much time to row up than as to row down the same distance in river. The speed of the current is:
(a) $3\frac{1}{3}$ km/hr (b) $3\frac{1}{9}$ km/hr
(c) [illegible]$\frac{2}{3}$ km/hr (d) 14 km/hr

5. A man can row a boat at 10 kmph in still water. If the speed of the stream is 6 kmph, the time taken to row a distance of 80 km down the stream is:
(a) 8 hours (b) 5 hours
(c) 10 hours (d) 20 hours

6. A boat takes 4 hours for travelling downstream from point A to point B and coming back to point A upstream. If the velocity of the stream is 2 kmph and the speed of the boat in still water is 4 kmph, what is the distance between A and B?
(a) 4 km (b) 6 km
(c) 3 km (d) 9 km

7. Speed of a boat in standing water is 9 kmph and the speed of the stream is 1.5 kmph. A man rows to a place at a distance of 105 km and comes back to the starting point. The total time taken by him is:

(a) 16 hours (b) 18 hours
(c) 20 hours (d) 24 hours

8. A man rows to a place 48 km distant and come back in 14 hours. He finds that he can row 4 km with the stream in the same time as 3 km against the stream. The rate of the stream is
(a) 1 km/hr (b) 1.8 km/hr
(c) 3.5 km/hr (d) 1.5 km/hr

9. A man can row three-quarters of a kilometre against the stream in $11\frac{1}{4}$ minutes and return in $7\frac{1}{2}$ minutes. The speed of the man in still water is:
(a) 2 km/hr (b) 3 km/hr
(c) 4 km/hr (d) 5 km/hr

10. A man can row 5 km/hr in still water. If the river is running at 1 km/hr, it takes him 75 minutes to row to a place and back. How far is the place?
(a) 3 km (b) 2.5 km
(c) 4 km (d) 5 km

* * *

Solutions

1. Ans. (c)

Speed in still water $= \frac{1}{2}(6 + 2)$ km/hr
$= 4$ km/hr

2. Ans. (a)

Rate upstream $= \left(\frac{[illegible]}{[illegible]}\right)$ km/hr $= 5$ km/hr

Rate downstream $= \left(\frac{[illegible]}{[illegible]}\right)$ km/hr $= [illegible]$ km/hr

∴ Speed of stream $= \frac{1}{2}([illegible])$ km/hr
$= [illegible]$ km/hr

3. Ans. (d)

Rate upstream $= \left(\frac{7}{42} \times 60\right)$ km/hr $= 10$ km/hr

Speed of stream = 3 km/hr

Let speed in still water be x km/hr.

Then speed upstream $= (x - 3)$ km/hr

∴ $x - 3 = 10$ or $x = 13$ km/hr

4. Ans. (b)

Let speed upstream be x km/hr.

Then speed downstream = 3x km/hr

∴ Speed in still water $= \frac{1}{2}(3x + x)$ km/hr
$= 2x$ km/hr

∴ $2x = \frac{28}{3} \Rightarrow x = \frac{14}{3}$

∴ Speed upstream $= \frac{14}{3}$ km/hr,

Speed downstream = 14 km/hr

∴ Speed of the current

$= \frac{1}{2}\left(14 - \frac{14}{3}\right)$ km/hr

$= \frac{14}{3}$ km/hr $= 4\frac{2}{3}$ km/hr

5. Ans. (c)

Speed downstream $= (13 + 5)$ km/hr
$= 18$ km/hr

Time taken to travel 90 km downstream

$= \left(\frac{90}{18}\right)$ hrs $= 5$ hrs.

6. Ans. (c)

Let the distance between A and B be x km.

Speed downstream = [illegible] km/hr

Speed upstream = [illegible] km/hr

∴ Distance A B = [illegible] km

7. Ans. (d)

Speed upstream = 7.5 km/hr

Speed downstream = 10.5 km/hr

∴ Total time taken $= \left(\frac{105}{7.5} + \frac{105}{10.5}\right)$ hrs
$= 24$ hours

8. Ans. (a)

Suppose the man can row 4 km downstream in x hours.

Then, speed downstream $= \left(\frac{4}{x}\right)$ km/hr and speed

upstream $= \left(\frac{3}{x}\right)$ km/hr

$\therefore \frac{48}{(8+x)} + \frac{48}{(8-x)} = 14 \Rightarrow x = \frac{1}{2}$ [illegible]

∴ Speed downstream = 8 km/hr.
Speed upstream = 6 km/hr

Rate of the stream $= \frac{1}{2}(8 - 6)$ km/hr

= 1 km/hr

8. Ans. (d)

Speed downstream = [illegible] km/hr

= [illegible] km/hr

Speed upstream = $\left(\frac{?}{4} \times \frac{2}{15} \times 60\right)$ km/hr

= 3 km/hr

Speed of the stream = $\frac{1}{2}$ ([illegible] − [illegible]) km/hr

= 5 km/hr

9. Ans. (a)
Speed downstream = (5 + 1) km/hr = 6 km/hr
Speed upstream = (5 − 1) km/hr = 4 km/hr
Let the required distance be x km.

Then, $\frac{x}{6} + \frac{x}{4} = \frac{75}{60}$ or 2x [illegible] ⇒ x = 3.

∴ Required distance = 3 km.

❑❑❑❑

Problems on Trains

I Practice Exercise

1. A train is moving at a speed of 132 km/hr. If the length of the train is 110 metres, how long will it take to cross a railway platform 165 metres long?
(a) 5 sec (b) 7.5 sec
(c) 10 sec (d) 15 sec

2. A train 300 m long, [illegible] km/hr, [illegible] passes [illegible] in 1 minute, [illegible] the length of the bridge is
(a) 7[illegible] m (b) 200 m
(c) 450 m (d) 350 m

3. A train 360 m long [illegible] platform [illegible] in 1 minute 12 seconds. The speed of the train (in km/h) is
(a) [illegible] (c) 30
(b) 54 (d) 90

4. A train passes a pole in 15 seconds and a platform 100 m long in 25 seconds. Its length is
(a) 200 m (b) 150 m
(c) 50 m (d) Data inadequate

5. If a train 110 m long passes a telegraph pole in 3 seconds, then the time taken by it to cross a railway platform 165 m long is
(a) 3 sec (b) 4 sec
(c) 5 sec (d) 7.5 sec

6. A train 240 m long, moving at a speed of [illegible] metres per second overtakes a man moving at [illegible] in the same direction. The train will pass the man in
(a) 5 sec (b) 6 sec
(c) $4\frac{2}{?}$ sec (d) 8 sec

7. Two trains 200 m and 150 m long are running on parallel rails at the rate of 40 km/hr and 45 km/hr respectively. In how much time will they cross each other, if they are running in the same direction?
(a) 72 sec (c) 192 sec
(b) 132 sec (d) 252 sec

8. Two trains 1[illegible] m and 111 m long [illegible] opposite directions [illegible] at the rate [illegible] 80 km/hr and [illegible] 42 km/hr [illegible] they will be clear of each other in
(a) 10 sec (c) 11 sec
(b) 11 sec (d) 12 sec

9. A train 110 m long passes a man, running at 6 km/hr in the direction opposite to that of the train, in 6 seconds. The speed of the train is
(a) 60 km/hr (c) 66 km/hr
(b) 54 km/hr (d) 72 km/hr

10. A train 150 m long [illegible] at a speed of [illegible] km/hr crosses another train 112 m long running in the opposite direction in 6 seconds. The speed of the second train is
(a) 48 km/hr (c) 54 km/hr
(b) 66 km/hr (d) [illegible] km/hr

11. [illegible] 120 [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

12. [illegible]
(a) 72 m (b) [illegible]
(c) [illegible] (d) [illegible]

13. [illegible] A and B [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

14. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

15. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

16. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

17. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

□□□□

Solutions

1. Ans. (b)

Speed = [illegible]

[illegible]

∴ [illegible]

2. Ans. (c)

Speed [illegible]

Time = 60 sec

∴ [illegible]

⇒ [illegible]

3. Ans. (c)

[illegible]

Time taken = [illegible]

∴ Speed = [illegible] m/sec

= [illegible]

4. Ans. (a)

[illegible]

5. Ans. (a)

Speed = [illegible] m/sec

[illegible]

= [illegible] 7.5 sec

6. Ans. (a)
Speed of the train relative to man
= (35 − 5) m/sec
= 30 m/sec
∴ Time taken to pass the man
$= \left(\frac{300}{30}\right)$ sec = 10 sec

7. Ans. (d)
Relative speed = (45 − 40) km/hr = 5 km/hr
$= \left(5 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{25}{18}\right)$ m/sec
Total distance covered = Sum of length of trains = 350 m
∴ Time taken $= \left(350 \times \frac{18}{25}\right)$ sec = 252 sec.

8. Ans. (c)
Relative speed = (50+22) km/hr = 72 km/hr
$= \left(72 \times \frac{5}{18}\right)$ m/sec = 20 m/sec
Distance covered in crossing each other
= (220 + 120) m = 340 m.
Required time $= \left(\frac{340}{20}\right)$ sec = 17 sec.

9. Ans. (a)
Speed of the train relative to man
$= \left(\frac{110}{6}\right)$ m/sec $= \left(\frac{110}{6} \times \frac{18}{5}\right)$ km/hr
= 66 km/hr
Let the speed of the train be x km/hr.
Then relative speed = (x + 6) km/hr.
x + 6 = 66 or x = 60 km/hr.

10. Ans. (c)
Let the speed of the second train be x km/hr.
Relative speed = (x + 50) km/hr
$= \left[(x + 50) \times \frac{5}{18}\right]$ m/sec.
$= \left(\frac{250 + 5x}{18}\right)$ m/sec.
Distance covered = (108 + 112) = 220 m.
∴ $\frac{220}{\left(\frac{250 + 5x}{18}\right)} = 6 \Rightarrow 250 + 5x = 660$
or x = 82 km/hr.

11. Ans. (a)
Let the speed of train C be x km/hr.
Speed of B relative to C = (120 − x)
$= \left[(120 - x) \times \frac{5}{18}\right]$ m/sec
$= \left(\frac{600 - 5x}{18}\right)$ m/sec
Distance covered = (100 + 200) m = 300 m.
∴ $\frac{300}{\left(\frac{600 - 5x}{18}\right)} = 120 \Rightarrow 5400$
$= 120(600 - 5x) \Rightarrow x = 111$

12. Ans. (c)
2 km/hr $= \left(2 \times \frac{5}{18}\right)$ m/sec
$= \frac{5}{9}$ m/sec and 4 km/hr $= \frac{10}{9}$ m/sec
Let the length of the train be x metres and its speed by y m/sec.
Then $\frac{x}{\left(y - \frac{5}{9}\right)} = 9$ and $\frac{x}{\left(y - \frac{10}{9}\right)} = 10$
∴ 9y − 5 = x and 10 (9y − 10) = 9x
∴ 9y − x = 5 and 90 y − 9x = 100
On solving we get x = 50
∴ Length of the train is 50 m.

13. Ans. (b)
Suppose they meet x hours after 7 a.m.
Distance covered by A in x hours
= 20x km
Distance covered by B in (x − 1) hours
= 25 (x − 1) km
∴ 20x + 25 (x − 1) = 110
or 45x = 135 or x = 3
So, they meet at 10 a.m.

14. Ans. (c)

Relative speed = (120 + 80) km/h

$= \left(200 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{500}{9}\right)$ m/sec

Let the length of the other train be x metres.

Then, $(270 + x) \times \frac{9}{500} = 9$ or $270 + x = 500$

$\Rightarrow x = 230$ m

∴ The length of the other train is 230 m.

15. Ans. (b)

Let the length of first train be x metres.

Then, the length of second train is (x/2) metres.

Relative speed = (48 + 42) km/h

$= \left(90 \times \frac{5}{18}\right)$ m/sec = 25 m/sec

∴ $\frac{\left(x + \frac{x}{2}\right)}{25} = 12$ or $\frac{3x}{2} = 300$

∴ x = 200.

∴ Length of first train = 200 m.

Let the length of platform be y metres.

Speed of the first train

$= \left(48 \times \frac{5}{18}\right)$ m/sec $= \frac{40}{3}$ m/sec.

∴ $(200 + y) \times \frac{3}{40} = 45 \Rightarrow 600 + 3y$

$= 1800 \Rightarrow y = 400$ m

16. Ans. (c)

Let the speed of second train be x km/h.

Relative speed = (120 + x) km/hr

$= (120 + x) \times \frac{5}{18}$ m/sec

$(150 + 100) \times \frac{18}{(120 + x)5} = 6$

∴ x = 30

17. Ans. (b)

Length of bridge = 1000 m.

Length of train = 500 m.

Total distance covered in clearing the bridge = 1500 m

Time taken = 120 seconds

∴ Speed $= \left(\frac{1500}{120}\right)$ m/sec

$= \left(\frac{25}{2} \times \frac{18}{5}\right)$ km/hr = 45 km/hr

B

Section

Algebra & Set Theory

2.1 CHAPTER

Surds, Indices & Logarithms

LAWS OF INDICES

(i) $a^m \times a^n = a^{m+n}$

Example:

(i) [illegible] $= 3^{17}$

(ii) [illegible]

(ii) $\frac{a^m}{a^n} = a^{m-n}$

Example:

(i) $\frac{3^5}{3^3} = 3^{5-3} = 3^2$

(ii) $\frac{2^7}{2^{-1}} = 2^8$

(iii) $(a^m)^n = a^{mn}$

Example:

(i) $(3^2)^3 = 3^{2 \times 3} = 3^6$

(ii) $(3^4)^2 = 3^{4 \times 2} = 3^8$

(iv) $(a \times b)^n = a^n \times b^n$

Example:

(i) $(3 \times 5)^2 = 3^2 \times 5^2$

(ii) $(4 \times 5)^3 = 4^3 \times 5^3$

(v) $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Example:

(i) $\left(\frac{3}{4}\right)^2 = \frac{3^2}{4^2} = \frac{9}{16}$

(ii) $\left(\frac{5}{3}\right)^3 = \frac{5^3}{3^3} = \frac{125}{27}$

(vi) $a^0 = 1$

Where a may be any number

Example:

(i) $5^0 = 1$

(ii) $(100)^0 = 1$

(vii) $a^x = a^y$

if and only if $x = y$

Example:

(i) $x = y$ [illegible]

(ii) $x = 1$, $y = 0$

(viii) $a^{-n} = \frac{1}{a^n}$

Example:

(i) $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$

(ii) $5^{-3} = \frac{1}{5^3} = \frac{1}{125}$

(ix) $a^{-1} = \frac{1}{a}$

Example: $(5)^{-1} = \frac{1}{5}$

Laws of Surds

We write $\sqrt[n]{a} = a^{1/n}$ and it is called a surd of order n.

(i) $\left(\sqrt[n]{a}\right)^n = \left(a^{1/n}\right)^n = a$

(ii) $\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$

Example:

(i) $\sqrt{2 \times 3} = \sqrt{2} \cdot \sqrt{3}$

(ii) $\sqrt[3]{7 \times 13} = \sqrt[3]{7} \cdot \sqrt[3]{13}$

(iii) $\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$

Example:

(i) $\sqrt[3]{\frac{4}{5}} = \frac{\sqrt[3]{4}}{\sqrt[3]{5}}$

(ii) $\sqrt{\frac{7}{13}} = \frac{\sqrt{7}}{\sqrt{13}}$

(iv) $\left(\sqrt[n]{a}\right)^m = \sqrt[n]{a^m}$

Example:

(i) $\left(\sqrt[3]{5}\right)^2 = \sqrt[3]{5^2} = \sqrt[3]{25}$

(ii) $\left(\sqrt[3]{2}\right)^2 = \sqrt[3]{2^2} = \sqrt[3]{4}$

(iii) $\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a} = a^{\frac{1}{mn}}$

Example:

(i) [illegible]

(ii) [illegible]

* * *

Solved Examples

1. Find the value of $\left(\frac{32}{243}\right)^{-\frac{3}{5}}$

Sol. $\left(\frac{32}{243}\right)^{-\frac{3}{5}} = \left[\frac{2^5}{3^5}\right]^{-\frac{3}{5}} = \left(\frac{2}{3}\right)^{-3}$

$= \left(\frac{3}{2}\right)^{3} = \frac{27}{8}$

2. Solve [illegible]

Sol. [illegible]

[illegible]

[illegible]

[illegible]

3. Find the value of x if [illegible]

Sol. [illegible]

[illegible]

[illegible]

[illegible]

4. Which is greater $\sqrt[4]{4}$ or $\sqrt[5]{5}$

Sol. $\sqrt[4]{4} = 4^{\frac{1}{4}}$ and $\sqrt[5]{5} = 5^{\frac{1}{5}}$

Now the LCM of 4 & 5 is 20, so to compare we should raise the power by 20.

$\left(4^{\frac{1}{4}}\right)^{20} = 4^5 = 1024$

$\left(5^{\frac{1}{5}}\right)^{20} = 5^4 = 625$

Hence $\sqrt[4]{4} > \sqrt[5]{5}$

5. Simplify $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

Sol. [illegible]

(Multiply numerator & denominator by conjugate of denominator)

$= \frac{(\sqrt{3}+\sqrt{2})^2}{(\sqrt{3})^2-(\sqrt{2})^2}$ = [illegible]

6. Simplify $\frac{\sqrt{a^2+1}+\sqrt{a^2-1}}{\sqrt{a^2+1}-\sqrt{a^2-1}}$

Sol.

$\frac{\sqrt{a^2+1}+\sqrt{a^2-1}}{\sqrt{a^2+1}-\sqrt{a^2-1}} \times \frac{\sqrt{a^2+1}+\sqrt{a^2-1}}{\sqrt{a^2+1}+\sqrt{a^2-1}}$

$= \frac{a^2+1+a^2-1+2\left(\sqrt{a^2+1}\right)\left(\sqrt{a^2-1}\right)}{a^2+1-(a^2-1)}$

$= \frac{2a^2+2\sqrt{a^4-1}}{2} = a^2+\sqrt{a^4-1}$

7. Which is greater $\sqrt[3]{4}$ or $\sqrt[4]{5}$

Sol. $\sqrt[3]{4} = 4^{\frac{1}{3}}$ and $\sqrt[4]{5} = 5^{\frac{1}{4}}$

Raise the power of both the terms by LCM of 3 and 4 (12)

$\left(4^{\frac{1}{3}}\right)^{12} = 4^4 = 256$

$\left(5^{\frac{1}{4}}\right)^{12} = 5^3 = 125$

Hence, $\sqrt[3]{4} > \sqrt[4]{5}$

8. If [illegible] then find the value of x

Sol. [illegible]

[illegible]

[illegible]

$\Rightarrow 5x = 10,\ x = 2$

9. If $2^x = 3^y = 6^{-z}$, then $\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)$ is equal to?

Sol: Let $2^x = 3^y = 6^{-z} = k$

So, $2 = k^{\frac{1}{x}}$, $3 = k^{\frac{1}{y}}$, $6 = k^{-\frac{1}{z}}$

We know that, $2 \times 3 = 6$, putting values

$$k^{\frac{1}{x}} \times k^{\frac{1}{y}} = k^{-\frac{1}{z}} \Rightarrow \frac{1}{x}+\frac{1}{y} = -\frac{1}{z}$$

$$\Rightarrow \frac{1}{x}+\frac{1}{y}+\frac{1}{z} = 0$$

10. Arrange $\sqrt{2}$, $\sqrt[3]{4}$ and $\sqrt[4]{6}$ in ascending order.

Sol: $\sqrt{2} = 2^{\frac{1}{2}}$

$\sqrt[3]{4} = 4^{\frac{1}{3}}$, $\sqrt[4]{6} = 6^{\frac{1}{4}}$

We raise the power of given surds to L.C.M of 2, 3 and 4 i.e 12

$$\left(2^{\frac{1}{2}}\right)^{12} = 2^6 = 64$$

$$\left(4^{\frac{1}{3}}\right)^{12} = 4^4 = 256$$

$$\left(6^{\frac{1}{4}}\right)^{12} = 6^3 = 216$$

Ans: $\sqrt{2}$, $\sqrt[4]{6}$, $\sqrt[3]{4}$

* * *

Logarithms

Definition

The logarithm of any number to a given base is equal to the index of the power to which the base should be raised to obtain the given number.

For example: If $a^x = b$

x is called logarithm of b to the base a and is written as $\log_a b = x$

Similarly

$2^3 = 8$ is written as $\log_2 8 = 3$

$4^{-2} = \frac{1}{4^2} = \frac{1}{16}$ is written as

so $\log_4 \frac{1}{16} = -2$

$10^3 = 1000 \Rightarrow \log_{10} 1000 = 3$

$3^5 = 243 \Rightarrow \log_3 243 = 5$

Properties of Logarithms

(a) $\log_a(m \times n) = \log_a m + \log_a n$

Example 1

$\log_2(15) = \log_2 3 + \log_2 5$

(b) $\log_a\left(\frac{m}{n}\right) = \log_a m - \log_a n$

Example 2.

$\log_2\left(\frac{5}{3}\right) = \log_2 5 - \log_2 3$

(c) $\log_a(m^n) = n\log_a m$

Example 3.

$\log_2 3^4 = 4\log_2 3$

(d) $\log_{a^n}(m) = \frac{1}{n}\log_a m$

Example 4.

$\log_{16} 8 = \frac{1}{4}\log_2 8$

$\log_{10^3} 1000 = \frac{1}{3}\log_{10} 1000$

(e) $\log_a b = \frac{\log_c b}{\log_c a}$

(Here c may be any positive number)

Example 5.

$\log_2 5 = \frac{\log_{10} 5}{\log_{10} 2}$

$\log_7 13 = \frac{\log_{10} 13}{\log_{10} 7}$

(f) $\log_a b = \frac{1}{\log_b a}$

Example 6.

$\log_2 3 = \frac{1}{\log_3 2}$

$\log_5 6 = \frac{1}{\log_6 5}$

(g) $\log_b a \times \log_a b = \frac{\log a}{\log b} \times \frac{\log b}{\log a} = 1$

Remark:

(1) When base is not mentioned it is taken as 10.
(2) Logs to the base 10 are known as common logarithms.
(3) $\log_b a =$

Example 7.

$\log_2 2 = 1$
$\log_2 1$

(h) $\log_a 1 = 0$

[∵ any no. to the power zero is one]

(i) $a^{\log_a x} = x$

$3^{\log_3 2} = 2$

$5^{\log_5 7} = 7$

Solved Examples

1. Find the logarithm of 32 to the base 2.

Sol: $\log_2 32 = \log_2(2^5)$

$= 5\log_2 2 = 5 \times 1 = 5$

2. Find the value of $2^{\log_2 5}$

Sol: $a^{\log_a x} = x$

So $2^{\log_2 5} = 5$

3. Find the value of $3^{2+\log_3 5}$

Sol. $3^{2+\log_3 5} = 3^2 \times 3^{\log_3 5}$

$= 3^2 \times 5 = 45$

4. Find the value of $3^{2-\log_3 5}$

Sol: $3^{2-\log_3 5} = \frac{3^2}{3^{\log_3 5}} = \frac{9}{5}$

5. Find the value of $\log_a a^3 - \log_a a$

Sol: $\log_a a^3 - \log_a a = 3\log_a a - \log_a a = 2$

6. If $\log_8 a = \frac{2}{3}$, Find a

Sol. $\log_8 a = \frac{2}{3}$

$a = 8^{\frac{2}{3}}$

$a = 4$

7. $\log_x \sqrt{3} = \frac{1}{6}$ Find the value of x

Sol: $\log_x \sqrt{3} = \frac{1}{6}$

$\Rightarrow \log_x 3^{\frac{1}{2}} = \frac{1}{6}$

$\therefore \left(3^{\frac{1}{2}}\right)^{6} = x = 3^3 = 27$

8. If $\log_4 x + \log_{16} x + \log_2 x = 14$ find the value of x

Sol. $\log_4 x + \log_{16} x + \log_2 x = 14$

$\Rightarrow \frac{1}{2}\log_2 x + \frac{1}{4}\log_2 x + \log_2 x = 14$

$\Rightarrow \frac{7}{4}\log_2 x = 14$

$\Rightarrow \frac{1}{4}\log_2 x = 2$

$\Rightarrow \log_2 x = 8$

$\Rightarrow x = 2^8 = 256$

9. Solve $\log_3 x - \log_3 4 = 2$

Sol: $\log_3 x - \log_3 4 = \log_3 \frac{x}{4} = 2$

$\log_3 \frac{x}{4} = 2$

$\therefore \frac{x}{4} = 3^2 \Rightarrow x = 3^2 \times 4 = 36$

10. Find the value of $\log\frac{x^2}{yz} + \log\frac{y^2}{zx} + \log\frac{z^2}{xy}$

Sol.: $\log\frac{x^2}{yz} + \log\frac{y^2}{zx} + \log\frac{z^2}{xy}$

$= \log\left(\frac{x^2}{yz} \times \frac{y^2}{zx} \times \frac{z^2}{xy}\right)$

$= \log\frac{x^2y^2z^2}{x^2y^2z^2} = \log 1 = 0$

11. Evaluate $\log_7\left(\frac{1}{343}\right)$

Sol: $\log_7\left(\frac{1}{343}\right) = \log_7 \frac{1}{7^3}$

$= \log_7 7^{-3} = -3\log_7 7 = -3$

12. Evaluate $\log_{[illegible]}$ [illegible]

Sol. $\log_{[illegible]}$ [illegible] $=$ [illegible]

13. If $\log_{[illegible]} x = 3\frac{1}{3}$, find the value of x.

Sol. $\log_{[illegible]} x = \frac{10}{3}$ [illegible]

[illegible] $= 2^5 = 32$

□□□□

Surds, Indices & Logarithms

1 Practice Exercise 1

1. The value of $(\sqrt{3})^{[illegible]}$ is:

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

2. $\left(\frac{1}{[illegible]}\right)^{[illegible]} + \left(\frac{1}{[illegible]}\right)^{[illegible]} = ?$

(a) $\frac{3}{2}$ (b) $\frac{2}{3}$

(c) [illegible] (d) $\frac{1}{[illegible]}$

3. If [illegible], then the value of n is:

(a) 6 (b) 4

(c) 3 (d) 12

4. If [illegible], then n equals:

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 4

5. If $(\sqrt{3})^5 \times 9^2 = 3^n \times 3\sqrt{3}$ then n equals:

(a) 2 (b) [illegible]

(c) 4 (d) 5

6. If x, y, z are real numbers, then the value of

$\sqrt{x^{-1}y}\cdot\sqrt{y^{-1}z}\cdot\sqrt{z^{-1}x}$ is:

(a) xyz (b) $\sqrt{xyz}$

(c) $\frac{1}{xyz}$ (d) 1

7. [illegible] $= ?$

(a) $x^{[illegible]}$ (b) $x^{[illegible]}$

(c) $x^{[illegible]}$ (d) 1

8. If [illegible] then x is equal to:

(a) 0 (b) 2

(c) [illegible] (d) [illegible]

9. If $2^{[illegible]} = \frac{1}{[illegible]}$, the value of x is:

(a) 5 (b) 2

(c) 0 (d) [illegible]

10. If $\sqrt{x + \sqrt[3]{x}} = $ [illegible], then x is equal to

(a) [illegible] (b) 64

(c) 27 (d) 9

11. If $a^x = b^y = c^z$ and $b^2 = ac$, then y equals:

(a) $\frac{xz}{x+z}$ (b) $\frac{xz}{2(x-z)}$

(c) $\frac{xz}{2(z-x)}$ (d) $\frac{2xz}{(x+z)}$

12. If $x = y^a$, $y = z^b$ and $z = x^c$, then the value of abc is:

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

□□□□

Solutions

1. Ans. (c)

[illegible]

[illegible]

2. Ans. (c)

$\left(\frac{1}{216}\right)^{[illegible]}$ $\left(\frac{1}{27}\right)^{[illegible]}$

= [illegible]

[illegible]

3. Ans. (a)

[illegible]

[illegible]

4. Ans. (c)

[illegible] = 27

⇒ [illegible]

[illegible]

[illegible]

[illegible]

∴ $2n + 4 = 10$

∴ $2n = 6$ or $n = 3$

5. Ans. (d)

[illegible]

= [illegible]

[illegible]

or [illegible]

or [illegible]

[illegible]

6. Ans. (d)

[illegible]

= [illegible] = 1

7. Ans. (c)

Given Exp.

= [illegible]

= [illegible]

= [illegible]

8. Ans. (d)

[illegible]

= [illegible]

= [illegible]

∴ [illegible]

9. Ans. (b)

[illegible]

⇒ [illegible]

∴ [illegible]

10. Ans. (a)

On equating both sides, we get

[illegible]

Dividing [illegible] we get

$x = (4 \times 4 \times 4)$ [illegible]

11. Ans. (c)

[illegible]

Then [illegible]

[illegible]

⇒ [illegible]

12. Ans. (a)

[illegible]

❑❑❑❑

Surds, Indices & Logarithms

Practice Exercise II

1. The value of $\log_{343} 7$ is:
   (a) $\frac{1}{3}$ (b) -3
   (c) $-\frac{1}{3}$ (d) 3

2. The value of $\log_{2}(.0625)$ is:
   (a) $\frac{1}{4}$ (b) $-\frac{1}{4}$
   (c) -4 (d) 4

3. If $\log_{x}$ [illegible] $= -\frac{2}{3}$, then the value of x is:
   (a) $\frac{3}{2}$ (b) $\frac{1}{2}$
   (c) [illegible] (d) [illegible]

4. If $\log_{32} x = 0.8$, then x is equal to:
   (a) 25.6 (b) [illegible]
   (c) 10 (d) 12.8

5. If $\log_4 x + \log_2 x = 6$, then x is equal to:
   (a) 2 (b) 4
   (c) 8 (d) 16

6. If $\log 2 = 0.30103$, then the number of digits in 2^{64} is:
   (a) [illegible] (b) 19
   (c) [illegible] (d) [illegible]

7. The value of $\log_2(\log_5 625)$ is:
   (a) 2 (b) [illegible]
   (c) 10 (d) 15

8. $(\log_b a \cdot \log_c b \cdot \log_a c)$ is equal to:
   (a) 0 (b) 1
   (c) abc (d) a + b + c

9. $\left[\frac{1}{(\log_a bc)+1}+\frac{1}{(\log_b ca)+1}+\frac{1}{(\log_c ab)+1}\right]$ is equal to:
   (a) 1 (b) 2
   (c) 3 (d) $\frac{1}{2}$

10. If $\log_2[\log_3(\log_2 x)] = 1$, then x is equal to:
    (a) 512 (b) 128
    (c) 12 (d) 0

11. If $\log_{10} 2 = 0.3010$, then $\log_2 10$ is:
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) [illegible]

12. If $\log_{10} 2 = 0.3010$, then the value of $\log_{10} 5$ is:
    (a) 0.5641 (b) [illegible]
    (c) 0.6990 (d) 0.7525

13. The value of $(\log_3 7 \times \log_7 32)$ is:
    (a) [illegible] (b) [illegible]
    (c) $\frac{7}{2}$ (d) $\frac{10}{6}$

14. If $\log_{10}$ [illegible] $= 3$, then the value of x is:
    (a) 5 (b) 32
    (c) 25 (d) [illegible]

15. If $\log x = \log y + \log(x - y)$, then:
    (a) [illegible] (b) $xy = 1$
    (c) $x = \frac{[illegible]}{y}$ (d) $x = \frac{y^2}{y-1}$

16. The value of $\left[\frac{1}{\log_{60} 3}+\frac{1}{\log_{60} 4}+\frac{1}{\log_{60} 5}\right]$ is:
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) 1

17. If $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$, then the value of $\log_5 512$ is:
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) None of these

□□□□

Solutions

1. Ans. (a)
   Let $\log_{343} 7 = x$.
   Then, $(343)^x = 7 \Rightarrow (7^3)^x = 7$
   $\Rightarrow 7^{3x} = 7$

$\Rightarrow 3n = 1 \Rightarrow n = \frac{1}{3}$

$\therefore \log_{125} 5 = \frac{1}{3}$

2. Ans. (c)

Let $\log_{10}(0.0001) = n$. Then,

$10^n = 0.0001 \Rightarrow 10^n = \frac{1}{10000} = 10^{-4}$

$\Rightarrow 10^n = 10^{-4} \Rightarrow n = -4$

$\therefore \log_{10}(0.0001) = -4$

3. Ans. (c)

$\log_8 x = \frac{4}{3} \Rightarrow x = 8^{4/3} = (2^3)^{4/3}$

$= 2^{3 \times \frac{4}{3}} = 2^4 = 16$

4. Ans. (b)

$\log_{32} x = 0.8 \Rightarrow x = (32)^{0.8}$

$= (2^5)^{0.8} = 2^4 = 16$

5. Ans. (d)

$\log_4 x + \log_2 x = 6 \Rightarrow \frac{\log x}{\log 4} + \frac{\log x}{\log 2} = 6$

$\therefore \frac{\log x}{2\log 2} + \frac{\log x}{\log 2} = 6 \Rightarrow 3\log x = 12\log 2$

$\Rightarrow \log x = 4\log 2 \Rightarrow \log x$

$= \log 2^4$ or $x = 2^4 = 16$

6. Ans. (a)

$\log 5^{20} = 20\log 5 = 20 \times \left[\log\left(\frac{10}{2}\right)\right]$

$= 20 \times [\log 10 - \log 2] = 20 \times (1 - 0.3010)$

$= 20 \times 0.6990 = 13.980$

∴ Characteristic = 13

∴ Number of digits in 5^{20} is 14

7. Ans. (a)

Let $\log_5 625 = x$. Then,

$5^x = 625 = 5^4 \Rightarrow x = 4$

Let $\log_2(\log_5 625) = y$. Then $\log_2(4) = y$

$\Rightarrow 2^y = 4 = 2^2 \Rightarrow y = 2$

$\therefore \log_2(\log_5 625) = 2$

8. Ans. (b)

Given exp. $= \left[\frac{\log b}{\log a} \times \frac{\log c}{\log b} \times \frac{\log a}{\log c}\right] = 1$

9. Ans. (a)

$= \frac{1}{\log_a bc + 1} + \frac{1}{\log_b ca + 1} + \frac{1}{\log_c ab + 1}$

$= \frac{1}{\log_a bc + \log_a a} + \dots$

$= \frac{1}{\log_a (abc)} + \frac{1}{\log_b (abc)} + \frac{1}{\log_c (abc)}$

$= \log_{abc} a + \log_{abc} b + \log_{abc} c$

$= \log_{abc}(abc) = 1$

10. Ans. (a)

$\log_2[\log_3(\log_2 x)] = 1$

$\Rightarrow \log_3(\log_2 x) = 2$

$\Rightarrow \log_2 x = 3^2 = 9$

$\Rightarrow x = 2^9 = 512$

11. Ans. (b)

$\log_5 10 = \frac{1}{\log_{10} 5} = \frac{1}{0.6990} = 1.4306$

12. Ans. (c)

$\log_{10} 5 = \log_{10}\left(\frac{10}{2}\right) = \log_{10} 10 - \log_{10} 2$

$\therefore \log_{10} 5 = (1 - 0.3010) = 0.6990$

13. Ans. (d)

$\log_9 27 + \log_8 32$

$\log_{3^2} 3^3 + \log_{2^3} 2^5$

$\frac{3}{2}\log_3 3 + \frac{5}{3}\log_2 2$

So, $\frac{3}{2} + \frac{5}{3} = \frac{19}{6}$

14. Ans. (a)

$\log_2(x^2 + 4) - \log_2(x - 1) = 2$

$$\Rightarrow \log_5\left(\frac{x^2-x}{x-1}\right)=2$$

$$\log_5\left[\frac{x(x-1)}{x-1}\right]=2$$

or $\log_5 x = 2$ or $x = 5^2 = 25$

15. Ans. (d)

$\log(x+y) = \log x + \log y$

$\Rightarrow \log(x+y) = \log(xy)$

$\therefore x + y = xy$ or $x = y(x-1)$

$$\therefore y = \frac{x}{x-1}$$

16. Ans. (d)

Given Expression

$$= \log_2\left(\frac{p}{q}\right) + \log_2\left(\frac{q}{r}\right) + \log_2\left(\frac{r}{p}\right)$$

$$\log_2\left(\frac{p}{q}\times\frac{q}{r}\times\frac{r}{p}\right) = \log_2 1 = 0$$

17. Ans. (a)

$$\log 4.5 = \log\left(\frac{9}{2}\right) = \log 9 - \log 2$$

$$= \log\left(3^2\right) - \log 2 = 2\log 3 - \log 2$$

$$= (2 \times 0.4771 - 0.3010) = 0.6532$$

■■■

2.2
CHAPTER

Progression

Talking about a series 1, 5, 9, 13, ... In this series every term is made by adding a fixed value in the previous term. So it can be stated as the series a, (a + d), (a + 2d), ... This sort of series is called as Arithmetic Series and [illegible] is the common difference between two consecutive terms.

Basics of Arithmetic Progression

- Finding out the nth term of an AP
  $T_1 = a$ [illegible] nth term
  $T_n = a + (n - 1)d$
- Sum of n terms of an AP

$$S_n = \Sigma T = \frac{n}{2}[2a + (n - 1)d]$$

$$= \frac{n}{2}[a + a + (n - 1)d]$$

$$= \frac{n}{2}[a + T_n]$$

$$\text{So } S_n = \frac{n}{2}[a + T_n] = \frac{n}{2}[2a + (n - 1)d]$$

Properties of Arithmetic Progression

- Assumption of numbers in an AP
  (a) If three numbers are in AP, then they can be assumed as a − d, a, a + d
  (b) If four numbers have to be assumed then they can be (a − 3d), (a − d), (a + d), (a + 3d)
  (c) If five numbers have to be assumed then they will be (a − 2d), (a − d), a, (a + d), (a + 2d)

  If in an AP sum of m terms is n and sum of n terms is m then sum of (m + n) terms will be −(m + n).

Example 1.

Sum of the first [illegible] terms [illegible] and sum of [illegible] terms is [illegible]. Find the sum of [illegible] terms of AP.

Solution.

If the first term be a and common difference be 'd' then

$$\frac{4}{2}[2a + (4 - 1)d] = 4$$

$$\Rightarrow \quad 2a + 3d = 2 \qquad \ldots(i)$$

$$\text{and } \frac{[illegible]}{2}[2a + ([illegible] - 1)d] = 2$$

$$\Rightarrow \quad [illegible] \qquad \ldots(ii)$$

On solving (i) & (ii) we get

$$d = \frac{[illegible]}{[illegible]} \text{ and } a = [illegible]$$

So sum of [illegible] terms

$$= \frac{[illegible]}{2}\left[2 \cdot [illegible] + ([illegible] - 1)\left(\frac{[illegible]}{[illegible]}\right)\right]$$

$$= \frac{[illegible]}{2}\left[[illegible] - \frac{15}{2}\right]$$

$$= [illegible]$$

- If in an AP mth term is n & nth term is m then
  (a) The common difference = −1 and [illegible]
  (b) The (m + n)th term of the AP will be zero
  (c) The first term of the AP will be (m + n − 1)

Example 2

[illegible] is an AP of common difference −1.
7, 6, 5, 4, 3, 2, 1, 0
Its 5th term is 3
and 3rd term is 5
then 8th term will be 0
And the first term is 5 + 3 − 1 = 7

- If same number is added or subtracted from each term of the AP, The new series will again be an AP.

Example 3

[illegible] 13, ... is an AP and a number 5 is either added or subtracted, then the new series [illegible]

7, 11, 15, 19, 23, ...

[illegible] (Both series are AP)

- If each term of a series is multiplied in the same AP, the new series obtained is also AP.

Example 4.

The series 1, 3, 5, 7, 9 ......

Multiplying it by 2 we get

2, 6, 10, 14, 18 ... This series is also an AP

- If the sum of m terms of an AP is equal to sum of n terms of the same AP then the AP will have

$\left(\frac{m+n+1}{2}\right)$ th term as 0.

This is valid only when (m + n) is odd.

When m + n is even:

Then it is impossible that the term would be zero in the AP. We can understand it with one example and discuss both the cases.

Example 5.

The sum of first 5 terms of an AP is equal to the sum of first [illegible] terms. [illegible]

Sol. $S_5 = S_{12}$

$\Rightarrow \frac{5}{2}[2a+4d] = \frac{12}{2}[2a+11d]$

$\Rightarrow 10a + 20d = 24a + 132d$

$\Rightarrow 14a = -112d$

$\Rightarrow a = -8d$

So, $T_n = a + (n-1)d = 0$

$\Rightarrow n = 9$

Sol. $S_5 = S_{13}$

$\Rightarrow \frac{5}{2}[2a+4d] = \frac{13}{2}[2a+12d]$

[illegible]

$\Rightarrow a = -\frac{17}{2}d$

$T_n = -\frac{17}{2}d + (n-1)d = 0$

$\Rightarrow n = \frac{19}{2}$

Which is not possible.

- If two APs are compared & the sum of n terms of first AP is S_n and the second AP is S'_n, then they will have the ratio of sum [illegible] in the case & method [illegible]

$$\frac{S_{2n-1}}{S'_{2n-1}} = \frac{[illegible]}{[illegible]}$$

Some Important Applications

- Sum of first n natural numbers

$$S_n = \sum n = \frac{n(n+1)}{2}$$

- Sum of the squares of first n natural numbers

$$S_{n^2} = \frac{n(n+1)(2n+1)}{6}$$

- Sum of the cubes of first n natural numbers

$$S_{n^3} = \left[\frac{n(n+1)}{2}\right]^2$$

So, $S_{n^3} = (S_n)^2$

Geometric Series

Consider the series 2, 4, 8, 16, 32 ... In this series, we see every term in the series is obtained by multiplying the preceding term by a fixed ratio. Such type of series are termed as geometric series. Such a general series may be written as

a, ar, ar^2, ar^3, ... ar^{n-1}

Here r is the common ratio and a is the first term.

Basics of GP

- N^{th} term of the GP is ar^{n-1}
- Sum of n terms

$$S_n = a\left(\frac{r^n-1}{r-1}\right) \quad \text{when } r > 1$$

$$S_n = a\left(\frac{1-r^n}{1-r}\right) \quad \text{when } r < 1$$

Infinite GP

This is a geometric series having infinite terms. [illegible] the sum of infinite terms of a GP can be calculated as:

$S_\infty = \infty$ (when r > 1)

$S_\infty = \frac{a}{1-r}$ (when r < 1)

Basic Properties of GP

Assume [illegible] terms in GP [illegible]

Assume $\frac{a}{r}$, a, ar [illegible] the four terms $\frac{a}{r^3}$, $\frac{a}{r}$, ar, ar^3

Harmonic Series

If the inverse of an arithmetic series are taken then the new series obtained will be harmonic series. Let us take a series 5, 7, 9, ... [illegible] arithmetic series. If we take inverse of each term [illegible] as $\frac{1}{5}, \frac{1}{7}$

$\frac{1}{5}, \frac{1}{7}, \frac{1}{9}, \frac{1}{11}$ ... this is harmonic series

Basics of HP

The nth term of a harmonic series can't be calculated directly but it can be found out by finding the nth term of the arithmetic series [illegible] and then [illegible] again inversing the term.

Example

Find out the 4th term for the series

$\frac{1}{5}, \frac{1}{11}, \frac{1}{17}, \frac{1}{23}$ ...

The reciprocal series will be in the AP series as 5, 11, 17, 23

So 4th term of HP is $\frac{1}{23}$

Basic Means

For the given items there are three types of means

- Arithmetic mean
- Geometric mean
- Harmonic mean

Arithmetic Mean

For n terms $a_1, a_2, a_3, \dots a_n$ the AM will be

$$\frac{a_1 + a_2 + a_3 + \dots + a_n}{n}$$

Geometric Mean

Geometric mean is the term which is inserted between the two terms in GP. [illegible] two terms [illegible] GM [illegible] GM [illegible] GP.

So GM = $\sqrt{a \cdot b}$

- [illegible]
- GM [illegible]

If there are n terms $a_1, a_2, a_3, \dots, a_n$ then

- GM = $(a_1 a_2 a_3 \dots a_n)^{1/n}$

Harmonic Mean

Harmonic mean is the term which is inserted between the two terms such that the terms form harmonic progression. The harmonic mean for the two terms a and b is

$$HM = \frac{2ab}{a+b}$$

Relation between AM, GM, HM

[illegible] highest value.

AM ≥ GM ≥ HM

- When [illegible] terms are [illegible] then arithmetic mean, geometric mean and harmonic mean [illegible]

HM [illegible]

[illegible]

Solved Examples

1. If in an AP, 6th term is 56 and 9th term is 40, then what will be the 100th term?

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (d)

[illegible]

Alternate: [illegible]

2. Consider the [illegible] 1, 2, 3, 4, [illegible] X is average of all the odd integers [illegible] average of all the even integers [illegible] then what is (X − Y)?

(a) −1 (b) [illegible]

(c) 1 (d) None of these

Ans. (a)

$$X = \frac{1 + 3 + 5 + \dots}{\text{No. of terms}}$$

$$= \frac{[illegible]}{2} = n + 2$$

$$Y = \frac{2 + 4 + 6 + \dots}{\text{No. of terms}}$$

$$= \frac{2 + [illegible]}{2} = n + 1$$

So X – Y = 1

Hence option (a)

Alternate: Difference of 2 consecutive terms in odd term and even term = 1 so difference of avg. of odd and avg. of even = 1

i.e. X – Y = 1.

5. The number of terms between [illegible] which are divisible by 11 are
(a) 37 (b) 2[illegible]
(c) 23 (d) [illegible]

Ans. (d)

The first term divisible by 11 = [illegible]

The last term divisible by 11 = 528

No. of terms = $\frac{528 - [illegible]}{11} + 1 = [illegible]$

Hence option (d)

4. Sol. Divide [illegible] into four parts in such a way that [illegible] parts are in AP and the product of first and last part is [illegible] less than the product of second & third part.

Sol.

Let the four parts be

$a - 3d, a - d, a + d, a + 3d$

[illegible]

$\Rightarrow a = [illegible]$

[illegible]

$\Rightarrow [illegible]$

$\Rightarrow [illegible] = \pm [illegible]$

So the parts are [illegible]

□□□□

Progression

Practice Exercise 1

1. How many terms are there in the AP 20, 25, 30, ..., 140?
(a) [illegible] (b) 24
(c) [illegible] (d) [illegible]

2. Find the 1st term of an AP whose 8th and 12th terms are respectively 39 and 59.
(a) [illegible] (b) 6
(c) 4 (d) [illegible]

3. Find the 15th term of the sequence 20, 15, 10, ...
(a) −45 (b) −55
(c) −50 (d) 0

4. A number 15 is divided into three parts which are in AP and the sum of their squares is 83. Find the smallest number.
(a) [illegible] (b) [illegible]
(c) 6 (d) 3

5. The sum of first 16 terms of an AP whose first and third terms are 5 and 15 respectively is
(a) [illegible] (b) [illegible]
(c) 680 (d) [illegible]

6. A boy agrees to work at the rate of one rupee on the first day, two rupees on the second day, and four rupees on the third day and so on. How much will the boy get if he started working on the 1st of February and finishes on the 20th of February?
(a) 2^{20} (b) 2^{19}
(c) $2^{20} - 1$ (d) $2^{[illegible]}$

7. The seventh term of a GP is 8 times the fourth term. What will be the first term when its 5th term is 48?
(a) 4 (b) 3
(c) 5 (d) 2

8. The sum of three numbers in GP is 14 and the sum of their squares is 84. Find the largest number.
(a) 8 (b) 6
(c) 4 (d) None of these

9. How many 3-digit numbers between 100 to 500 are multiples of 7?
(a) 2[illegible] (b) 2[illegible]
(c) 2[illegible] (d) None of these

10. The 4th and 10th terms of a GP are [illegible] and 243 respectively. Find the 2nd term.
(a) [illegible] (b) 1
(c) 1/27 (d) 1/9

11. The 7th and 21st terms of an AP are 6 and −22 respectively. Find the 26th term.
(a) −34 (b) −32
(c) [illegible] (d) [illegible]

12. Find the number of terms in the series 1/81, 1/27, 1/9, ..., 729.

(a) 1 (b) 12
(c) [illegible] (d) 15

13. a and b [illegible] AM is [illegible] and GM is 7. Which of these can be a possible value of a?
(a) [illegible] (b) 20
(c) [illegible] (d) 25

14. For a number A and B [illegible] GM is [illegible] less than their AM. Find the ratio between the numbers
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

* * *

Solutions

1. Ans. (b)
In series 20, 25, 30 [illegible] 130
a = 20, d = 5
nth term is 130
⇒ 20 + (n − 1)5 = 130
⇒ 5n = [illegible], n = [illegible]

2. Ans. (c)
From a + 7d = [illegible] ...(i)
a + 11d = [illegible] ...(ii)
So 4d = 20
d = 5
[illegible] (7 × 5) = [illegible]
So [illegible]

3. Ans. (b)
AP [illegible]
Here a = 20
d = −5
15th term will be [illegible]
20 + (−5) × 14 = [illegible]

4. Ans. (b)
Let numbers are
a − d, a and a + d
Now it is given that
sum = [illegible] and sum of their squares is 83 [illegible]
3a = [illegible] ...(i)
(a − d)² + a² + (a + d)² = 83 ...(ii)
3a² + 2d² = 83
or [illegible] = 83

2d² = 8
d² = 4, d = 2
So, first term is a − d = 3

5. Ans. (d)
a = 5, a [illegible] = 15
So d = [illegible]
now sum of 18 terms will be
18/2 [10 + [illegible] × 5] = [illegible]

6. Ans. (b)
This sequence is in GP 1, 2, 4, 8, ...
Now sum of first 20 terms will be
[illegible]

7. Ans. (b)
It is given that
[illegible]
[illegible] = 2
Now [illegible] = 48
[illegible] = 48 [illegible]

8. Ans. (a)
[illegible]
[illegible] ...(i)
[illegible] ...(ii)
[illegible] 8
So [illegible] term is 8

9. Ans. (a)
Between 200 and 400 the first term divisible by 7 is 203 and last term divisible by 7 is [illegible]
So here a = 203, d = 7
l = a + (n − 1)d
[illegible] = 203 + (n − 1) 7
⇒ 7n = [illegible]
n = [illegible]

10. Ans. (c)
It is given that
ar³ = 1/3 ...(i)
ar⁶ = 243 ...(ii)
From (i) and (ii) we get
r³ = 729
r = 9 ...(iii)
From (i) and (iii) we get
[illegible] = [illegible] a = [illegible]
[illegible] term will be [illegible]

11. Ans. (b)

It is given that

a + 6d = 6 and

a + 20d = −22

⇒ 14d = −28 ∴ d = −2

∴ a = 18

26th term is then −32

12. Ans. (a)

It is given that

GP is $-\frac{1}{81}, \frac{1}{27}, -\frac{1}{9}, \ldots, 729$

Here $a = -\frac{1}{81}$, r = −3

Now $ar^{n-1} = 729$

$-\frac{1}{81}(-3)^{n-1} = 729$

$(-3)^{n-1} = 3^{10} \Rightarrow n = 11$

13. Ans. (c)

$\frac{a+b}{2} = 25$

a + b = 50

$\sqrt{ab} = 7$

ab = 49

Here a = 1 & b = 49 or vice versa.

14. Ans. (a)

$\frac{a+b}{2} = AM$

$\sqrt{ab} = GM$

Here it is given that

GM = 20% less than AM that is

$GM = \frac{4}{5} AM$

$\Rightarrow \sqrt{ab} = \frac{4}{5} \times \frac{a+b}{2}$

Only possibility is a = 1 & b = 4

or a = 4, b = 1

So ratio is 4

■■■■

Progression

Practice Exercise II

1. Determine k so that $\frac{2}{3}$, k and $\frac{5}{4}$k are three consecutive terms of an A.P.
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

2. If 7 times the 7th term of an A.P. is equal to 11 times its 11th term, then the 18th term of the A.P. is
(a) 1 (b) [illegible]
(c) [illegible] (d) 0

3. If the [illegible] and [illegible] terms of an A.P. are [illegible] respectively, find the value of [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

4. A car [illegible] metres during the first second, [illegible] metres during the second, 25 metres during the next and so on. How much distance will it travel during the 6th second?
(a) [illegible] metres (b) [illegible] metres
(c) [illegible] metres (d) [illegible] metres

5. The sum of a series in A.P. is [illegible]. Its first term is [illegible] and last term is [illegible]. Find the common difference.
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

6. The sum of n terms of an A.P. is [illegible]. Find the nth term.
(a) [illegible] (b) [illegible]
(c) 6n + 3 (d) [illegible]

7. The 5th term of a G.P. is [illegible]. Find the product of its first 9 terms.
(a) [illegible] (b) 512
(c) [illegible] (d) [illegible]

8. The 3rd term of a G.P. is the square of the first term. If the second term is 8, determine its 6th term.
(a) [illegible] (b) [illegible]
(c) 128 (d) [illegible]

9. The sum of first three terms and the sum of first six terms of a G.P. are in the ratio of 125 : 152. Find the common ratio of G.P.

(a) $\frac{2}{3}$ (b) [illegible]

(c) $\frac{3}{4}$ (d) [illegible]

10. Evaluate $\sum_{j=1}^{11}(2+3^j)$

(a) $22+\frac{3}{2}(3^{11}-1)$ (b) $\frac{3}{2}(3^{11}-1)$

(c) $22+\frac{3}{2}(3^{10}-1)$ (d) None of these

11. The common ratio of a G.P. is $-\frac{4}{5}$ and its sum to infinity is $\frac{80}{9}$. Find its first term.

(a) [illegible] (b) 15

(c) 12 (d) 10

12. Sum the series to infinity

$\frac{2}{5}$ [illegible] $\frac{1}{5^2}+\frac{3}{5^3}$ [illegible] $\frac{3}{5^5}$ [illegible] ....

(a) $\frac{3}{11}$ (b) $\frac{7}{12}$

(c) $\frac{7}{11}$ (d) [illegible]

13. Find the 8th term of the H.P. 6, 4, 3, ...

(a) 7/6 (b) 5/6

(c) 4/3 (d) None of these

14. If x > 1, y > 1, z > 1 are in G.P., then

$\frac{1}{1+\log x}, \frac{1}{1+\log y}, \frac{1}{1+\log z}$ are in

(a) A.P. (b) H.P.

(c) G.P. (d) None of these

15. If a be the first term of a G.P., l the nth term and P the product of first n terms, then $P^2 =$

(a) $(al)^n$ (b) $(a-l)^n$

(c) $(a+l)^{2n}$ (d) None of these

□□□

Solutions

1. Ans. (a)

∵ [illegible] is an A.P.

∴ [illegible] $= \frac{5k}{8} - 2k$ [illegible]

$\Rightarrow \frac{-11k}{[illegible]} = \frac{-2}{[illegible]} \Rightarrow k = \frac{16}{33}$

2. Ans. (c)

Let a be the first term and d be the common difference of the A.P.

∴ $a_8 = a + 7d$

$a_{11} = a + 10d$ [illegible] $7a_7 = 11a_{11}$

[illegible]

$\Rightarrow 7a + 42d = 11a + 110d$

$\Rightarrow 4a + 68d = 0$

$\Rightarrow a + 17d = 0$

$\Rightarrow a_{18} = 0$

3. Ans. (a)

Let A be the first term and D the common difference of A.P.

$a_p = a = A + (p-1)D$ ...(i)

$a_q = b = A + (q-1)D$ ...(ii)

$a_r = c = A + (r-1)D$ ...(iii)

∴ $a(q-r) + b(r-p) + c(p-q)$

$= [A + (p-1)D](q-r) + [A + (q-1)D](r-p)$

[illegible]

$+ (r-1)(p-q)]D$ [illegible]

$= 0 \cdot A + 0 \cdot D = 0$

4. Ans. (a)

Distance covered during the 1st second = 16 m

Distance covered during the 2nd second = 32 m

Distance covered during the 3rd second = 48 m

These distances are in A.P. = 16 + 32 + 48 + ... up to n terms

a = 16, d = 16

∴ Distance covered in the 9th second

= 8th term of the A.P.

= a + 7d = 38 + 7(−4)

= [illegible] = [illegible] metres

5. Ans. (a)

[illegible]

[illegible]

where a is the first term and d the common difference.

∴ [illegible]

Also $S_n = \frac{n}{2}[\ldots]$

∴ 525 = $\frac{n}{2}$ [illegible]

or n = [illegible] = [illegible]

Substituting n = 25 in (i), we get

[illegible]

6. Ans. (b)

Here $S_p = 3p^2 + 4p$

Putting p = n, we have

$S_n = 3n^2 + 4n$

Changing n to n − 1, we get

$S_{n-1} = 3(n-1)^2 + 4(n-1)$

[illegible]

[illegible]

∴ $T_n = S_n - S_{n-1}$

[illegible]

7. Ans. (c)

[illegible]

∴ [illegible] ...(i)

[illegible]

[illegible]

[illegible]

= [illegible] = 512.

8. Ans. (a)

[illegible]

G.P.

We have [illegible]

⇒ [illegible] ...(i)

Also [illegible]

⇒ [illegible] ...(ii)

[illegible]

[illegible]

∴ [illegible]

[illegible]

[illegible]

= 4 × 32 = 128

9. Ans. (b)

Here, $\frac{S_3}{S_6} = \ldots = \frac{125}{152}$

⇒ [illegible] $= \frac{125}{152}$

⇒ [illegible]

⇒ [illegible] $= \frac{27}{125}$

⇒ [illegible]

Hence the common ratio of G.P. is [illegible]

10. Ans. (a)

[illegible]

[illegible] ... to n terms

[illegible] ... to n terms

[illegible]

11. Ans. (c)

[illegible]

⇒ [illegible] = 16

Hence [illegible]

12. Ans. (c)

[illegible]

[illegible]

[illegible]

$= \frac{3}{4} \times \frac{16}{5} \ldots \frac{3}{16} \times \frac{[illegible]}{15} = \frac{4}{5} = \frac{1}{3}$

$= \frac{12+5}{[illegible]} = \frac{[illegible]}{15}$

14. Ans. (b)

The given sequence is 3, 4, 3 ... which is H.P. The general term of this sequence is

$\frac{1}{3}, \frac{1}{4}, \frac{1}{5}$ ... which is an A.P.

Here, $d = \frac{1}{4} - \frac{1}{3} = -\frac{1}{12}$

∴ a_9 of A.P. $= a + 8d$

$= \frac{1}{3} - 8 \times \frac{1}{12} = \frac{[illegible]}{6} = \frac{4}{3} = \frac{5}{3}$

∴ 9th term of H.P. is $\frac{[illegible]}{[illegible]}$

15. Ans. (b)

x, y, z are in G.P.

∴ $y^2 = xz$

Taking log on both sides

$2 \log y = \log x + \log z$

⇒ $2 + 2 \log y = (1 + \log x) + (1 + \log z)$

⇒ $2(1 + \log y) = (1 + \log x) + (1 + \log z)$

⇒ $1 + \log x,\ 1 + \log y,\ 1 + \log z$ are in A.P.

⇒ $\frac{1}{1+\log x}, \frac{1}{1+\log y}, \frac{1}{1+\log z}$ are in H.P.

16. Ans. (a)

Let r be the common ratio of G.P., then

$1 = ar^{n-1}$ ...(i)

Let P be product of the n terms

$P = a \cdot ar \cdot ar^2 \ldots ar^{n-1}$

$P = a^n r^{1+2+\ldots+(n-1)}$

$= a^n r^{\frac{n(n-1)}{2}} = (a^2)^{n/2} \times (r^{n-1})^{n/2}$

$= (a^2 r^{n-1})^{n/2} = (a \cdot ar^{n-1})^{n/2} = (al)^{n/2}$

□□□

III Practice Exercise: III

1. If the sum of the 3rd and the 15th elements of an arithmetic progression is equal to the sum of the 6th, 11th and 13th elements of the same progression, then which element of the progression should necessarily be equal to zero?
   (a) 10th (c) 8th
   (b) 1st (d) None of these

2. The nth term of the [illegible] sequence [illegible] is
   (a) $\frac{1}{\sqrt{3}} \times [illegible]$ (c) [illegible]
   (b) $\frac{1}{4} [illegible] \frac{1}{[illegible]}$ (d) None of these

3. If $\log_x a$, $a^{x/2}$ and $\log_b x$ are in GP then x is
   (a) $\log_a(\log_b a)$
   (b) $\log_a(\log_e a) + \log_a(\log_e b)$
   (c) $-\log_a(\log_a b)$
   (d) $\log_a(\log_e b) - \log_a(\log_e a)$

4. A person pays Rs. 975 in monthly instalments, each monthly instalment being less than the former by Rs. 5. The amount of the first instalment is Rs. 100. In what time, will the entire amount be paid?
   (a) 12 months (c) 26 months
   (b) 15 months (d) 18 months

5. Let S_n be the sum of the first n terms of an A.P. If $S_{2n} = 3S_n$, then the ratio S_{3n}/S_n is equal to
   (a) 4 (c) 8
   (b) 6 (d) 10

6. Three numbers are in G.P. Their sum is 28 and their product is 512. The numbers are
   (a) 6, 8 and 14 (c) 4, 8 and 16
   (b) 2, 8 and 16 (d) 3, 8 and 18

7. The sum of the series
   $1 + 2^2 + 3^2 + 4^2 + \ldots + 15^2$
   (a) 1081 (c) 1240
   (b) 1160 (d) 1500

8. If $\frac{1}{b-a} + \frac{1}{b-c} = \frac{1}{a} + \frac{1}{c}$, then a, b, c are in
   (a) Arithmetic Progression
   (b) Geometric Progression

(c) Harmonic Progression
(d) None of these

9. The value of
$(1^3 + 2^3 + 3^3 + \ldots + 15^3) - (1 + 2 + 3 + \ldots + 15)$ is
(a) 14280 (b) 14400
(c) 12280 (d) 13280

10. The sum of the cubes of the first n natural numbers is
(a) $\frac{n(n+1)}{2}$ (b) n^2
(c) [illegible] (d) [illegible]

11. If $\frac{1+3+5+7+\ldots+n \text{ terms}}{2+5+8+11+\ldots+10 \text{ terms}} = 4$ then the value of n is
(a) 8 (b) 36
(c) 4 (d) 16

12. If the sum of first n natural numbers is one-fifth of the sum of their squares, then n is
(a) 5 (b) 6
(c) 7 (d) 8

13. What is the least value of n such that
$1 + 3 + 3^2 + \ldots$ n terms exceeds 2000?
(a) 7 (b) 5
(c) 8 (d) 6

14. The sum of [illegible] terms of an A.P., whose first term is 4, is [illegible]. What is the last term?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

15. If log 2, log$(2^x - 1)$ and log$(2^x + 3)$ (all to the base 10) be the three consecutive terms of an Arithmetic Progression, then the value of x is
(a) 0 (b) 1
(c) [illegible] (d) [illegible]

16. The third term of a Geometric Progression is 4. The product of the first five terms is
(a) 4^3 (b) 4^5
(c) 4^4 (d) None of these

□□□□

Solutions

1. Ans. (b)
Let a be the first term and d be the common difference of an A.P.
∴ [illegible]
[illegible]
⇒ [illegible]
∴ [illegible] term = 0

2. Ans. (c)
p, q, r are in Harmonic progression
⇒ $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in A.P.
[illegible]

3. Ans. (a), (c)
Given statement
[illegible]
[illegible]
[illegible]

4. Ans. (c)
Let n be the number of months in which all the loan is paid.
First instalment = Rs. 100
Common Difference = [illegible]
⇒ Sum of the series [illegible]
i.e. [illegible]
⇒ [illegible]
⇒ [illegible] = 0
⇒ n = [illegible] or n = 15
For n = 15, total amount paid
= $\frac{15}{2}$[2 × 100 + (15 − 1)(−5)]
= $\frac{15}{2}$[200 − [illegible]] = [illegible]

5. Ans. (a)

$S_n = \frac{n}{2}[2a + (n-1)d]$

Where a is the first term and d is the common difference.

$S_{3n} = \frac{3n}{2}[2a + (3n-1)d]$

$S_{2n} = \frac{2n}{2}[2a + (2n-1)d]$

Given, $S_{2n} = 3S_n$

$\Rightarrow n[2a + (2n-1)d] = 3\left(\frac{n}{2}\right)[2a + (n-1)d]$

$\Rightarrow d = \frac{2a}{n+1}$

$\therefore \frac{S_{3n}}{S_n} = \frac{\frac{3n}{2}[2a + (3n-1)d]}{\frac{n}{2}[2a + (n-1)d]}$

$= \frac{3\left[2a + \frac{2a(3n-1)}{n+1}\right]}{2a + \frac{2a(n-1)}{n+1}} = 3\left[\frac{8n}{4n}\right] = 6$

6. Ans. (b)

Let the three numbers be a, ar, ar², where r is common ratio

$\therefore a + ar + ar^2 = 28$ and $a^3r^3 = 512$

$\therefore ar = 8 \Rightarrow \frac{8}{r} + 8 + 8r = 28$

$\Rightarrow 8r^2 - 20r + 8 = 0$

$\Rightarrow r = 2, \frac{1}{2}$

If r = 2, a = 4. Therefore, the three numbers are 4, 8, 16

7. Ans. (b)

The sum of the squares of first n natural numbers is

$\frac{n(n+1)(2n+1)}{6}$

Put n = 15, we have, $1^2 + 2^2 + 3^2 + 4^2 + \ldots + 15^2$

$= \frac{15(15+1)(30+1)}{6} = 1240$

8. Ans. (c)

$\frac{2}{b} = \frac{1}{a} + \frac{1}{c}$

$\Rightarrow b = \frac{2ac}{a+c} \Rightarrow \frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P.

$\Rightarrow$ a, b, c are in H.P.

9. Ans. (a)

Given expression

$= \left[\frac{15\times16}{2}\right]^2 - \frac{15\times16}{2} = (120)^2 - 120$

$= 120 \times 119 = 14280$

10. Ans. (a)

Sum of cubes of first n natural numbers

$= \left[\frac{n(n+1)}{2}\right]^2 = \frac{n^2(n+1)^2}{4}$

$\therefore$ Mean $= \frac{n(n+1)^2}{4}$.

11. Ans. (a)

S_n = Sum of n terms of an A.P.

$= \frac{n}{2}[2a + (n-1)d]$

Where a = first term

d = common difference

$\therefore \frac{3+5+7+\ldots \text{ n terms}}{5+8+11+14+\ldots+10 \text{ terms}} = 7$

$\Rightarrow \frac{\frac{n}{2}[2\times3 + (n-1)\times2]}{\frac{10}{2}[2\times5 + (10-1)\times3]} = 7$

$\Rightarrow \frac{n(2n+4)}{370} = 7$

$\Rightarrow 2n^2 + 4n - 2590 = 0$

$\Rightarrow n^2 + 2n - 1295 = 0$

$\Rightarrow n^2 + 37n - 35n - 1295 = 0$

$\Rightarrow n(n+37) - 35(n+37) = 0$

$\Rightarrow (n-35)(n+37) = 0$

$\Rightarrow n = 35$

12. Ans. (c)

Sum of the first n natural numbers $= \frac{n(n+1)}{2}$.

Sum of the squares of the first n numbers equals

$= \frac{n(n+1)(2n+1)}{6}$

$$\therefore \quad \frac{n(n-1)}{2} = \frac{[illegible]}{[illegible]}$$

$\Rightarrow \quad 2n - 1 = 13 \Rightarrow n = 7.$

13. Ans. (c)

$$\frac{3^n - 1}{3 - 1} \times 5000 \; [illegible] \; 40000 \Rightarrow n = 8$$

14. Ans. (a)

$$S = \frac{n}{2}[\text{First term} + \text{last term}]$$

Where S = 288, n = 12, L = ?

$$\therefore \quad S_{12} = 288 = \frac{12}{2}[1 + L]$$

$\Rightarrow \quad 1 + L = 48$

$\Rightarrow \quad L = 47$

15. Ans. (c)

log 2, log(2^x − 1),

log(2^x + 3) are in A.P.

$$\Rightarrow \quad 2\left[\log(2^x - 1)\right] = \log 2 + \log(2^x + 3)$$

$$= \log\left[2\left(2^x + 3\right)\right]$$

$$\Rightarrow \quad \log(2^x - 1)^2 = \log\left[2^{x+1} + 6\right]$$

$$\Rightarrow \quad (2^x - 1)^2 = 2^{x+1} + 6 = 2^x \cdot 2 + 6$$

Let $2^x = y$

$$\therefore \quad (y - 1)^2 = 2y + 6 \Rightarrow y^2 - 2y + 1 = 2y + 6$$

$$\Rightarrow \quad y^2 - 4y - 5 = 0$$

$$\Rightarrow \quad (y - 5)(y + 1) = 0$$

$$\Rightarrow \quad y = 5, -1$$

If $y = 5 \Rightarrow 2^x = 5 \Rightarrow x\log 2 = \log 5$

$$\Rightarrow \quad x = \frac{\log 5}{\log 2} \Rightarrow x = \log_2 5$$

16. Ans. (a)

Let a be the first term of a G.P. and r be the common ratio

∴ [illegible] terms of a G.P. are ar^3, ar^5, ar^7

∴ Third term $= ar^2 = 4 \Rightarrow$ [illegible]

IV Practice Exercise: IV

1. [illegible] respectively [illegible] will have the value as
   - (a) 0
   - (b) $\frac{1}{[illegible]}$
   - (c) 1
   - (d) $\frac{[illegible]}{[illegible]}$
2. The sum of all the odd 3 digit integers which are [illegible] divisible by 9 is
   - (a) 23100
   - (b) 27900
   - (c) 25100
   - (d) 25950
3. If first, [illegible] and last term of an AP are a, b, 2a respectively then its sum is
   - (a) [illegible]
   - (b) $\frac{3ab}{b-a}$
   - (c) $\frac{3ab}{2(b-a)}$
   - (d) $\frac{5ab}{3(b-a)}$
4. If |x| < 1 and $S = x + x^2 + x^3 + \ldots$ then x = [illegible]
   - (a) S
   - (b) [illegible]
   - (c) $\frac{S}{1-S}$
   - (d) $\left(\frac{S}{1+S}\right)^{1/2}$
5. A car moves 2 m in 1st second, [illegible] meters in 2nd second, [illegible] second and so on. How far it will move in 31st second?
   - (a) [illegible]
   - (b) 181
   - (c) [illegible]
   - (d) 1[illegible]
6. The sum of n terms of an AP is $n^2 + 2n$, the common difference is
   - (a) 1
   - (b) 2
   - (c) [illegible]
   - (d) [illegible]
7. If a, b, c, d are four real numbers what will be the maximum possible value of
   $$(a + b + c + d)\left[\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}\right]$$
   - (a) 4
   - (b) 2
   - (c) abcd
   - (d) 16
8. Take an AP 2, 5, 8, ... and a GP 3, 6, 12, ... till taken [illegible] how many terms will be common in both these series [illegible]

(a) 2[illegible] (b) 30

(c) [illegible] (d) [illegible]

9. The second term of an AP is equal to the 3rd term of a [illegible] AP. What will be the sum of 12 terms of [illegible] AP if the sum of first 3 terms of first AP is given [illegible]

(a) 36 (b) 1[illegible]6

(c) 201 (d) 3[illegible]

10. There are three numbers in AP. When added their sum is 48 and product is [illegible]. The largest of the numbers

(a) [illegible] (b) 25

(c) 35 (d) [illegible]

11. A ball is dropped from a height of [illegible] m and it rebounds [illegible] of its height. It continues to rebound in the same manner. What is the distance travelled by the ball in the air

(a) 75 (b) [illegible]0

(c) 1[illegible] (d) 1[illegible]

12. [illegible] terms [illegible] AP [illegible]

(a) [illegible] (b) [illegible]

(c) 30 (d) [illegible]

13. Find the sum to infinite terms of the series

$$5[illegible] + \frac{1}{[illegible]2} + \frac{1}{[illegible]0} + \frac{1}{110} + \dots$$

(a) $\frac{1}{8}$ (b) $\frac{[illegible]}{7}$

(c) $\frac{[illegible]}{9}$ (d) $\frac{[illegible]}{28}$

14. Let {1, 2, 3, [illegible]} [illegible] how many APs can be formed by taking [illegible] starting from 1 and ending at [illegible] [illegible]

(a) 12 (b) 1[illegible]

(c) 1[illegible] (d) 24

15. Find the sum of the 10 terms of the series

12 [illegible]

(a) [illegible] (b) 25[illegible]

(c) [illegible] (d) 2[illegible]

Solutions

1. Ans. (a)

Let first term be a

$a + (n-1)d = [illegible]$

[illegible]

2. Ans. (a)

First 3 digit integer divisible by [illegible] = [illegible]

Last 3 digit integer divisible by [illegible] = [illegible]

[illegible]

$\Rightarrow$ [illegible]

Sum = $\frac{[illegible]}{2}[100 + 9[illegible]]$ = [illegible]

$\Rightarrow$ Sum = [illegible]

3. Ans. (a)

Common difference = [illegible]

[illegible]

4. Ans. (d)

[illegible]

5. Ans. (b)

[illegible]

6. Ans. (c)

[illegible]

[illegible]

[illegible]

[illegible]

7. Ans. (c)

Applying A.M. ≥ G.M.

[illegible]

[illegible]

[illegible]

i.e. the min. possible value = 12

8. Ans. (b)

[illegible] consecutive 3 terms

[illegible] = 29

9. Ans. (d)

[illegible]

[illegible]

[illegible]

[illegible]

10. Ans. (b)

[illegible] = 15

[illegible] 875

[illegible]

= 15 [illegible]

11. Ans. (c)

[illegible]

[illegible]

$= 50 + \frac{50}{2} + \frac{50}{3}$ [illegible] $+ \frac{50}{27}$ [illegible]

[illegible]

$= 100\left(1 + \frac{1}{3} + \frac{1}{9} \cdots\right) - 50$

$= 100\left(\frac{1}{1-\frac{1}{3}}\right) - 50 = 100$ m

12. Ans. (d)

[illegible]

[illegible]

[illegible]

Solving these equations

[illegible]

13. Ans. (d)

[illegible]

[illegible] 9 [illegible] 10 ...

[illegible]

[illegible]

14. Ans. (c)

[illegible]

So the possible value of n will be the number of factors of 540

Number of factors of 540 = 3 × 4 × 2 = 24

[illegible]

[illegible]

[illegible]

[illegible]

15. Ans. (a)

Here [illegible]

[illegible] + 3 [illegible]

General term

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

S_{10} = [illegible] 10

[illegible]

2.3 CHAPTER Permutation & Combination

Being the basis of probability, students must grasp permutations & combinations because this is one of the important module from exam point of view.

Fundamental Principle of Counting

Multiplication Rule

If a task A can be done in m ways & a second task B can be done in n ways, the number of ways of doing both the tasks one after another is m × n ways.

Addition Rule

If task A can be done in m ways & another task B can be done in n ways then total no. of ways of doing either of task

= (m + n) ways

These two rules are the basic building blocks of permutations & combinations principles.

Some Basic Examples

1. In a building there are 5 floors. In how many ways can 5 persons be placed on 5 different floors such that exactly one person is placed at any floor (order in which person are going down is not important)

Solution

1st person has 5 choices of floor. Next person only 4 choices (because one of the floors is occupied by 1st person)

Progressing with same logic

Total no. of ways (because all five to be placed hence multiplication rule)

= 5 × 4 × 3 × 2 × 1 = 120 ways

2. In a party there are 20 couples, 20 boys (single) & 20 girls (single) are invited. The dance between any two persons of opposite sex is allowed & dance between couples is not allowed. Find how many total dances took place in the party?

Solution

	Males	Females
Couples	20	20
Singles	20	20

For each male among couple he can dance with 39 females (because he can not dance with his partner) & for each single boy there are 40 female partners available.

Hence total no. of dances

= 20 × 39 + 20 × 40 = 780 + 800 = 1580

Permutations

Number of ways of arranging 'n' distinct things in a row is known as permutations. For example 3 cards a, b & c can be arranged in multiple ways (6 in total i.e. 3!), total 6 different arrangements as follows:

$$\left| \begin{matrix} a\ b\ c & b\ a\ c & c\ a\ b \\ a\ c\ b & b\ c\ a & c\ b\ a \end{matrix} \right. \quad \text{Total six ways}$$

$$^nP_r = \frac{n!}{(n-r)!}$$

Total permutations of n things taken out of n things taken r at a time.

The terms permutation & arrangement are synonyms and can be used interchangeably.

Combinations

Combination is basically selection of a group of certain things and gives us no information, order of things is not matter.

Combinations of n things taken r at a time is

$$^nC_r = \frac{^nP_r}{r!} = \frac{n!}{r!(n-r)!}$$

Special Notes

At times question may not directly say whether we have to use permutations or combinations, but nature of question itself gives us what has to be used to solve the question.

For Example

If we say how many 2 digit numbers can be made using digits 1, 2, 3 exactly once, then possible numbers are 12, 21... here order is important hence permutation will be used.

If any [illegible] things [illegible] that [illegible] how many ways I can take three items [illegible] [illegible] [illegible] [illegible]

In the beginning [illegible] we will cover [illegible] permutation and combination formulas with [illegible] concepts

- [illegible] things are distinct
- Each item is used exactly [illegible] once

Then Permutation [illegible] without repetition

$$^nP_r = \frac{\lfloor n}{\lfloor n-r}$$

$\lfloor n = 1 \times 2 \times 3 \times \ldots \times n$

$\lfloor 0 = 1$

Number of combinations of n distinct things taken r at a time

$$= {^nC_r} = \frac{n!}{(n-r)!\,r!}$$

${^nC_r} = {^nC_{n-r}}$

Number of arrangements of n items of which P are of one type, q are of another type and r are of third [illegible]

$$= \frac{\lfloor n}{\lfloor P \times \lfloor q \times \lfloor r}$$

Number of Permutations of n distinct items when each item can be used any number of times (repetition allowed) = n^r

Number of ways of selecting at least one item from n given items = $2^n - 1$

$\Rightarrow {^nC_1} + {^nC_2} + \ldots + {^nC_n} = 2^n - 1$

Division into groups

Dividing (P + q) things into 2 groups of P things & q things

$$= \frac{(P+q)!}{P!\,q!}$$

Special Cases

(i) Dividing 2P things into two groups having P items each [illegible] grouping [illegible] $= \frac{(2P)!}{2(P!)^2}$

(ii) Dividing 3P things into three groups each having P items each $= \frac{(3P)!}{(P!)^3}$ [illegible]

Circular Permutations

Number of circular permutations of n distinct things = (n − 1)! (when clockwise & anticlockwise arrangements are different)

$= \frac{(n-1)!}{2}$ (when clockwise & anticlockwise arrangements are same)

Partition Rule

No. of ways of distributing n identical things among r people

Case-1.

When every person can have zero things

$= {^{n+r-1}C_{r-1}}$

Case-2.

When each person has to receive at least one thing

$= {^{n-1}C_{r-1}}$

The total number of ways in which a selection can be made by taking one or more out of p + q + r + … things where p are of one kind, q of a second kind, r of a third kind and so on

$[(p+1)(q+1)(r+1)\ldots] - 1$

Some Additional Points

${^{n+1}C_r} = {^nC_r} + {^nC_{r-1}}$

${^nP_r} = r! \times {^nC_r}$

${^nC_0} + {^nC_2} + \ldots = {^nC_1} + {^nC_3} + \ldots = 2^{n-1}$

${^nC_0} + {^nC_1} + {^nC_2} + \ldots = 2^n$

${^nC_1} + {^nC_2} + {^nC_3} + \ldots = 2^n - 1$

*****

Solved Examples

Direction (Q.1 to Q.4): How many [illegible]-digit numbers are possible with digits [illegible]

1. When each digit is distinct?

   (a) [illegible] (b) [illegible]

   (c) [illegible] (d) None of these

   Ans. (b)

   [illegible]

2. When repetition of digits is allowed?

   (a) [illegible] (b) [illegible]

   (c) [illegible] (d) None of these

   Ans. (c)

   [illegible]

3. What is sum of all numbers in example [illegible]

(a) [illegible] × 1111 × 28 (b) [illegible] × 11111 × 28

(c) [illegible] × 11111 × 28 (d) None of these

Solution for Example 3.

Total no. possible [illegible] = 5040

In these 5040 numbers each digit [illegible] digits out of 1, 2, 3, 4, 5, 6, 7 will come [illegible]

[illegible] place [illegible]

[illegible] will be [illegible] place [illegible]

[illegible] total number [illegible]

$= \frac{[illegible]}{7}(1+2+3+4+5+6+7)$

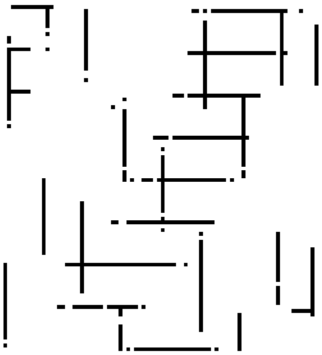
Hence [illegible]

$= \frac{[illegible]}{7}(1+2+3+4+5+6+7)$

[illegible]

$= \frac{[illegible]}{7} \times 28 \times [illegible] = [illegible] \times 28 \times [11111]$

Directions (Q.4 to Q.6): Below is a square grid of 8 × 8



Example 4.

What is total No. of squares in the grid?

(a) 204 (b) [illegible]

(c) 140 (d) None of these

Ans. (a)

Squares of 1 × 1 unit = 64

Squares of 2 × 2 unit = [illegible]

Squares of 3 × 3 unit = [illegible]

[illegible]

[illegible]

Squares of 7 × 7 unit = [illegible]

Squares of 8 × 8 unit = 1

Total no. of squares

$= 1^2 + 2^2 + [illegible] + 8^2 = 204$

Hence option (a)

Example 5

What is total number of rectangles in the grid?

(a) 36 × 28 (b) 35 × 21

(c) 36 × 21 (d) 36 × 32

Ans. (c)

To form one rectangle we need to select [illegible] horizontal [illegible] which can be selected as ⁹C₂ ways [illegible] vertical [illegible] can be selected as ⁷C₂ ways

([illegible] total [illegible] horizontal lines and [illegible] vertical lines)

Hence total no. of rectangles are

$= {}^9C_2 \times {}^7C_2 = \left(\frac{9 \times 8}{2}\right) \times \left(\frac{7 \times 6}{2}\right) = 36 \times 21$

Hence option (c)

Example 6

How many rectangles [illegible] different [illegible] are there?

(a) 34 (b) 36

(c) 38 (d) 3?

Ans. (c)

Rectangles of

1 × 1, 1 × 2, 1 × 3, 1 × 4, 1 × 5, 1 × 6, 1 × 7,

1 × 8 = 8 rectangles

2 × 2, 2 × 3, 2 × 4, 2 × 5, 2 × 6, 2 × 7, 2 × 8

= 7 rectangles

3 × 3, 3 × 4 .... 3 × 8 = 6 rectangles

4 × 4 .... 4 × 8 = 5 rectangles

5 × 5 .... 5 × 8 = 4 rectangles

6 × 6, 6 × 7, 6 × 8 = 3 rectangles

7 × 7, 7 × 8 = 2 rectangles

8 × 8 = 1 rectangles

Hence total no. of rectangles

= 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1

= 36 rectangles

Directions (Q.7 & Q.8): There are 10 points in a plane & out of these 4 are collinear.

Example 7

How many triangles can be made using these 10 points?

(a) ¹⁰C₃ − ⁴C₃ (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (a)

To make triangle we need 3 non-collinear points.

⇒ Out of 10 points we can select 3 in ${}^{10}C_3$ ways but in this selection ${}^4C_3$ selections are waste because all these 4 points are collinear [illegible] triangles

= ${}^{10}C_3 - {}^4C_3$ Option (c)

Example 8.

How many different lines can be drawn?

(a) ${}^{10}C_2 - {}^4C_2$ (b) ${}^{10}C_2 - {}^4C_2 + 1$

(c) ${}^{10}C_2 - {}^4C_2 - 1$ (d) None of these

Ans. (b)

To draw a line we need two points out of 10 points we can select 2 points in ${}^{10}C_2$ ways but in this selection 4 points are collinear which only one line possible

Hence total no. of lines

= ${}^{10}C_2 - {}^4C_2 + 1$

Hence option (b)

Example 9

How many non-negative integral solutions possible for equation below?

$x + y + z + w = 20$

(a) ${}^{23}C_3$ (b) ${}^{24}C_3$

(c) ${}^{22}C_3$ (d) None of these

Ans. (a)

(x, y, z, w) are taking non-negative values (zero to 20) it is a question of partition of 20 things to be distributed among x, y, z, w [illegible]

Hence no. of non-negative integral solutions

= ${}^{20+4-1}C_{4-1} = {}^{23}C_3$

Hence option (a)

Example 10.

How many positive integral solutions are possible for equation below?

$x + y + z + w = 20$

(a) ${}^{19}C_3$ (b) ${}^{20}C_4$

(c) ${}^{19}C_4$ (d) None of these

Ans. (a)

[illegible]

Hence total ways = ${}^{20-1}C_{4-1} = {}^{19}C_3$

Hence option (a)

Example 11

There are 12 people to be seated around a round table. In how many ways can [illegible]

(i) There is no restriction

(a) 11! (b) 12

(c) 10! (d) 11

Ans. (a)

No. of circular permutations = (12 − 1)!

Hence option (a)

(ii) Such that a particular person A, B, C are all ways together

(a) 12 (b) 10

(c) 9! × 3! (d) 10! × 3!

Ans. (c)

Consider those three persons as one group, so we have 10 persons (9 persons and 1 group) which can be arranged in (10 − 1)! ways but 3 persons of group can be arranged in 3! ways.

Hence total possible no. of arrangements

= 9! × 3!

Hence option (c)

(iii) Such that A, B, C all three are never together

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

Ans. (b)

Total no. of required permutations

(total no. of permutations) − (no. of circular permutations where all three are together)

= [illegible]

= [illegible]

Hence option (b)

* * *

Solved Examples

1. [illegible]

   Solution: [illegible]

2. How many words can be formed by using letters of word [illegible]

   Solution: In [illegible] we have

   2 − [illegible]

   2 − A's

So, total number of ways of forming teams are

$$\frac{5!}{2!\times 2!} = 30$$

3. In how many different ways can the letters of the word [illegible] be arranged? How many begin with [illegible] and end with [illegible]?

Solution: [illegible]

[illegible] are fixed in first and last positions. Then we have to arrange [illegible] among themselves [illegible] this can be done in [illegible] ways.

4. Six boys and 4 girls [illegible] How many ways of sitting arrangement can be possible [illegible] together?

Solution: $B_1B_2B_3B_4B_5B_6G_1G_2G_3G_4$ ... (1)

Now the girls [illegible] together then

$B_1B_2B_3B_4B_5B_6X$ ... (2)

[illegible] together)

Above arrangement can be arranged in 7! ways.

Now girls can be arranged among themselves in 4! ways. So, total [illegible] 7! [illegible] ways.

5. In the above question find number of ways of arrangement if no two girls sit together.

Solution: The boys can be seated in the following manner:

B_1 [illegible] B_6 [illegible]

First of all, boys can be arranged in 6! ways. [illegible] This can be done in $^7P_4$ ways. So, total arrangement $= {}^7P_4 \times 6!$

6. How many 5-digit numbers can be formed by using 0, 1, 2, 3, 4, 5, 6, 7 (without repetition)?

Solution: [illegible]

As first place cannot be filled with zero so only 7 numbers can be filled in first place and so on.

$7\times 7\times 6\times 5\times 4 = 5880$ ways

7. How many different sums can be formed with the following coins by selecting any number of each kind: 5 paise, [illegible], 50 paise, 25 paise, 10 paise, 1 paise

Solution: A sum of money can be formed by selecting either 1 or 2 or 3 [illegible] coins at a time;

$^6C_1 + {}^6C_2 + {}^6C_3 + {}^6C_4 + {}^6C_5 + {}^6C_6$ ways.

By [illegible] this is equal to $2^6 - 1$ ways.

Answer: [illegible]

8. [illegible] 15 points in [illegible] plane [illegible] How many [illegible] can be formed?

Solution: [illegible]

[illegible]

9. How many triangles can be formed by joining the [illegible]

Solution: To form a triangle [illegible] This can be done in $^9C_3$ ways = 84

10. In the above question, how many straight lines can be formed [illegible]

Solution: The straight lines will be given by

[illegible]

□□□□

Practice Exercise I

1. How many numbers of 3 digits can be formed with the digits 1, 2, 3, 4, 5 (repetition of digits not allowed)?
   (a) 25 (b) 120
   (c) [illegible] (d) [illegible]

2. How many numbers between 2000 and 3000 can be formed with the digits 0, 1, 2, 3, 4, 5, 6, 7 (repetition of digits not allowed)?
   (a) [illegible] (b) 210
   (c) [illegible] (d) [illegible]

3. In how many ways can a person send invitation cards to 6 of his friends if he has four servants to distribute the cards?
   (a) [illegible] (b) [illegible]
   (c) 24 (d) None of these

4. In how many ways can 7 Indians, 5 Pakistanis and 8 Dutch be seated in a row so that all persons of the same nationality sit together?
(a) 3! (b) 7!5!8
(c) [illegible] (d) 15

5. How many straight lines can be formed from 8 non-collinear points on the X-Y plane?
(a) 28 (b) [illegible]
(c) [illegible] (d) [illegible]

6. In how many ways can the letters of the word PATNA be arranged?
(a) 60 (b) 120
(c) [illegible] (d) [illegible]

7. In the above question, how many words would be made when the word starts with letter P?
(a) 24 (b) 12
(c) [illegible] (d) [illegible]

8. A cricket team of 11 players is to be chosen out of a group of 14 players. How many ways are there to do this?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

9. In how many ways can we choose three vowels and [illegible] consonants from the word ALLAHABAD?
(a) 4 (b) [illegible]
(c) 3 (d) 7

10. In how many ways can the letters of the word [illegible] be arranged so that all the vowels come together?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Directions for questions 11-13: [illegible]

11. How many straight lines can be formed?
(a) 7 (b) [illegible]
(c) [illegible] (d) None of these

12. How many triangles can be formed from these points?
(a) 1[illegible] (b) 2235
(c) 7[illegible] (d) None of these

13. How many [illegible]
[illegible]
[illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

14. How many distinct words can be formed out of the word [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

15. How many 7-digit numbers are there having the digit [illegible] (three times) and the digit [illegible] (four times)?
(a) [illegible] (b) [illegible]
(c) 35 (d) None of these

□□□□

Solutions

1. Ans. (c)
Three digits can be formed in [illegible] ways [illegible]
[illegible] = [illegible]

2. Ans. (a)
Numbers between 3000 and 8000 [illegible]
[illegible]

3 □ □ □

So 3 places [illegible]
[illegible] can be filled in
$^7P_3$ ways

$= \frac{7!}{(7-3)!} = 210$ ways

3. Ans. (b)
[illegible]
[illegible]

4 × [illegible] ways

4. Ans. (c)
We have

7 Indians
5 Pakistanis and
8 Dutch

7 Indians can [illegible] ways
5 Pakistanis can sit in 5! ways
8 Dutch can sit in 8! ways
Also they can sit together in 3! [illegible] ways

7! × 5! × 8! × 3!

5. Ans. (a)
[illegible]
So $^8C_2$ = 28 ways

6. Ans. (a)

This can be done in $\frac{5!}{3!}$ ways.

$\frac{5!}{3!} = 20$

7. Ans. (c)

In OPTICAL [illegible] we have only four letters [illegible] in which the vowels [illegible].

So, [illegible] = [illegible]

9. Ans. (c)

$^{10}C_2$ [illegible] ways [illegible]

8. Ans. (c)

In alphabet [illegible] there [illegible] only one vowel and 4 consonants [illegible]

So only four combination.

[illegible] are only 4 possibilities [illegible]

10. Ans. (d)

In EQUATION there are five vowels A, E, I, O and U and three consonants [illegible]. [illegible] arrangements [illegible] is 5! ways

11. Ans. (c)

The number of straight lines

= [illegible] + 1 = 40

12. Ans. (b)

Total triangles formed [illegible] to

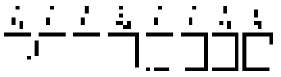
[illegible] = [illegible]

13. Ans. (d)

[illegible]

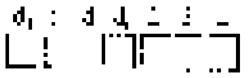
= [illegible] = [illegible]

14. Ans. (c)



[illegible] ways

15. Ans. (a)



In this question we need a four digit number [illegible] this can be done in

$\frac{6!}{4! \times 2!} = 15$ ways

* * *

Practice Exercise 1

1. There are 15 buses running between Delhi & Mumbai. In how many ways can a man go to Mumbai and return by a different bus?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

2. [illegible] questions [illegible]?
(a) [illegible] (b) 140
(c) [illegible] (d) [illegible]

3. A code word is to consist of two distinct English alphabets followed by two distinct numbers between 1 and 9. For example, CA23 is a code word. How many such code words are there?
(a) [illegible] (b) 46800
(c) [illegible] (d) [illegible]

4. There are [illegible] letters and [illegible] addressed envelopes. Find the number of ways in which the letters can be [illegible] into the envelopes?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

5. How many different numbers of two digits can be formed with the digits 1, 2, 3, 4, 5, 6 no digit being repeated?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

6. How many three digit numbers can be formed from the digits 1, 2, 3, 4, 5, 6 when
(i) repetition of digits is not allowed
(ii) repetition of digits is allowed?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

7. How many numbers are there between 100 and 1000 such that all the digits are distinct?
(a) 648 (b) [illegible]
(c) [illegible] (d) [illegible]

8. Solve for [illegible]
(a) 6 (b) [illegible]
(c) 8 (d) [illegible]

9. How many words, with or without meaning, can be formed using all the letters of the word EQUATION, using each letter exactly once?
(a) 40320 (b) 38320
(c) 41320 (d) 38400

10. It is required to seat 5 men and 4 women in a row so that the women occupy the even places. How many such arrangements are possible?
(a) 2880 (b) 2780
(c) 2480 (d) 2980

11. Four books, one each in Chemistry, Physics, Biology and Mathematics, are to be arranged in a shelf. In how many ways can this be done?
(a) 12 (b) 36
(c) 24 (d) 48

12. How many different numbers of six digits can be formed with the numbers [illegible] 0, 4, 5?
(a) 720 (b) 640
(c) 600 (d) 360

13. How many 3-digit numbers are there, with no digit repeated?
(a) 548 (b) 648
(c) 748 (d) 749

14. In how many different ways, the letters of the word ALGEBRA can be arranged in a row if
(i) The two As are together?
(ii) The two As are not together?
(a) (i) 720, (ii) 1800
(b) (i) 1050, (ii) 1600
(c) (i) 750, (ii) 1800
(d) (i) 1720, (ii) 1800

15. How many different words can be formed with the letters of the word "BHARAT"?
In how many of these B and H are never together?
(a) 720, 180 (b) 240, 360
(c) 360, 240 (d) 360, 360

16. How many different numbers can be formed [illegible] digits all different?
(a) 18 (b) 21
(c) 24 (d) 25

17. In how many ways can a committee be selected from [illegible]?
(a) 270 (b) 362
(c) 257 (d) 342

Solutions

1. Ans. (d)
The first event of going from [illegible] to Ahmedabad can be performed in 15 ways and in each of such ways by any of the 15 buses. And the second event of coming back from Ahmedabad can be performed in 14 ways (a different bus is to be taken).
Hence, both the events can be performed in 15 × 14 = 210 ways.

2. Ans. (c)
Since the first exercise contains 11 questions, the number of ways of choosing the first question is 11. Since the second exercise contains 12 questions, the number of ways of choosing the second question is 12. Hence, by the fundamental principle, two questions can be selected in 11 × 12 = 132 ways.

3. Ans. (b)
(i) There are in all 26 English alphabets. We have to choose 2 distinct alphabets.
The first place can be selected in 26 ways.
Second place can be selected in 25 ways.
Again, there are 10 digits (0, 1, ..., 9), first digit can be selected in 10 ways. Second digit can be selected in 9 ways.
Thus, the number of such badges
= 26 × 25 × 10 × 9 = 58500

4. Ans. (c)
Here the first letter can be put in any one of the 5 envelopes in 5 ways. Second letter can be put in any one of the remaining 4 envelopes in 4 ways. Continuing in this way, we get the total number of ways in which 5 letters can be put into 5 envelopes
= 5 × 4 × 3 × 2 × 1 = 120
But out of these 120 ways, there is one and only way to putting each letter in the correct envelope. Hence, the number of ways of putting the letters in wrong envelopes = 120 − 1 = 119 ways.

5. Ans. (c)
We have to fill two places (since number be of two digits).
The first place can be filled up in 9 ways, as zero cannot be at the tens place.
The 2nd place can be filled in 9 ways, as digit is to be repeated. Hence, the two places can be filled up in 9 × 9 = 81 ways

6. Ans. (a)

(i) When repetition of digits is not allowed: Since [illegible] the digit at unit's place [illegible]. Hence the unit's place can be filled up by 1, 3 or 5, i.e., in 3 ways.
Also, the ten's digit can be filled up by any of the remaining digits in 5 ways and then the hundred's place can be filled up by the remaining digits in 4 ways.
So, the number of [illegible] 3 × [illegible]

(ii) When repetition of digits is allowed: Again, the unit's place can be filled up by 1, 3, 5 i.e., in 3 ways. Also the ten's and hundred's place can be filled up by any of the six given digits in 6 ways each (as repetition is allowed).
Hence, the number of three digited odd numbers that can be formed
= 3 × 6 × 6 = 1[illegible]

7. Ans. (b)

All numbers between 100 and 1000 have three digits. So the number will have distinct digits selected from 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are allowed.
Also 0 cannot be chosen on the hundred's place. Hundred's place can be filled in 9 ways. Tenth place can be filled in 9 ways, unit's place can be filled in 8 ways.

∴ The total no. of such numbers
= 9 × 9 × 8 = 648

8. Ans. (c)

[illegible]

⇒ [illegible] [(n − 1) [illegible]] = 8[(n [illegible])!]

⇒ n^2 [illegible] 8 [illegible] n − 8 [illegible] 0

⇒ (n [illegible]) [illegible] 0

∴ Either n [illegible] 8 [illegible] n − 1 = 0

⇒ n = 8 or n = 1

n = 1 is not possible as [illegible] = 5

∴ n = 8

9. Ans. (c)

The word EQUATION has exactly 8 letters which are all different.

∴ The number of words that can be formed = number of permutations of 8 letters taken all at a time.

= P(8, 8) = 8!

= 8 × 7 × 6 × 5 × 4 × 3 × 2 × 1

= 40320

10. Ans. (b)

Total number of seats [illegible] = 9
In a row of 9 seats, the even places are 2nd, 4th, 6th and 8th. Now number of women = 4, [illegible] women to be seated in even places [illegible]

∴ Even places can be filled in P(4, 4) ways.
Number of men = 5

∴ The remaining 5 places can be filled by 5 men in P(5, 5) ways.

∴ [illegible]

∴ The required number of seating arrangements

= P(4, 4) × P(5, 5) = 4! × 5!

= 24 × 120 = 2880

11. Ans. (c)

4 different books can be arranged among themselves in 4! ways [illegible]

= 4 × 3 × 2 × 1 = 24 ways

12. Ans. (d)

6! numbers can be formed by taking all six digits together i.e.,

$^6P_6 = 6!$

But we have to reject the numbers which begin with zero. The number of these [illegible] in the 1st place = 5!.
Hence the required numbers = 6! − 5!
= 720 − 120 = 600

13. Ans. (a)

The required number of three digit numbers = the permutations of the 10 objects 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 taken 3 at a time, with the condition that 0 is not in the hundred's place

= P(10, 3) − P(9, 2)

$= \frac{10!}{7!} - \frac{9!}{7!}$

$= \frac{10 \times 9 \times 8 \times 7!}{7!} - \frac{9 \times 8 \times 7!}{7!}$

10 × 9 × 8 − 9 × 8

= 720 − 72 = 648

14. Ans. (a)

All 7 letters [illegible] 2 A, [illegible]

(i) Since two A's are always together, we take both the A's as one letter.

Let p be the number of arrangements, then

$p = 6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$

(ii) Total number of permutations

$$q = \frac{7!}{2!} = 7 \times \frac{6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 1}$$

$= 2520$

In these permutations, are some permutations, two A's are together and in the rest they are not together. Hence, the number of permutations in which two A's are not together is

$q - p = 2520 - 720 = 1800$

15. Ans. (b)

Total letters in the word 'BHARAT' are 6 out of which A's are alike.

$\therefore$ Number of permutations $= \frac{6!}{2!} = 360$

Number of words in which B and H are never together

= Total number of words − Number of words in which B and H are together

$$= 360 - \frac{5!}{2!}\,2! = 360 - 120 = 240$$

16. Ans. (c)

The total no. of beads $= 6 + 5 = 11$

$n_1 = 6,\ n_2 = 5$

$\therefore$ No. of different necklaces

$$= \frac{1}{2}\frac{(11-1)!}{6!\,5!} = \frac{10!}{2 \cdot 6!\,5!}$$

$$= \frac{10 \times 9 \times 8 \times 7 \times 6!}{2 \times 6! \times 5 \times 4 \times 3 \times 2} = 3 \times 7 = 21$$

17. Ans. (d)

Required the number of ways $= C(10, 5)$

$$= \frac{10!}{5!\,5!} = \frac{10.9.8.7.6}{5 \times 4 \times 3 \times 2} = 252$$

Practice Exercise : I

1. The letters of word 'PROMISE' are arranged so that no two of the vowels should come together. The total number of arrangements is
(a) 49 (b) 1440
(c) 7 (d) 1898

2. In an examination, a question paper consists of two groups, each containing 4 questions. A candidate is required to attempt 5 questions but not more than 3 questions from any group. In how many ways can 5 questions be selected?
(a) 24 (b) 48
(c) 96 (d) None of these

3. A box contains 10 balls out of which 3 are red and the rest are blue. In how many ways can a random sample of 6 balls be drawn from the bag so that at the most 2 red balls are included in the sample and no sample has all the 6 balls of the same colour?
(a) 105 (b) 168
(c) 189 (d) 120

4. A cricket team of 11 players is to be formed from 20 players including 6 bowlers and 3 wicket-keepers. The number of ways in which a team can be formed having exactly 4 bowlers and 2 wicket-keepers is
(a) 20790 (b) [illegible]
(c) [illegible] (d) 360

5. In a football championship, there were 153 matches played. Every two teams played one match with each other. The number of teams participating in the championship is
(a) 18 (b) 16
(c) 17 (d) 19

6. Seven points are marked on a circle. How many straight lines can be drawn by joining these points.
(a) 35 (b) 42
(c) 21 (d) 54

7. Ten different letters of an alphabet are given. Words with 5 letters are formed from these given letters. Then the number of words which have at least one letter repeated is
(a) 69760 (b) 30240
(c) 99748 (d) None of these

8. [illegible] A, B, C, D and E [illegible] sit [illegible] possible ways can these five people sit?
(a) 24 (b) 48
(c) 72 (d) None of these

9. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

10. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

11. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) 5

12. A five digit numbers divisible by 3 is to be formed using the numbers 0, 1, 2, 3, 4 and 5 without repetition. The total number of ways in which this can be done is
(a) [illegible] (b) 216
(c) [illegible] (d) [illegible]

13. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) None of these

14. [illegible]
(a) 2 (b) [illegible]
(c) [illegible] (d) [illegible]

Solutions

1. Ans. [illegible]
[illegible]

2. Ans. [illegible]
[illegible]

3. Ans. (b)
[illegible]
(i) [illegible]
(ii) [illegible]
[illegible]
[illegible]

4. Ans. [illegible]
[illegible]

5. Ans. [illegible]
[illegible]

6. Ans. (b)
[illegible]

7. Ans. [illegible]
[illegible]

8. Ans. (b)

4! / 2 ways, i.e. 24 / 2 = 12.

9. Ans. (b)

$\therefore {}^8C_3 \times {}^8C_3 = \frac{8 \times 7 \times 6}{3 \times 2} \times \frac{8 \times 7 \times 6}{3 \times 2}$

= 56 × 56 = 3136.

10. Ans. (c)

[illegible]

= [illegible] + 21 = 756

11. Ans. (a)

Let the number of sides be n.

[illegible] = 44

$\Rightarrow n^2 - 3n - 88 = 0$

$\Rightarrow n^2 - 11n + 8n - 88 = 0$

$\Rightarrow n(n - 11) + 8(n - 11) = 0$

$\Rightarrow (n - 11)(n + 8) = 0$

$\Rightarrow n = 11.$

12. Ans. (b)

All 5-digit numbers formed with 1, 2, 3, 4, 5 (sum = 15) will be divisible by 3.

[illegible]

∴ Required number = 120 + 96 = 216.

13. Ans. (c)

[illegible] = 315

14. Ans. (c)

${}^5C_3 = {}^5C_2 = \frac{5 \times 4}{2 \times 1} = 10.$

■■■■

2.4 CHAPTER

Probability

Introduction

The probability has its origin in the problems dealing with games of chance such as gambling, coin tossing, die throwing and playing cards. In all these cases the outcome of a trial is uncertain. These days probability is widely used in business and economics in prediction and forecasting future.

Questions based on coins, dice, playing cards and balls etc. in urns generally are asked in various competitive examinations.

Theory

Probability means the chance of occurrence of an event. In layman terms, we can say that it is likely to occur. Something that is defined as an event which can be calculated mathematically.

$$\text{Probability } P(E) = \frac{\text{Number of favourable events}}{\text{Total number of events}}$$

For example, probability of getting an even number on the throw of a dice can be calculated as follows:

$$P(E) = \frac{\{2, 4, 6\}}{\{1, 2, 3, 4, 5, 6\}} = \frac{3}{6} = \frac{1}{2}$$

Here {2, 4, 6} are even numbers & are favourable outcomes and {1, 2, 3, 4, 5, 6} are all 6 possible outcomes. Similarly, we can calculate probability of getting a number divisible by 3 out of all single digit numbers in following manner. Probability

$$= \frac{\text{Number divisible by 3}}{\text{All the single digit numbers}}$$

$$= \frac{\{3, 6, 9\}}{\{1, 2, 3, 4, 5, 6, 7, 8, 9\}} = \frac{3}{9} = \frac{1}{3}$$

The following elements may be important for solving this chapter on probability:

1. Dice: A dice is small cube used in games of chance. It has six faces which are marked with numbers (1, 2, 3, 4, 5, 6).
2. Playing cards: A pack (or deck) of playing cards has 52 cards, divided into four suits.
   (1) Hearts (3) Clubs
   (2) Spade (4) Diamonds
   Each suit has 13 cards:
   (a) Nine number cards 2, 3, 4, 5, 6, 7, 8, 9, 10.
   (b) An Ace, a King, a Queen and a Jack are known as face cards.
   Ace – A King – K
   Queen – Q Jack – J
   Spades and Clubs are black cards while Hearts and Diamonds are red coloured cards.
   The King, Queen and Jack are called face cards.
3. Unbiased coin: A coin having two faces head (H) and tail (T).

Some Basic Concepts

Random experiment

An experiment whose all outcomes are known in advance (that is completely known) but whose exact outcome is unknown is random experiment.
Eg: (1) throwing a dice (2) tossing of a coin

Sample Space

This is defined in the context of a random experiment and denotes the set representing all the possible outcomes of the random experiment.

Eg: 1. Sample Space when coin is tossed is Head (H) or tail (T).
2. Sample space when a dice is thrown is {1, 2, 3, 4, 5, 6}

Event

A set representing the outcome of a particular random experiment is called event. Event is a subset of a sample space. For example: Probability of getting a number divisible by 3 on a dice shows {3, 6} favourable events are the event.

Here sample space is {1, 2, 3, 4, 5, 6} event is {1, 3, 5} [illegible]

$$\text{So probability} = \frac{\{5\}}{\{1, 3, 5\}} = \frac{1}{3}$$

Non Event

The outcome that is opposite of the desired event is [illegible] non event.

Note: If the event occurs, the non-event does not [illegible]

Impossible Event

An event that can never occur is an impossible event. The probability of an impossible event is 0.

Eg: probability of [illegible] 7 [illegible] dice with 6 [illegible]

Mutually Exclusive Events

Two or more events are mutually exclusive when the occurrence of one of them means that the other event cannot occur.

Eg: 1. If head appears in a coin toss, tail will not appear simultaneously.

2. If 5 occurs in a single throw of a die then 1, 2, 3, 4, 6 will not appear.

Equally likely Events

If two events have the same probability or chance of occurrence, they are called equally likely events.

Example: In a throw of a dice the chance of 1 showing [illegible] 2, [illegible] 3, [illegible] 6 [illegible]

Exhaustive Set of Events

A set of events that includes all the possibilities in a sample space is said to be an exhaustive set of events.

Example: In a throw of a die [illegible]

Independent Events

An event is described as such if the occurrence of an event has no effect on the probability of occurrence of another event.

Example: [illegible] girl [illegible] second child being a girl

Conditional Probability

Probability of the occurrence of an event A given that event B has already occurred.

This is denoted by P(A/B)

Example: The probability that in two throws of a dice we get a total of 7 or more given that in the first throw the dice number 4 had occurred.

Concept of AND and OR

Whenever we use AND as the word a conjunction joining two separate parts of event definitions, we replace the AND by the multiplication sign.

Example: If probability of passing in an exam is [illegible] for A and probability of passing the exam is [illegible] for B then probability of passing of A and B is = P(A) × P(B)

$$= \frac{1}{[illegible]} \times \frac{1}{[illegible]} = \frac{1}{[illegible]}$$

Whenever we use OR as the conjunction joining two separate parts of the event definition, we replace the OR by an addition sign.

Example: If we have the probability of A winning a race as [illegible] and that of B as [illegible] then probability that either A or B wins a race is given by

$$P(A) + P(B) = [illegible]$$

◆ ◆ ◆

Solved Example

1. In throwing a die [illegible] the probability of getting the number 5?

(a) [illegible] (b) $\frac{1}{6}$

(c) [illegible] (d) [illegible]

2. Find the chance of throwing at least one ace in a simple throw with two dice.

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

3. Find the chance of drawing 2 blue balls in succession from a bag containing 5 red and 7 blue balls if the balls are not being replaced.

(a) $\frac{[illegible]}{13}$ (b) [illegible]

(c) $\frac{7}{[illegible]}$ (d) [illegible]

4. A card is drawn at random from a pack of 52 cards. Find the probability that it is
(i) a spade
(a) $\frac{1}{8}$ (b) $\frac{1}{6}$
(c) $\frac{1}{2}$ (d) $\frac{1}{4}$
(ii) a king or queen
(a) $\frac{5}{13}$ (b) $\frac{2}{13}$
(c) $\frac{7}{13}$ (d) $\frac{1}{52}$
(iii) a spade or a king or a queen?
(a) $\frac{22}{52}$ (b) $\frac{5}{13}$
(c) $\frac{8}{52}$ (d) None of these

5. Three coins are tossed. What is the probability of getting 2 tails and 1 head?
(a) [illegible] (b) $\frac{5}{8}$
(c) $\frac{2}{3}$ (d) $\frac{3}{4}$

6. For the above question, the probability that there is at least one tail is:
(a) [illegible] (b) $\frac{7}{8}$
(c) [illegible] (d) $\frac{1}{2}$

7. A bag contains 4 green and 7 white balls. Two balls are drawn from the bag in succession without replacement. What is the probability that both are white?
(a) $\frac{1}{2}$ (b) [illegible]
(c) [illegible] (d) [illegible]

8. What is the probability of throwing a number greater than 2 with a fair dice?
(a) $\frac{2}{3}$ (b) [illegible]
(c) 1 (d) $\frac{3}{5}$

9. Two fair coins are tossed. Find the probability of obtaining
(i) 2 heads
(a) 1 (b) [illegible]
(c) [illegible] (d) $\frac{1}{4}$
(ii) 1 Head and 1 Tail
(a) [illegible] (b) 1
(c) $\frac{1}{2}$ (d) [illegible]
(iii) 2 tails
(a) 1 (b) $\frac{1}{4}$
(c) [illegible] (d) [illegible]

10. On rolling two dice, find the probability of
(i) there is at least one '6'
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]
(ii) the sum is 5
(a) $\frac{1}{4}$ (b) [illegible]
(c) [illegible] (d) [illegible]

11. From a bag containing 4 white and 5 black balls, a man draws 3 at random. What are the odds against these being all black?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

12. Two balls are to be drawn from a bag containing [illegible] green and [illegible] blue balls. Find the probability that both will be blue.
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

13. [illegible]

(a) $\frac{[illegible]}{21}$ (b) $\frac{1}{[illegible]}$

(c) $\frac{[illegible]}{[illegible]}$ (d) $\frac{1}{[illegible]}$

14. [illegible] 2, 3, 5, 7 [illegible]

(a) $\frac{1}{[illegible]}$ (b) $\frac{1}{[illegible]}$

(c) $\frac{[illegible]}{[illegible]}$ (d) $\frac{1}{11}$

15. [illegible]

(a) $\frac{16}{[illegible]}$ (b) $\frac{1}{[illegible]}$

(c) $\frac{1}{[illegible]}$ (d) $\frac{[illegible]}{[illegible]}$

16. [illegible]

(a) $\frac{1}{[illegible]}$ (b) $\frac{7}{[illegible]}$

(c) $\frac{12}{1[illegible]}$ (d) $\frac{3}{4[illegible]}$

17. [illegible]

(i) [illegible]

(a) $\frac{[illegible]}{[illegible]}$ (b) $\frac{[illegible]}{[illegible]}$

(c) $\frac{1}{4}$ (d) $\frac{[illegible]}{[illegible]}$

(ii) [illegible]

(a) $\frac{[illegible]}{[illegible]}$ (b) $\frac{[illegible]}{[illegible]}$

(c) $\frac{[illegible]}{[illegible]}$ (d) $\frac{[illegible]}{[illegible]}$

(iii) [illegible]

(a) $\frac{[illegible]}{21}$ (b) $\frac{15}{[illegible]1}$

(c) $\frac{1}{2[illegible]}$ (d) $\frac{[illegible]}{[illegible]}$

Solutions

1. Ans. (b)

2. Ans. (d)

[illegible]

$= \frac{[illegible]}{[illegible]}$ [illegible]

3. Ans. [illegible]

[illegible] $\frac{7}{[illegible]}$

[illegible]

[illegible] $\frac{[illegible]}{[illegible]} \times \frac{6}{11} = \frac{7}{[illegible]}$

4. (i) Ans. (c)
(ii) Ans. (b)
(iii) Ans. [illegible]

(i) $\frac{[illegible]}{[illegible]} = \frac{1}{4}$

(ii) [illegible] = 8

$= \frac{[illegible]}{[illegible]}$

(iii) [illegible]

[illegible] $\frac{[illegible]}{52}$

5. Ans. (b)

[illegible]

[illegible]

Required [illegible] = $\frac{[illegible]}{[illegible]}$

6. Ans. (c)

[illegible] (H, H, H) [illegible]

So, $P = \frac{7}{8}$

7. Ans. (d)

[illegible]

$\frac{^{7}C_2}{^{10}C_2} = \frac{21}{45} = \frac{7}{15}$

8. Ans. (a)

[illegible]

So, P = [illegible]

9. (i) Ans. (c)

(ii) Ans. (a)

(iii) Ans. (b)

[illegible]

HH, HT, TH, TT

(i) P = [illegible]

(ii) P = [illegible]

(iii) P = [illegible]

10. (i) Ans. (b)

(ii) Ans. (c)

[illegible]

2. [illegible] (1, 1)

3. Three (1, 2), (2, 1)

4. Four [illegible] (2, 2)

5. [illegible] (1, 4), (4, 1), (2, 3), (3, 2)

6. [illegible] (1, 5), (5, 1), (2, 4), (4, 2), (3, 3)

7. Seven [illegible]

8. Eight [illegible]

9. [illegible]

10. [illegible]

11. [illegible] (4, 6), (6, 4), (5, 5)

12. Eleven (6, 5), (5, 6)

13. Twelve (6, 6)

(i) P = [illegible]

(ii) $P = \frac{4}{36} = \frac{1}{9}$

11. Ans. (c)

Probability that [illegible]

[illegible]

[illegible] is [illegible]

12. Ans. (b)

[illegible] 3 blue balls

probability [illegible] $= \frac{^{4}C_3}{^{12}C_3} = \frac{4}{55}$

13. Ans. (a)

[illegible] balls [illegible]

P = [illegible]

14. Ans. (b)

[illegible]

probability [illegible] is [illegible]

15. Ans. (a)

[illegible] $\frac{24}{[illegible]} = \frac{16}{[illegible]}$

16. Ans. (c)

Here [illegible] red, [illegible] white & 7 black balls

P = [illegible] $= \frac{1}{35}$

17. (i) Ans. (c)

(ii) Ans. (d)

(iii) Ans. (a)

Bag 1 → 4 white & 2 black and

Bag 2 → 3 white & 5 black [illegible]

(i) Probability [illegible] both white [illegible]

(ii) Probability [illegible] both black

[illegible] $\frac{2}{6}$ [illegible] $\frac{5}{[illegible]}$

(iii) [illegible]

1 Practice Exercise

1. Three coins are tossed. Find the probability of no heads.

   (a) [illegible] (b) $\frac{1}{6}$

   (c) $\frac{1}{2}$ (d) None of these

2. A coin is tossed three times. Find the probability of getting head and tail alternately.

   (a) [illegible] (b) [illegible]

   (c) $\frac{1}{4}$ (d) None of these

3. In a single throw of two dice, find the probability of getting a total of 3 or 5.

   (a) [illegible] (b) [illegible]

   (c) $\frac{1}{6}$ (d) [illegible]

4. [illegible]

   (a) $\frac{1}{4}$ (b) $\frac{3}{8}$

   (c) $\frac{1}{8}$ (d) $\frac{1}{16}$

5. What is the chance that a leap year, selected at random, will contain 53 Sundays?

   (a) $\frac{1}{7}$ (b) $\frac{2}{7}$

   (c) $\frac{3}{7}$ (d) $\frac{4}{7}$

6. Find the probability that in a random arrangement of letters of the word 'UNIVERSITY', the two I's come together.

   (a) $\frac{4}{5}$ (b) $\frac{1}{5}$

   (c) [illegible] (d) [illegible]

7. An integer is chosen at random from first two hundred natural numbers. What is the probability that the integer chosen is divisible by 6 or 8?

   (a) $\frac{1}{4}$ (b) [illegible]

   (c) $\frac{1}{2}$ (d) None of these

8. In a simultaneous throw of two dice, find P(A or B) if A denotes the event 'a total of 11' and B denotes the event 'an odd number on each die'.

   (a) $\frac{11}{36}$ (b) $\frac{1}{4}$

   (c) $\frac{5}{18}$ (d) [illegible]

9. A and B are two mutually exclusive events of an experiment. If P(not A) = 0.65, P(A ∪ B) = 0.65 and P(B) = p, find the value of p.

   (a) [illegible] (b) 0.30

   (c) 0.60 (d) [illegible]

10. The probabilities that a student will obtain grades A, B, C or D are [illegible] respectively. What is the probability that a student will receive at least C grade?

    (a) [illegible] (b) [illegible]

    (c) [illegible] (d) None of these

11. A card is drawn from an ordinary pack and a gambler bets that it is a spade or an ace. What are the odds against his winning the bet?

    (a) 9 : 4 (b) 4 : 9

    (c) [illegible] (d) 9 : 5

12. A problem in mathematics is given to [illegible] students A, B, C and D. Their chances of solving it are [illegible] respectively. What is the probability that the problem will be solved?

    (a) [illegible] (b) $\frac{4}{5}$

    (c) [illegible] (d) None of these

Directions for Question Nos. 13-14: An urn contains 25 balls numbered 1 to 25. Suppose getting an odd numbered ball is considered a success. Two balls are drawn from the urn with replacement.

13. Find the probability of getting two successes.

(a) $\frac{3[illegible]9}{625}$ (b) $\frac{512}{[illegible]}$

(c) $\frac{481}{625}$ (d) $\frac{144}{[illegible]}$

14. Find the probability of getting no success.

(a) $\frac{[illegible]}{625}$ (b) $\frac{2[illegible]2}{[illegible]}$

(c) $\frac{48}{625}$ (d) $\frac{1[illegible]}{[illegible]}$

Direction for Question No. 15–18: A husband and wife appear in an interview for two vacancies in the same post. The probability of husband's selection is [illegible] and that of wife's selection is [illegible].

15. What is the probability that only one of them will be selected?

(a) $\frac{[illegible]}{7}$ (b) $\frac{[illegible]}{[illegible]}$

(c) $\frac{34}{35}$ (d) [illegible]

16. What is the probability that both of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{[illegible]}$

(c) $\frac{24}{35}$ (d) $\frac{1}{[illegible]}$

17. What is the probability that none of them will be selected?

(a) $\frac{[illegible]}{7}$ (b) $\frac{[illegible]}{35}$

(c) $\frac{34}{35}$ (d) $\frac{1}{35}$

18. What is the probability that at least one of them will be selected?

(a) $\frac{2}{7}$ (b) $\frac{1}{35}$

(c) $\frac{24}{35}$ (d) $\frac{1}{[illegible]}$

19. A man speaks truth in [illegible]% of the cases and B in 80% of the cases. While stating the same fact, what is the probability that they may contradict?

(a) $\frac{[illegible]7}{20}$ (b) $\frac{13}{[illegible]}$

(c) $\frac{7[illegible]}{[illegible]0}$ (d) None of these

20. A speaks [illegible]% of [illegible] given [illegible] and B [illegible] 70%. What [illegible] probability [illegible] one of them [illegible] from [illegible]?

(a) $\frac{[illegible]}{100}$ (b) $\frac{[illegible]}{[illegible]}$

(c) $\frac{[illegible]}{[illegible]}$ (d) $\frac{[illegible]}{1[illegible]}$

21. Find [illegible] arrangement of the letters of the word [illegible] the [illegible] come [illegible] first [illegible]

(a) $\frac{[illegible]}{[illegible]}$ (b) [illegible]

(c) $\frac{[illegible]}{[illegible]}$ (d) [illegible]

□□□□

Solutions

1. Ans. (b)

Sample space S = {[illegible] HH, HTH, [illegible] TH, [illegible] TH, TTT}

Number of exhaustive cases = 8

P(all heads) = P(no tail) = $\frac{1}{8}$

[illegible] case TTT

2. Ans. (a)

Sample space S = {HHH, HHT, HT[illegible], [illegible] TH, TTH, [illegible] TT}

Number of exhaustive cases = [illegible]

Favourable cases are [illegible]

Number of favourable cases = [illegible]

∴ Required probability = $\frac{[illegible]}{[illegible]}$

3. Ans. (c)

A total of 8 or 9 may be obtained in [illegible] ways, [illegible], [illegible], (2, [illegible]), [illegible], (2, [illegible]), (3, [illegible]), [illegible].

Number of exhaustive cases = 6 × 6 = 36

∴ Probability of getting [illegible] = $\frac{[illegible]}{[illegible]} = \frac{[illegible]}{[illegible]}$

4. Ans. (a)
A doublet means both the dice show the same number on uppermost faces. Therefore, the outcomes favourable to this event are (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6).
Thus, the number of favourable cases = 6.

Hence, P(doublet) = $\frac{6}{36} = \frac{1}{6}$

5. Ans. (c)
We know that a leap year has 366 days and thus, 52 weeks and 2 days over.
These two left over (successive) days may be [illegible] cases:
(i) Sunday and Monday
(ii) Monday and Tuesday
(iii) Tuesday and Wednesday
(iv) Wednesday and Thursday
(v) Thursday and Friday
(vi) Friday and Saturday
(vii) Saturday and Sunday
∴ Number of exhaustive cases n = 7
Out of these, the favourable cases are (i) and (vii)
∴ Number of favourable cases m = 2
∴ Probability of having 53 Sundays = $\frac{2}{7}$

6. Ans. (a)
[illegible]

∴ Number of permutations [illegible] $\frac{10!}{2}$ [illegible]

[illegible]

$\frac{[illegible]}{[illegible]} = 9! [illegible] = [illegible] = [illegible]$

∴ Required probability = $\frac{[illegible]}{10!/2} = \frac{[illegible]}{10!}$

$= \frac{[illegible]}{[illegible]} = \frac{4}{5}$

8. Ans. (a)
A: [illegible] divisible by 6 [illegible] divisible by 8

n(A) = 33, n(B) = 25, n(A ∩ B) = 8, n(S) = 200

P(A) = $\frac{33}{200}$, P(B) = $\frac{25}{200}$

P(A ∪ B) = P(A) + P(B) − P(A ∩ B)

$= \frac{33}{200} + \frac{25}{200} - \frac{8}{200} = \frac{50}{200} = \frac{1}{4}$

7. Ans. (c)
A: Getting total of 11 B: Getting odd number on both dice
A = {(5, 6), (6, 5)}
B = {(1, 1), (1, 3), (1, 5), (3, 1), (3, 3), (3, 5), (5, 1), (5, 3), (5, 5)}

P(A) = $\frac{2}{36}$, P(B) = $\frac{9}{36}$, P(A ∩ B) = 0

∴ Required probability
= P(A) + P(B) − P(A ∩ B)

$= \frac{2}{36} + \frac{9}{36} - 0 = \frac{11}{36}$

9. Ans. (b)
We know P(A) = 1 − P(Ā)
= 1 − 0.35 = 0.65
P(A ∪ B) = P(A) + P(B) − P(A ∩ B)
⇒ 0.85 = 0.65 + P(B) − 0
[∵ A and B are mutually exclusive events]
⇒ P(B) = 0.85 − 0.65 = 0.20

10. Ans. (c)
P(at least C grade) = P(C grade) + P(A grade)
= [illegible] = [illegible]

11. Ans. (a)
Let A: a spade is drawn and
B: an ace is drawn
Probability of drawing a spade or an ace P(A ∪ B)
= P(A) + P(B) − P(A and B)

$= \frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$

Probability of not drawing = $1 - \frac{4}{13} = \frac{9}{13}$

Odds against drawing [illegible] = 9 : 4

12. Ans. (b)
Probability that A fails to solve the problem is

$1 - \frac{1}{3} = \frac{2}{3}$

Probability that B fails to solve the problem is

$$1-\frac{1}{4}=\frac{3}{4}$$

Probability that C fails to solve the problem is

$$1-\frac{1}{5}=\frac{4}{5}$$

Probability that D fails to solve the problem is

$$1-\frac{1}{6}=\frac{5}{6}$$

Since the events are independent, the probability that none of them is able to solve the problem is

$$\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\frac{5}{6}=\frac{1}{3}$$

∴ The probability that the problem will be solved

$$=1-\frac{1}{3}=\frac{2}{3}$$

13. Ans. (a)

Success: Getting red in one draw, $p=\frac{13}{25}$

$$\Rightarrow q=1-p=1-\frac{13}{25}=\frac{12}{25}$$

P(two successes) = p × p

$$=\frac{13}{25}\times\frac{13}{25}=\frac{169}{625}$$

14. Ans. (a)

$$P(\text{no success})=q\times q=\frac{12}{25}\left(\frac{12}{25}\right)=\frac{144}{625}$$

15. Ans. (a)

A : Husband is selected

B : Wife is selected

$$P(A)=\frac{1}{7}\Rightarrow P(\bar{A})=1-P(A)=1-\frac{1}{7}=\frac{6}{7}$$

$$P(B)=\frac{1}{5}\Rightarrow P(\bar{B})=1-P(B)=1-\frac{1}{5}=\frac{4}{5}$$

P(only one of them will be selected)

$$=P(A)\,P(\bar{B})+P(\bar{A})\,P(B)$$

$$=\frac{1}{7}\left(\frac{4}{5}\right)+\frac{1}{5}\left(\frac{6}{7}\right)=\frac{4+6}{35}=\frac{10}{35}=\frac{2}{7}$$

16. Ans. (c)

P(both of them will be selected)

$$=P(A)\times P(B)=\frac{1}{7}\times\frac{1}{5}=\frac{1}{35}$$

17. Ans. (c)

P(none of them will be selected)

$$=P(\bar{A})\,P(\bar{B})=\frac{6}{7}\times\frac{4}{5}=\frac{24}{35}$$

18. Ans. (d)

P(at least one of them will be selected)

$$=1-P(\bar{A})\,P(\bar{B})$$

$$=1-\frac{6}{7}\times\frac{4}{5}=1-\frac{24}{35}=\frac{11}{35}$$

19. Ans. (c)

Let [illegible] A and B

A: A speaks truth

B: B speaks truth

$$P(A)=\frac{80}{100}\Rightarrow P(\bar{A})=1-P(A)=1-\frac{80}{100}=\frac{20}{100}$$

$$P(B)=\frac{90}{100}\Rightarrow P(\bar{B})=1-P(B)=1-\frac{90}{100}=\frac{10}{100}$$

∴ Required probability

$$=P(A)\,P(\bar{B})+P(B)\,P(\bar{A})$$

$$=\frac{80}{100}\times\frac{10}{100}+\frac{90}{100}\times\frac{20}{100}$$

$$=\frac{8}{100}+\frac{18}{100}=\frac{26}{100}=\frac{13}{50}$$

20. Ans. (a)

A: A solves the problem.

B: B solves the problem.

$$P(A)=\frac{90}{100}\Rightarrow P(\bar{A})=1-P(A)=1-\frac{90}{100}=\frac{10}{100}$$

$$P(B)=\frac{70}{100}\Rightarrow P(\bar{B})=1-P(B)=1-\frac{70}{100}=\frac{30}{100}$$

Required probability $=1-P(\bar{A})\,P(\bar{B})$

$$=1-\frac{10}{100}\times\frac{30}{100}=1-\frac{3}{100}=\frac{97}{100}$$

21. Ans. (a)

If B occupies the first place

n(A) = 7!   Total words = n(S) = 8!

∴ Required probability

$$=P(A)=\frac{n(A)}{n(S)}=\frac{7!}{8!}=\frac{1}{8}$$

■■■■

Practice Exercise: 4

1. The probability of raining on day 1 is 0.2 and on day 2 is 0.3. What is the probability of raining on both the days?
   (a) 0.2 (b) 0.5
   (c) 0.06 (d) 0.24

2. A bag contains 4 green balls and 2 [illegible] balls. [illegible] the probability that [illegible] green.
   (a) [illegible] (b) [illegible]
   (c) 1/8 (d) [illegible]

3. The probability that A will live 15 years is $\frac{2}{3}$ and that B will live 15 years is $\frac{1}{5}$, then what is the probability that both will be alive after 15 years?
   (a) $\frac{1}{20}$ (b) $\frac{88}{90}$
   (c) $\frac{1}{5}$ (d) None of these

4. The probability that a student is not a swimmer is 1/5. Then the probability that out of the five students exactly four are swimmers is
   (a) ${}^5C_4\left(\frac{4}{5}\right)^4\left(\frac{1}{5}\right)$ (b) $\left(\frac{4}{5}\right)^4\left(\frac{1}{5}\right)$
   (c) $5\left(\frac{1}{5}\right)\left(\frac{4}{5}\right)^4$ (d) None of these

5. If events A and B are independent and P(A) = 0.3, P(A ∪ B) = 0.5, then P(B) =
   (a) $\frac{4}{10}$ (b) $\frac{2}{7}$
   (c) $\frac{5}{11}$ (d) $\frac{5}{29}$

6. Four different objects 1, 2, 3, 4 are distributed at random in four places marked 1, 2, 3, 4. What is the probability that none of the objects occupy the place corresponding to its number?
   (a) 7/24 (b) 3/8
   (c) 1/2 (d) 5/8

7. If the probability of rain on any given day in Pune city is 50%, then what is the probability that it rains on exactly 3 days in a 5 day period?
   (a) 8/125 (b) 5/16
   (c) 8/25 (d) 2/25

8. The probability that an event A happens in one trial of an experiment is 0.4. Three independent trials of the experiment are performed. The probability that the event A happens at least once is
   (a) 0.934 (b) 0.784
   (c) 0.548 (d) 0.216

9. A number is chosen at random among the first 120 natural numbers. The probability of the number chosen being a multiple of 5 or 15 is
   (a) 1/8 (b) 1/5
   (c) 1/[illegible] (d) 1/[illegible]

10. From a pack of 52 playing cards, two cards are drawn at random. What is the probability of both the cards being kings?
    (a) 1/15 (b) 25/57
    (c) 35/256 (d) None of these

11. From a box containing [illegible] standard and [illegible] substandard articles, two articles are chosen at random. What is the probability that one of them is standard and the other substandard?
    (a) $\frac{[illegible]}{[illegible]} \times \frac{[illegible]}{100}$ (b) $\frac{[illegible]}{100} \times \frac{[illegible]}{100}$
    (c) $\frac{[illegible]}{[illegible]}$ (d) [illegible]

Solutions

1. Ans. (c)
   0.2 × 0.3 = 0.06

2. Ans. (a)
   Probability of drawing the first ball of green colour
   $= \frac{4}{24} = \frac{1}{6}$
   Probability that second ball drawn is also of green colour
   $= [illegible]$

3. Ans. (c)

$P(A \cap B) = \frac{7}{8} \times \frac{9}{10} = \frac{63}{80}$

4. Ans. (c)

5. Ans. (b)

$P(A \cap B) = P(A) \times P(B) = 0.15 \times P(B)$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$0.45 = 0.15 + P(B) - 0.15 \times P(B)$

$= 0.15 + P(B)(1 - 0.15)$

$= 0.15 + 0.85P(B)$

$\therefore 0.85P(B) = 0.45 - 0.15 = 0.30$

$\therefore P(B) = \frac{0.30}{0.85} = \frac{30}{85} = \frac{6}{17}$

6. Ans. (a)

Let's fix the objects in $\boxed{1}$, $\boxed{2}$, 3, 4

Now object 1 can't occupy the place [illegible]

Suppose object 2 occupies the place $\boxed{1}$. Then the other three objects can be arranged in 6 ways as follows

(1) 2 1 3 4
(2) 2 1 4 3
(3) 2 3 1 4
(4) 2 3 4 1
(5) 2 4 1 3
(6) 2 4 3 1

From all of these six ways only three ways are possible because (1), (3) and (5) [illegible] condition (A). Hence required probability is $\frac{3}{6} = \frac{1}{2}$. Similarly we can also [illegible] objects 3 and 4 to occupy place 1 and in each case we can find the probability is 1/2.

7. Ans. (c)

Probability that it rains on any day $= \frac{1}{2}$ and it does not rain $= 1 - \frac{1}{2} = \frac{1}{2}$

Probability that it rains on exactly 3 days in 5 day period

$= {}^5C_3 \times \left(\frac{1}{2}\right)^3 \left(\frac{1}{2}\right)^2$

(${}^5C_3$ for choosing three days from 5 days among which it rains, $\left(\frac{1}{2}\right)^3$ for that it rains on those three days,

$\left(\frac{1}{2}\right)^2$ for that it does not rain on remaining 2 days)

8. Ans. (c)

Required probability

$= {}^3C_1(0.4)(0.6)^2 + {}^3C_2(0.4)^2(0.6) + {}^3C_3(0.4)^3$

$= 3(0.144) + 3(0.096) + (0.064) = 0.784$

Alternative:

Probability that A happens = 0.4

Probability that A doesn't happen

= 1 − 0.4 = 0.6

So, required probability

= 1 − Probability that event A does not happen in any of the three times

= 1 − 0.6 × 0.6 × 0.6

= 1 − 0.216

= 0.784

9. Ans. (a)

10. Ans. (d)

Two cards can be drawn from a pack of 52 playing cards in ${}^{52}C_2$ ways,

i.e. $\frac{52 \times 51}{2} = 1326$ ways

The event that two kings appear in a single draw of cards can happen in ${}^4C_2$ ways i.e. 6 ways.

∴ The probability that the two cards drawn from a pack of 52 cards are kings $= \frac{6}{1326} = \frac{1}{221}$

11. Ans. (c)

Required probability

$= \frac{60}{150} \times \frac{45}{100} + \frac{40}{100} \times \frac{32}{99}$

$= \frac{4500}{[illegible]} = \frac{16}{[illegible]}$

2.5

CHAPTER

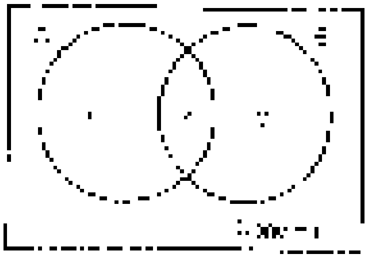
Set Theory

Venn Diagram

Venn Diagrams are pictorial way of representation of sets of things having different attributes. Basic information of things are represented by Venn diagram to be used for solving these questions.

The Venn diagram is represented as shown [illegible] attributes [illegible] the rectangle [illegible] (including [illegible] particular thing [illegible] belonging to any of attributes.)

Venn-diagram involving two attributes



Clearly the region are shown by x, y, z & u

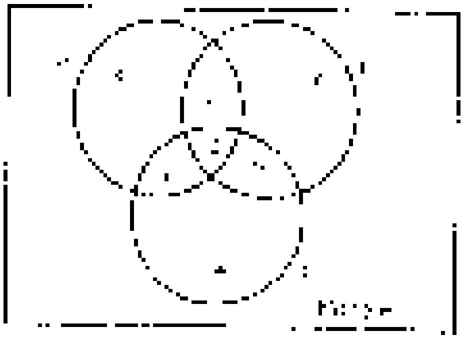
Region can be represented as:

- (a) z = things that belongs to both attribute A & B
- (b) x = things that belong to A but not to B
- (c) y = things that belong to B but not to A
- (d) u = represents region of things which neither belongs to A nor to B

Further observations

- (a) Things taken in whole universe [illegible] region [illegible]
- (b) Things belonging to at least one of the attributes [illegible] exactly one [illegible] exactly two n(A ∪ B) = x + y + z
- (c) [illegible] (Things belonging at least one [illegible] things belonging [illegible] [illegible] = x + y + [illegible]
- (d) Things belonging to both attributes n(A ∩ B) = z
- (e) Things belonging to attribute A n(A) = x + z
- (f) Things belonging to attribute B n(B) = y + z
  (A ∪ B) = n(A) + n(B) − n(A ∩ B)
- (g) Things does not belong to attribute A = (y + u)
- (h) Things does not belonging to attribute B = (x + u)

Venn diagram with three attributes



Total sample sets = 8

Here X, Y, Z are sets of 3 attributes having

- (a) Total number [illegible] = 8
- (b) n(A) = [illegible] things belong to only A = x
- (c) n(B) = [illegible] things belong to only B = y
- (d) n(C) = [illegible] things belong to only C = z
- (e) Things belong to exactly one attribute x + y + z = [illegible]
- (f) Things belong to attribute (A & B) both n(A ∩ B) = [illegible]
- (g) Things belong to attribute (B & C) both n(B ∩ C) = [illegible]
- (h) Things belong to attribute (A & C) both n(A ∩ C) = [illegible]
- (i) Things belonging to all attributes (A, B, C) both = g
- (j) Things belong to only [illegible] (A & B) both = [illegible]

(k) Things belong to only one attribute (A, B, C) [illegible]

(l) Things belong to [illegible] the three attributes n(A ∩ B ∩ C) = p

(m) Things belong to all the three attributes n(A ∩ B ∩ C) = p

(n) Things belong to none of the attributes = [illegible]

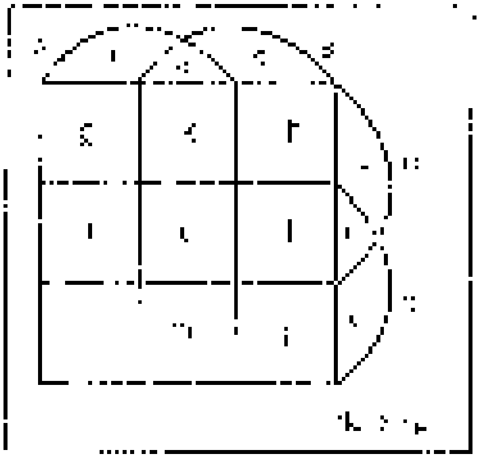
(o) Things belong to at least one of the attributes [illegible]
= Exactly one + Exactly two + Exactly three
= [illegible] = p
n(A ∪ B ∪ C) = n(A) + n(B) + n(C) − [illegible] − n(C ∩ A)
+ n(A ∩ B ∩ C)

(p) Things does not belong to A = [illegible]

(q) Things belong to A or B = [illegible]

(r) Things belong neither A nor B = [illegible]

Venn diagrams with 4-attributes

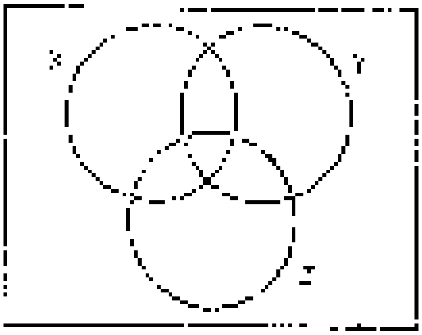


Total sample = n

1. n(A) = [illegible]
2. n(B) = [illegible]
3. n(C) = [illegible]
4. n(D) = [illegible]
5. Only A = a
6. Only B = b
7. Only C = c
8. Only D = d
9. Things belong to exactly one of attributes = [illegible]
10. A & B only n(A ∩ B) = [illegible]
11. A & C only = n(A ∩ C) = [illegible]
12. A & D only = n(A ∩ D) = [illegible]
13. B & C both = n(B ∩ C) = [illegible]
14. B & D both = n(B ∩ D) = [illegible]
15. C & D both = n(C ∩ D) = [illegible]
16. Only to (A & B) both = [illegible]
17. Only to (A & D) both = [illegible]
18. Only to (A & C) both = [illegible]
19. Only to (B & C) both = [illegible]
20. Only to (B & D) both = [illegible]
21. Only to (C & D) both = [illegible]
22. To exactly two attributes = [illegible]
23. (A, B & C) all three = [illegible]
24. (B, C & D) all three = [illegible]
25. (A, B & D) all three = [illegible]
26. (A, C & D) all three = [illegible]
27. Only to (A, B, C) all three = [illegible]
28. Only to (B, C, D) all three = [illegible]
29. Only to (A, B, D) all three = [illegible]
30. Only to (A, C, D) all three = [illegible]
31. To exactly three out of four attributes = [illegible]
32. Belong to A, B, C, D all four = [illegible]
33. None of among A, B, C, D = p

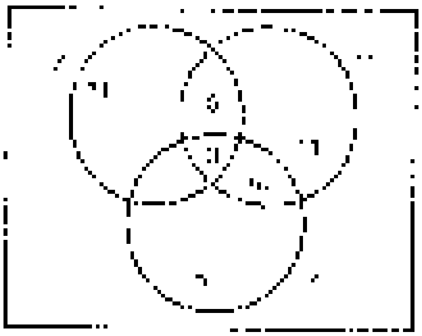
Solved Examples

Direction (Q. 1 to Q. 5): These examples are based on following diagram.



Total sample = first 50 natural numbers.
Circle X represent even numbers in sample.
Circle Y represent [illegible] numbers in sample.
Circle Z represent [illegible] numbers in sample.

Solution: Following given diagram can be drawn.

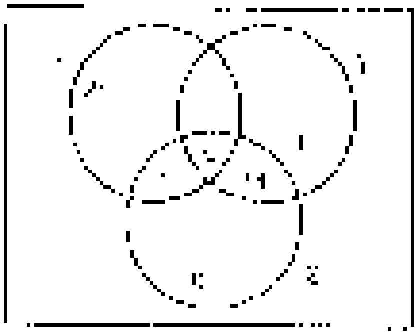


1. How many numbers belong to X only?
   (a) 25 (b) 34
   (c) [illegible] (d) 12

Ans. (b)

[illegible] option (b)

2. How many numbers belong to Y only



   (a) 14 (b) 25
   (c) [illegible] (d) 19

Ans. (c)

[illegible] elements.

3. How many elements are there in (Y ∩ Z)?
   (a) 12 (b) [illegible]
   (c) [illegible] (d) 4

Ans. (a)

[illegible]

4. How many elements are there in X ∩ Y ∩ Z?
   (a) 0 (b) 1
   (c) 2 (d) 3

Ans. (c)

Z is [illegible] element.

5. How many elements [illegible]
   (a) 15 (b) 32
   (c) 14 (d) 12

Ans. (b)

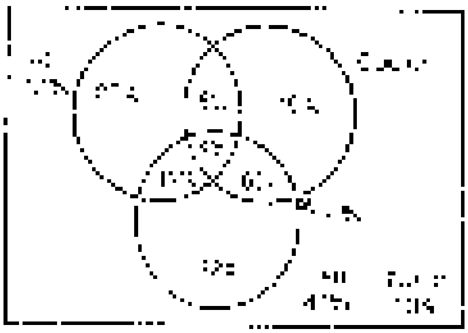
[illegible]

Direction (Q.6 to Q. 10): In a survey [illegible] was conducted in a colony to know how many houses are equipped with fans, ACs & coolers. 234 houses have coolers. 10% of the houses have coolers & fans. 40% houses have ACs. 45% of the houses have fans. 10% of houses have none of three. 22% have only fans & 12% of the houses have ACs & coolers.

Sol.

Since maximum data is in % terms we can comfortably work by assuming sample size to be 100%

And we can draw the venn diagram



Means [illegible]% of houses have coolers

$\frac{[illegible]}{100} \times (T) = 234$

$T = \frac{100 \times 234}{[illegible]} = 800$

Total houses surveyed = 800

Now all questions can be answered

6. How many houses have fans only?
   (a) [illegible] (b) 176
   (c) 80 (d) [illegible]

Ans. (b)

22% have fans only $22 \times \frac{800}{100} = 176$

Hence option (b)

7. How many houses have at most two devices among AC, fan & cooler?
   (a) 408 (b) 800
   (c) 420 (d) 768

Ans. (d)

At most two means

= Total no. of houses − No. of houses having all 3 devices

$= 800 - \frac{800 \times 4}{100} = 768$

Hence option (d)

8. How many more houses were surveyed?
(a) 640 (b) 780
(c) 700 (d) 800

Ans. (d)

Total houses surveyed 800
Hence option (d)

9. How many houses do not have fans?
(a) [illegible] (b) 352
(c) 448 (d) 332

Ans. (c)

Overall 44% houses have fans
Hence 56% do not have fans.

Hence 56 × $\frac{800}{100}$ = 448

Hence option (c)

10. What is the ratio of number of houses that have exactly 2 or more 3 appliances to those that have [illegible] more [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) 4 : 7

Ans. (d)

[illegible] = 25% of population
[illegible] = 40%
Ratio = [illegible]
Hence option (d)

Practice Exercise 1

Question (Q.1 to Q.5): In the following table, [illegible] [illegible] of students [illegible] who like Hockey & Cricket. There are 500 students in the school.

	Hockey	Cricket	Both	Total
Boys	100			200
Girls		170		
Total				500

In the total students, 40% like Cricket, 50% like Hockey & 20% like both the games. 20% of the girls like both the games.

1. The number of girls who like Cricket is
(a) 40 (b) 50
(c) 60 (d) 75

2. The number of boys who like both games is
(a) 20 (b) 40
(c) 60 (d) 100

3. How many boys do not like either games?
(a) 0 (b) 50
(c) 100 (d) 150

4. How many girls like Hockey?
(a) [illegible] (b) 250
(c) 150 (d) 200

5. How many girls like at least one of the games?
(a) 250 (b) 350
(c) 200 (d) 200

Direction (Q.6 to Q.8): During the annual sports competition at a college it was found that in [illegible] 30% played Cricket, 40% played Hockey, 35% played Football, 20% played [illegible] [illegible] students played exactly two of these three sports, 20 of them played all three games.

6. If 45 students played only Cricket, then find the number of students who played neither [illegible] & Hockey only
(a) 10 (b) 15
(c) 20 (d) 25

7. If 20 students played both Cricket and Football but not Hockey, find the number of students who played only Hockey
(a) 10 (b) 15
(c) 25 (d) 30

8. 130 students played Hockey but not Football, then find the number of students who played Cricket and Hockey
(a) 110 (b) 120
(c) 130 (d) 140

Direction (Q.9 to Q.13): In an experiment, a survey was conducted among 1000 people to find their reading habits of 3 magazines: India Today, Business Today and Frontline. It is known that 500 people read at least two of these magazines. Also [illegible] read [illegible] only [illegible] of them [illegible] The 300 readers [illegible] [illegible] [illegible] India Today [illegible] Business Today [illegible] [illegible] [illegible] Frontline [illegible].

9. How many people read at least one of the [illegible] magazines among the [illegible]?
(a) 140 (b) 160
(c) 240 (d) 320

10. How many people read all three magazines?
(a) 140 (b) 14
(c) 90 (d) Can't be determined

11. How many people read [illegible] only?
(a) 130 (b) 130
(c) 140 (d) 120

12. How many people read two magazines?
(a) 60 (b) 40
(c) 50 (d) None of these

13. How many people read exactly one among these magazines?
(a) 300 (b) 200
(c) 240 (d) 350

Directions (Q. 14 to Q. 21): In a survey [illegible] of people who take tea, there are [illegible] people who take coffee, [illegible] there are total 120 people in the survey.

14. What is the maximum possible number of people who take none of these two?
(a) 30 (b) 20
(c) 40 (d) None of these

15. What is the least possible number of people who take exactly one of these two drinks?
(a) 50 (b) 60
(c) 120 (d) 100

16. What is the maximum possible number of people who take both of these two drinks?
(a) 60 (b) 80
(c) 70 (d) 100

17. What is the maximum possible number of people who take at least one of these two drinks?
(a) 120 (b) 130
(c) 110 (d) None of these

18. What is the minimum possible number of people who take both the drinks?
(a) 10 (b) 20
(c) 30 (d) None of these

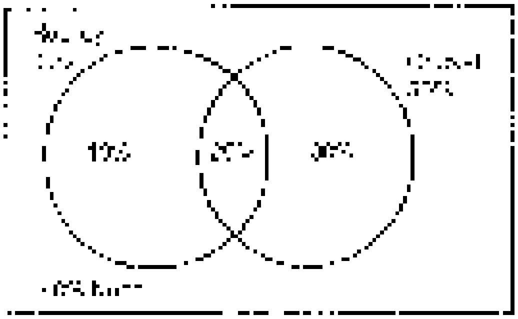
19. What is the minimum possible number of people who take none of the two drinks?
(a) 20 (b) 40
(c) 60 (d) None of these

20. What is the minimum possible number of people who take exactly one of the two drinks?
(a) 10 (b) 20
(c) 60 (d) 70

21. What is the maximum possible number of people who take exactly one of these?
(a) 20 (b) 40
(c) 10 (d) None of these

□□□□

Solutions



1. [illegible]

Students playing both the games

$= 800 \times \frac{20}{100} = 160$

Number of students playing none of two games is 40%.

Hence $\frac{40}{100} \times 800 = 320$ students play none of the games.

Total number of students who play both games

$= 800 \times \frac{20}{100} = 160$

Total number of students who play Cricket

$= 800 \times \frac{50}{100} = 400$

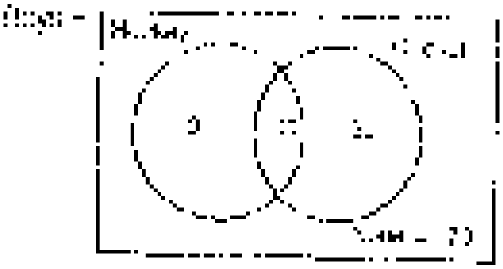
Total number of students who play Hockey

$= 800 \times \frac{30}{100} = 240$

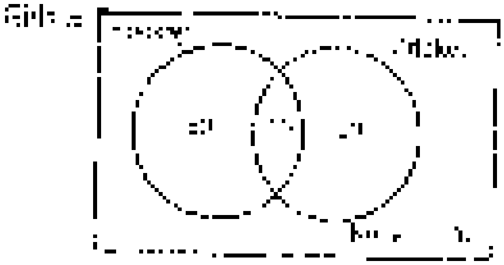
Now we can easily understand the table

	Hockey	Cricket	Both	Total Playing	Not playing
[illegible]	160	280	[illegible]	[illegible]	[illegible]
[illegible]	80	[illegible]	[illegible]	400	320
Total	240	400	[illegible]	[illegible]	[illegible]

Boys =

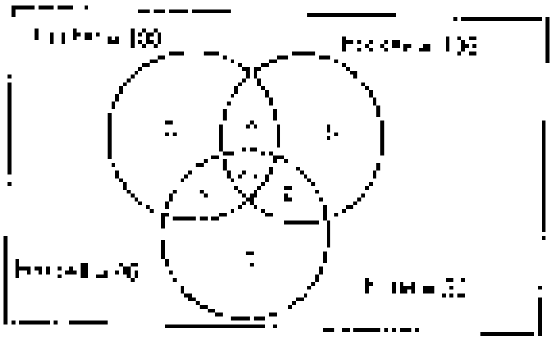


Girls =



1. (c) No. of girls like [illegible] = [illegible]
2. (d) No. of boys like both games = 105.
3. (a) No. of boys like none of the games = 70.
4. (c) No. of students like hockey = 240.
5. (d) No. of students who like at least one of the game = 225.

Question No. 6 to 8



No. of students who played at least one of the three games
= 225 − 20 = 205
[illegible] = 45 (as 45 students played exactly two of the three games)

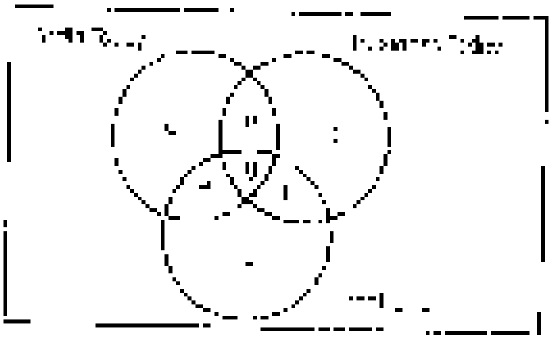
6. (c) a = 20 (given)
[illegible] = 100
[illegible]
[illegible] = 10
[illegible] Football only = [illegible]
Option (b)

7. (d) y = 20
[illegible] = 105 (Total Hockey = 105)
[illegible] = 45
[illegible]

b [illegible] = 105
h = 105 − 45 = 60
Hence option (b)

8. (b) [illegible]
[illegible] = 105
⇒ z = 55
[illegible] = 45
⇒ [illegible] = 10
[illegible] + 20 = [illegible]
⇒ [illegible]
[illegible] = 20 + 50 = [illegible]
Hence option (c)

Question 9 to 15



a + b [illegible] = 500 (i)
[illegible] + g [illegible] = 450
a + b [illegible] = 360 ⇒ h = 40
[illegible] = 420
b [illegible] + 130 [illegible]
b = 100 ...(ii)
c = 150 ...(iii)
a = 100 (iv)
[illegible] = 200
[illegible] = 60 ...(v)
[illegible] = 360 − [illegible]
[illegible] = 100
a = 200 − 100 = 100 (vi)

9. (c) [illegible] = 200, [illegible] [illegible]
No. of [illegible] required
= [illegible] = 200 − [illegible]

10. (c) [illegible]

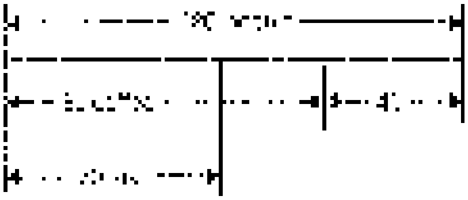
11. (d) [illegible] = a = 100

12. (b) [illegible]

13. (a) [illegible] = 500

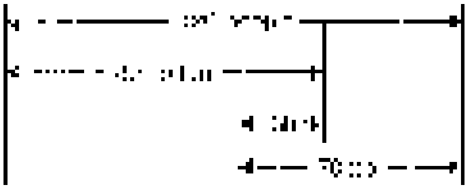
Questions 14 to 21:

14.(c)



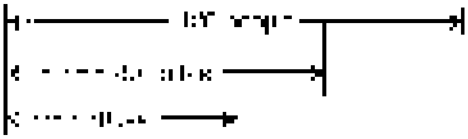
Maximum possible number of people [illegible] none of these [illegible]
(180 – 140) = 40. Option (c)

15.(b) To maximize the number of people [illegible] we minimize [illegible]



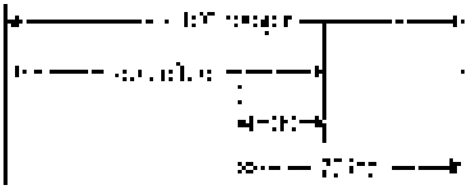
Maximum number [illegible]
= 180 – [illegible] = 50. Option (b)

16.(c)



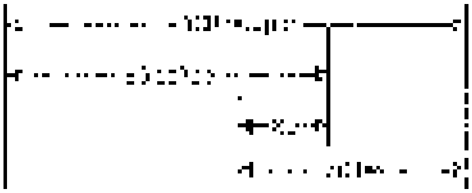
Maximum number of people [illegible]
= 70. Option (c)

17.(c)



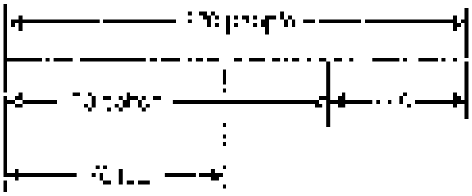
To maximize at least [illegible] we have to minimize the others.
Hence 130. Option (c)

18.(c)



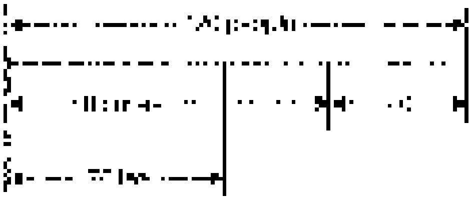
Answer 20. Option (b)

19.(c)



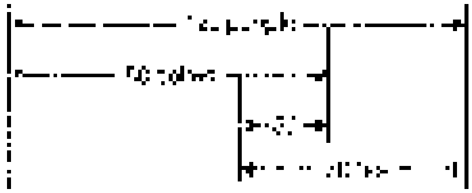
To minimize the number of people who took at least one, we need to maximize the number of people who took none. Option (c)

20.(c) To minimize the number of people who took at most one, [illegible]



Maximum 70 people [illegible] Hence [illegible] people are there who will take at most one drink. Option (c)

21.(b)



Answer is 20. Option (b)

C

Section

Reasoning & Data Interpretation

3.1 CHAPTER

Blood Relationship

In these questions, the success of the candidate lies in [illegible] [illegible] [illegible] [illegible] [illegible] the relations [illegible] [illegible] [illegible]. The easiest and most convincing way to solve these questions is [illegible] family tree diagram [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

1st stage

Great Grand [illegible] Grandfather, Grandmother, Grand [illegible]

2nd stage

Parents & their [illegible] — Father, Mother, Uncle, Aunt, Father-in-law, Mother-in-law

3rd stage

Siblings, Spouse & In-laws — Brother, Sister, Cousin, Wife, Husband, Brother-in-law, Sister-in-law

4th stage

Children & In-laws — Son, Daughter, Niece, Nephew, Son-in-law, Daughter-in-law

5th stage

Grandchildren — Grandson, Granddaughter

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	
[illegible]	

Example 1.

Pointing to a man in the photograph, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man in the photograph?

(a) Sister (b) Mother

(c) Wife (d) Daughter

Sol. (b) The only daughter of the woman's mother is the woman herself and hence the man in the photograph is her son. Therefore the woman is the mother of the man in the photograph.

Example 2.

Pointing to a man in a photograph a woman said, "The father of his brother is the only son of my grand father." How is the woman related to the man in the photograph?

Sol. (c) The only son of the woman's grand father is the father of woman and the father of the man's brother is also the father of the man. On combining, these two [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] woman is sister of the man in the photograph.

Direction (for Ex. 3 to 5)

A ÷ B means A is the daughter of B

A × B means A is the husband of B

A − B means A is the brother of B

Example 3.

If P ÷ Q × R, which of the following is true?

(a) R is the daughter of P

(b) R is the sister-in-law of P

(c) P is the aunt of R

(d) R is the mother of P

Sol. (d) P ÷ Q × R means P is the daughter of Q and Q is the husband of R, i.e. R is P's mother.

Example 4.

If P − Q × R, which of the following is true?

(a) P is the brother of R

(b) P is the uncle of R

(c) P is the son of R

(d) P is the father of R

Sol. (?) P − Q × R means P is the brother of Q, who is the husband of R, [illegible] [illegible] of R.

Example 5

If P + Q × R, which of the following is true

(a) [illegible] is the Niece of R

(b) P is Daughter of R

(c) P is Cousin of R

(d) P is the Daughter-in-law of R

Sol. (a) [illegible] R means P is the daughter of Q who is the mother of R i.e. P is [illegible] of R.

Example 6

A [illegible] consists of grand mother, father, mother, four sons & their wives and one son and two daughters of each of the sons. How many females are there?

(a) 14 (b) 16

(c) 18 (d) 24

Sol. (a) 14

[illegible] wives of four sons, [illegible] and two daughters of each of the four sons are 8 female. So total

1 + 1 + 4 + 8 = 14 female

Example 7.

Seema and Meena are sisters. Shalu is Meena's stepdaughter. How is Seema related to Shalu?

(a) Sister (c) [illegible]

(b) Mother (d) Step mother

Sol. (c) [illegible]

Shalu is Meena's stepdaughter [illegible] Meena is Shalu's [illegible] the daughter of [illegible] Seema is the sister of [illegible] Shalu is [illegible] of Shalu.

Direction for Ex. 8 to 10.

A + B means A is daughter of B

A × B means A is the son of B

A – B means A is the wife of B

Example 8.

If P × Q – S, which of the following is true?

(a) S is wife of Q

(b) S is father of P

(c) P is daughter of Q

(d) Q is mother of P

Sol. (d) [illegible] S means P is the son of Q who is the wife of S.

Example 9.

If T – S × B – M, which of the following is not true?

(a) [illegible] of S

(b) M is [illegible] of B

(c) [illegible] of S

(d) S is daughter of B

Sol. (d) T – S × B – M means T is the wife of S who is [illegible] the son of B who is the wife of M. [illegible] [illegible] [illegible] So [illegible] is not true.

Example 10.

If Z + P – S × B, [illegible]

(a) Mother

(b) Grand mother

(c) Father

(d) Can't be determined

Sol. (b) [illegible] means Z is [illegible] of P who is the wife of S [illegible] [illegible] [illegible] is daughter [illegible] Hence [illegible] mother of B.

Some Standard Coding Technique

1. Proper noun should always be denoted by capital letters.

   Children: Mary and Robert [illegible]

   John [illegible] Mary [illegible]

2. Female [illegible] should be [illegible] to indicate [illegible] and [illegible] sign [illegible]:

   (i) + Mary [illegible] Mary [illegible]

   (ii) – [illegible]

3. Relationship

   (a) Is the Son of

   [illegible] is the son of [illegible]

   (b) Is the daughter of

   [illegible] is daughter of [illegible]

   (c) Is the Parent of

   [illegible] A is the parent of [illegible] $\frac{A}{B}$ or $\frac{A}{C}$

   (d) Is the spouse of

   [illegible] A is spouse of [illegible] [illegible]

[Note: [illegible] A & B [illegible]]

[illegible] Seema [illegible] B [illegible]

[illegible] B.

[Note: [illegible]

[illegible]]

(e) Is the sibling of

[illegible] A is sibling of [illegible]

1. A [illegible] (A is B's brother)
2. A [illegible] (A is sister of B)
3. A [illegible] (B is sister of A)
4. A [illegible] (A & B are sisters)

(f) Grand father-grand son relation

[illegible]

[illegible]

S[illegible]

[illegible]

B[illegible]

(Note: [illegible]

[illegible])

(g) When the sex of a person is not mentioned write it in a box.

i.e. [illegible]

[illegible]

[illegible]

* * *

Practice Exercise-I

Direction (Qs. 1 to 6): Read the following information carefully and answer the questions [illegible].

[illegible] P, Q, R, [illegible]

1. How many [illegible]?
   (a) 1 (b) 2
   (c) 3 (d) 4

2. Who is the [illegible] of Z?
   (a) X (b) U
   (c) [illegible] (d) P

3. How many [illegible]?
   (a) One (b) Two
   (c) Three (d) Four

4. Who is the [illegible] of [illegible]?
   (a) P
   (b) [illegible]
   (c) [illegible]
   (d) can't be determined

5. Which of the following [illegible]?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

6. How is [illegible] related to [illegible]?
   (a) Father
   (b) Brother
   (c) Uncle
   (d) can't be determined

Direction (Qs. 7 to 12): Read the following information carefully and answer the questions given below.

[illegible]

7. Who is the [illegible]?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

8. Who is the father of [illegible]?
   (a) [illegible] (b) P
   (c) [illegible] (d) [illegible]

9. How many [illegible]?
   (a) One (b) Two
   (c) Three (d) Four

10. How many [illegible]?
   (a) One (b) Two
   (c) Three (d) Four

11. How is [illegible] related to [illegible]?
   (a) Father (b) [illegible]
   (c) Brother (d) Uncle

12. Which is a pair of brothers?
   (a) P and [illegible] (b) [illegible] and Z
   (c) Q and X (d) [illegible] and Y

Direction (Qs. 13 to 15): Read the following information carefully and answer the questions given below:

[illegible]

13. How is [illegible] related to Q?
(a) Cousin (b) Nephew
(c) Uncle (d) Brother

14. How is [illegible] related to [illegible]?
(a) Sister (b) Daughter
(c) Niece (d) Wife

15. How many [illegible] does [illegible] have?
(a) Two (b) One
(c) [illegible] (d) None

16. Rajan is the brother of Sachin and Manik is the father of Rajan. Jagat is the brother of Priya and Priya is the daughter of Sachin. Who is the uncle of Jagat?
(a) Rajan (b) Sachin
(c) Manik (d) None of these

Direction (Qs. 17 & 18): Read the following information carefully and answer the questions given below:
(i) A is the father of C.
(ii) D is the daughter of [illegible]. E is the spouse of A.
(iii) B is the brother of C. F is the son of B.
(iv) [illegible] is the spouse of B. [illegible] is the [illegible] of [illegible].

17. Who is the grandmother of [illegible]?
(a) A (b) C
(c) [illegible] (d) [illegible]

18. Who is the son of F?
(a) [illegible] (b) C
(c) [illegible] (d) [illegible]

Direction (Qs. 19 to 23): Read the following information carefully and answer the questions given below:
P, Q, R, S, T and U are members of the same family. There are two fathers, two sons and two wives [illegible] two members of the group. The Engineer was the wife of Teacher [illegible] the Farmer. [illegible] is the wife of [illegible] is the younger [illegible] of the family and S is the [illegible].

19. How is [illegible] related to Q?
(a) Husband (b) Wife
(c) Mother (d) Daughter

20. Who is the husband of R?
(a) P (b) Q
(c) S (d) [illegible]

21. Who is the youngest?
(a) P (b) Q
(c) R (d) S

22. Who are the [illegible] in the group?
(a) T and P (b) Q and [illegible]
(c) [illegible] and Q (d) T and Q

23. How is [illegible] related to T?
(a) Wife (b) Husband
(c) Father (d) Son

Direction (Qs. 24 to 28): Read the following information carefully and answer the questions given below:
(i) A is the mother of B and [illegible] is A's [illegible] daughter.
(ii) [illegible] is the cousin of [illegible] and is the brother of K.
(iii) D and [illegible] are [illegible].
(iv) [illegible] has 2 daughters and 1 son. [illegible] has [illegible] daughter.
(v) G and [illegible] have 2 daughters [illegible] C.
(vi) [illegible] and A [illegible] daughter [illegible] relationship.
(vii) D [illegible].

24. How is [illegible] related to A?
(a) Mother (b) Brother
(c) Aunt (d) Cousin

25. [illegible] is [illegible]?
(a) Daughter (b) Granddaughter
(c) Grandson (d) Son

26. How is [illegible] related to [illegible]?
(a) Uncle (b) Brother
(c) Sister (d) Father

27. How is [illegible] related to [illegible]?
(a) Brother-in-law (b) Sister-in-law
(c) Daughter (d) Wife

28. How is [illegible] related to [illegible]?
(a) Daughter (b) Son-in-law
(c) Wife (d) Husband

□□□□

Solutions

Hints (1–4)

Sol → [illegible]

- [illegible]
- [illegible]
- [illegible]

— [illegible]

[illegible]

[illegible]

1. (d)
2. (d)
3. (c)
4. (d)
5. (d)
6. [illegible]

Sol. (7 – 12)

[illegible]

7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]

Sol. (13 to 15)

[illegible]

13. [illegible]
14. [illegible]
15. [illegible]

Sol. (16) [illegible]

16. [illegible]

Sol. (17 – 18)

[illegible]

17. [illegible]
18. [illegible]

Sol. (19 to 23)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

→ [illegible]

→ [illegible]

[illegible]

S [illegible]

G – P

F

19. [illegible]
20. [illegible]
21. [illegible]
22. (a)
23. [illegible]

Sol. (24 to 28)

[illegible]

24. [illegible]
25. (a)
26. [illegible]
27. (b)
28. [illegible]

II Practice Exercise: II

1. [illegible] said to guests, "[illegible] father is the only son of my father." How is [illegible] related to [illegible]?
(a) Daughter (b) Mother
(c) Sister (d) Niece

2. Akash said to Vikas, "This boy in the photo is the younger of the two brothers of the daughter of my father's wife." How is the boy in the photograph related to Akash?
(a) Father (b) Uncle
(c) Brother (d) Nephew

3. Pointing to a man in the photograph, [illegible] said, "[illegible]." How is the man in the photograph related to [illegible]?
(a) Son (b) Father
(c) Cousin (d) Nephew

4. Pointing to a photograph, Vinod said, "She is the daughter of [illegible] is my son." How is Vinod related to the girl in the photograph?
(a) Father (b) Brother
(c) Cousin (d) Data inadequate

5. A man said to a woman, "[illegible] mother's [illegible]." How is the man related to the woman?
(a) Nephew (b) Son
(c) Cousin (d) Uncle

6. Looking at a picture of a man, [illegible] said, "His mother is the wife of my father's son. Brothers and sisters I have none." At whose picture was [illegible] looking?
(a) His son (b) His uncle
(c) His cousin (d) His nephew

7. [illegible] and [illegible] are [illegible]. [illegible] mother's [illegible] sister [illegible]. How is [illegible] related to [illegible]?
(a) Daughter (b) Granddaughter
(c) Mother (d) Sister

8. If Meena says, "Anita's father Raman is the only son of my father-in-law Mahipal", then how is [illegible], who is the [illegible] of Anita, related to Meena?
(a) Granddaughter (b) Daughter
(c) Sister (d) Niece

9. Pointing to a girl in the photograph, Amar said, "Her mother's brother is the only son of my mother's father." How is the girl's mother related to Amar?
(a) Mother (b) Sister
(c) Aunt (d) Grandmother

10. [illegible] what is A of B?
(a) Son (b) Grandson
(c) Brother (d) Grandfather

11. [illegible]. How is [illegible] related to [illegible]?
(a) Uncle (b) Father
(c) Grandfather (d) Brother

12. If [illegible]
(i) [illegible]
(ii) [illegible]. Which of the following [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

13. Deepak is the brother of Ravi. Rekha is the sister of Ajay. Ravi is the son of Rekha. How is Deepak related to Rekha?
(a) Son (b) Brother
(c) Nephew (d) Father

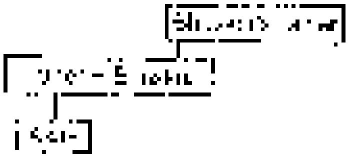
14. A is B's sister. C is B's mother. D is C's father. E is D's mother. Then, how is A related to D?
(a) Grandmother (b) Grandfather
(c) Daughter (d) Granddaughter

15. [illegible] A [illegible] of B; [illegible] is the father of [illegible]; F is daughter [illegible] uncle of F?
(a) A (b) B
(c) C (d) D

16. A is the [illegible] of B. [illegible] C. [illegible] daughter. How is [illegible] related to D?
(a) Brother (b) Uncle
(c) Father-in-law (d) Brother-in-law

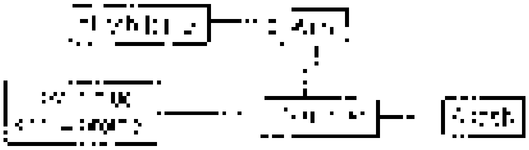
Solutions

1. (a)



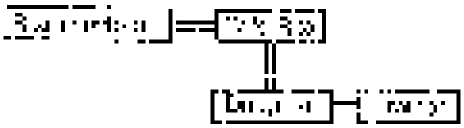
[illegible]

2. (c)



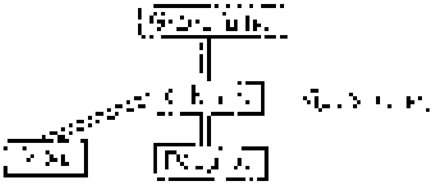
[illegible]

3. (d)



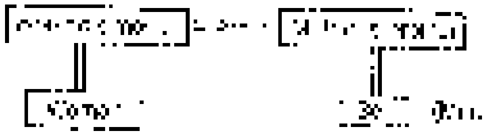
[illegible]

4. (b)



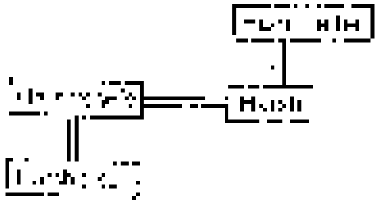
[illegible]

5. (a)



[illegible]

6. (a)



[illegible]

7. Sister (b)

8. [illegible]

9. Aunt (c)

10. [illegible]

11. Father (b)

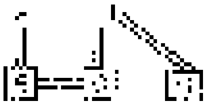
12. [illegible]

13. [illegible]

14. [illegible]

15. [illegible]

16. (c)



[illegible]

3.2
CHAPTER
Coding and Decoding

Directions (Qs. 1 to 5): Read the following information carefully and answer the question below.

1. If 'Rat' is called 'Dog', 'Dog' is called 'Mongoose', 'Mongoose' is called 'Lion', 'Lion' is called [illegible] and [illegible] is called [illegible], which animal is [illegible] [illegible]?
   (a) Rat (b) Dog
   (c) Mongoose (d) Lion

2. If finger is called [illegible], [illegible] is called [illegible], [illegible] is called [illegible], Thumb is called Ankle, Ankle is called [illegible] and [illegible] is called [illegible], which of the finger has different name?
   (a) Thumb (b) Ankle
   (c) Knee (d) Palm

3. In a certain code language, [illegible] means [illegible], [illegible] means [illegible] and [illegible] means [illegible]. Which word in that language means [illegible]?
   (a) [illegible] & [illegible] (b) [illegible] & [illegible]
   (c) [illegible] & [illegible] (d) [illegible] & [illegible]

4. [illegible] Organising Committee, [illegible] Olympic Games [illegible] Modern Games History, which [illegible] coded as [illegible]?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

5. In a certain code language [illegible] means [illegible] Good Mangoes, [illegible] means [illegible] Mangoes and [illegible] and [illegible] Zoo Kit means Purchase [illegible], which word in the language means Good?
   (a) Zoo (b) [illegible]
   (c) [illegible] (d) [illegible]

Directions (Qs. 6 to 10): Read the following information carefully and answer the question below.

[illegible]

6. [illegible]
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

7. [illegible]
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

8. [illegible]
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

9. [illegible]
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

10. [illegible]
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) [illegible]

Directions (Qs. 11 to 12): Read the following information carefully and answer the question below.

[illegible] denotes [illegible] denotes [illegible] denotes [illegible] denotes [illegible] denotes [illegible]. Choose the correct statement in each of the following questions.

11. (a) [illegible]
    (b) [illegible]
    (c) [illegible]
    (d) [illegible]

12. (a) [illegible]
    (b) [illegible]
    (c) [illegible] 25 [illegible]
    (d) 12 [illegible]

13. (a) [illegible]
(b) [illegible] 8
(c) [illegible]
(d) [illegible]

14. (a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

15. (a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

Direction (Qs. 16 to 18): Read the following information carefully and answer the questions given below.

In a certain code, [illegible]

16. How is [illegible] written in that code?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

17. How is [illegible] written in that code?
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) cannot be determined

18. How [illegible] code?
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) cannot be determined

Direction (Qs. 19 to 22): Read the following information carefully and answer the questions given below.

[illegible] Birthday cards, [illegible] Christmas cards and [illegible] Marriage Anniversary cards. The number of Birthday cards [illegible] the Marriage Anniversary cards. The number of [illegible] Christmas cards.

19. The number of [illegible] cards in the collection is
(a) [illegible] (b) [illegible]15
(c) 1[illegible] (d) [illegible]

20. The number of [illegible] cards is
(a) [illegible] (b) [illegible]
(c) 35 (d) [illegible]

21. The number of Christmas cards is
(a) [illegible] (b) [illegible]
(c) 30 (d) [illegible]

22. [illegible] Birthday [illegible] Christmas [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Direction (Qs. 23 to 28): Read the following information carefully and answer the questions given below.

[illegible]

23. The digit in the unit [illegible]
(a) 2 (b) [illegible]
(c) [illegible] (d) [illegible]

24. The digit in the tens place is
(a) 8 (b) 6
(c) 9 (d) [illegible]

25. The digit in the [illegible] place is
(a) [illegible] (b) 3
(c) [illegible] (d) [illegible]

26. The sum of [illegible]
(a) [illegible] (b) 12
(c) [illegible] (d) 18

27. The three digit number is
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

28. The three digit number is always divisible by
(a) [illegible] (b) 18
(c) [illegible] (d) [illegible]

Direction (Qs. 29 to 30): [illegible]

[illegible]

29. [illegible]
(a) 4 (b) [illegible]
(c) 8 (d) 7

30. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

31. [illegible]
(a) G (b) Y
(c) Z (d) X

32. [illegible] XZO. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Directions (Qs. 33 to 37): [illegible]

[illegible]

33. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

34. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

35. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

36. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

37. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) Z

Solutions

Answer 1 to 3:

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

5. [illegible]

Answer 6 to 10:

6. [illegible]

7. [illegible]

8. [illegible]

9. [illegible]

10. [illegible]

Answer 11 to 15:

11. [illegible]

12. [illegible]

13. [illegible]

14. [illegible]

15. [illegible]

Answer 16 to 18:

16. [illegible]

17. (d) [illegible]

18. (c) [illegible]

Answer 19 to 22:

Number of Christmas cards = x

Then, number of Deepawali cards = 2x

Number of New Year cards = 4x

and number of Birthday cards

= x + 2x + 4x

= 7x

∴ 7x + x + 2x + 4x + 1 = 211

14x = 210

x = 15

Thus, number of Birthday cards

= 15 × 7

= 105

Number of New Year cards

= 15 × 4

= 60

Number of Deepawali cards

= 15 × 2

= 30

Number of Christmas cards

= 15 × 1

= 15

Number of wedding anniversary card

= 1

Total = 211

19. (c)

20. (d)

21. (b)

22. (b) 105 + 15 = 120

Answer 23 to 28:

[illegible] number is 100x + 10y + z

[illegible] numbers which we may get by using these 3 digits will be

100x + 10z + y

100y + 10x + z

100y + 10z + x

100z + 10x + y

100z + 10y + x

[illegible] by these three digits

222(x + y + z) = 3996 ⇒ (x + y + z) = 18

Also [illegible] y = 5

Thus, [illegible]

[illegible]

23. (c)

24. (c)

25. (c)

26. (c)

27. (c)

28. (b)

Answer 29 to 32

29. (c) [illegible]

30. (d) [illegible]

31. (c)

32. (a)

Answer 33 to 37

33. (c) [illegible]

34. (d) There is a gap of [illegible]

35. (c) [illegible]

36. (d) [illegible]

37. (a) [illegible]

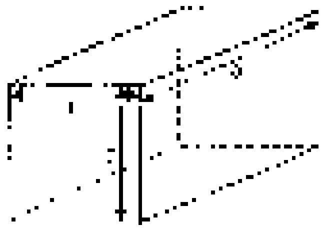
[illegible]

3.3
CHAPTER

Cubes and Dices

Cubes

A [illegible] in which [illegible] length, breadth & height are equal. [illegible] cubes are [illegible]



In a cube there are 8 corners/vertices.
There are 6 faces (all square in shape)
There are 12 edges (all equal in length)
No. of edges = No. of vertices + No. of faces – 2

The [illegible] in cubes and [illegible] cutting of faces of cubes & then [illegible] painted [illegible] into identical cubes etc. [illegible] questions are [illegible] & [illegible] cubes are [illegible] [illegible] always [illegible] while answering questions.

- [illegible]
- If [illegible] cubes are [illegible] such that [illegible] is [illegible]
- The number of [illegible] can have [illegible] [illegible] edges [illegible] following examples.

Practice Exercise 1

Directions for Questions (1 – 9)

[illegible] cube [illegible] painted [illegible] faces of cube [illegible] questions.

1. [illegible] total number of [illegible] cubes [illegible]?
2. [illegible] number of possible pairs [illegible] of [illegible]?
3. How many cubes will [illegible] painted?
4. How many cubes will [illegible] painted?
5. How many cubes will have only [illegible] painted?
6. How many cubes will have no faces painted?
7. How many cubes will have at least 2 faces painted?
8. How many cubes will have at least 1 face painted?
9. [illegible]

Directions (Qs. 10 to 15): A cube is cut into 216 [illegible]

10. How many cubes are there which are painted [illegible]?
    (a) 48 (c) [illegible]
    (b) [illegible] (d) 16
11. How many cubes [illegible]?
    (a) [illegible] (b) 56
    (c) 108 (d) [illegible]

12. [illegible]

(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

Directions (Qs. 13 to 17): [illegible]

13. [illegible]

(a) 160
(b) [illegible]
(c) 165
(d) 148

14. [illegible]

(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

15. [illegible]

(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

16. [illegible]

(a) 6
(b) 4
(c) [illegible]
(d) [illegible]

17. [illegible]

(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

Directions (Qs. 18 to 22): [illegible] figures.

18. [illegible]

(a) 16
(b) [illegible]
(c) [illegible]
(d) [illegible]

19. [illegible]

(a) [illegible]
(b) 16
(c) [illegible]
(d) [illegible]

20. [illegible]

(a) 16
(b) [illegible]
(c) [illegible]
(d) [illegible]

21. [illegible]

(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) [illegible]

22. [illegible]

(a) 16
(b) 24
(c) [illegible]
(d) [illegible]

[illegible]

Solution

1. [illegible]

2. [illegible]

3, 4, 5, 6

[illegible]

7. [illegible]

8. [illegible]

= 27

9. [illegible]

As the total surface area of the large was $6n^2$ [illegible] litre of paint was required. Hence total paint required to paint all uncoloured faces of small

cubelets = $\frac{6n^2(n-1)}{6n^2}$ [illegible] = (n − 1) litres

10. 11 & 12

Because there are cubelets with same color on opposite of the faces. We can still use formula [illegible]

= [illegible]

10. Each [illegible]

$= {}^3C_1(n-2)^2 \times 2$

$= 3 \times (n-2)^2 \times 2$

$= 3 \times 4^2 \times 2 = 96$

Option (b)

11. Basically we are looking for no. of cubes which are coloured on two faces or one face

= [illegible]

$= 3 \times 4 \times 4 + 8 = 56$

Option (c)

12. Basically in this question we are looking for no. of cubelets which are uncoloured & no. of cubelets which are coloured on 1 face only.

$= {}^3C_0(n-2)^3 + {}^3C_1(n-2)^2 \times 2$

$= (n-2)^3 + 3 \times 2 \times (n-2)^2$

$= 4^3 + 6 \times 4^2$

= 64 + 96 = 160 Option (c)

Alternatively, total no. of cubelets which are coloured on [illegible] = total no. of cubelets − total no. of cubelets which are coloured on multiple faces

= 216 − 56 = 160 Option (c)

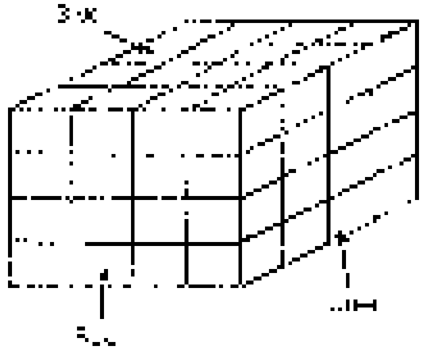
13. From each face 5 × 5 = 25 cubelets are [illegible] coloured. So total = 25 × 6 = 150 cubelets. Further because each face is having one similar colour adjacent face and 3 other different colour faces, [illegible] × 2 = [illegible] cubelets will come from the edges where adjacent faces of similar colour are meeting. Hence total = 150 + 15 = 165 cubes will be [illegible] exactly one colour?

Hence option (c)

14. $n^3 = 343 = 7^3 \Rightarrow n = 7$

Minimum number of cubes = 2(n − 1)

= 2(7 − 1) = 2 × 6 = 12 Option (b)



As we can see in the above figure, 3 faces are visible [illegible] hidden faces [illegible] = 8 [illegible] & [illegible]

15. Number of cubes which have no paint on them at all

$= (n-2)^3 = [illegible]$

[illegible]

= [illegible]

Option (c)

16. Only those cubelets [illegible] visible in figure & all the [illegible] diagonals [illegible] opposite corner [illegible] will [illegible]. Option (c)

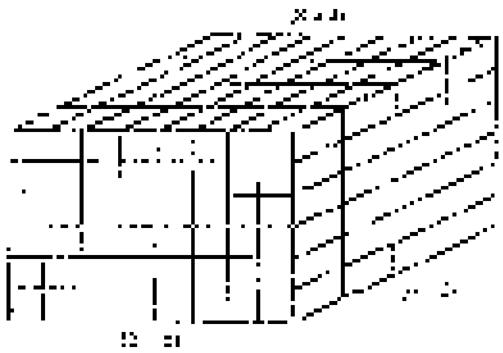
17. No. of cubes coloured in multiple colours

= No. of cubelets with three colours + No. of cubelets with two colour

= 8 + 52 = 60. Option (c)

18. As we can see in the figure [illegible] cubelets [illegible] opposite [illegible] × 4. Hence no. of green coloured cubelets [illegible] = 24 [illegible] face. There are two such faces hence maximum total no. of [illegible] will be = 24 × 2 = 48

Hence option (c)



19. The no. of [illegible] 192 will be [illegible] 3 pieces. [illegible] 4 × 4 × 4 cubes have two opposite faces of 4 × 4 and two opposite faces of ? × 2 and two opposite faces [illegible] (8 – 1) [illegible] 7, [illegible] 17. Hence option (a)

20. To maximize [illegible] cubelets with [illegible] (5 × 6), (4 × 5) respectively [illegible] edges [illegible] desired cubelets [illegible] = 1 = [illegible] = 16. Hence option (c)

21. Against [illegible] cubelets [illegible] with 3 [illegible] 3 cubelets with [illegible] Hence option (c)

22. Number of unpainted cubes [illegible] (? – 2) × (5 – 2) × (8 – ?) = ? × 4 × ? = 48. Hence option (d)

□□□□

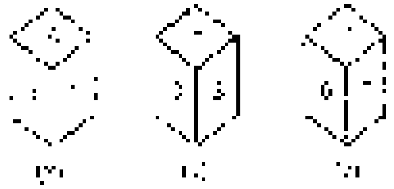
DICES

Generally dices are cubes [illegible] numbers [illegible] are marked on faces. Dices are of two kinds:

1. Symmetric: Where sum of the numbers on opposite pair of faces is same.
   Normally the faces opposite to each other are 1 — 6, 2 — 5, 3 — 4.
2. Asymmetric: Where sum of the numbers on opposite pair of faces is different.

Example:

A dice with [illegible] faces numbered 1 to 6 is shown in three different positions x, y, z.



Find opposite faces pairs.

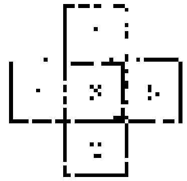
Solution:

Here we get:

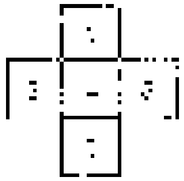
[illegible] — 8

2 — [illegible]

5 — [illegible]



[illegible] opposite [illegible]



[illegible] opposite [illegible] 4

□□□□

Practice Exercises

Direction (Qs. 1 to 5): A cube [illegible] is divided into [illegible] smaller [illegible] minimum number of cuts [illegible] painted [illegible] face.

1. What is the minimum no. of cuts required?
   (a) 21
   (b) [illegible]
   (c) 2[illegible]
   (d) None of these
2. How many smaller pieces have exactly 3 painted faces?
   (a) 20
   (b) 8
   (c) 1[illegible]
   (d) 1
3. How many smaller pieces have at least 2 faces painted?
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]
   (d) [illegible]
4. How many smaller pieces have at least one face painted?
   (a) 488
   (b) 2[illegible]
   (c) 3[illegible]
   (d) None of these
5. How many smaller pieces have no face painted?
   (a) 14[illegible]
   (b) 12[illegible]
   (c) [illegible]
   (d) 1[illegible]

Direction (Qs. 6 to 8): [illegible] following information.

Three adjacent [illegible] faces [illegible] remaining faces [illegible] The cube is then cut into [illegible] cubes.

6. How many of cubelets will have [illegible]
   (a) [illegible]
   (b) 2
   (c) [illegible]
   (d) 4

7. How many of the smaller cubes have only [illegible] colour on them?
(a) 16 (b) 10
(c) 18 (d) 24

8. How many smaller cubes have [illegible] on them?
(a) 32 (b) 08
(c) 37 (d) 42

9. How many [illegible] cubes have only [illegible] painted on them?
(a) 38 (b) 32
(c) 16 (d) 56

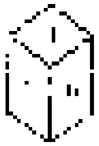
10. How many of the smaller cubes have [illegible] on them?
(a) 152 (b) 117
(c) 63 (d) [illegible]

11. How many of the [illegible] cubes are [illegible]?
(a) 85 (b) 128
(c) 20 (d) [illegible]

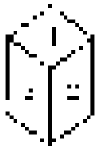
12. How many [illegible] on them?
(a) 140 (b) 100
(c) 150 (d) 125

13. How many of [illegible] have [illegible] on them?
(a) [illegible] (b) 56
(c) 51 (d) 64

14. The six faces of a cube are numbered 1, 2, 3, 4, 5 & 6. Given below are two different positions of the same cube.



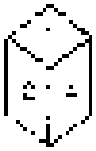
(i)



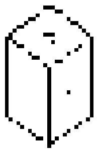
(ii)

Which number is opposite the face marked 4?
(a) 2 (b) 1
(c) 3 (d) 6

15. The six faces of a cube are marked as 1, 2, 3, 4, 5 & 6. Given below are two positions of the cube. Which face is opposite the face marked 1?



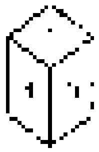
(i)



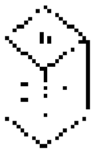
(ii)

(a) 4 (b) 6
(c) 5 (d) 2

16. Six faces of a cube are numbered 1, 2, 3, 4, 5 & 6. Given below are two different views of the same cube.



(i)



(ii)

Which face is opposite the face marked 1?
(a) 3 (b) [illegible]
(c) 2 (d) None of these

17. [illegible]
(a) 1600 (b) [illegible]
(c) 1275 (d) None of these

18. [illegible] of size 3 × 3 × 3. What is least possible integer [illegible]?
(a) 81 (b) 75
(c) 32 (d) 54

Directions (Qs. 19 to 22): Read the following information carefully & answer the questions asked.

A cube is painted in following manner?
(i) 1 is in between 2 & 3
(ii) [illegible]
(iii) 4 is in between 5 & 6
(iv) [illegible]
(v) [illegible]

19. The number opposite to 1 is
(a) 2 (b) 4
(c) 3 (d) [illegible]

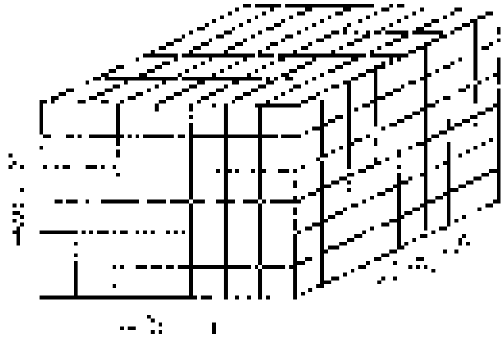
20. The opposite face is
(a) 1 (b) [illegible]
(c) [illegible] (d) [illegible]

21. [illegible] are
(a) 2, 5, [illegible] 4 (b) 1, [illegible] 4, 3
(c) 3, 4, [illegible] (d) 2, [illegible] 4, 3

22. [illegible] are
(a) 5, [illegible] 1, 2 (b) [illegible]
(c) 5, 3, [illegible] (d) [illegible] 5

Solutions

Answer 1 to 5: [illegible]



[illegible]

[illegible]

1. (c) [illegible]

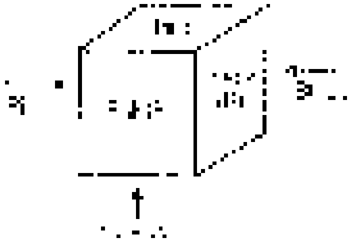
2. (b) [illegible]

3. (b) [illegible]

4. (c) [illegible]

5. (c) [illegible]

Answer 6 to 13: [illegible]



[illegible]

Colours		Edges	Faces
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

6. (b) [illegible]

7. (c) [illegible]

8. (c) [illegible]

9. (b) [illegible]

10. (c) [illegible]

11. (c) [illegible]

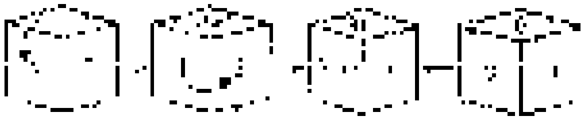
12. (c) [illegible]

13. (c) [illegible]

14. (b) As 3 is adjacent to (1 & 6) and [illegible] (1 & 2) hence 3 is opposite to the remaining face 5.

15. (c) 2 & 6 both are adjacent to both 3 & 4. Hence 2 & 6 have to be opposite.

16. (c) From (i) and (ii) we know that 1 is adjacent to 2, 4, 5, 3 hence 1 is opposite to 6. We can find other two pairs of opposite faces by rotating one of the cube to match another.



∴ Opposite [illegible] opp. [illegible] 2 is 5

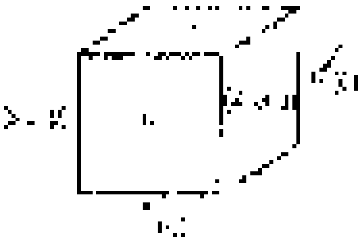
17. (b) Least possible dimension of cube [illegible] 60 Therefore [illegible]

$= \frac{60 \times 60 \times 80}{4 \ldots} = 1800$

18. (b) The least possible dimension of cubes [illegible] No. of [illegible] can be obtained

$= \frac{[illegible]}{[illegible]} = 72$

Answer 19 to 22:



19. (c) The [illegible] will be 4.

20. (b) The [illegible]

21. (c) The [illegible] (1, 2, 3, 4 [illegible]) [illegible]

22. (d) [illegible]

3.4
CHAPTER

Direction Sense Test

1. Gopal is facing south. He turns 135° in the anticlockwise direction and then 180° in the clockwise direction. Which direction is he facing now?
(a) North-east (b) North-west
(c) South-east (d) South-west

2. Manoj is facing North-West. He turns 90° in the clockwise direction and then 135° in the anticlockwise direction. Which direction is he facing now?
(a) East (b) West
(c) North (d) South

3. Ramesh starts walking straight towards East. After walking 75 metres, he turns to the left and walks 25 metres straight. Again he turns to the left, walks a distance of 40 metres straight, again he turns to the left and walks a distance of 25 metres. How far is he from the starting point?
(a) 35 metres (b) 50 metres
(c) 140 metres (d) None of these

4. Pradeep leaves from the front of his house. He walks towards East. After moving a distance of 40 m, he turns towards South and walks 30 m. Then he walks 40 m moving to the West and further 5 m towards the North. He then turns towards East and walks 40 m. What is the straight distance in metres between his initial and final position?
(a) 0
(b) 5
(c) 10
(d) cannot be determined

5. Vinod walks 30 metres towards North. He then turns left and walks 40 metres. He again turns left and walks 30 metres. Further, he moves 20 metres after turning to the right. How far is he from his original position?
(a) 40 metres (b) 30 metres
(c) 50 metres (d) 60 metres

6. Sudeep starts from his house towards West. After walking a distance of 35 metres, he again turned towards North and walked 25 metres. He then turned right and moving a distance of 10 metres turned to his left and walked 10 metres. He turns at 90° left and walks [illegible]. Finally he turns to his right. In which direction is he walking now?
(a) North (b) South
(c) East (d) South-West

7. A man turned towards East and turns [illegible] 15° and turns right, turns 3[illegible] and again turns to left 45°, turns 5° and then turns to left [illegible]. In which direction is he now facing?
(a) East (b) West
(c) North (d) South

8. Suman is facing from her house. She first walks 30 metres in North-West direction and then 30 m in South-West direction. Next, she walks 30 metres in South-East direction and turns towards her house. In what direction is she moving?
(a) North-east (b) North-west
(c) South-east (d) South-west

9. I am facing South. I turn right and walk 20 m. Then I turn right again and walk 10 m. Then I turn left and walk 10 m and then turning right walk 20 m. Then I turn right again and walk 60 m. In which direction am I from the starting point?
(a) North (b) North-west
(c) East (d) North-east

10. A man walks 1 km towards East and then he turns to South and walks 5 km. Again he turns to East and walks 2 km, after this he turns to North and walks 9 km. Now, how far is he from his starting point?

(a) [illegible] (b) 4 km
(c) 5 km (d) [illegible]

11. From his house Ramu went 15 kms to the North. Then he turned West and covered 10 kms. Then he turned South and covered 5 kms. Finally turning to East, he covered 10 kms. In which direction is he from his house?
(a) East (b) West
(c) North (d) South

12. Going 50 m to the South of her house, Radha turns left and goes another 20 m. Then, turning to the North, she goes 30 m and then starts walking to her house. In which direction is she walking now?
(a) North-west (b) North
(c) South-east (d) East

13. [illegible] walks 20 m North. Then he turns right and walks 30 m. Then he turns right and walks 35 m. Then he turns left and walks 15 m. Then he again turns left and walks 15 m. In which direction and how many metres away is he from the original position?
(a) 15 metres West (b) 30 metres West
(c) 30 metres East (d) 45 metres East

14. A child is looking for his father. He went 90 metres in the East before turning to his right. He went 20 metres before turning to his right again to look for his father at his uncle's place 30 metres from this point. His father was not there. From here he went 100 metres to the North before meeting his father in a street. How far did the son meet his father from the starting point?
(a) 80 metres (b) 100 metres
(c) 140 metres (d) 260 metres

15. [illegible] walks [illegible] towards East. Then he turns to his left and walks straight 30 metres, then turns to his right and walks 50 metres again turning [illegible] towards [illegible] and [illegible] walking 25 metres. Now, [illegible] is in which direction from the starting point?
(a) South-east (b) North-east
(c) South-west (d) North-west

16. Two buses start from the opposite points of a main road, 150 kms apart. The first bus runs for 25 kms and takes a right turn and then runs for 15 kms. It then turns left and runs for another 25 kms and then takes the direction back to reach the main road. In the meantime, due to a minor breakdown, the other bus has run only 35 kms along the main road. What would be the distance between the two buses at this point?
(a) 65 kms (b) 75 kms
(c) 80 kms (d) 85 kms

17. [illegible] start walking towards [illegible] from the same point. [illegible] walks [illegible] m, [illegible] walks 20 m [illegible] turns right and goes 40 m [illegible] turns right again and comes back to the [illegible] walk with the same speed, what is the distance between them now?
(a) 20 m (b) 50 m
(c) 40 m (d) 50 m

18. [illegible]
(a) East (b) [illegible]
(c) [illegible] (d) [illegible]

19. [illegible] turned right and covered a distance of [illegible] km, then turned left and covered a distance of [illegible]. Towards which direction did he walk last?
(a) North (b) South
(c) East (d) West

20. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

21. A boy rode his bicycle Northward, then turned left and rode 1 km and again turned left and rode 2 km. He found himself exactly 1 km west of his starting point. How far did he ride northward initially?
(a) 1 km (b) 2 km
(c) 3 km (d) 5 km

Directions (Qs. 22 to 26): Read the following information carefully and answer the questions given below it.

(i) There are six flats on a floor in two rows facing North and South allotted to P, Q, R, S, T and U.

(ii) Q gets a North facing flat and is not next to S.

(iii) S and U get diagonally opposite flats.

(iv) R next to U, gets a South facing flat and T gets a North facing flat.

22. Which of the following combinations get South facing flats?
(a) QTS (b) UPT
(c) URP (d) Data inadequate

23. Whose flat is between Q and S?
(a) T (b) U
(c) R (d) P

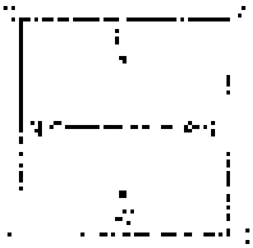
24. If the flats of T and P are interchanged then whose flat will be next to that of U?
(a) P (b) Q
(c) R (d) T

25. The flats of which of the other pairs than SU, is diagonally opposite to each other?
(a) QT (b) QR
(c) PT (d) TS

26. To arrive at the answers to the above questions, which of the following statements can be dispensed with?
(a) None (b) (i) only
(c) (ii) only (d) (iii) only

27. [illegible] direction is he going now?
(a) North-East (b) [illegible]-West
(c) North-West (d) South-West

Directions (Qs. 28 to 29): The following questions are based on the diagram given below showing four persons stationed at the four corners of a square piece of plot as shown.



28. A starts crossing the field diagonally. After walking half the distance, he turns right, walks some distance and turns left. Which direction is A facing now?
(a) North-East (b) North-West
(c) North (d) South-East

29. From the original position given in the above figure, A and B move one arm length clockwise and then cross over to the corner diagonally opposite; C and D move one arm length anti-clockwise and cross over the corner diagonally opposite. The original configuration ABCD has now changed to:
(a) CDBA (b) BDAC
(c) DACB (d) ABCD

30. From the original position, B and D move one and a half length of sides clockwise and anti-clockwise respectively. Which one of the following statements is true?
(a) B and D are both at the midpoint between A and C.
(b) D is at the midpoint between A and C, and B is at the corner originally occupied by A.
(c) B is at the midpoint between A and C, and D is at the corner originally occupied by A.
(d) B and D are both at the midpoint between A and C.

31. From the positions in the original figure, C and A move diagonally to opposite corners and then one side each clockwise and anti-clockwise respectively. B and D move two sides each clockwise and anti-clockwise respectively. Where is A now?
(a) At the north-west corner
(b) At the north-east corner
(c) At the south-east corner
(d) At the south-west corner

32. After the movements given in Q. 31 above, who is at the north-west corner?
(a) A (b) B
(c) C (d) None of these

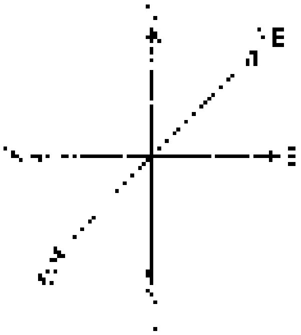
33. A square field ABCD of side 90 m is so located that its diagonal AC is from north to south and the corner A is to the west of D. [illegible] and [illegible] start walking along the field from A and C respectively in the clockwise and anti-clockwise directions at the speeds of 8 km/h and 10 km/h. Where will they meet each other for the first time?
(a) On AD at a distance of 30 m from A
(b) On AD at a distance of 10 m from D

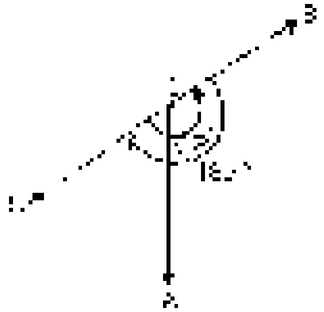
(d) On AB at a distance of 40 m from B

(e) On BC at a distance of 10 m from C

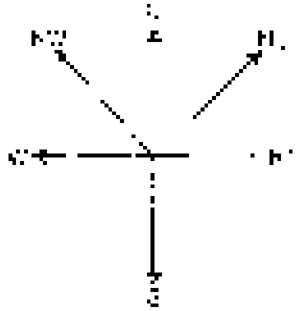
Solutions

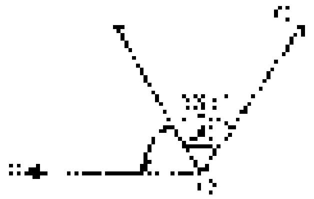
1. (c) As shown in Fig. 1, Dabbu initially faces in the direction OA. On moving 135° anticlockwise he faces in the direction OB. On further moving 180° clockwise, he faces in the direction OC which is South-west.



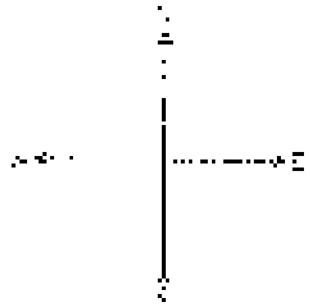


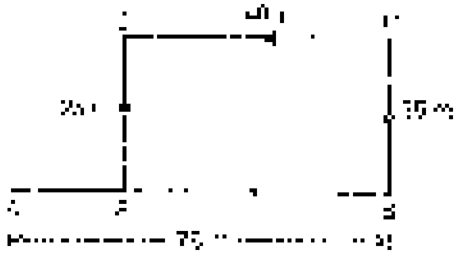
2. (b) As shown in Fig. 2, Mudrita initially facing in the direction OP. On moving 90° clockwise, he faces in the direction OQ. On further moving 135° anticlockwise, he faces in the direction OR which is West.





3. (d) The movements of Rakesh are as shown in fig.

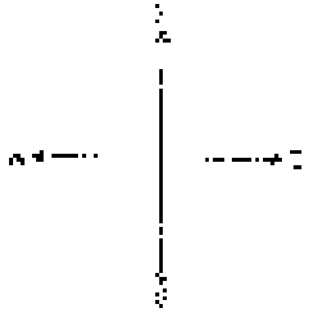


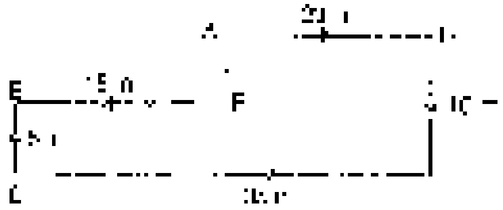


Clearly, EB = DC = 40 m.

∴ Rakesh's distance from his starting point A = (AB − EB) = (75 − 40) m = 35 m

4. (c) The movements of Neelesh from point A are as shown in fig.





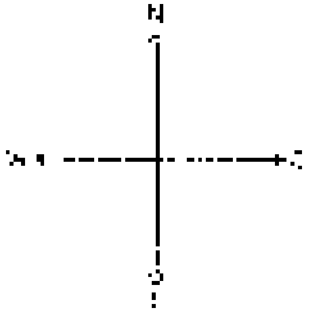
Clearly DC = AB + EF.

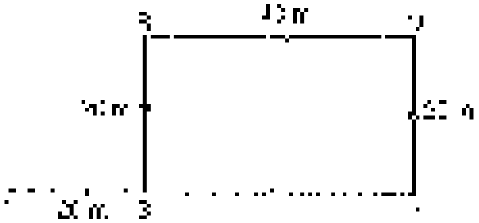
∴ F is in line with A.

Also AF = (20 − 15) = 5 m

So, Neelesh is 5 metres away from his initial position.

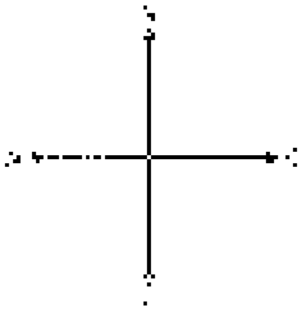
5. (d) [illegible] as shown in Fig.

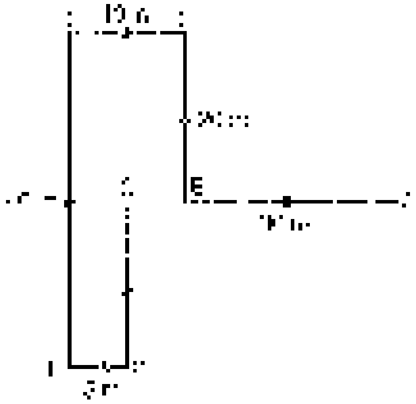




Clearly, [illegible] from [illegible] initial position
[illegible]

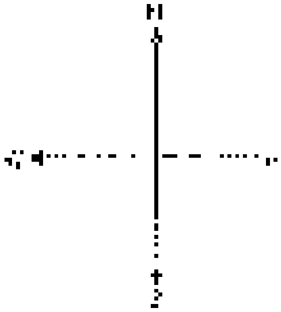
6. (a) [illegible] as shown in Fig.
from A to G

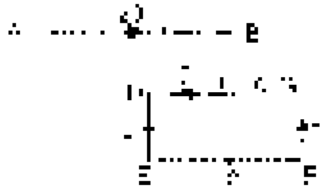




Clearly, [illegible] finally walking in the direction
[illegible] North

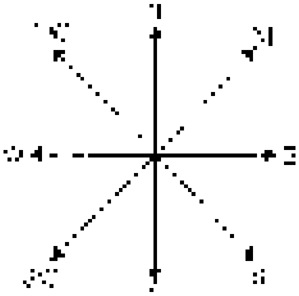
7. (a) The movements [illegible] are as shown in Fig.

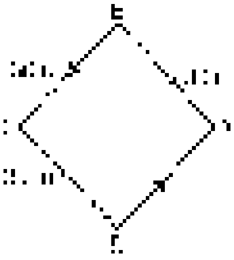




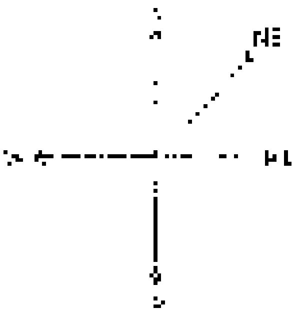
Clearly, [illegible] finally walking in the direction [illegible] North.

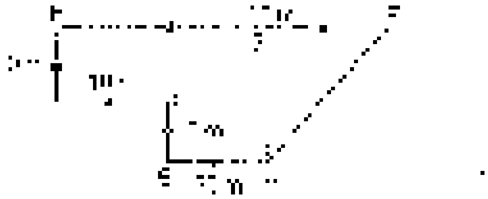
8. (c) The movements [illegible] as shown in Fig.
[illegible]
[illegible]



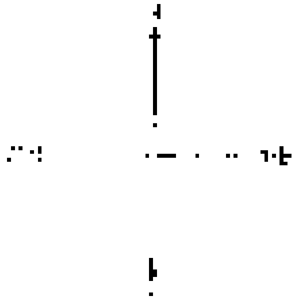


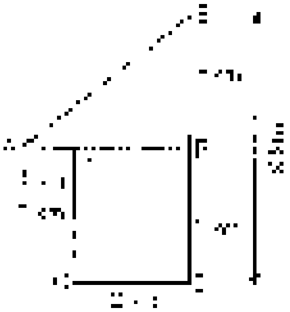
9. (b) The movements [illegible] A [illegible] as shown in Fig. Clearly, the final position [illegible] North-East [illegible] starting point A.





10. (a) The movements of the [illegible] are as shown in Fig. ([illegible] B to C, C to D, D to E).



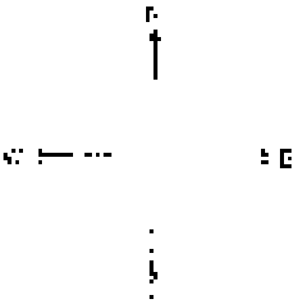


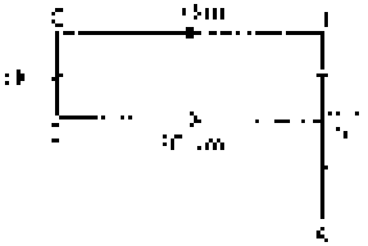
Clearly, DE = AC = 5 km
BF = (DE – DC) = ([illegible]) km = 4 km
EF = CD = [illegible] km
AF = AB + BF = AF = CD = [illegible] km = [illegible] km
∴ Man's distance from starting point A

$= AE = \sqrt{AF^2 + EF^2} = \sqrt{[illegible]}$

$= \sqrt{25} = 5\ km$

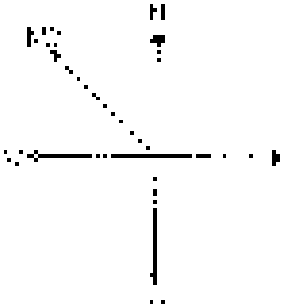
11. (b) The movements of [illegible] are as shown in Fig. (A to B, B to C, C to D and D to E).

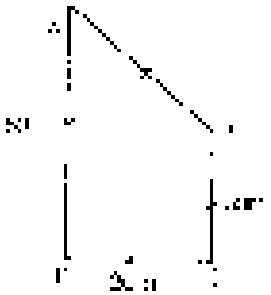




Clearly, the final position is E which is [illegible] of his house A.

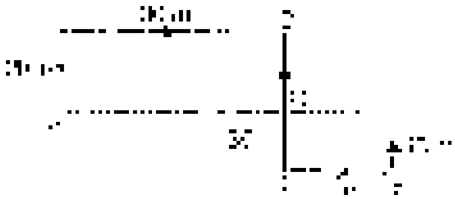
12. (a) The movements of [illegible] are as shown in Fig. (A to B, B to C, C to D [illegible] A).





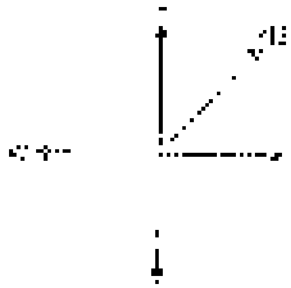
[illegible] (North-west).

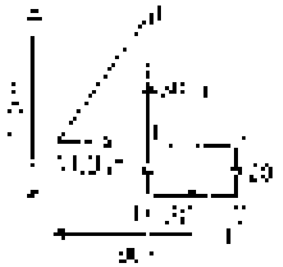
13. (c) The movements of Mithilesh are as shown in Fig.



Since CD = AB [illegible] A.
∴ Mithilesh's distance from starting point A
= AE = (AC + CE)
= ([illegible]) = [illegible] km.
Ans. [illegible] east of A.

14. (b) The movements of the man are as shown in Fig.





Clearly, the [illegible] distance [illegible] is AE.

Here, [illegible] = (AB [illegible]) = (AB [illegible] DC)

= (30 − 20) m = 10 m

EF = [illegible] − [illegible]

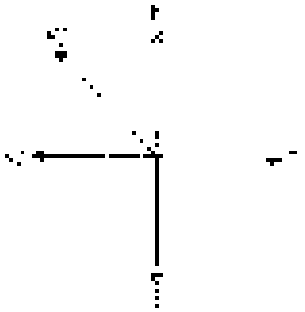
= [illegible] m = [illegible] m

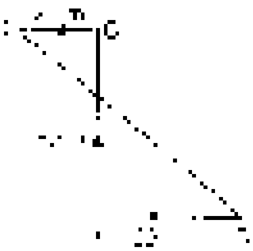
AE = $\sqrt{(AF)^2 + (FE)^2}$

= $\sqrt{[illegible]}$ = [illegible] m

18. (c) [illegible] Adhir [illegible] towards West [illegible] walking towards West. Thus, the movements of Adhir [illegible] as shown in Fig. [illegible] A, B, [illegible] C [illegible].

Clearly, [illegible] A.





16. (c) 1st X [illegible] then [illegible]

[illegible] along the path [illegible]

[illegible] AB, DC [illegible]

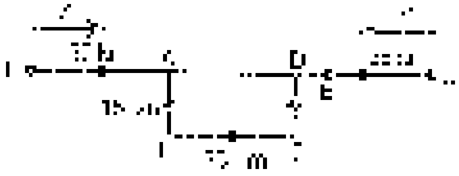
Now, [illegible] = 40 − 20 km

But Y [illegible] 35 km [illegible]

∴ Distance between [illegible]

EC = [illegible]

= [illegible] − 35) = [illegible] km



17. (c) Clearly, [illegible] 80 m [illegible] A [illegible] and [illegible] D.

[illegible] = [illegible] m

[illegible] (80 [illegible]) m = [illegible] m.

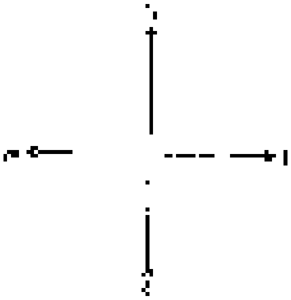
Since [illegible] will [illegible]

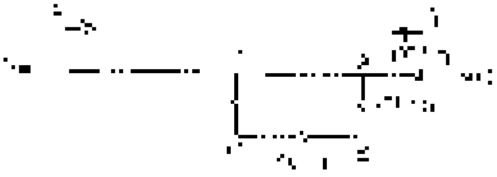
[illegible]

[illegible] = [illegible]

[illegible]

∴ AD = [illegible] = [illegible] m.





19. (c) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

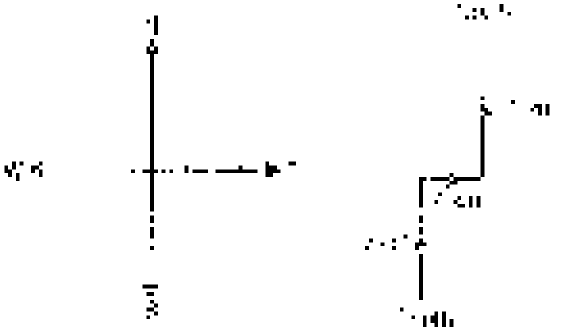
[illegible]

[illegible]

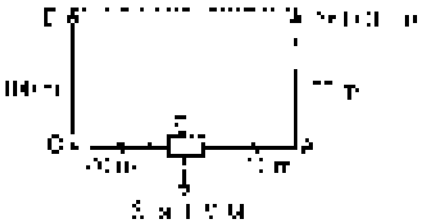
□ [illegible]

[illegible] arrangements we have: Sm, Sh, T, Sa.
So Shreet is [illegible] on the right.

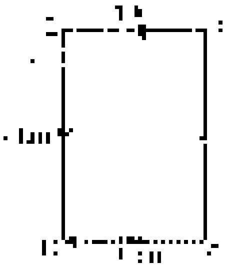
19. (c) Clearly the route is as shown in the following diagram. Thus, he started the journey from the South and moved northwards.



20. (c) Clearly the point at the starting [illegible] is as [illegible] So [illegible] that point the distance of [illegible] from [illegible]
= [illegible] + AB + BC
= 5[illegible] + 40 = [illegible] m

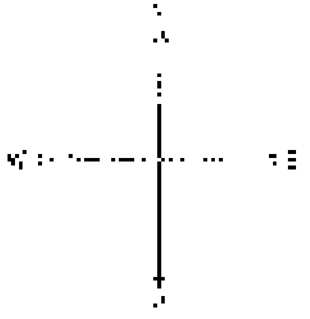


21. (c) Clearly the [illegible] A, B, C, D [illegible] [illegible] required distance
= AB + CD = 2 km

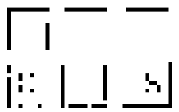


Answer 22 to 28

[illegible]

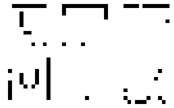


[illegible]

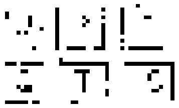


[illegible] facing [illegible]

[illegible]



[illegible] South facing [illegible]



[illegible]

South facing [illegible]

[illegible] facing [illegible]

22. (c) The South facing [illegible] are [illegible]

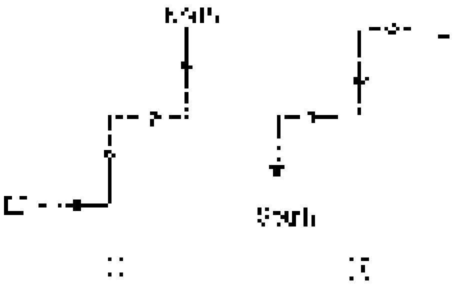
23. (c) [illegible]

24. (c) [illegible]

25. (b) [illegible]

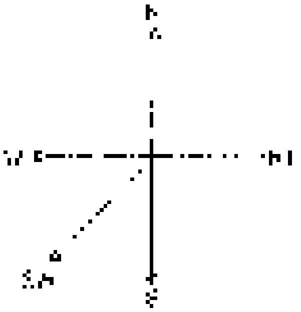
26. (c) Clearly, all the statements [illegible] are to answer the given question.

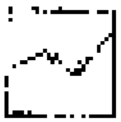
27. (b) Clearly there are two possible [illegible] of A [illegible] below.



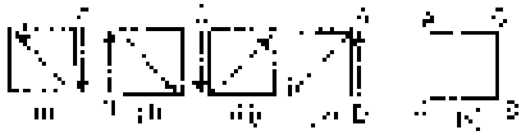
[illegible] of South

28. (c) Clearly [illegible]
[illegible]
[illegible]



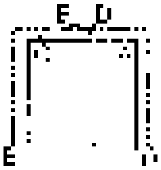


28. (a) [illegible] (i), (ii), (iii) and (iv) show the movements of A, B, C and D [illegible] the new arrangement [illegible] shown in (v). So, the [illegible] arrangement changes [illegible] DCBA.

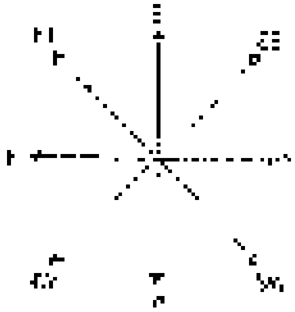


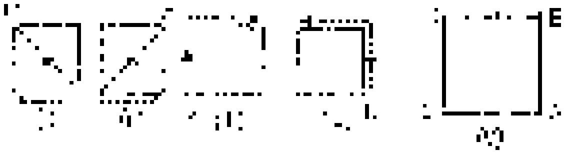
Required position

30. (c) The movements of [illegible] shown in the following diagram.
So, [illegible] is [illegible]



31. (c) The movements of A, C, B and D are shown in figures (i), (ii), (iii) and (iv) respectively. The final configuration is shown in (v). Comparing (v) with the given diagram, A is [illegible] south-west corner.

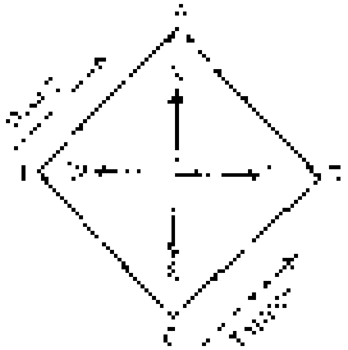




Final position

32. (a) Clearly, C is at the [illegible] north-west corner.

33. (c) Clearly, the arrangement [illegible] shown in the following diagram.



It is given that,
Mahesh's speed = 8 m/s
Mohan's speed = 10 m/s
It is clear from the above figure that [illegible] meet for the first time they have to cover a distance of [illegible] m [illegible]

[illegible] = AD + CD = 80 + [illegible] = 270 m

[illegible] clockwise and [illegible] direction respectively, they have [illegible] distance of [illegible] of the [illegible] meeting from the first meeting point.

Thus, total distance to be covered [illegible] meeting = 270 + [illegible] = 870 m

$$\text{Time required} = \frac{300}{8+10} = \frac{[illegible]}{[illegible]}$$

= [illegible] seconds

Distance covered by Mahesh in clockwise direction in [illegible] seconds = [illegible] × 8 = [illegible] m

Distance covered by [illegible] in anticlockwise direction in [illegible] seconds = [illegible] × 10 = [illegible] m

Thus, Mahesh and Mohan [illegible] meet [illegible] D [illegible] point 10 m from [illegible] and [illegible] from [illegible].

3.5 CHAPTER Line Graph

Data Analysis

Data analysis is a process of [illegible] necessary and [illegible] of the information contained in the [illegible] data [illegible] combined with mathematical and analytical tools to reach a final conclusion. Visual representation is the best representation of data. Because of ease of comprehension, visual representation data can be mostly represented in following forms.

1. Line graphs/bar graphs
2. Tables
3. Bar diagrams
4. Caselets
5. Some other non-conventional miscellaneous figure

Skills that are required to handle DI (Data Interpretation) effectively [illegible]

1. Data Comprehension Skills: Ability to select relevant information from any given set of data in order to solve the asked [illegible] based upon that data set.
2. Ability to differentiate between easy & difficult questions: [illegible] how many questions [illegible] calculations [illegible] answered [illegible] patterns [illegible] questions [illegible] actually [illegible] many questions required [illegible] available.
3. Ability to apply approximation techniques: [illegible] the scene [illegible] calculations [illegible] values.
4. Last but not the least [illegible] strategy [illegible] attempt [illegible] accuracy.

Strategy [illegible] questions [illegible] reading [illegible] comprehension [illegible]

Strategy 2: Doing all the questions [illegible]

5. [illegible]
   - Percentage [illegible]
   - Averages
   - Ratios
   - [illegible]

Data Interpretation

[illegible] Annual General Meeting, Quarterly Reports [illegible] corrective action [illegible] following [illegible]

- Graph
- Table
- Bar Diagrams
- Pie Charts
- Miscellaneous Figures

Line Graph

Line graph [illegible] shows [illegible] multiple sets of [illegible] analysis.

- Increase in profit in absolute terms
- Increase in profit in percentage terms
- Growth rate of the given [illegible]
- Average annual growth rate
- Average [illegible]
- Capacity utilisation
- Income [illegible] Tax [illegible]

Advantage: Advantage with the graph is that it gives an idea about the quantitative increase. Line graph takes all the given time periods as well.

Disadvantage: Usually exact values are not available while [illegible] the graph [illegible] graph becomes complex.

Here we have an example of graph.

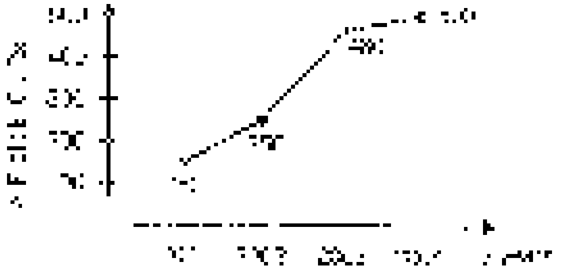


Fig. (1) Balance Sheet of ABC corporation.

On the basis of the given balance sheet of ABC we can conclude the following things:

1. Increase in the absolute terms

2001-02 250-150 = 100 Cr.
2002-03 480-250 = 230 Cr.
2003-04 500-480 = 20 Cr.

- The highest absolute increment in profit is observed during the fiscal year 2002-03.
- The lowest absolute increment in profit is achieved during the fiscal year 2003-04.

2. Percent increase in profit

2001-02 $\frac{250-150}{150} \times 100 = 66.66\%$

2002-03 $\frac{480-250}{250} \times 100 = 92\%$

2003-04 $\frac{500-480}{480} \times 100 = 4.16\%$

- The highest percent increment in profit is observed during the fiscal year 2002-03.
- The minimum percent increment in profit is observed during the fiscal year 2003-04.

3. Growth rate of the data over all the years

$$= \frac{500-150}{150} \times 100 = 233\%$$

Growth rate for the duration

$$= \frac{\text{Final year's value} - \text{Base year's value}}{\text{Base year's value}}$$

4. Average annual growth rate

$$= \frac{\text{Increment over the duration}}{\text{Base year's profit}} \times \frac{100}{\text{Number of years}}$$

In the above example

$$\frac{500-150}{150} \times \frac{100}{4}$$

$$= \frac{350}{150} \times \frac{100}{4} = 58.33\%$$

5. Average profit = $\frac{\text{Addition of all the duration}}{\text{Number of years}}$

$$= \frac{150+250+480+500}{4} = \frac{1380}{4} = 345$$

Capacity Utilization

$$\text{Capacity utilization} = \frac{\text{Total Production}}{\text{Total Capacity}} \times 100$$

Ex 1. The total installed capacity of a steel plant is [illegible] per day. In the month of April 2006 the plant produced an average of 120 [illegible]. Find the capacity utilisation in the month of April.

Sol: Capacity utilisation in April 2006

$$= \frac{120}{150} \times 100 = 80\%$$

Ex 2. The capacity utilisation of Nokia mobile plant [illegible] 80%. [illegible] total capacity [illegible] 3,00,000 [illegible]. Find the total production in March 2006.

Sol: Capacity utilisation

$$= \frac{\text{Total Production}}{\text{Total Capacity}} \times 100$$

Total production in March 2006

$$= \frac{\text{Capacity Utilisation} \times \text{Total Capacity}}{100}$$

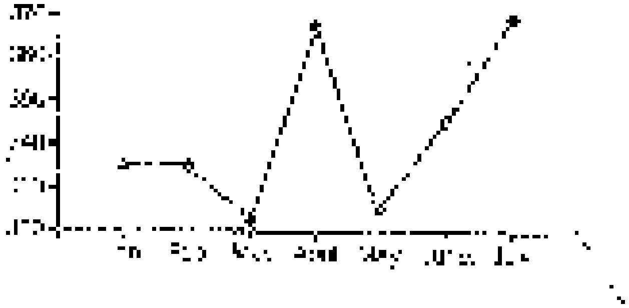
$$= \frac{80 \times 3,00,000}{100}$$

= 2,40,000 Ans.

Practice Exercise: 1

Direction (Qs. 1 to 5): Refer to the graph (Fig.) and answer the questions given below that.

(Consumer price index in 1993-1994)



1. Which month showed the least percentage rise in the Consumer Price Index (CPI) over the previous month?
   (a) March (b) April
   (c) May (d) July

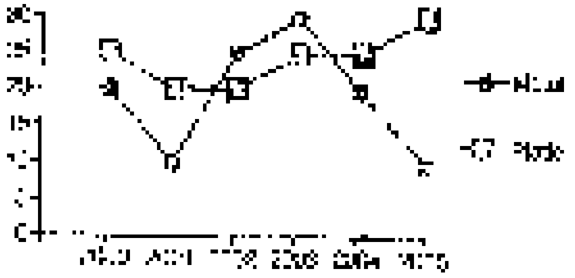
2. Which month showed the highest percentage difference in the CPI over the previous month?
   (a) March (b) April
   (c) May (d) July

3. For how many months was the CPI greater than 350?
   (a) One (b) Two
   (c) Three (d) Four

4. In how many months was there an increase in the CPI over the previous month?
   (a) One (b) Two
   (c) Three (d) Four

5. The difference in the number of months in which there was an increase in the CPI and the number of months in which there was a decrease was
   (a) One (b) Two
   (c) Three (d) Four

Direction (Qs. 6 to 10): Study the following graph to answer the given questions.



Consumption of Metals versus plastics in the given Years for car manufacturing (in thousands tonnes). The graph shows the trend of consumption of metals and plastics in the car manufacturers between 2000-05.

6. The number of years for which the consumption of Metals was less than the consumption of Plastic over the given time period was
   (a) One (b) Two
   (c) Three (d) Four

7. The [illegible] consumption of plastic [illegible] to the total consumption of Metals [illegible] over the period given is [illegible]
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

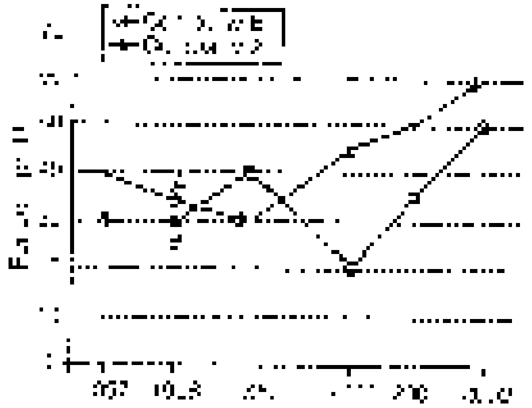
8. Which metal [illegible] showed the highest percentage change in consumption over the previous year?
   (a) [illegible] 2003 (b) [illegible] 2003
   (c) [illegible] 2002 (d) [illegible] 2005

9. For how many years [illegible] was a decrease in consumption over previous year for both the items?
   (a) One (b) Two
   (c) Three (d) Four

10. Which year showed the highest percentage increase in the total consumption of the year?
   (a) 2001 (b) 2002
   (c) 2004 (d) 2005

Direction (Qs. 11 to 15): Study the following graph to answer the given questions.

Percent profit earned by two companies over the given years.



11. If the expenditure of Company B in year 2000 was Rs. 200 crore, what was its income?
    (a) Rs. 240 crore
    (b) Rs. 220 crore
    (c) Rs. 160 crore
    (d) Cannot be determined

12. If the income of Company A in year 2002 was Rs. 600 crore, what was its expenditure?
    (a) Rs. 360 crore
    (b) Rs. 400 crore
    (c) Rs. 375 crore
    (d) Can't be determined

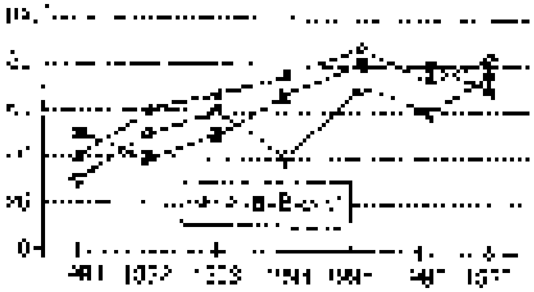
13. If the income of Company B in 1997 was Rs. 200 crore, what was its expenditure in 1997?
    (a) Rs. 21.5 crore
    (b) Rs. 150 crore
    (c) Rs. 146.15 crore
    (d) Can't be determined

14. If the incomes of the two companies in 1998 were equal, what was the ratio of their expenditure?
    (a) 1 : 2
    (b) 26 : 27
    (c) 100 : 67
    (d) Can't be determined

15. What is the percent increase in percent profit for company B from year 2000 to 2001?
    (a) 12 (b) 175
    (c) 42.86 (d) Can't be determined

Direction (Qs. 16 to 20): Study the following graph carefully and answer the questions given below.

Imports of 3 companies over the years
(Rs. in crore)



16. In which of the following years, the imports made by Company A was exactly equal to its own average imports?
    (a) 1992 (b) 1996
    (c) 1994 (d) None of these

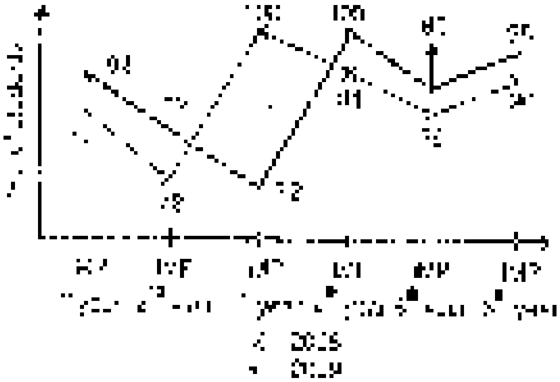
17. In which of the following years was the difference between the imports made by Company B and C the maximum?
    (a) 1996 (b) 1994
    (c) 1991 (d) 1992

18. In which of the following years was the imports made by Company A exactly half of the total imports made by Company B and C together in that year?
    (a) 1992 only (b) 1996 only
    (c) 1992 and 1995 (d) 1995 only

19. What was the percentage increase in imports of Company B from 1992 to 1993?
    (a) 8 (b) 25
    (c) 40 (d) 20

20. In which of the following years was the total imports made by all the three companies together the maximum?
    (a) 1995 only (b) 1997 only
    (c) 1996 only (d) 1996 & 1997 only

Direction (Qs. 21 to 24): The line graph gives the number of students in a Engg. college's M.Tech. program (Integrated IMP) for the years 2008 & 2009. The program runs in such a way that students can only take admission in 1st year & students can leave college only if they complete 5-years program. Every year the students who pass the annual exam of a particular year are promoted to the next class while students who fail have to study in the same class next year.



Note: It is given that 78 students passed out of total 84 students of IMP in the year 2008.

21. How many total students joined the program (IMP) in the year 2009?
    (a) 94 (b) 82
    (c) 80 (d) 86

22. In how many classes did exactly [illegible] students [illegible] in year 2005?
(a) [illegible] (b) 6
(c) [illegible] (d) 2

23. How many students in total [illegible] the entire [illegible] year [illegible]?
(a) 28 (b) 3[illegible]
(c) 32 (d) 31

24. In which year [illegible] highest [illegible] year 2005
(a) [illegible] year (b) [illegible] year
(c) [illegible] year (d) [illegible] year

25. How many total students [illegible] together [illegible] in 2005?
(a) 32
(b) 34
(c) 38
(d) Cannot be determined

26. How many total students passed in [illegible] 3 years combined in year 2006?
(a) 28[illegible]
(b) 29[illegible]
(c) 182
(d) Cannot be determined

[illegible]

Solutions

Answers [illegible]:

1. (b)
2. (b) Visually it can be seen, it is April
3. (c) April and July = Two
4. (c) The CPI decreased in March and May
5. (a) The CPI increased in three months (April, June and July) while it decreased in two months (March and May)
6. (c) Visually seen it is 2000, 2001, 2003 & 2004
7. (b) 145 : 115 = 29 : 23 is [illegible] to 5 : 4
8. (a) [illegible] in 2003 is more than [illegible] months [illegible] in 2002
9. (c) 2000 is the only year with [illegible] condition
10. (b) 33.33% between 2000 and [illegible]
11. (c) [illegible]

$$= 2000 \times \frac{120}{100} = \text{Rs. } 2400$$

12. (c) [illegible] 2002

$$800 \times \frac{[illegible]}{100} = \text{Rs. } [illegible]$$

13. (a) [illegible]
14. (b) [illegible]

$$\frac{[illegible]}{35} \times \frac{[illegible]}{100} = 22 [illegible]$$

15. (a) [illegible] $= \frac{[illegible]}{22} \times 100 = [illegible]\%$
16. (c) Average [illegible] by company A

$$= \frac{90 + 50 + 80 + [illegible]}{7}$$

$$= \frac{385}{7} = 55$$

[illegible] (c)

17. (d) Obvious inspection it is seen that 1992 is the [illegible] year [illegible] between two [illegible]
18. (c) [illegible] in year 2006

$$\left[[illegible] = \frac{[illegible] + 90}{2} \right]$$

So [illegible] C

19. (c) Required percentage increase $= \frac{50 - 40}{40}$

= 25%

20. (c) [illegible]

In 1995 = 75 + 85 [illegible] = [illegible]
In 1997 = [illegible] = 20
Condition [illegible]

[illegible]

[illegible]

[illegible]

	[illegible]		[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	93 [illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	100	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

3.6

CHAPTER

Table

[illegible]

Advantages: [illegible]

Disadvantages: [illegible]

Practice Exercise I

Direction (Qs. 1 to 5): Study the following table carefully and answer the questions given below.

Production of major crops in India (in million tonnes)

Crops	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pulses	[illegible]	[illegible]	[illegible]	23.5	[illegible]	28.9
Oilseeds	[illegible]	31.5	40.0	45.1	[illegible]	[illegible]
Rice	30.5	50.4	[illegible]	82.0	[illegible]	[illegible]
Sugarcane	140.0	154.2	152.9	[illegible]	[illegible]	[illegible]
Wheat	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coarse grain	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1. [illegible]
   (a) 50
   (b) [illegible]
   (c) [illegible]
   (d) [illegible]
2. Production of which type of crop was continuously increasing in the given years?
   (a) Rice
   (b) Pulses
   (c) Sugarcane
   (d) Oilseeds
3. What was the average production of pulses in the given years?
   (a) 20.5 million tonnes
   (b) 20.8 million tonnes
   (c) 21.5 million tonnes
   (d) 22.5 million tonnes
4. [illegible]
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]
   (d) [illegible]
5. [illegible]
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]
   (d) [illegible]

Direction (Qs. 6 to 9): [illegible]

Production of cars by a company

Years / Type	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total
P	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Q	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
R	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
T	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

6. [illegible]
   (a) [illegible]
   (b) [illegible]
   (c) [illegible]
   (d) None of these
7. [illegible]
   (a) P
   (b) Q
   (c) R
   (d) S
8. [illegible]
   (a) S
   (b) [illegible]
   (c) [illegible]
   (d) P

9. The [illegible] increase in total production of [illegible] of cars in 1989 [illegible] 1991 was:
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Direction (Qs. 10 to 14): The following five questions are to be answered on the basis of the following table. Weight Distribution in the average Adult

Organs	Weight (in grams)
Muscles	30000
Skeleton	10000
Blood	5000
Gastrointestinal Tract	2000
Lungs	[illegible]
Liver	[illegible]
Brain	[illegible]

10. The [illegible] weight of the average adult is
(a) 70000 grams
(b) More than 51 kg
(c) 50000 grams
(d) Less than 52 kg

11. If the weight of the skeleton is represented as G, then the weight of the liver can be represented as
(a) [illegible] (b) 0.175
(c) [illegible] (d) [illegible]

12. The ratio representing the [illegible] of the weight of the heart to the weight of the gastrointestinal tract is
(a) 0.4 (b) [illegible]
(c) 2.5 (d) 0.05

13. The ratio expressing the weight of the brain to weight of the muscles is
(a) [illegible] (b) [illegible]
(c) 0.20 (d) 0.05

14. The ratio [illegible] the weight of the liver to the weight of the lungs is
(a) 1.5 (b) 0.15
(c) 15.0 (d) 0.1

Direction (Qs. 15 to 19): The figures for a country's Foreign Trade for the years 1990-91 to 1996-97 are given in the following table. Answer the questions on the basis of the information given.

A Country's Foreign Trade
(Rupees in Crores)

Year	Exports	Imports	Trade Deficit
1990-91	[illegible]	12548	[illegible]
1991-92	7022	13308	5319
1992-93	8803	14365	5560
1993-94	[illegible]	[illegible]	[illegible]
1994-95	11655	17172	5518
1995-96	[illegible]	[illegible]	[illegible]
1996-97	12550	20062	7512

15. Which of the following showed an increase every year?
(a) Exports (b) Imports
(c) Trade deficit (d) All of these

16. The increase in imports was maximum in the year
(a) [illegible] (b) 1993-94
(c) [illegible] (d) [illegible]

17. The percentage increase in exports over previous year was maximum in the year
(a) [illegible] (b) [illegible]
(c) 1994-95 (d) 1993-94

18. The total trade deficit for the last five years is
(a) Rs. [illegible] crore (b) Rs. [illegible] crore
(c) Rs. [illegible] crore (d) Rs. [illegible] crore

19. The difference between imports and exports was maximum in the year
(a) [illegible] (b) [illegible]
(c) 1994-95 (d) 1995-96

Direction (Qs. 20 to 25): In the table given below, the [illegible] students who applied for [illegible] in a [illegible] the [illegible] process [illegible] through the next stages [illegible] discussion, [illegible] interview [illegible] [illegible] [illegible] of the [illegible] stage.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

For Example, [illegible] of the [illegible] from [illegible] region [illegible] [illegible] and a 20% of them [illegible] aptitude are qualified for group discussion.

20. If the candidates appearing for written test from [illegible] [illegible] [illegible] respectively
(a) 5 : 13 (b) 19 : 13
(c) 15 : 19 (d) 5 : 13

21. [illegible] region, from [illegible] the region [illegible] candidates [illegible]
(a) East (b) South
(c) West (d) Central

22. [illegible]
(a) Northern (b) West
(c) Central (d) None of these

23. [illegible] South [illegible] checking?
(a) 300 (b) 1200
(c) 1100 (d) 800

24. [illegible] final selection [illegible]
(a) South (b) West
(c) North (d) Central

25. [illegible] candidates [illegible]
(a) South (b) West
(c) East (d) Central

— □□□

Solutions

Answers 1 to 5:

1. (b) Required percent = $\frac{52.2}{88.4} \times 100$ = [illegible]%

2. (c)

3. (b) Average production of pulse

$= \frac{20.5 + 27.4 + 24.6 + 24.0 + 27.5}{5}$ = [illegible]

$= \frac{147.0}{6}$ = 24.5 million tonne

4. (a) Required percentage = [illegible] × 100 = [illegible]%

5. (b) The production [illegible] region [illegible] = 72.4 − 46.6 = 25.8 [illegible]

Which is above the production [illegible]

6. (c) [illegible]

7 + 2 = [illegible]

7. (d)

8. (b) [illegible]

9. (d) Required percentage

$= \frac{80 - 75}{75} \times 100$ = [illegible]%

10. (a) [illegible]

11. (b) [illegible]

∴ [illegible] = 1770

$\frac{y}{100} \times 1770$ = [illegible]

12. (c) [illegible]

13. (b) $\frac{1250}{25000} = \frac{1}{20} = 0.05$

14. (a) [illegible]

15. (d)

16. (b) The ratio of imports to exports [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

17. (c) Percentage increase [illegible]

[illegible] × 100 = [illegible]%

[illegible] = [illegible]
3771

[illegible] × 100 = [illegible]
3900

18. (a) [illegible] + 2016 + 7361 + [illegible]
= Rs. [illegible] crore

19. (a) [illegible]
1995-96 = Rs. [illegible] crore
[illegible] = Rs. 7519 crore
[illegible] = Rs. 5216 crore
[illegible] = Rs. [illegible] crore

20. (b) [illegible]
[illegible]
= [illegible]
[illegible]
[illegible]
= [illegible]
Hence required ratio = [illegible]

21. (c) Suppose number of candidates [illegible]
[illegible] = 0.55 [illegible]
[illegible]

[illegible]
[illegible]
[illegible]

22. (d) From table, [illegible]
[illegible] North-east. Hence (d)

23. (b) [illegible]
[illegible]
[illegible]
= [illegible] = 1600

[illegible] 1600
[illegible]

[illegible]

= [illegible] 1600 [illegible]

= [illegible]

24. (c) From table it [illegible]
[illegible]
Hence option (c).

25. (d) [illegible]

Bar Diagrams

There are mainly six types of Bar Diagrams:

- Simple Bar Diagram
- Multiple Bar Diagram
- Component Bar Diagram
- Percent Bar Diagram
- Horizontal Bar Diagram
- [illegible] Bar Diagrams

Advantage

[illegible] categories.

Disadvantage

Parameters of different quantity need to approximate the values.

Simple Bar Diagram

Simple Bar Diagram is similar to Line graph. Only one set of data can be represented in simple Bar Diagram. It is different from line graph only in the aspect that in place of the points, bars with corresponding values of respective years.

Ex. 1

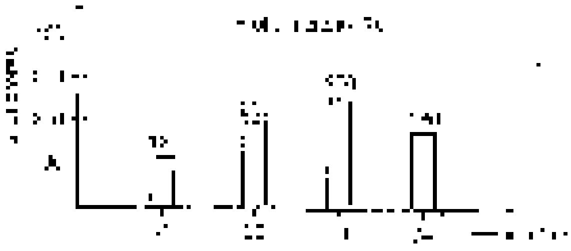


Fig. (1) Balance Sheet of [illegible]

Note: From the Bar Diagram shown in Fig. (1) we can conclude following things:

- Percent increment in profits

$$2001-02 \rightarrow \frac{[illegible]}{97} \times 100 = [illegible]$$

$$2002-03 \rightarrow \frac{80}{[illegible]} \times 100 = [illegible]$$

$$2003-04 \rightarrow \frac{-72}{240} \times 100 = [illegible]$$

[illegible]

- Maximum increase in profit was observed in financial year 2001-02.
- Minimum increase in profit was observed in financial year 2003-04.

2. Average profit $= \frac{[illegible] + [illegible] + [illegible] + [illegible]}{4}$

$$= \frac{750}{4} = 187.5 \text{ crores}$$

3. Annual average growth rate from 2001-2004

$$= \frac{[illegible]}{[illegible]} \times \frac{100}{3}$$

$$= \frac{80}{100} \times \frac{100}{3} = [illegible]$$

Multiple Bar Diagram

In Simple Bar Diagram only one set of data can be represented. To represent multiple set of data for different years we use multiple bar diagrams.

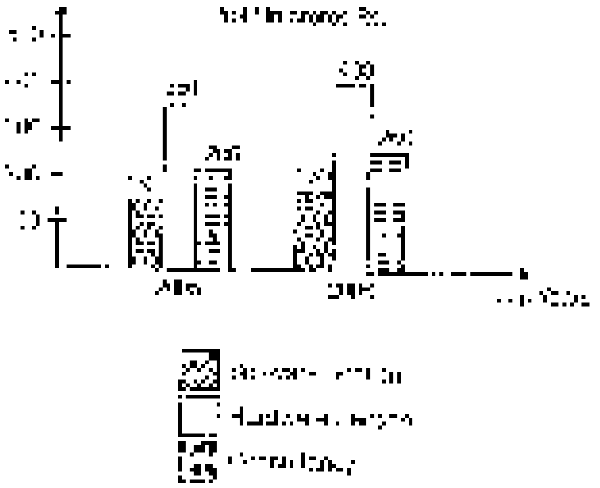


Fig. (2) Balance Sheet of Maple Ltd. for two financial years 2005 and 2006.

From the multiple bar diagram shown in Fig. (2) we can calculate following things:

1. Growth of [illegible]
   (a) Share capital [illegible] = 80 [illegible]
   (b) Reserves & surplus [illegible]

(c) Consultancy 280 − 200 = 80 Cr

- Highest absolute increase in profit is observed by consultancy sector
- Minimum absolute increase in profit is observed by software sector

(d) Growth rate in percent terms.

$$\text{Software section} = \frac{180 - 150}{150} \times 100 = 20\%$$

$$\text{Hardware section} = \frac{400 - 350}{350} \times 100 = 14.28\%$$

$$\text{Consultancy} = \frac{280 - 200}{200} \times 100 = 40\%$$

- Minimum growth is observed by hardware sector
- Maximum growth is observed by consultancy sector.

(e) Growth rate in aggregate for three sectors.

$$\%\ \text{Growth} = \frac{\text{Profit in 2006} - \text{Profit in 2005}}{\text{Profit in 2005}} \times 100$$

$$= \frac{(180 + 400 + 280) - (150 + 350 + 200)}{150 + 350 + 200} \times 100$$

$$= \frac{860 - 700}{700} \times 100$$

$$= \frac{16000}{700} = 22.85\%$$

Compound Bar Diagram

Compound Bar Diagrams are similar to Multiple Bar Diagrams. The only difference between these two Bar Diagrams is that in Compound Bar Diagram the Single Bar Diagram is sub-divided into different parts, while multiple bars are used in Multiple Bar Diagrams. Compound Bar Diagrams are also known as sub-divided Bar Diagrams.

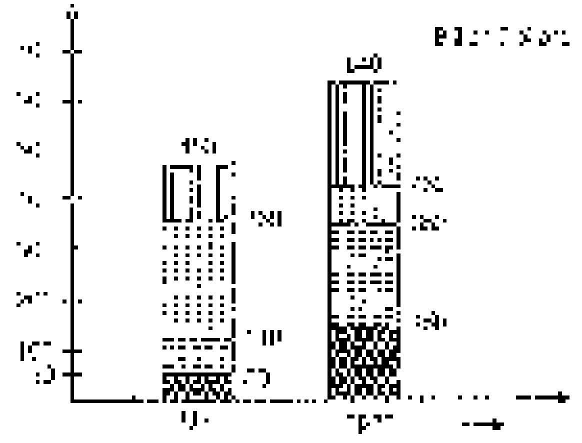


Fig. Export Basket of two countries UK and Japan for year 2005 in $ billion

From the Compound Bar Diagram we answer following some questions:

Ex. 1. Export of Agriculture product of UK is how much percent of export of Automobile product of Japan?

Sol. Export of Agriculture product of UK

= $ 50 billion

Export of Automobile product of Japan

= $ 200 billion

$$= \frac{50}{200} \times 100 = 25\%$$

Ex. 2. Export of Automobile product of Japan is how many times of automobile export of UK?

Sol. Automobile Export of Japan

= $ 200 billion

Automobile export of UK = 60 billion

$$\frac{200}{60} = \frac{10}{3} = 3.33 \text{ times}$$

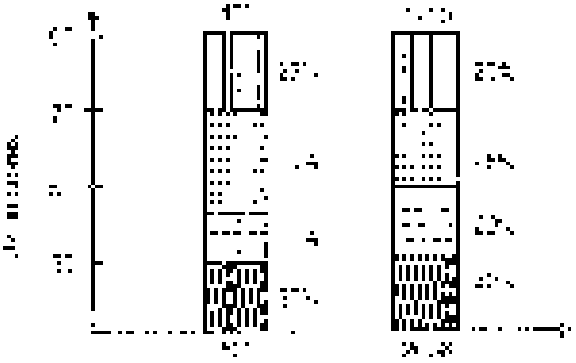
Ex. 3. Total export given in fig. of Japan is how much percentage higher than that of UK?

$$\text{Sol.} = \frac{640 - 480}{480} \times 100$$

$$= \frac{160}{480} \times 100 = 33.33\%$$

Percent Bar Diagram

Percent Bar Diagram is similar to Compound Bar Diagram. The only difference is that the total height of each bar is equal and represents hundred percent. In percent bar diagram the heights of bars are equal, whereas in compound bar diagrams bars heights may not be equal.



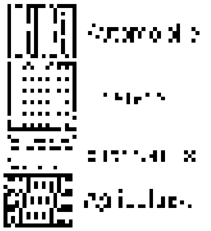


Fig. Export Basket of XYZ for financial year 2001 and 2003 in billion dollars.

From the above figure we can infer the following things:

(1) Percent increase in exports for the given period i.e. 2001-03

$$\frac{1200 - [illegible]}{[illegible]80} \times 100 = [illegible]\%$$

(2) Export of Japan for financial year 2001 consists of

- $ 120 billion for Automobiles
- $ [illegible] billion for financial services
- $ 72 billion for Electronic Goods
- $ [illegible] billion for Agricultural products

(3) Export Basket of Japan for financial year 2003 consists of

- $ 480 billion for Automobiles
- $ 300 billion for financial services
- $ 240 billion for electronic goods
- $ [illegible] billion for Agriculture produce

(4) Export of financial services in year 2003 is how many times more than export of electronic goods in 2001?

Sol. Export of financial services in 2003 = 300
Export of electronic goods in 2001 = 72

$$\frac{300 - 72}{72} = 3.16 \text{ times approx.}$$

Horizontal Bar Diagrams

Horizontal Bars are similar to simple bar diagrams. The only difference is that in case of horizontal bars representation is horizontal and vertical in case of simple bar diagram. Horizontal bar diagram is used in cases where we require to compare a big sets for comparatively large number of years. All the calculations and observations of [illegible] diagrams are similar.

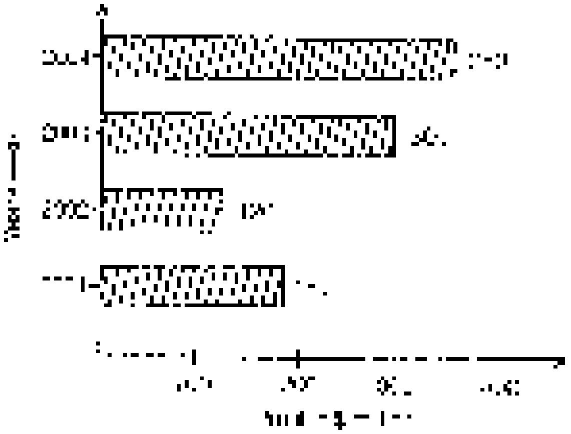
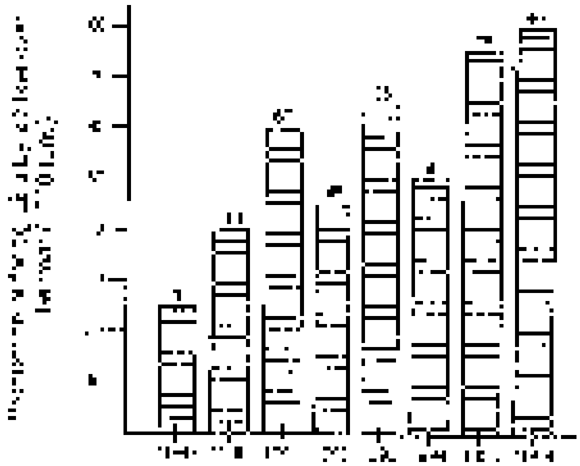


Fig. (3) Profile of [illegible] for four consecutive financial years.

Practice Exercises

Directions (Qs. 1 to 5): Study the following graph carefully and answer the questions given below.



1. The average production of 1996 and 1997 was exactly equal to the average production of which of the following pairs of years?
   (a) [illegible] and [illegible] (b) [illegible] and [illegible]
   (c) 1995 and 1999 (d) None of these

2. What was the difference in the production of [illegible] between 1995 and 1997?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) [illegible]

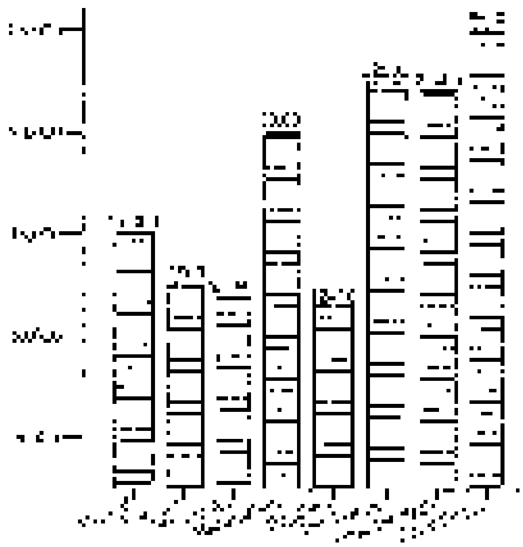
3. In which of the following years was the percentage increase in production from the previous year the maximum among the given years?
(a) 1991 (b) 1994
(c) 1995 (d) 1998

4. In how many of the given years was the production of fertilizers more than the average production of the given years?
(a) 2 (b) 3
(c) 4 (d) 1

5. What was the percentage drop in the production of fertilizers from 1997 to 1998?
(a) 10 (b) 20
(c) 25 (d) 40

Direction (Qs. 6 to 10): Study the following graph carefully and answer the questions given below.

Rose Production



6. Which of the following state(s) has/have less than 10% of the total rose production?
(a) Only Rajasthan
(b) Rajasthan, Karnataka
(c) Rajasthan, Karnataka and Haryana
(d) Rajasthan, Karnataka, Haryana and Gujarat

7. By what percentage is the production of roses in [illegible] more than that of the Maharashtra?
(a) 25 (b) 30
(c) 20 (d) 15

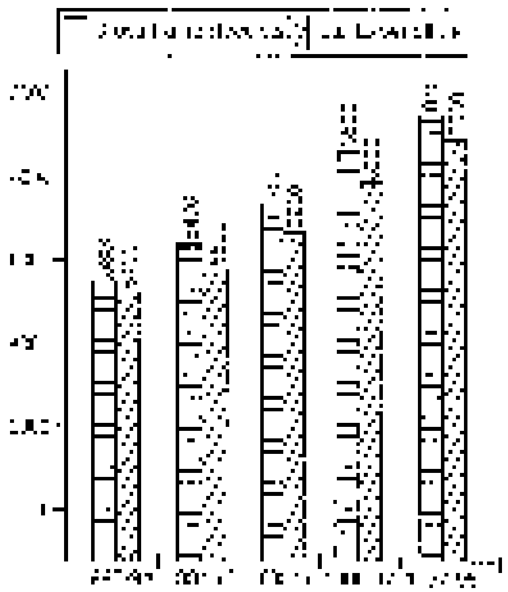
8. What is the approximate average production of roses (in thousands) of the states?
(a) 21 (b) 20
(c) 18 (d) 13

9. Approximately what percentage of the total rose production is shared by Gujarat State?
(a) 12.5 (b) 17.5
(c) 15.5 (d) 20.5

10. If the percentage contribution of the states having production of roses below twenty thousand is calculated, which of the following statements is true?
(a) It is little above 50%
(b) It is approximately 33.5%
(c) It is below 30%
(d) It is little above 40%

Direction (Qs. 11 to 15): These questions are based on the following bar graph. Study the graph and answer the questions.

Finances of XYZ Railway



11. What is the percentage increase in the gross traffic receipts in 1998-99 as compared to 1995-96?
(a) 33.5% (b) 29.0%
(c) 22.4% (d) 17%

12. If [illegible] of total expenditure from in 1996-97 what percentage of gross traffic receipts is share of it?
(a) 5.0% (b) 6.4%
(c) 7.2% (d) 4%

15. In which year was the total expenditure as a percentage of gross traffic receipts the highest?

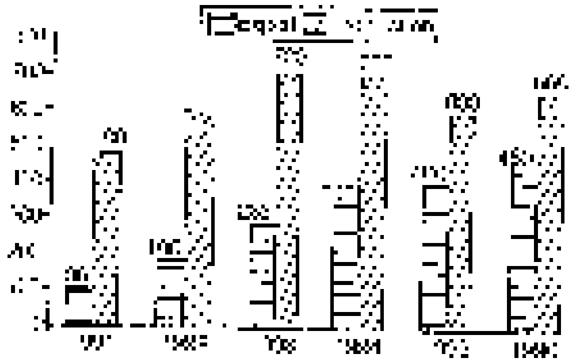
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

14. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

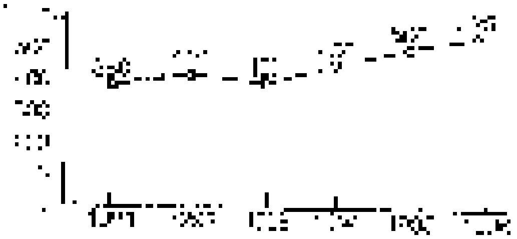
15. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Direction (Qs. 16 to 20): Study the following graphs and answer these questions.

[illegible] in India (in million kg)



Per Capita Availability (in gm)



16. Which year shows the maximum percentage of [illegible]?
(a) 1992 (b) 1963
(c) 1975 (d) [illegible]

17. Assuming that entire quantity is consumed after [illegible] in 1993 [illegible]
(a) 900 million (b) 1050 million
(c) [illegible] million (d) 900 million

18. The [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

19. In which year [illegible] percentage of [illegible]
(a) [illegible] (b) 1992
(c) [illegible] (d) 1984

20. In which year [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Solutions

Answers 1 to 5.

1. (c)

2. (d) Required difference
= [illegible] − 50 = 10,000 [illegible]

3. (c) Percentage increase in [illegible] in 1995 [illegible]

$$= \frac{15}{75} \times 100 = 20\%$$

4. (d) Average production
= [illegible]

$$= \frac{440}{8} = [illegible]$$

[illegible]

5. (c) Required [illegible]

$$\frac{60 - 45}{[illegible]} \times 100 = [illegible]$$

6. (c) Total [illegible] production
= [illegible]
Percentage of [illegible]
Rajasthan [illegible] [illegible]
[illegible] [illegible] [illegible]

7. (a) Required percentage

$$= \frac{[illegible]}{20} \times 100 = 25\% \text{ (more)}$$

8. (c) Total consumption of rice by all the states = 145250

∴ Average = $\frac{145250}{[illegible]}$ = 18 [illegible]

9. (c) Required percentage

= $\frac{24}{110.25} \times 100 \approx 22\%$

10. (b) [illegible]

11. (c) $\frac{7500 - 5000}{5000} \times 100$ = [illegible]

12. (a) $\frac{6000 - 4000}{6500} \times 100$ = [illegible]

13. (d)

14. (c) [illegible]

[illegible]

[illegible] = [illegible]

15. (d) 6000 − [illegible] = [illegible]

16. (c) Percentage [illegible]

In [illegible], $\frac{180}{510} \times 100$ = [illegible]

In [illegible], $\frac{288}{720} \times 100 = 40\%$

In [illegible], $\frac{400}{600} \times 100$ = [illegible]

In [illegible], $\frac{440}{880} \times 100$ = [illegible]

17. (b) [illegible] − 258 = 462 [illegible] in 1997

[illegible] = [illegible]

18. (d) Average [illegible] during 1991–1995 = [illegible] million kg. Average [illegible] during 1991–1995 = [illegible]

∴ [illegible] = [illegible] = 0.7

19. (a)

20. (c)

In [illegible], [illegible] − 88 = [illegible] million tonnes

In 1994, [illegible] − 288 = [illegible] million tonnes

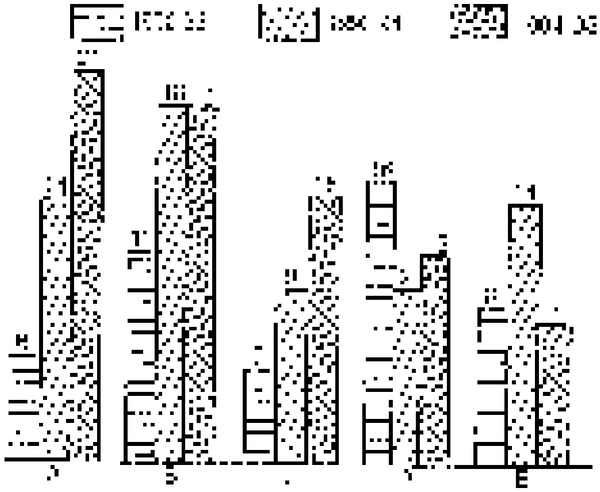
In [illegible], 750 − 340 = [illegible] million tonnes

In [illegible], 980 − 410 = [illegible] million tonnes

□□□□

Practice Exercise II

Directions (Qs. 1 to 5): Study the diagram carefully and answer the questions given below.



Cotton production of some states in '000 tonnes

1. The production of state D in 1993-94 is how many times its production in 1994-95?
(a) 1.33 (b) 0.75
(c) 0.56 (d) 1.77

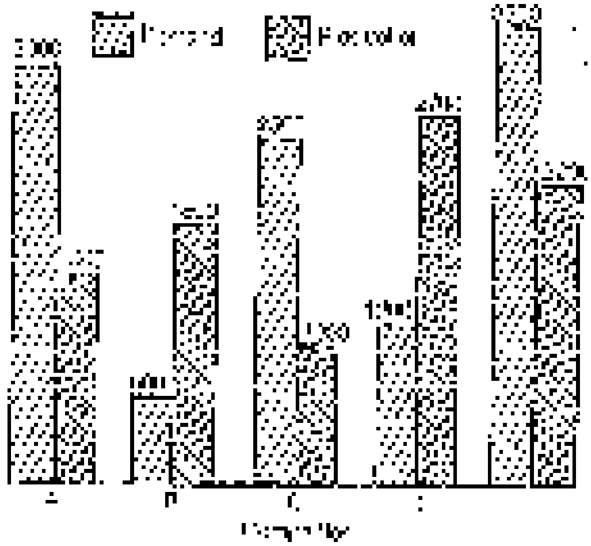
2. In which of the states there is a continuous [illegible] in the production of cotton during the given period?
(a) A & B (b) A & C
(c) B only (d) D & E

3. How many [illegible] of cotton was produced by state B during the given period?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

4. How many states showing below average production in 1992-93 showed above average production in 1993-94?
(a) 4 (b) 2
(c) 3 (d) 1

5. Which of the following statements is false?
(a) States A and E showed the same production in 1993-94
(b) There was no improvement in the production of cotton in state C during 1994-95.
(c) State A has produced maximum cotton during the given period.
(d) Production of States C and D together is equal to that of state B during 1992-93.

Direction (Qs. 6 to 10): Study the (bar) graph carefully and answer the questions given below it.



6. What is the ratio of companies having more demand than production to those having more production than demand?
(a) 2 : 3 (b) 4 : 1
(c) 2 : 2 (d) 3 : 2

7. What is the difference between average demand and average production of the five companies taken together?
(a) 1400 (b) 400
(c) 280 (d) 130

8. The production of company D is approximately how many times that of production of company A?
(a) 1.8 (b) [illegible]
(c) 2.5 (d) 1.1

9. The demand of company B is approximately what percent of the demand for company C?
(a) 4 (b) 24
(c) 20 (d) 60

10. If company A desires to meet the demand by purchasing surplus TV sets from a single company, which one of the following companies can meet the need adequately?
(a) B (b) C
(c) D (d) None of these

Direction (Qs. 11 to 15): Study the following bar charts (Figs) before answering the questions.

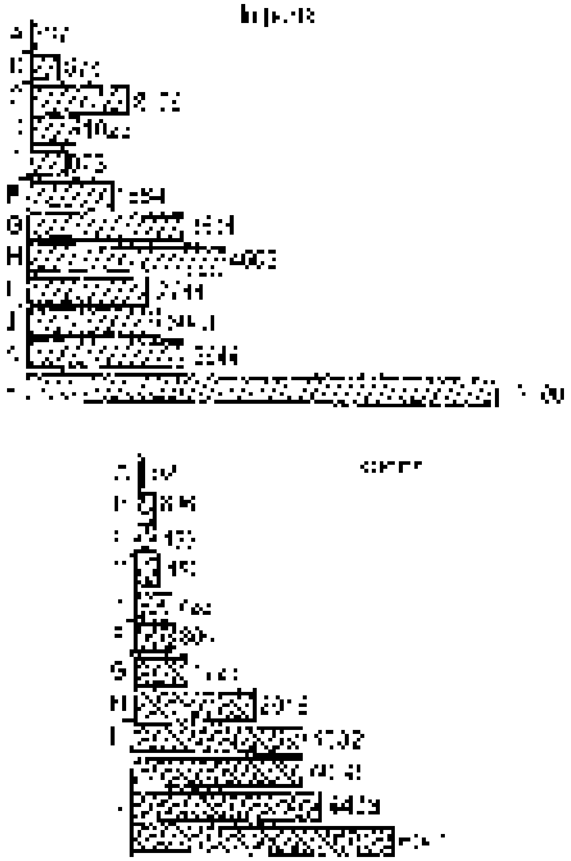


Fig. Foreign Trade by countries for year 1983-84

11. How many countries had an export surplus?
(a) 1 (b) 4
(c) 3 (d) 0

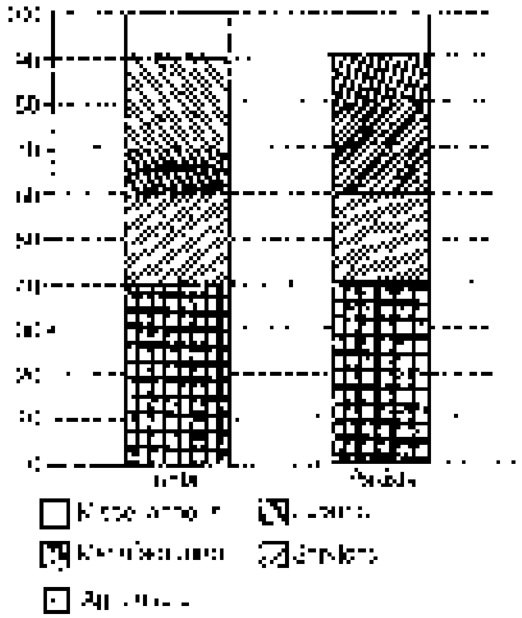
12. The highest export surplus was shown by which country?
(a) C (b) D
(c) G (d) [illegible]

13. The ratio of Exports to Imports was highest for which country?
(a) A (b) I
(c) J (d) K

14. The trade balance position for all the countries put together was?
(a) 11245 surplus (b) 10295 deficit
(c) 10985 deficit (d) None of these

15. The ratio of the maximum exports to the minimum imports was close to
(a) 91 (b) 11
(c) 74 (d) None of these

Direction (Qs. 16 to 20): Shows the composition of the GDP of two countries (India and Pakistan).



16. What percentage of India's GDP is accounted for by services?
(a) 30% (b) 15%
(c) 12% (d) None of these

17. If the total GDP of Pakistan is Rs. 10,000 crore, then the GDP accounted by Manufacturing is
(a) Rs 200 crore (b) Rs 1000 crore
(c) Rs 3,000 crore (d) Rs 4,000 crore

18. If the total GDP of India is Rs 30,000 crore, then the GDP accounted for by Agriculture, Services and Miscellaneous is
(a) Rs 19,500 crore (b) Rs 18,000 crore
(c) Rs 21,000 crore (d) Rs 15,500 crore

19. Which country accounts for higher earning out of Services and Miscellaneous put together?
(a) India
(b) Pakistan
(c) Both earn equal amounts
(d) Cannot be determined

20. If the total GDP is the same for both the countries, then what percentage is Pakistan's income through agriculture more than India's income through services?
(a) 30% (b) 2.0%
(c) 133.33% (d) None of these

❑❑❑

Solutions

Answers 1 to 10:

1. (b) Let production of D in 1993-94 be K = production of D in 1994-95
Then, 9 lakhs = x × 12 lakhs
or x = $\frac{9}{12} = \frac{3}{4}$ = 0.75.

2. (b) Clearly, there is a steady increase in the production of cotton during the given period in case of states A and C.

3. (b) (2 + 14 + 4) × 1000 = 20000 tonnes

4. (b)

5. (c) During the given period, state D has produced 48000 tonnes of the state A has produced only 41000 tonnes.
Hence, statement (c) is true.

6. (d) The companies having more demand than production are A, C, E. The companies having more production than demand are B and D. Their ratio is 3 : 2

7. (b) Average demand
$= \left(\frac{3000 + 600 + 2500 + 1200 + 3300}{5}\right)$
= 2120
Average production
$= \left(\frac{1500 + 1800 + 1000 + 2700 + 2200}{5}\right)$
= 1840
∴ Difference in having average demand & production = (2120 − 1840) = 280

8. (a) Let production of D
= x × production of A
Then, [illegible] = x × $\frac{9900}{500}$ = 1.0.

9. (c) Let x% of demand of C = Demand of E.
Then, $\frac{x}{100}$ × 2500 = 600
or x = $\left(\frac{600 \times 100}{2500}\right)$ = 24%.

10. (a) Since D produces highest number of sets and A desires to meet the demand by purchasing surplus sets from a single company.
So D can meet the demand of A.

11. (c) [illegible]

12. (c) [illegible]

13. (b) [illegible] = [illegible] highest

14. (b) [illegible]

15. (b) [illegible]

16. (c) [illegible] of India

17. (a) [illegible] = [illegible]

18. (c) [illegible] = [illegible]

19. (d) Although the percentage of Services and Manufacturing [illegible] for both the countries. But we cannot comment on this as we have no data about the respective GDPs.

20. (c) Since the GDP is [illegible]

■■■■

3.8 CHAPTER

Pie-Chart

[illegible]

100% = 360°

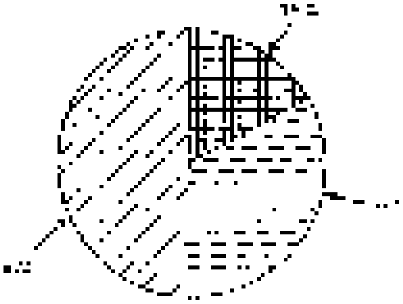
1% = 3.6°

[illegible] $\left(\frac{15}{5}\right)$

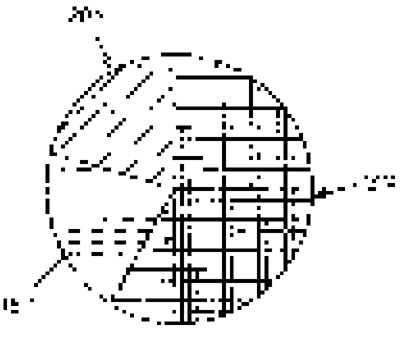
[illegible] $\left(\frac{[illegible]}{12}\right)\%$

Pie-Charts are also known as circular charts to represent data in [illegible] and [illegible] [illegible] [illegible]. Let's have a glimpse of [illegible] through Pie Charts.

Pie-Chart I



Sectoral Contribution to GDP of Indian Economy by [illegible] (2013-14)



Workforce employed in different sectors of Indian Economy (Financial Year 2009-10)

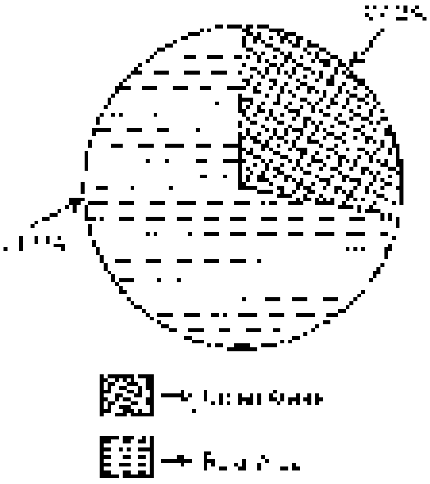
Where shaded regions for each [illegible] are represented as below:

▦ → Agriculture (Primary Sector)

▤ → Industrial (Secondary Sector)

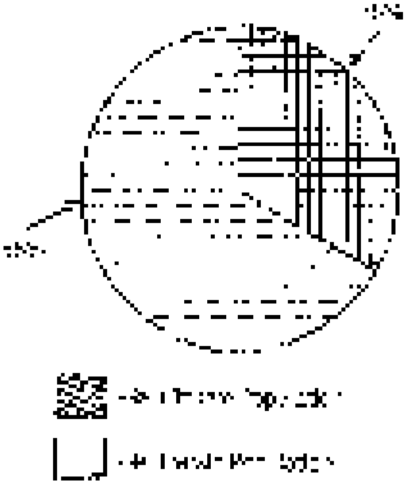
▨ → Services (Tertiary Sector)

Pie-Chart II



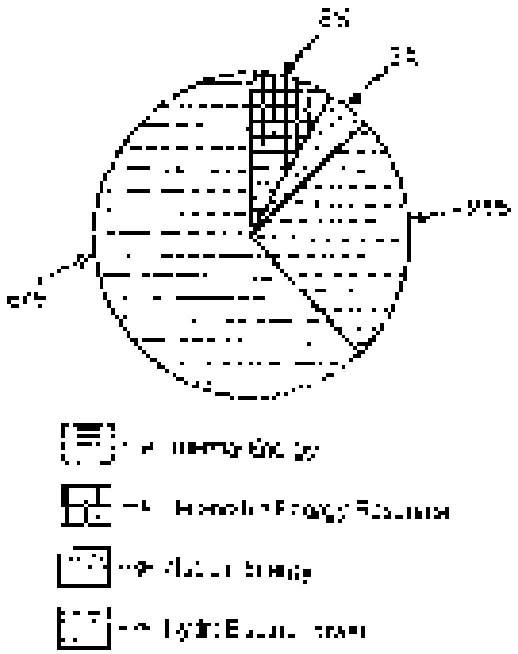
Demographic composition of Indian population in Rural & Urban areas according to census 2011

Pie-Chart III



Literacy rates of Indian Population according to census 2011

Pie Chart-IV



Sources of Power in India
(Installed Capacity)

Pie Chart-I
Shows that major contributor in GDP of Indian Economy is the share of Services (Tertiary Sector) is 55% yet number of people employed in this sector is merely 20%. Share of agriculture is merely 18% yet approximately two-third of population is still dependent on agriculture to support their livelihood.
Contribution of industries is 27% and approximately 15% people are employed in industries.

Pie Chart-II
It shows that more than 2/3 of our population are living in rural areas. Urban population is still less than 1/3. Need urgent attention to provide facilities of urban amenities in rural areas. Rural development should be given top most priority.

Pie Chart-III
Literacy rate is shown in pie chart III. It reveals that more than one third of population of our country is unable to read and write. We need more resources and constitutional power to local bodies and state government so that they can increase their efforts to improve literacy rates.

Pie Chart-IV
It shows composition of different resources for power generation. We are still dependent much on thermal power to fulfil our energy demands. Nuclear energy and renewable resources of energy contribute merely 3% and 8% respectively.

Pie Chart

There are two types of Pie Charts:
1. Pie Chart represented in Angle form.
2. Pie Charts represented in percentage form.

Conversion

$\because$ 100% = 360°

$$\therefore \quad 1\% = \frac{360}{100} = 3.6^\circ$$

Similarly

$\because$ 360° = 100%

$$\therefore \quad 1^\circ = \frac{100}{360} = \left(\frac{5}{18}\right)\%$$

All following examples are in Angle form.

Example 1

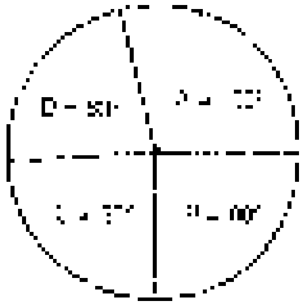


Fig. 2

Sectionwise composition of 360 students in a class in MADE EASY

From above pie chart we can answer following questions:

1. Students in section A are how many percent more than students in section B?

Sol. Section A = 105°
Section B = 90°

$$\Rightarrow \frac{105-90}{90} \times 100$$

$$\Rightarrow \frac{15}{90} \times 100$$

$\Rightarrow$ 16.66% Ans.

2. Students in section A are how many times more than that of students in section D?

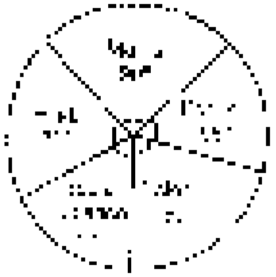
Sol. Students in A = 105°

Students in D = 80°

$$\frac{105}{80} = \frac{21}{16} = 1.3125 \text{ times}$$

1 Practice Exercise 1

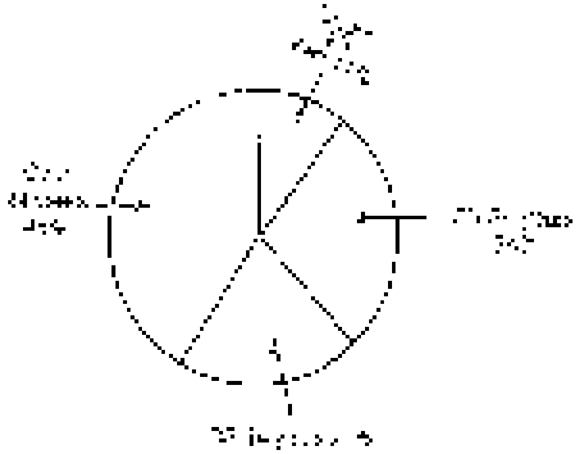
Direction (Qs. 1 to 6): These questions are to be answered on the basis of the following pie chart which gives the marks scored by a student in different subjects – English, Hindi, Mathematics, Science and Social Science in an examination. Assuming that the total marks obtained for the examination is 540, answer the following questions.



1. The marks scored by the student in Hindi and Mathematics exceed the marks scored in English and Social Science by
   (a) 30 (b) [illegible]
   (c) 40 (d) [illegible]
2. The subject in which the student scored 27.5% marks is
   (a) Hindi (b) Science
   (c) Social Science (d) English
3. The subject in which the student scored 105 marks is
   (a) Mathematics (b) Hindi
   (c) Science (d) [illegible]
4. The marks obtained in the three subjects English, Science and Social Science are what percentage of the total marks?
   (a) [illegible] (b) [illegible] $\frac{[illegible]}{9}$%
   (c) 55% (d) [illegible]
5. The marks obtained in Mathematics are what percentage of the total marks?
   (a) 20% (b) 30%
   (c) [illegible] (d) 25%
6. The difference of marks between English and Social Science is the same as between
   (a) Science and Hindi
   (b) Hindi and Social Science
   (c) English and Hindi
   (d) Social Science and Science

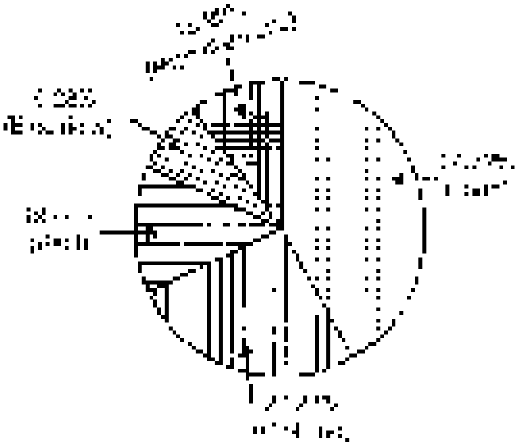
Direction (Qs. 7 to 11): The following pie chart shows the percentage distribution of personal income by age group in the year 2000.

Rs. 2400.4 billions = 100%



7. In 2000 what was the amount of personal income of persons in the age group 35–44 years?
   (a) 360 (b) [illegible]
   (c) [illegible] (d) None of these
8. How many more degrees will there be in the angle devoted to the personal income of the age group 35–44?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) None of these
9. What is the ratio of the personal income of the age group 25–34 to that of the age group 35–44?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) None of these
10. If the total income in 2001 was 20 percent greater than in 2000, then what was the approximate personal income [illegible] (Rs. in billions)?
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) None of these
11. If the total income in the year 2001 is projected to [illegible] 2000, [illegible] growth [illegible]?
    (a) 20 (b) [illegible]
    (c) [illegible] (d) None of these

Direction (Qs. 12 to 16): These questions are based on the following pie chart showing percentage [illegible] items [illegible]



12. The ratio between the money spent on [illegible] and [illegible] is
(a) [illegible] (b) 7 : 5
(c) [illegible] (d) None of these

13. If the income of a family is Rs. 2000 p.m. then the difference between the expenditure (in rupees) on Clothing and Education is nearly
(a) 270 (b) 240
(c) 300 (d) None of these

14. If the income of a family is Rs. 25000 p.m. then the ratio of the expenditure on Rent and Miscellaneous items is
(a) 8 : 9 (b) 7 : 8
(c) 7 : 6 (d) None of these

15. If the income of a family increases by Rs. 1000 p.m., then the amount spent (in rupees) on [illegible] should increase by nearly
(a) 150 (b) 300
(c) 200 (d) 400

16. If the income of a family is Rs. 8000 p.m. then the [illegible] difference of the expenditure on Rent and Miscellaneous items in percent is
(a) 16 (b) 12
(c) 5 (d) None of these

Direction (Qs. 17 to 21): Study the following information to answer the given questions.

Percentage of total students in various courses (A,B,C,D,E,F) in the pie chart I and percentage of girls in pie Chart II.

Total students : 1200
(800 girls + 400 boys)

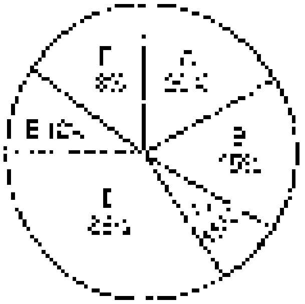


Chart I

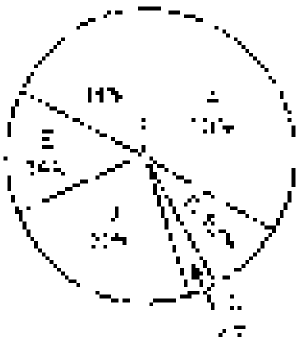


Chart II

17. For course D what is the ratio of boys and girls?
(a) 3 : 4 (b) 4 : 5
(c) 4 : 3 (d) 5 : 6

18. For which pair of courses is the number of boys the same?
(a) E and F (b) A and D
(c) C and F (d) B and D

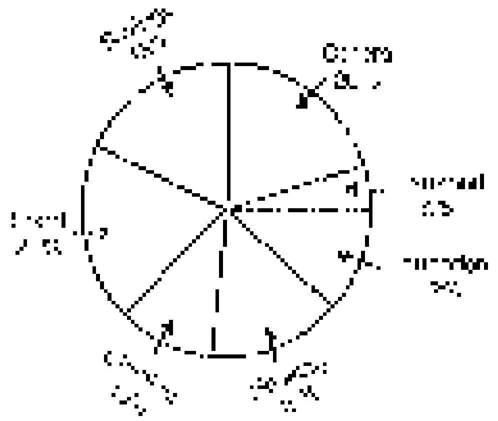
19. For course E the number of girls is how much percent more than the number of boys for course E?
(a) 250 (b) 350
(c) 150 (d) 80

20. For which course is the number of boys the [illegible]?
(a) E (b) F
(c) C (d) A

21. How many girls are there in course C?
(a) 44 (b) 16
(c) 40 (d) 160

Direction (Qs. 22 to 26): The pie chart [illegible] [illegible] during the year 1998. Study the graph and answer these questions.

Percent of money spent by a family on various items during 1998



22. If the total amount spent during the year 1998 was Rs. 46000, the amount spent on food was:
(a) Rs. 2000 (b) Rs. 10580
(c) Rs. 23000 (d) Rs. [illegible]

23. If the total amount spent was Rs. 46000, how much money was spent on clothing and housing together?
(a) Rs. 11500 (b) Rs. 1150
(c) Rs. 10000 (d) Rs. 15000

24. The ratio of the total amount of money spent on housing to that spent on education was:
(a) 5 : 2 (b) 2 : 5
(c) 4 : 5 (d) 5 : 4

25. Graph shows that the maximum amount was spent on:
(a) Food (b) Housing
(c) Clothing (d) Others

26. If the total expenditure of the family for the year 1998 was Rs. 46000, the family saved during the year:
(a) Rs. 1500 (b) Rs. 15000
(c) Rs. 46000 (d) Rs. 3067 approx.

❑❑❑

Solutions

Answer 1 to 5

1. (a) Marks scored in Hindi and Maths is [illegible]

Marks scored in [illegible] is [illegible]

2. (b) [illegible]

Required difference is [illegible]

3. (c) [illegible]

4. (c) [illegible]

5. (d)

6. (c)

7. (a) [illegible]

8. (c)

9. (d) [illegible]

10. (b) [illegible]

11. (c) [illegible]

12. (c) [illegible]

8. (d) Second time spending
= 20.28% of Rs. 12000 = Rs. 2433.60
Expenditure on electricity
= 10.28% of 12000 = Rs. 1233.60
∴ Required difference = Rs. 1200.

Alternative

Difference of expenditure on Clothing & Electricity is
20.28% − 10.28% = 10%
10% of 12000
= Rs. 1200 Ans.

14. (c) Required ratio $= \frac{[illegible]}{15.28} = 1.77$
Whatever the family income may be

15. (a) Amount on electricity will increase by Rs. 102.93 ≈ Rs. 103

16. (c) Required difference will be 15.28% − 10.28% = 5% irrespective of family income

17. (a) Number of students in course D = 35% of 1200 = 420
No. of girls students for course D = 30% of 800 = 240
No. of boys students for course D = 420 − 240 = 180
Required ratio = 180 : 240 = 3 : 4

18. (c) No. of boys for different courses are
A = [illegible]; B = 100; C = 44 [illegible] = 180; E = 32 [illegible]
Hence C & [illegible] are same

19. (a) Total students for E = 12% of 1200 = 144
No. of girls for course E = 14% of 800 = 112
∴ No. of boys for course E = 32

Required % $= \frac{112 - 32}{32} \times 100 = 250\%$

20. (d) Using the formula as given in Q. No. (1)

21. (c) No. of girls for course C = 15% × 800 = 120

22. (b) 22% of 48000 = Rs. 10560

23. (a) 24% of 48000 = Rs. 11520

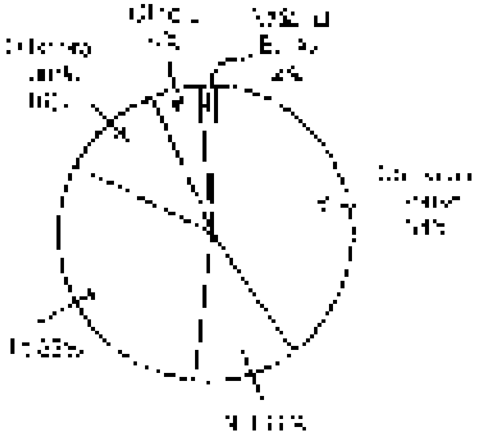
24. (c) Required ratio = 15 : 12 = 5 : 4

25. (b) [illegible]

26. (c) [illegible] of 48000 = Rs. [illegible]

Practice Exercise – II

Direction (Qs. 1 to 7): The following pie-chart shows the amount of subscription generated for India Bonds from different categories of investors.



1. If the investment by NRIs are Rs. [illegible] crore, then the investment by Corporate Houses and FIIs together is:
(a) [illegible] crore (b) [illegible] crore
(c) [illegible] crore (d) [illegible] crore

2. What percentage of the total investment is coming from either FIIs or NRIs?
(a) 33% (b) 11%
(c) 44% (d) 22%

3. If the investment flows from NRIs and Corporate Houses is Rs. [illegible] crore, then the investment by NRIs and Others would be (approximately):
(a) [illegible]
(b) [illegible]
(c) [illegible]
(d) Can't be determined

4. What is the approximate ratio of investment flows into India Bonds from NRIs to corporate houses?
(a) 1 : 4
(b) 1 : 2
(c) 2 : 1
(d) Can't be determined

5. In the corresponding pie chart, how many degrees should be subtended at the central angle?
(a) [illegible] (b) 121
(c) 102 (d) [illegible]

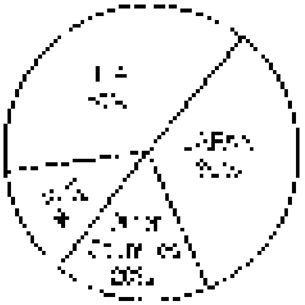
6. If the total investment flows from FIIs were to be doubled in the next year and the investment flows

[illegible] (other sources) and the remaining [illegible] existing levels for this year, then what would be the proportion of FII investment in the total investment in India in the next year (approximately)?
(a) 40%
(b) 30%
(c) 20%
(d) Can't be determined

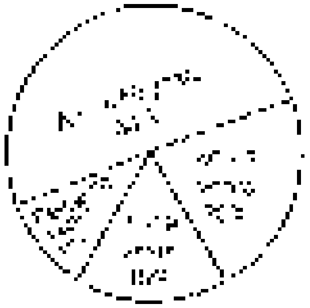
7. If the inflow from the FIIs after the doubling (as given in Question 6) were approx US$ 500 million, what would be the total investment in India in the next year (in US$ million)?
(a) 7000
(b) 3000
(c) 9000
(d) Can't be determined

Direction (Qs. 8 to 11): Given below are two pie charts of the tourist traffic from India. The first one shows the tourist distribution by country (X) and the age profile (Y) of the tourists respectively. Study the charts carefully and answer the questions which follow.

(X)



(Y)



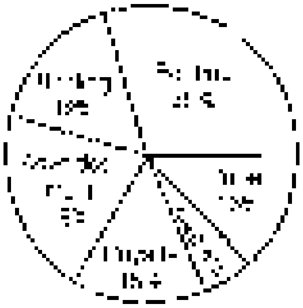
8. What percentage of the total Indian tourists went to USA or UK?
(a) 40% (b) 50%
(c) 60% (d) 70%

9. The ratio of the number of male tourists who went to USA to the number of female tourists who were below 30 years of age is
(a) 2 : 1
(b) 8 : 3
(c) 3 : 8
(d) Can't be determined

10. If amongst other countries, Switzerland accounted for 25% of the Indian tourist traffic, and it is known from official Swiss records that a total of 25 lakh Indian tourists had gone to Switzerland during the year, then find the number of 30-40 year old Indian tourists who went abroad in that year.
(a) 18.75 lakh (b) 25 lakh
(c) 50 lakh (d) 75 lakh

11. For Question 10, what was the volume of traffic of Indian tourists in the US?
(a) 150 lakh (b) 120 lakh
(c) 100 lakh (d) None of these

Direction (Qs. 12 to 15): Pie Chart given below shows the expenditure incurred in bringing out a book by a publisher.



Study the graph carefully and answer the questions given below:

12. What is the central angle of the sector for the cost of the paper?
(a) 22.5° (b) 16°
(c) 54.8° (d) 72°

13. If the cost of printing is Rs. 17500, the royalty is
(a) Rs. 6125 (b) Rs. 7500
(c) Rs. 3125 (d) Rs. 5250

14. If the miscellaneous charges are Rs. 6000, the advertisement charges are
(a) Rs. 12000 (b) Rs. 20000
(c) Rs. 40000 (d) Rs. 1600

15. If 5500 copies are published and miscellaneous expenditures amount to Rs. 1848 and the publisher earns a profit of 25%, then the selling price of each copy is

(a) Rs 34.20 (b) Rs 37.40

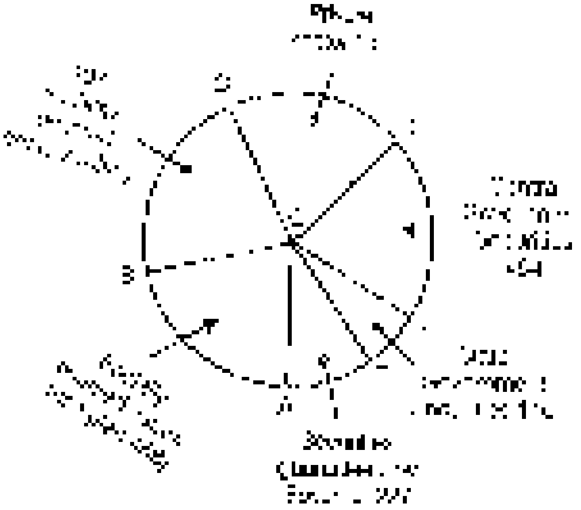
(c) Rs 27.50 (d) Rs 30

16. [illegible] of the book is credited, [illegible] then [illegible] would be

(a) 2% (b) $16\frac{2}{3}\%$

(c) 20% (d) None of these

Direction (Qs. 17 to 21): The following pie chart shows investment of an Insurance Company in various [illegible] (of rupees) in [illegible] as shown in the pie chart given below.



On the basis of the above information answer the following questions.

17. The percentage of gross investment in State Government Securities is nearly:

(a) 7.15 (b) 7.05

(c) 9.35 (d) 9.20

18. [illegible] is nearly:

(a) 10% (b) 12%

(c) [illegible] (d) [illegible]

19. [illegible] investment in Government Securities [illegible] Central and State is nearly ...

(a) More than [illegible] (b) More than [illegible]

(c) More than [illegible] (d) Less than [illegible]

20. The investment in [illegible] sector is nearly [illegible] percent more than the investment in State Government Securities?

(a) 48 (b) 54

(c) 43 (d) 40

21. The ratio of investment of the [illegible] to the area of [illegible] is nearly:

(a) 1 (b) 0.84

(c) 1.14 (d) 0.92

[illegible]

Solutions

Answer (1 to 5)

1. (a) [illegible] × 400 = [illegible]
2. (c) 55% + [illegible] = 65%
3. (b) [illegible] Also, [illegible] fund and NRI's is equal to 27%. Hence, $27\% \times \frac{50,000}{55} = [illegible]$
4. (b) 11 [illegible]
5. (c) 3.6 × 36 = 129.6 [illegible]
6. (b) [illegible] currently account for 20% [illegible] 100. If their [illegible] doubled [illegible] then [illegible] 50%
7. (c) [illegible] approximately 50% of [illegible] total investment, then [illegible] will be the total investment.
8. (a) 10 [illegible] 50% [illegible]
9. (c) 30 − 15 = [illegible]
10. (d) [illegible] will be [illegible]
11. (c) [illegible]
12. (d) Central angle [illegible] $= \left(\frac{16}{100} \times 360\right)^{\circ} = 57.6^{\circ}$
13. (b) [illegible] Rs [illegible] 7500 [illegible] $= \left[\frac{100 \times 7500}{[illegible]}\right]$ = Rs 1500

14. (c) [illegible] Rs. [illegible]

Rs. [illegible] 9000 [illegible] = [illegible] / 4

= Rs. [illegible]

15. (a) [illegible] Rs. [illegible]

[illegible] 100 [illegible]

= ([illegible] / 4) = Rs. [illegible]

∴ Balance = Rs. [illegible]

∴ [illegible]

= Rs. ([illegible] / [illegible]) = Rs. [illegible]

∴ Market price = 125% of Rs. [illegible]

= Rs. ([illegible] / 100 × [illegible]) = Rs. [illegible]

16. (b) [illegible] Rs. 15. The [illegible] = Rs. 10

∴ Required percentage = ([illegible] × [illegible])% = Rs. [illegible]

17. (a) Total investment = ([illegible] + [illegible] + [illegible] + [illegible] + 110) = [illegible] crores

∴ Required percentage = ([illegible] / [illegible] × [illegible])%

= [illegible]%

18. (c) [illegible] = [([illegible] + [illegible]) crores / [illegible] crores]

= ([illegible] / [illegible] × 360) = [illegible]°

19. (b) Investment [illegible] = ([illegible] + [illegible]) crores = [illegible] crores. ∴ Investment [illegible] Government [illegible] by [illegible].

20. (b) Investment [illegible] = [illegible] crores. Investment [illegible] Government [illegible] crores.

∴ Required [illegible] = ([illegible] × 100)%

= [illegible]%

21. (c) Required Ratio

= ([illegible] + [illegible] + [illegible]) / ([illegible] + 450 + [illegible]) = [illegible] / [illegible]

= [illegible] / [illegible] = 0.[illegible]

[illegible]

3.9
CHAPTER

Miscellaneous Puzzles

Puzzles

A puzzle is a problem or enigma that tests the ingenuity of the solver. In a basic puzzle, one is intended to piece together objects (puzzle pieces) in a logical way in order to come up with the desired shape, picture or solution.

Solutions to puzzles may require recognizing patterns and creating a particular order. People with a high inductive reasoning aptitude may be better at solving these puzzles.

Types of Puzzles

The large number of puzzles that have been created can be divided into various categories for example logical puzzles using a chess board.

Other categories include:

- Puzzle of Numbers
- Mathematical
- Mechanical puzzle [illegible] puzzle
- Picture puzzle
- Connect the box
- Logical puzzle like Sudoku
- Spot the difference

Let's have a glimpse of different types of puzzles.

Numbers

Ex.1 Find a ten digit number where first digit represents number of ones present in the number. Second digit represents number of twos present in the number. Similarly, third digit represents number of threes present in the number and so on till ninth digit which represents number of nines present in the number. Tenth digit represents number of zeros present in the number.

Sol.: Let the ten digit number be

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The smallest possible ten digit number is 1,00,00,00,000.

We will go through [illegible] number [illegible] each digit [illegible] number of zeros [illegible]

I^st step : 1,00,00,00,009

Since there are now 8 zeros, digit [illegible] should be 1.

II^nd step : 1,00,00,01,008

Since number of 8 present is 1, the above case is not the result of this condition.

III^rd step : 1,00,00,00,108.

Now number of zeros are only seven so,

IV^th step : 1,00,00,00,107

Here, since number of 1 present is [illegible] the second [illegible] will be

V^th step : [illegible]

Here, since number of [illegible] present, [illegible] the next modification will be

VI^th step : 2,00,00,01,007

Number of 2 present is [illegible] the next modification will be

VII^th step : 2,10,00,01,007

Here, since number of zeros [illegible] so, the next modification will be

VIII^th step : 2,10,00,01,006.

Here, since number of 6 present is 1 [illegible], modification will be

IX^th step : 2,10,00,10,006.

This number 2,10,00,10,006 satisfy all the conditions and is the desired number.

Triangles

Ex.2 Find out the total number of triangles in the given figure.

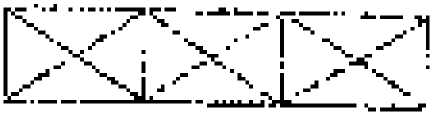


Fig. (i)

50. Estimate the total no. of single triangle
Number of single triangles = 12

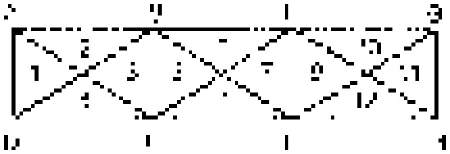


Fig. (2)

Now, we will count triangles made by joining two triangles for example in the below given fig. (3) we mean the triangles made by joining two single triangles.

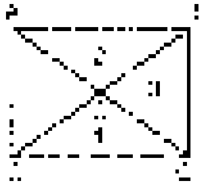


Fig. (3)

ΔABD = Δ1 + Δ2
ΔADC = Δ1 + Δ4
ΔBDC = Δ3 + Δ4
ΔABC = Δ2 + Δ3

So, in the given fig. (2) we will have 12 such type of double triangles.

Now, we will count number of triangles made by joining four triangles.

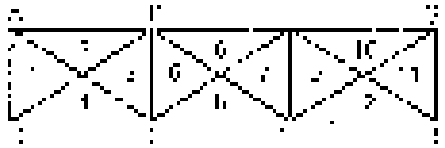


Fig. (4)

ΔAGE = Δ1 + Δ2 + Δ3 + Δ4
ΔFBG = Δ4 + Δ3 + Δ5 + Δ6
ΔGCH = Δ8 + Δ7 + Δ9 + Δ10
ΔBHC = Δ6 + Δ7 + Δ8 + Δ10

So, we have
12 Single triangle
12 Double triangles and
4 Four triangles
⇒ 28 triangles Ans.

Ex.3 Find number of triangles present in figure fig. (5)

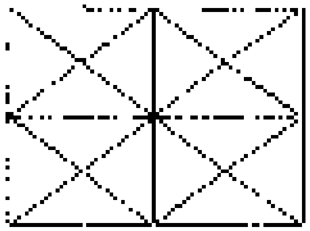


Fig. (5)

Sol. Number of Single triangles present in the given figure is 16.

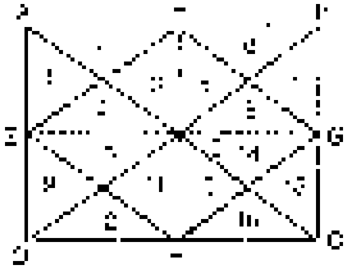


Fig. (6)

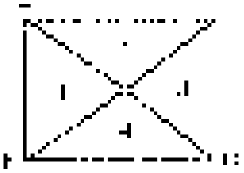


Fig. (7)

So, we will find number of Double triangles in fig. (7) which is equal to 4 as:
ΔAEF = Δ1 + Δ2
ΔEFC = Δ2 + Δ3
ΔEG = Δ3 + Δ4
ΔAEF = Δ1 + Δ4
So total double triangles in fig. (6) are 16.

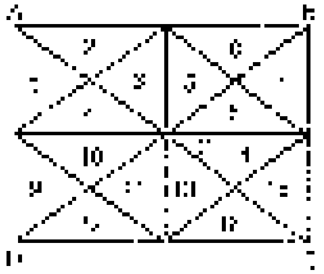


Fig. (8)

Number of Four triangles will be 4.
ΔACD = Δ1 + Δ4 + Δ9 + Δ10
ΔBCD = Δ2 + Δ3 + Δ6 + Δ7
ΔBDC = Δ5 + Δ6 + Δ7 + Δ8
ΔGCD = Δ8 + Δ11 + Δ13 + Δ16

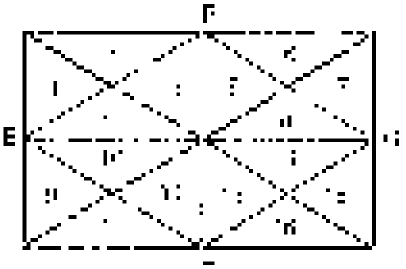


Fig. (9)

Number of Four triangles will be 4
ΔEFF = Δ5 + Δ1 + Δ10 + Δ11

[illegible]

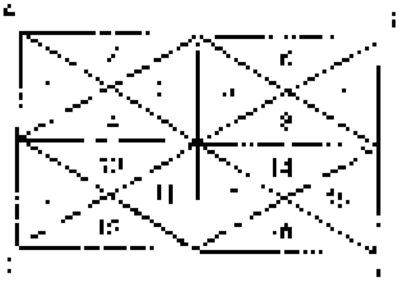


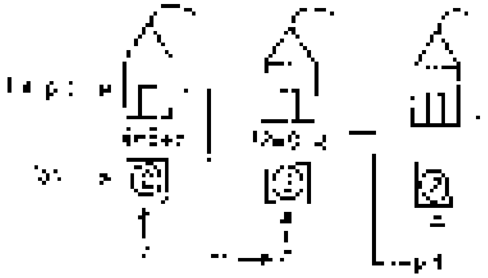
Fig. (18)

[illegible]

Temple and Tank

Ex.4 [illegible]

Sol.

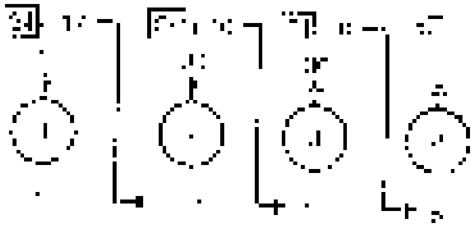


[illegible]

Cat and Mouse

Ex.5 [illegible]

Sol.



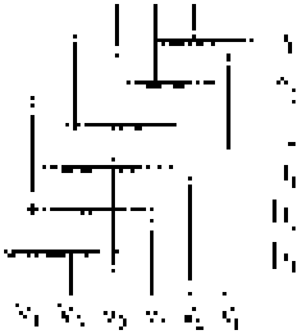
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

- [illegible]
- [illegible]

Rectangles

Ex.6 Six vertical and six horizontal lines are intersecting [illegible] to each other. Find number of rectangles formed after their intersection.

Sol.:



Here V_1 to V_6 represents six vertical lines and H_1 to H_6 horizontal six parallel to each other.

To form a rectangle we need to select any two horizontal parallel lines and any two vertical parallel lines.

Thus

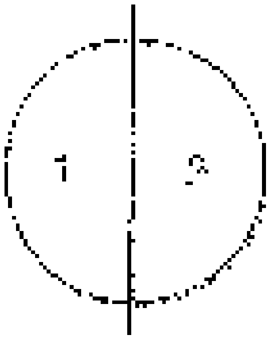
$^6C_2 \times {}^6C_2 = 15 \times 15 = 225$

225 rectangles will be formed.

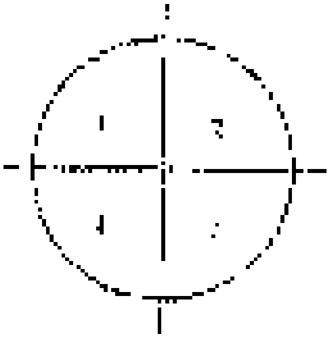
Birthday Cake

Ex.7 In a birthday party there is a cake which is to be cut into different pieces. How many maximum pieces are possible if five vertical cuts are made given that all cuts are [illegible].

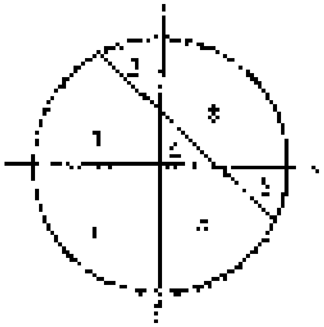
Sol.



[Fig. First cut]
Total pieces = 1 + 1 = 2



[Fig. Second cut]
Total pieces = 1 + 1 + 2 = 4



[Fig. Third cut]
Total pieces = 1 + 1 + 2 + 3 = 7

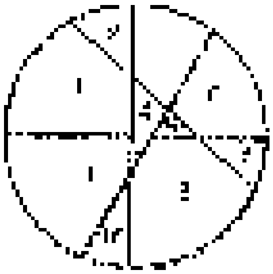


Fig. Fourth cut
Total pieces = 1 + 1 + 2 + 3 + 4 = 11

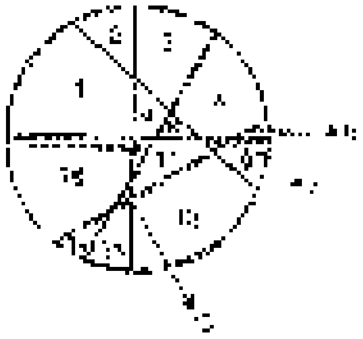


Fig. Fifth cut

Total pieces will be
= 1 + 1 + 2 + 3 + 4 + 5 = 16 pieces

∴ Similarly for n cuts we get
1 + 1 + 2 + 3 + 4 ... n pieces

⇒ $1 + \Sigma n$ pieces

⇒ $1 + \frac{n(n+1)}{2}$ pieces (formula for [illegible])

Intersecting Lines

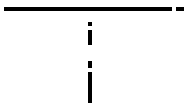
Ex. 3 Five lines are intersecting each other. Find maximum how many intersecting points are possible.

Sol.

1. Single line

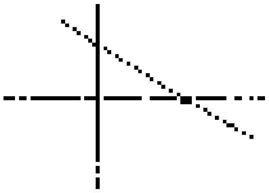
0 intersecting points

2. Two lines



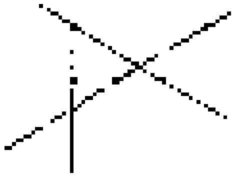
One intersecting point = 0 + 1

3. Three lines



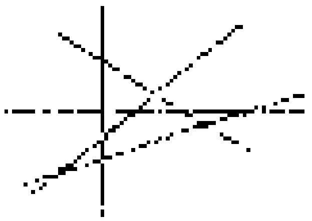
Three intersecting points = 0 + 1 + 2 = 3

4. Four lines



Six intersecting points = 0 + 1 + 2 + 3 = 6

5. Five Lines



Ten intersecting points

= 0 + 1 + 2 + 3 + 4 = 10

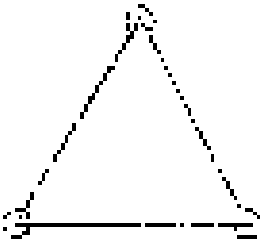
Similarly for n intersecting lines, maximum intersecting points will be

$0 + 1 + 2 + 3 + \ldots (n - 1) = n(n - 1)$

Coins

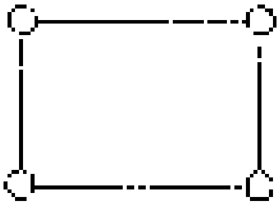
Ex. 4 Ten coins are to be placed in five lines in such a manner that each line contains four coins.

Sol. 1. Triangles



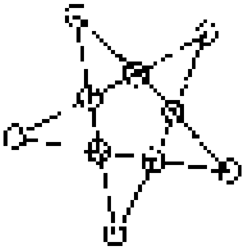
Triangle represents a figure in which three coins are placed in three lines such that each lines contains two coins.

2.



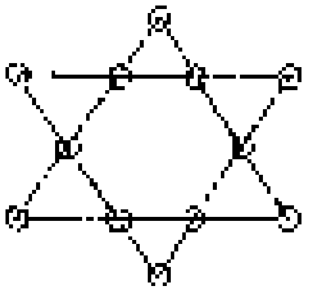
Square represents a figure in which four coins are placed in four lines such that each lines contains two coins.

3.



A Pentagonal star represents a figure in which ten coins are placed in five lines such that each lines contains four coins.

4.

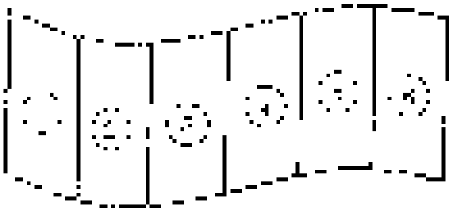


Similarly we can represent a given hexagon in such that twelve coins are placed in six lines and in each lines contains four coins.

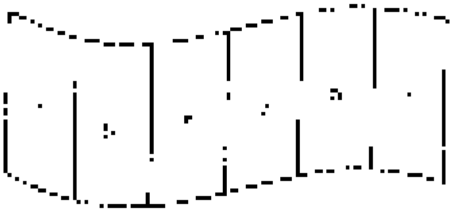
Time Flag

Ex. 10. [illegible]

Sol.



[illegible]



[illegible] = 18750 Ans

4500

Practice Exercise 1

Direction (Qs. 1 to 3): Read the following information carefully and answer the questions below. [illegible]

1. How many sheets [illegible]?
   (a) 8 (c) 16
   (b) 14 (d) 18

2. How many [illegible] in the [illegible]?
   (a) 3 (b) 4
   (c) 5 (d) 6

3. How many [illegible] the game [illegible]?
   (a) [illegible] (b) 8
   (c) 30 (d) 22

Direction (Qs. 4 to 7): Read the following information carefully and answer the questions that follow. Study the [illegible] letters [illegible] and answer the [illegible] questions.

U
Y T S
G C S K P
N Q [illegible] K I A L
J H L W X O V Z B

4. [illegible]?
   (a) F (b) I
   (c) [illegible] (d) T

5. [illegible]
   (a) WX (b) HK
   (c) JV (d) ZB

6. [illegible]?
   (a) [illegible] and O (b) [illegible] and K
   (c) R and F (d) R and K

7. [illegible]?
   (a) [illegible] (b) O and Y
   (c) [illegible] and O (d) [illegible] and O

Direction (Qs. 8 to 15): Read the following information carefully and answer the questions that follow. The Selection [illegible] the following [illegible] for the post of Manager [illegible]:

(i) The candidate must be a [illegible] graduate in Commerce.

(ii) The candidate must have completed 21 years and should not be more than 35 years as on 31-12-1993.

(iii) The candidate should [illegible] graduation [illegible] Commerce [illegible] referred to Director – Finance [illegible] the candidate [illegible]

(iv) The candidate [illegible] all the criteria [illegible] (i) and (ii) above, he/she will be called for group discussion.

(v) The candidate must [illegible] marks in the group discussion.

(vi) If the candidate [illegible] group discussion [illegible] will be called for interview.

(vii) The candidate must get 50% marks in the interview to be finally selected.

Based on the above criteria, decide which of the following courses of action should be taken in the case of candidates given below in each of the following questions.

Mark answer as:

(1) If the candidate can be selected.
(2) If the candidate is to be referred to Director – Finance.
(3) If the candidate can be called for group discussion.
(4) If the candidate can be called for interview.
(5) If the candidate cannot be selected.

8. Mr. [illegible] M. Com and his date of birth is [illegible]

9. Mrs. [illegible] is a qualified CA and was 25 years old on 31-12-1993.

10. Mr. [illegible] a post-graduate in Commerce obtained 70% marks in group discussion and secured [illegible] marks in interview. He was [illegible] years old on 31-12-1993.

11. Mr. [illegible] is a post-graduate in [illegible] and his date of birth is [illegible]

12. Mr. [illegible] a post-graduate was [illegible] by Director Finance [illegible] his [illegible] 1993 [illegible] interview.

13. Mr. [illegible] M. Com [illegible] years old on [illegible] He obtained [illegible] marks in interview.

14. Mr. [illegible] is a commerce graduate. His date of birth is [illegible]

15. Mr. [illegible] his date of birth is [illegible] a post-graduate with Commerce and obtained [illegible] marks in the interview.

Directions (Qs. 16 to 20): Read the following information carefully and answer the questions that follow:

Three small children [illegible] Mohan and Tanu went on a picnic with their dog [illegible]. They came with their [illegible] chocolates [illegible] the night [illegible] got up [illegible] gave one chocolate to the dog [illegible] the remaining [illegible] and slept. After some time Mohan woke up [illegible] gave one chocolate to the dog and distributed [illegible] After some time Tanu woke up and [illegible] In the later [illegible] of them woke up [illegible] gave one chocolate to the dog and divided the remaining chocolates among them and each one ate his share. By chance we know that the total number of chocolates were [illegible] in the beginning and [illegible] break any chocolate.

16. How many chocolates were there in the beginning?
(a) 96 (b) 94
(c) 110 (d) 79

17. What is the difference in the number of chocolates eaten by [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) 10

18. What is the difference in the number of chocolates eaten by [illegible] and Tanu?
(a) 22 (b) [illegible]
(c) 20 (d) 15

19. Mohan and Tanu ate the chocolates in the ratio
(a) 13 : [illegible] (b) [illegible] : 7
(c) 4 : [illegible] (d) [illegible]

20. How many more chocolates did [illegible] than Jimmy?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Direction (Qs. 21 to 25): Read the following information carefully and answer the question that follow.

Amit, Bhupinder, Charles and Deepak are four brothers playing a game where the loser doubles the money of each of the other players by giving cash from his share at that point of time. They played four games and each brother lost one game in alphabetical order. At the end of the fourth game each brother had Rs. 64.

21. Who started with the lowest amount?
    (a) Amit (b) Bhupinder
    (c) Charles (d) Deepak

22. What was the amount with Charles at the end of the second round?
    (a) 72 (b) 144
    (c) [illegible] (d) 136

23. How many losses did Bhupinder [illegible]?
    (a) [illegible] (b) [illegible]
    (c) [illegible] (d) [illegible]

24. At the end of [illegible] round, who had the [illegible] ([illegible] starting amount)?
    (a) Amit (b) Bhupinder
    (c) Charles (d) Deepak

25. Who had the [illegible] deviation from his starting amount?
    (a) Amit (b) Bhupinder
    (c) Charles (d) Deepak

Direction (Qs. 26 to 28): Read the following information carefully and answer the questions below it.

Life was not easy before Aryabhatta. Zero was not invented and also people could not multiply numbers. This is the reason they used only digits 1 to 9 and called them [illegible] 11 [illegible]. Find the answer to following questions in mathematics used then.

26. What is 7 + 11 + 5 = ?
    (a) [illegible] (b) [illegible]
    (c) 22 (d) [illegible]

27. What is [illegible] = ?
    (a) [illegible] (b) [illegible]
    (c) 52 (d) [illegible]

28. What is 13 + 5 + 1 + 9 = ?
    (a) 56 (b) 8
    (c) [illegible] (d) [illegible]

Direction (Qs. 29 to 33): Read the following information carefully and answer the question below it.

Renu was at a crossroads in his life. He was at an age to learn what he [illegible]. His [illegible] Renu had many choices to [illegible] and could only [illegible] Renu could [illegible] 213 or 251 to get the next step. The first [illegible] choice between [illegible] and the second choice between [illegible] business.

In all four cases, Rohit would [illegible]. Renu [illegible] India [illegible]. If [illegible] Rohit would go to the US [illegible] spare parts manufacturing.

29. [illegible] possible?
    (a) 213
    (b) 251
    (c) Either (a)
    (d) Cannot be determined

30. If Renu took [illegible] number 251 [illegible] Rohit [illegible]?
    (a) Marketing job
    (b) Production job
    (c) Garments business
    (d) Spare parts business

31. If Rohit [illegible] number 213 and [illegible] Renu [illegible] country [illegible]?
    (a) India (b) UK
    (c) US (d) Canada

32. If Rohit [illegible] spare parts business, which of the following would be his wife's name?
    (a) [illegible] (b) [illegible]
    (c) Sweta (d) [illegible]

33. If [illegible] which of the following is possible?
    (a) Production job [illegible] spare parts business
    (b) [illegible]
    (c) Garments business [illegible]
    (d) Marketing job [illegible] garments business

[illegible]

Solutions

Answer 1 to 3:

Let the number of seeds be x.

Number of seeds left with him after the [illegible] temple

$$= x - \left(\frac{x}{2} - 1\right) = \frac{x}{2} + 1$$

Number of seeds left with him after giving to the beggars = $\frac{x}{4} - 2$

Number of seeds left with him after giving to the [illegible] = $\frac{x}{8} - 1$

Number of seeds left with him after giving the [illegible] = $\frac{x}{4} - 2 - 1$

This gives x = 12

1. (4)
2. (3)
3. (3)

Answer 4 to 8

4. (2) [illegible]
5. (3) [illegible] occur together in alphabetical order. Where [illegible] are not vertical neighbours of the given pyramid. ST occur together in alphabetical order and also are vertical neighbours in the given pyramid.
6. (5) [illegible] and [illegible], [illegible] and [illegible] are vertical neighbours in the given pyramid but none of these pairs does not occur together in alphabetical order. Both in the pyramid and in alphabetical order Y and X are separated by exactly one letter.
7. (3) [illegible] are separated by [illegible] letters in the alphabetical order while [illegible] are separated by [illegible] letters. [illegible] is separated by [illegible] letters [illegible] in the given pyramid.

Answer 8 to 15:

8. (4) Condition (i) is not satisfied.
9. (2) All the conditions of eligibility are satisfied.
10. (1) All conditions are satisfied.
11. (3) Condition (iii) is not satisfied.
12. (5) [illegible] condition [illegible] candidate [illegible]
13. (5) [illegible] (iv)
14. (5) According to condition (ii) his case should be referred to [illegible] Director-Finance.
15. (1) He will be selected.

Answer 16 to 20:

Let the number of [illegible] in the beginning be x.

[illegible]

$\frac{x}{3}$ [illegible]

When [illegible]

$$\frac{2}{3}\left[\frac{2}{3}x - 4 - 1\right] [illegible]$$

[illegible] $= \frac{8x + 30}{27}$

Finally [illegible] $\frac{8x + 30}{27} - 1$ [illegible] three equal parts.

So, $\frac{8x + 30 - 27}{27}$ [illegible] $\frac{8x + 3}{27}$ [illegible] divided into three equal parts. This means $\frac{8x + 3}{27}$ is divisible by 3 [illegible] multiple of [illegible] $8x + 3 = 81$ [illegible]

$8x + 3$ [illegible] should be divisible by [illegible] odd number [illegible] 1, 3, 5, ... [illegible] 1 [illegible] number [illegible] = 102, which is not acceptable. So, n = 7 is [illegible] We can [illegible] accordingly. The table below [illegible]

Rounds	Start	[illegible]	Left	[illegible]
First	[illegible]	[illegible]	[illegible]	[illegible]
Second	[illegible]	12	[illegible]	[illegible]
Third	11	[illegible]	[illegible]	[illegible]
Last	7	7	7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] each during four rounds. [illegible] required [illegible] Using [illegible] particular [illegible] to represent [illegible]

16. (b)

17. (c)

18. (b)

19. (a)

20. (a)

Answer 21 to 25:

[illegible]

	A	B	C	D
Initially	132	68	36	20
Round 1	8	136	72	40
Round 2	16	16	144	80
Round 3	32	32	32	160
Round 4	64	64	64	64

Refer to the table [illegible] the money [illegible] the round [illegible]

21. (c)

22. (c)

23. (a)

24. (c)

25. (c)

Answer 26 to 28:

[illegible]

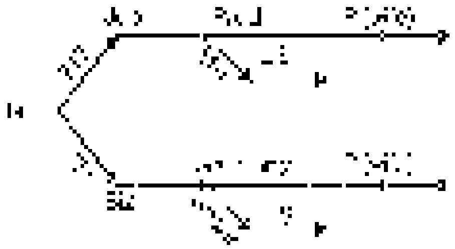
26. (d) [illegible]

27. (b) [illegible]

28. (a) [illegible]

Answer 29 to 33:

[illegible] Your [illegible] result is shown [illegible] below.



29. (c)

30. (a) [illegible]

31. (c) [illegible]

32. (c)

33. (c) [illegible]

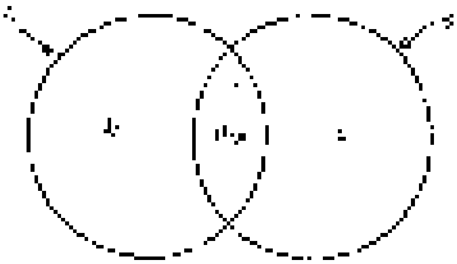
3.10
CHAPTER

Logical Venn Diagrams

Venn Diagrams

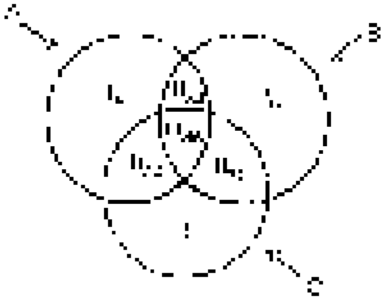
Venn Diagrams are the pictorial representation of sets of objects. There are different diagrams which need proper understanding for solving problems based on logical venn diagrams.

Case I : When there are two circles



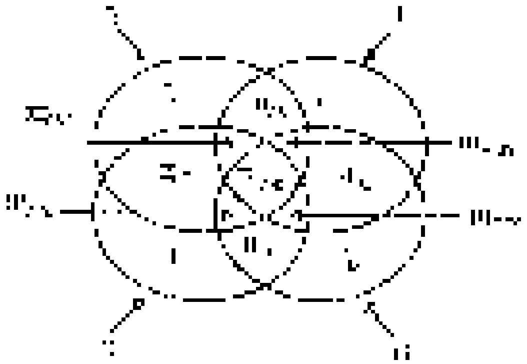
Here I_A represents A only (i.e. not B)
I_B represents B only (i.e. not A)
II_{AB} represents A and B only (i.e. both A and B)

Case II : When there are only three circles



Here I_A represents A only (not B or C)
I_B represents B only (not A or C)
I_C represents C only (not A or B)
II_{AB} represents A and B only (not C)
II_{BC} represents B and C only (not A)
II_{AC} represents A and C only (not B) and
III_{ABC} represents A, B and C only (i.e. region which is common to A, B and C)

Case III : When there are only four circles



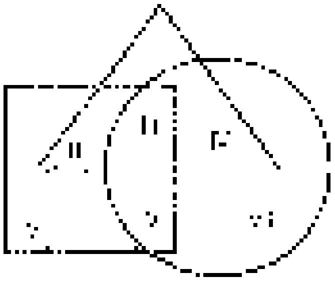
I_A represents A only (not B, C or D)
I_B represents B only (not A, C or D)
I_C represents C only (not A, B or D)
I_D represents D only (not A, B or C)
II_{AB} represents A and B only (not C or D)
II_{AC} represents A and C only (not B or D)
II_{BD} represents B and D only (not A or C)
II_{CD} represents C and D only (not A or B)
III_{ABC} represents A, B and C only (not D)
III_{BCD} represents B, C and D only (not A)
III_{ACD} represents A, C and D only (not B)
III_{ABD} represents A, B and D only (not C)
IV_{ABCD} represents A, B, C and D i.e. region which is common to all A, B, C and D.

Note: A, B, C and D can be represented in form of triangle, circle, rectangle or square. The logic behind Venn diagram will remain unchanged irrespective of the type of figure.

□□□□

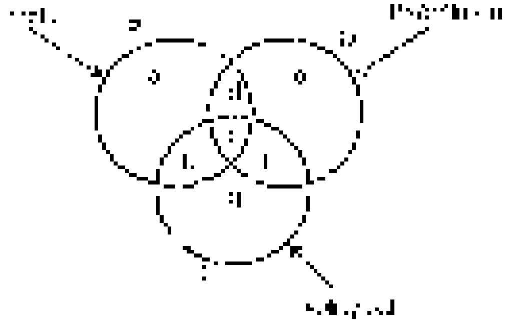
Practice Exercise 1

1. The triangle, square and circle [illegible] the urban, hard working and educated people respectively. [illegible] represented by the urban educated [illegible] not hard working?



(a) [illegible] (b) I
(c) [illegible] (d) I

Direction (Qs. 2 to 5): The figure given below consists of three intersecting circles which represent sets of students who play Tennis, Badminton and Volleyball. Each region in the figure is represented by a small letter.



On the basis of the above figure, answer the questions given below.

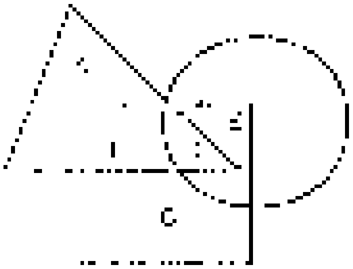
2. Which letter represents the set of students who play all the three games?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) g

3. Which letter represents the set of students who play Tennis and Volleyball but not Badminton?
(a) g (b) e
(c) c (d) b

4. Which letter represents [illegible] Badminton [illegible] Volleyball?
(a) [illegible] (b) b
(c) [illegible] (d) d

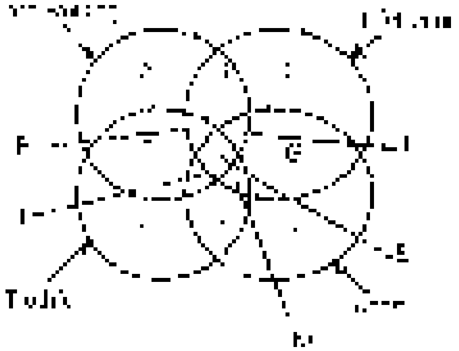
5. Which letter represents the set of persons who play Tennis and Badminton but not Volleyball?
(a) b (b) [illegible]
(c) [illegible] (d) [illegible]

6. In the given figure, the triangle [illegible] square represents [illegible] persons and the circle [illegible] represents [illegible] who are [illegible]



(a) A (b) B
(c) [illegible] (d) [illegible]

Direction (Qs. 7 to [illegible]): Below is given a figure with four intersecting circles each representing a group of persons [illegible] the figure [illegible] answer the questions that follow.



7. The region which is represented [illegible]
(a) [illegible] (b) F
(c) M (d) [illegible]

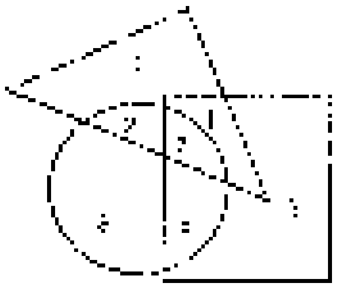
8. The persons [illegible] all the [illegible] is represented by
(a) [illegible] (b) [illegible]
(c) F (d) E

9. The region which represents people [illegible] is denoted by
(a) F (b) [illegible]
(c) F (d) I

10. People who are not hard working but intelligent and truthful are represented by
(a) [illegible] (b) 5
(c) 10 (d) [illegible]

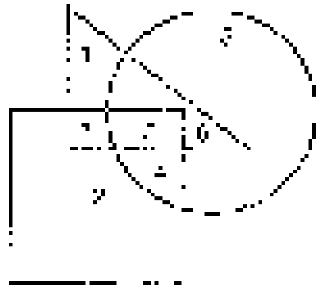
11. People who are not honest and truthful but are hard working and intelligent are represented by
(a) 8 (b) 3
(c) 4 (d) [illegible]

12. If 'A' is represented by circle, 'B' by triangle and 'C' by square, then which number [illegible] represents [illegible]?



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

Direction (Qs. 13 to 15): The following questions are based on the diagram given below. In the diagram the triangle stands for graduates, square stands for membership of professional organisation and the circle stands for membership of trade organisation. Read each statement and find out the number(s) to represent the people covered by the given statement.

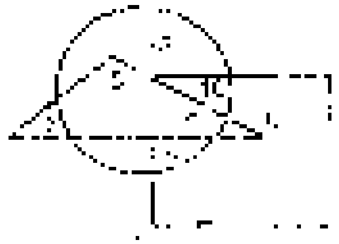


13. Number of graduates in [illegible] organisations
(a) 1 (b) 5
(c) 6 (d) 5 and 6

14. Number of graduates in trade organisation and [illegible]
(a) 2 (b) 4
(c) 5 (d) 6

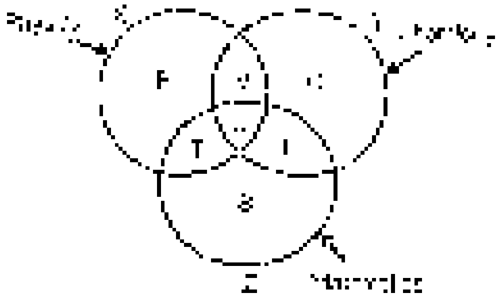
15. Number of graduates in professional organisation
(a) 2 and 7 (b) 5, 6 and 7
(c) 6 and 7 (d) 1, 5 and 6

16. In the following diagram, square represents women, triangle represents [illegible] and circle represents graduates. Which number [illegible]?



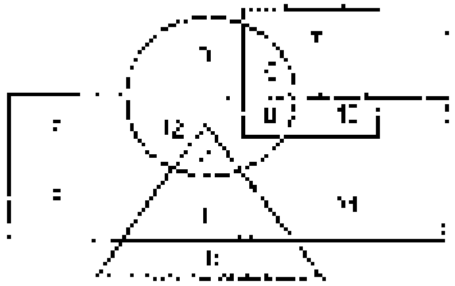
(a) 5 (b) 4
(c) 8 (d) 13

17. The diagram given below represents the students who study Physics, Chemistry and Mathematics. Study the diagram and identify the region which represents the students who study Physics and Mathematics but not Chemistry.



(a) T
(b) P + T + S
(c) V
(d) P + Q + R + S + T + U + V

Direction (Qs. 18 to 25): The following questions are based on the diagram given below.



1. Rectangle represents males
2. Triangle represents educated
3. Circle represents urban
4. Square represents civil servants

18. [illegible]?
(a) 4 (b) [illegible]
(c) 9 (d) 11

19. [illegible]?
(a) [illegible] (b) 3
(c) [illegible] (d) 10

20. [illegible]?
(a) 2 (b) [illegible]
(c) 10 (d) [illegible]

21. [illegible]?
(a) [illegible] (b) 2
(c) 11 (d) [illegible]

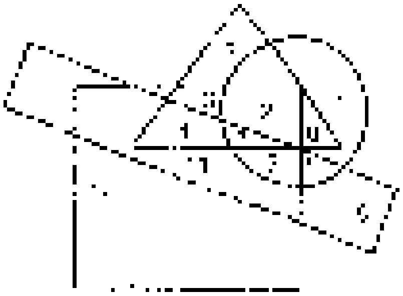
22. [illegible]?
(a) [illegible] (b) 3
(c) [illegible] (d) 12

23. [illegible]?
(a) [illegible] (b) 5
(c) 3 (d) 11

24. [illegible]?
(a) 13 (b) 12
(c) 3 (d) 6

25. [illegible]?
(a) 7 (b) 13
(c) 4 (d) 1

Direction (Qs. 26 to 35): [illegible]



26. [illegible]
(a) 5 (b) [illegible]
(c) [illegible] (d) [illegible]

27. [illegible]
(a) 12 (b) 11
(c) 10 (d) [illegible]

28. [illegible]
(a) 11 (b) 8
(c) 9 (d) 6

29. [illegible]
(a) 5 (b) 7
(c) 6 (d) 12

30. [illegible]
(a) 1 (b) 2
(c) 3 (d) 4

31. [illegible]
(a) 6 (b) [illegible]
(c) [illegible] (d) 2

32. [illegible]
(a) [illegible] (b) 4
(c) [illegible] (d) [illegible]

33. [illegible]
(a) 1 (b) 2
(c) 3 (d) 4

34. [illegible]
(a) 1 (b) [illegible]
(c) 3 (d) [illegible]

35. [illegible]
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

Solutions

1. (c) [illegible]

(c) The required region is the one common to [illegible] figures i.e. [illegible].

(d) The required region is the one which is common to circles P and R but lies outside circle Q i.e. 6.

(e) The required region is the one which lies inside circle P but is not common to circle Q or circle R or both i.e. [illegible].

(f) The required region is the one which is common to circles P and Q but lies outside circle R i.e. [illegible].

8. (c) The required region is the one which is common to the triangle and circle but lies outside the rectangle i.e. [illegible].

[illegible] (c) The required region is the one which is common to circles 2 and 4 but lies outside circle [illegible] i.e. [illegible].

8. (c) The required region is the one which is common to [illegible] and the [illegible] i.e. [illegible].

9. (b) The required region is the one which is common to the circles 1, 3 and 4 but lies outside circle 2 i.e. [illegible].

10. (d) The required region is the one which lies inside circles 1, 2 and 4 i.e. [illegible].

11. (c) The given conditions are satisfied by the persons represented by the region which is common to circles 1 and 2 but lies outside the circle 3 or circle 4 i.e. [illegible].

12. (b) Strong government will be represented by the region which is common to the square and the triangle but lies outside the circle i.e. 4.

13. (c) The required region is the one common to the [illegible] triangle i.e. regions 5 and 6.

14. (c) The required region is the one common to the triangle and circle but lies outside the square i.e. [illegible].

15. (c) The required region is the one common to the triangle and [illegible] i.e. regions [illegible].

16. (b) The required region is the one common to the square, triangle and circle i.e. [illegible].

17. (c) The required region is the one which is common to circles X and Y but lies outside circle Z i.e. 7.

18. (d) The person satisfying the given conditions is represented by the region which is common to the triangle and the rectangle but lies outside the circle i.e. 11.

19. (c) The person satisfying the given conditions is represented by the region which lies inside the circle but outside the square and rectangle and the triangle i.e. 3.

20. (a) The person satisfying the given conditions is represented by the region which lies inside the rectangle and is common to the circle and the square i.e. 11.

21. (b) The person satisfying the given conditions is represented by the region which is common to the [illegible] and the rectangle but lies outside the [illegible] i.e. [illegible].

22. (c) The person satisfying the given conditions is represented by the region which lies outside the triangle and is common to the circle and the rectangle i.e. 8.
Remember: The condition [illegible] not [illegible] the required region [illegible] the square and there is [illegible] on the answer.

23. (c) The person satisfying the given conditions is represented by the region which lies inside the square but outside the circle, rectangle and triangle i.e. 7.

24. (b) The person satisfying the given conditions is denoted by the region which is common to the rectangle, circle and the square but outside the triangle i.e. 3.

25. (b) The person satisfying the given conditions is represented by the region common to the rectangle and the square but lying outside the triangle and the circle i.e. 13.

26. (d) The required set of people is represented by the region which lies inside the triangle and is common to the circle, square and rectangle i.e. 8.

27. (c) The required set of people is represented by the region which lies outside the triangle, inside the circle but outside the rectangle and the square i.e. 2.

28. (c) The required set of people is represented by the region which is common to the rectangle, circle and square but lies outside the triangle i.e. [illegible]

29. (d) The required set of people is denoted by the region which lies inside the square but outside the triangle, circle and rectangle, i.e. 12.

30. (a) The required set of people is denoted by the region common to the circle, square, rectangle and triangle, i.e. 1.

31. (b) The required set of people is represented by the region which is common to the triangle and the square but lies outside the circle and rectangle, i.e. 3.

32. (c) The required set of people is denoted by the region which is common to the triangle and the circle, and is not a part of either the rectangle or the square, i.e. 5.

33. (b) The required set of people is represented by the region which is common to the triangle, square and circle but is not a part of the rectangle, i.e. 6.

34. (d) The required set of people is represented by the region which lies outside the circle and is common to the triangle, square and rectangle, i.e. 4.

35. (c) The required set of people is denoted by the region which is common to the rectangle and circle but is not a part of either the triangle or the square, i.e. 7.

■■■

3.11

CHAPTER

Analytical Reasoning

Practice Exercise I

Directions for Questions (1 to 3)

(i) Six friends A, B, C, D, E and F are sitting around the sides of a hexagonal table for playing a game, though not necessarily in the same order.

(ii) E who is sitting exactly opposite to A is to the immediate left of B.

(iii) D is between A and B and is exactly opposite to C.

1. A is sitting between which of the following pairs of persons?
   (a) D and F (b) B and E
   (c) D and C (d) None of these
2. Who is sitting opposite to B?
   (a) E (b) F
   (c) A (d) C
3. Three of the following are alike in a certain way on the basis of sitting positions and so form a group. Which is the one that does not belong to that group?
   (a) F, C (b) A, D
   (c) E, F (d) B, A

Directions for Questions (4 to 8)

A, B, C and D are four friends living together in a flat and they have a box of laddoos which they will share equally among themselves. One day A is very hungry and he opens the box of laddoos. Since no one was around, A divides the laddoos in four equal parts and ate his share and puts the remaining in the box. As he was closing the box, B arrived in and took the box. He again divides the remaining laddoos in four equal parts. A and B ate one part each and kept the remaining laddoos in the box. Suddenly C appeared and snatched the box. He again divided the laddoos in four equal parts, A, B and C ate one part each and kept the remaining laddoos in the box. Later on when D opened the box he again divided the laddoos in four equal parts and all the four ate their respective share. In total D got 9 laddoos.

4. How many laddoos initially were there?
   (a) 8 (b) 16
   (c) 32 (d) None of these
5. How many laddoos A got in all?
   (a) 21 (b) 15
   (c) 29 (d) None of these
6. How many laddoos C got in all?
   (a) 8 (b) 12
   (c) 7 (d) None of these
7. How many laddoos were given to A by his friends?
   (a) 27 (b) 25
   (c) 119 (d) None of these
8. How many laddoos did A eat the first time?
   (a) 32 (b) 24
   (c) 7 (d) None of these

Directions for Questions (9 to 13)

(i) A, B, C, D, E, F, G and H are eight friends. Three of them play cricket, two table tennis and two of them play football. Each one of them is of different height.

(ii) The tallest does not play football and the shortest does not play cricket.

(iii) F is taller than A and E but shorter than H and G. E, who does not play cricket, is taller than B and is second to the tallest. G is shorter than D but taller than A.

(iv) H who is fourth from the top plays table tennis with D.

(v) G does not play either cricket or football. H does not play football.

9. Who is the tallest?
   (a) B (b) H
   (c) [illegible] (d) Data inadequate

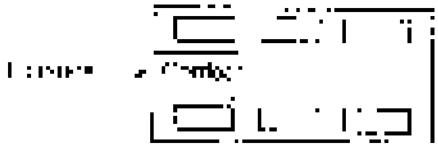
10. Who is the shortest?
   (a) D (b) [illegible]
   (c) A (d) Data inadequate

11. Which of the following pairs of friends play [illegible]?
   (a) [illegible] (b) EA
   (c) [illegible] (d) Data inadequate

12. What is the position of A with respect to his height when they are arranged in descending order of their height?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) None of these

13. Which of the following groups of friends plays [illegible]?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) None of these

Directions for Questions (14 to 17)



The diagram above shows six office blocks for six companies A, B, C, D, E and F, with B and C occupying offices to the right of the corridor (as one enters the office block) and A occupying office to the left of the corridor. E and F occupy offices on opposite sides of the corridor but their offices do not face each other. The offices of C and D face each other. E does not have a corner office. F's office is further down the corridor than A's, but on the same side.

14. If E sits in his office and faces the corridor, whose office is on his left?
   (a) A (b) B
   (c) C (d) D

15. Whose office faces A's office?
   (a) [illegible] (b) [illegible]
   (c) D (d) [illegible]

16. Who is/are the corner office occupant(s)?
   (a) A only (b) A and B
   (c) [illegible] (d) [illegible]

17. [illegible]
   (a) A (b) B
   (c) C (d) E

Directions (Qs. 18 to 22)

A, B, C, D, E, F and G are travelling in three different vehicles. There are at least two passengers in each vehicle – Maruti, Santro, Opel and only one of them is a male. There are two Engineers, two Doctors and three Teachers among them.

(i) C is a lady doctor and she does not travel with the pair of sisters, A and F.
(ii) B, a male engineer, travels with only G, a teacher in a Maruti.
(iii) D is a male doctor.
(iv) Two persons belonging to the same profession do not travel in the same vehicle.
(v) A is not an engineer and travels in Santro.

18. What is F's profession?
   (a) Engineer (b) Doctor
   (c) Teacher (d) Data inadequate

19. In which vehicle does C travel?
   (a) Maruti (b) Santro
   (c) Opel (d) Data inadequate

20. Which of the following represents the three teachers?
   (a) [illegible] (b) [illegible]
   (c) [illegible] (d) Data inadequate

21. How many lady members are there among them?
   (a) Three (b) Four
   (c) Three or four (d) Data inadequate

22. Which of the following is/are correct?
   (a) E-Male-Teacher
   (b) B-Male-Engineer
   (c) A-Female-Teacher
   (d) All are correct

Directions (Qs. 23 to 27)

Six friends A, B, C, D, E and F work in [illegible] companies namely [illegible], Ranbaxy, [illegible], Tata & Sons and [illegible]. Each of them [illegible] a different [illegible] Blue, Green, Yellow, [illegible] and Red, though not necessarily in the same order.

(i) [illegible]
(ii) [illegible] Tata & Sons [illegible]
(iii) [illegible]
(iv) [illegible] Green and Pink [illegible] Ranbaxy [illegible]
(v) [illegible]
(vi) Tata & Sons [illegible]

23. Which colour shirt is sponsored by Raymond's?
    (a) Yellow
    (b) Blue
    (c) Pink
    (d) Cannot be determined

24. Which pair is correctly matched?
    (a) Red-Raymond's-A
    (b) Red-Trump & Gates-B
    (c) Blue-[illegible]-C
    (d) None of these

25. Which of the following is true?
    (a) [illegible]
    (b) D is working in Trump & Gates
    (c) [illegible] Red Shirt
    (d) Red shirt is sponsored by Trump & Gates

26. What is the sequence of companies representing A, B, C, D, E & F?
    (a) [illegible], Pentacott, Trump & Gates, Raymond's, Jump, Summit
    (b) [illegible], Trump & Gates, Pentacott, Raymond's, Jump, Summit
    (c) [illegible], Pentacott, Trump & Gates, Summit, Jump, Raymond's
    (d) None of these

27. If Raymond's and Summit desire to interchange the colours of their sponsored shirts then which two persons have to interchange their shirt?
    (a) D & F (b) A & C
    (c) D & E (d) B & D

Direction (Qs. 28 to 30)

Five courses – A, B, C, D and E each of one month [illegible] have to be taught from January to May one after [illegible] though not necessarily in the same order by [illegible] P, Q, R, S and T [illegible]. A is taught in the month of April or May. Q teaches course [illegible] in the month of March. B is taught in the month of January by [illegible].

28. Which course is taught by S?
    (a) C (b) E
    (c) Either C or E (d) D

29. Which teacher's course immediately follows the course E?
    (a) Q (c) R
    (b) S (d) T

30. Which course is taught in the month of January?
    (a) C (b) D
    (c) E (d) Data inadequate

Direction (Qs. 31 to 34)

Rajeev planted some plants in his lawn following certain fixed pattern:
    (i) In most of the rows there are neither Roses nor Marigold
    (ii) [illegible] rows of Orchids than tulips and two more rows of Roses than tulips
    (iii) There are four more rows of Roses than tulips.
    (iv) [illegible] rows of lily as Orchids
    (v) [illegible] marigold rows than lilies
    (vi) There is just one row of Tulips.
    (vii) The maximum number of rows he planted is six.

31. How many rows of roses are planted?
    (a) Two
    (b) Five
    (c) Four
    (d) Cannot be determined

32. Which of the above information is redundant and can be dispensed with?
    (a) (i) (b) (iii)
    (c) (i) and (iii) both (d) All are necessary

33. What is the sum of the rows of Orchids and Marigolds he planted?
    (a) Three
    (b) Nine
    (c) Seven
    (d) Cannot be determined

34. How many rows of flowers did he plant?
    (a) Ten (b) Six
    (c) [illegible] (d) Data inadequate

Direction: (Qs. 35 to 37)
    (i) Five friends Amar, Kavi, Ganesh, Rohan and Nageshwar [illegible] red, yellow, blue, white and green not necessarily in the same order.
    (ii) Each one of them has different likings viz. reading, playing, travelling, singing and writing.
    (iii) Kavi [illegible] singing does not [illegible] yellow [illegible]. Ganesh wears red trousers and does not like reading or writing. Nageshwar [illegible] wear blue or yellow trousers. Amar [illegible] and Rohan does not wear yellow or green trousers.

85. What is the colour of Kapil's trousers?
    (a) White (b) Blue
    (c) Green (d) Data inadequate

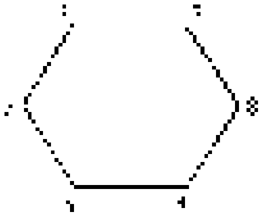
86. What is the hobby of Sharma?
    (a) Writing (b) Travelling
    (c) Reading (d) Data inadequate

87. Which of the following combinations of [illegible] colour [illegible] is correct?
    (a) [illegible]-Blue-Reading
    (b) Nagesh-White-Playing
    (c) Anand-Yellow-Writing
    (d) None of these

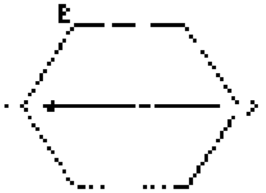
Solutions

Solution (1 to 3)

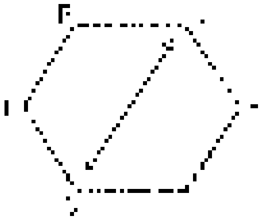
Construct the following figure



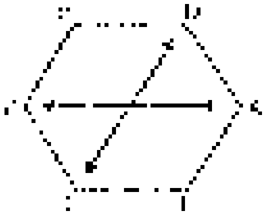
- From the second [illegible] it is clear that [illegible] opposite to each other and [illegible] the immediate right of C [illegible] arrangement can be [illegible]



- From the third [illegible] sitting between A and B and opposite to C [illegible] arrangement can be [illegible]



- There is [illegible] opposite [illegible] sitting [illegible]



1. (c)
2. (a)
3. (c)

Solution (4 to 8)

We will start solving this problem from the end line of the question.

Before D [illegible] 3 × 4 = 12 [illegible]

Before C [illegible] 12 × 3 = 18 [illegible]

Before B [illegible] 24 × 3 [illegible] = 36 [illegible]. Before A [illegible]

$\frac{[illegible]}{3}$ = 120 [illegible]

[illegible] 96 [illegible]

	A	B	C	D	Remaining
[illegible]	32				64
[illegible]	24	36			40
[illegible]	12	12	12		12
[illegible]	3	3	3	3	[illegible]
	71	34	15	3	

Now we can answer all the questions [illegible]

4. (b)
5. (c)
6. (c)
7. (a)
8. (a)

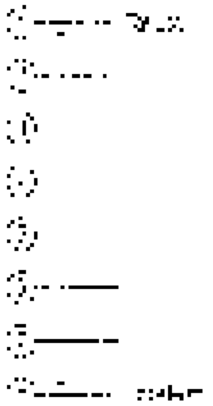
Solution (9 to 13)

[illegible]

- [illegible]

[illegible]

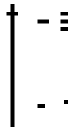
[illegible]



- The [illegible] does not play [illegible] and the [illegible] [illegible]

  ① [illegible] ④ [illegible]

- [illegible] A [illegible] than H and D. The [illegible] can be [illegible]



Note: [illegible] heights of [illegible] and A [illegible] given.

[illegible]

[illegible]

And [illegible] B and [illegible] position [illegible]

So, [illegible] ⑦

[illegible]

So, [illegible]

- [illegible] position [illegible]

  H → ⓒ

  H [illegible] T [illegible]

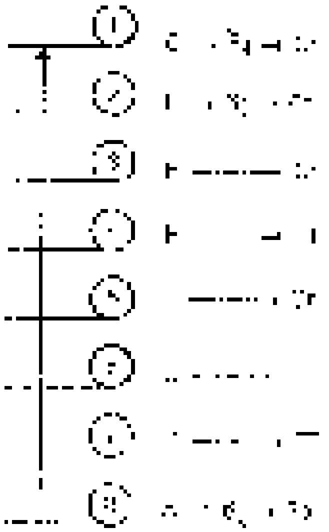
  H → T

  D → T

- G does not [illegible] G → T [illegible]

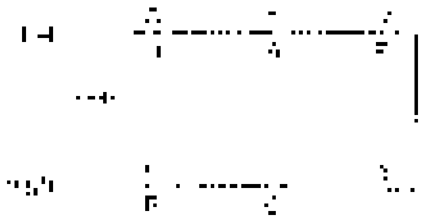
  G → T

  Now [illegible] will be as follows



9. (c)
10. (c)
11. (d)
12. (a)
13. (d)

Solution (14 to 17)



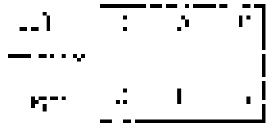
From the last statement, we get that F's [illegible] will have [illegible] the left side.

D does not have [illegible] A or B [illegible]

E and F do not face each other and E's office is [illegible] F occupies the [illegible]

Office of C and J [illegible] C will have first office on the right side and D will have the first office on the [illegible] side.

Final office arrangement will be as follows



14. (c)
15. (d)
16. (c)

    Since there is a corridor between offices of F & B so A [illegible] F

17. (b)

Solution (18 to 22)

[illegible]

Maruti, Santro & Opel

There are [illegible] altogether

[illegible]

- [illegible] A & F

  G → [illegible]

  [illegible]

[illegible]

- C → Tea
- ? → Engg
- ? G → Maruti

[illegible]

D → Doc.

[illegible]

A, E → Santro

Obviously C is travelling in Opel.

[illegible]

Vehicle	Person	Profession
Maruti	C	Engg.
	G	Tea.
Santro	A	Tea.
	E	Engg.
	D	Doc.
Opel	B	Doc.
	F	Tea.

18. (c)
19. (c)
20. (b)
21. (b)
22. (c)

Solution (23 to 27)

These questions can be solved easily with this chart.

[illegible]	A	B	C	D	E	F
[illegible]						
[illegible]						
[illegible]						
[illegible]						
T.N.						
[illegible]						

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]			
[illegible]			
[illegible]			
[illegible]			
[illegible]			

[illegible]

[illegible]

[illegible]	A	B	C	D	E	F
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						
[illegible]						

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	×	×	×	[illegible]	×	×
[illegible]	×	×				
[illegible]	×	×				
[illegible]	×	×	×	×	×	×
[illegible]	×	×				
[illegible]	×	×				

Further applying condition (ii) we get following tables.

Shirt / Company	A	B	C	D	E	F
Parakash						
Gulab						
Raymonds						×
Siemens						
T & C						×
Unique						

Colour / Company	Blue	Green	Pink	White	Purple	Red
Parakash	×	✓	×	×	×	×
Gulab	×	×				
Raymonds	×	×				
Siemens	✓	×	×	×	×	×
T & C	×	×				
Unique	×	×				

Applying condition (iii) we get following tables.

Shirt / Company	A	B	C	D	E	F
Parakash	×					
Gulab	✓	×	×	×	×	×
Raymonds	×					
Siemens	×					
T & C	×					×
Unique	×					

Colour / Company	Blue	Green	Pink	White	Purple	Red
Parakash	×	✓	×	×	×	×
Gulab	×	×	✓	×	×	×
Raymonds	×	×	×			
Siemens	✓	×	×	✓	×	×
T & C	×	×	×			
Unique	×	×	×			

Further applying condition (iv) we get following tables.

Shirt / Company	A	B	C	D	E	F
Parakash		×				
Gulab	×	×	×	×	×	✓
Raymonds	×					×
Siemens	×					
T & C	×			×		×
Unique	×					

Colour / Company	Blue	Green	Pink	White	Purple	Red
Parakash	×	✓	×	×	×	×
Gulab	×	×	✓	×	×	×
Raymonds	×	×	×		×	
Siemens	✓	×	×	×	×	×
T & C	×	×	×			
Unique	×	×	×			

Further applying condition (v) we get following tables.

Shirt / Company	A	B	C	D	E	F
Parakash	×					
Gulab	✓	×	×	×	×	×
Raymonds	×				×	×
Siemens	×	×		×	×	
T & C	×			×	×	×
Unique	×	×		×	✓	×

Colour / Company	Blue	Green	Pink	White	Purple	Red
Parakash	×	✓	×	×	×	×
Gulab	×	×	✓	×	×	×
Raymonds	×	×	×		×	
Siemens	✓	×	×	×	×	×
T & C	×	×	×			
Unique	×	×	×			

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

23. [illegible]
24. [illegible]
25. [illegible]
26. [illegible]
27. [illegible]

[illegible] (28 to 30)

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A				
B				
C				
D				
E				

[illegible]	[illegible]	[illegible]	[illegible]
A			
B			
C			
D			
E			

[illegible]

[illegible] B [illegible] the month of April [illegible]

[illegible]	Jan	Feb	Mar	Apr	May
A					
B				[illegible]	[illegible]
C					
D					
E					

[illegible]	F	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]				
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]				
D	[illegible]				
E	[illegible]				

[illegible] A [illegible]

[illegible]	Jan	Feb	Mar	Apr	May
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B			[illegible]	[illegible]	[illegible]
C			[illegible]		
D			[illegible]		
E			[illegible]		

[illegible]	F	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]			
D	[illegible]	[illegible]			
E	[illegible]	[illegible]			

[illegible]

[illegible]	Jan	Feb	Mar	Apr	May
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]		
D	[illegible]	[illegible]	[illegible]		
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	F	[illegible]	[illegible]	[illegible]	[illegible]
A	[illegible]	[illegible]	[illegible]	[illegible]	
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	[illegible]	[illegible]	[illegible]		
D	[illegible]	[illegible]	[illegible]		
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Now we can easily answer given questions with the help of above table.

Note: After drawing [illegible]

Final table [illegible]

28. (c)

29. (c)

30. (c)

Month	Subject	Teacher
January		F
February	S	F
March	A	G
April	[illegible]	ST
May	[illegible]	[illegible]

Solution (31 to 34)

→ [illegible]

[illegible]

Also

[illegible]

Where [illegible]

So, from (b) There are [illegible]

∴ [illegible]

So [illegible]

Now we can answer all the question easily.

91. (b)

92. (c)

93. (c)

94. (b)

Solution (95 to 97)

These questions can be solved easily by drawing a tabular chart.

Colour / Name	Red	Yellow	Blue	White	Green
Amar					
Ravi					
Suresh					
Rohan					
Rajesh					

Likes / Name	Dance	Read	Travel	Sing	Write
Amar					
Ravi					
Suresh					
Rohan					
Rajesh					

We will start reading each condition and mark ✓ sign or ✗ sign accordingly.

- Rajesh who has liking for singing does not wear yellow t-shirt.

Colour / Name	Red	Yellow	Blue	White	Green
Amar					
Ravi		[illegible]			
Suresh					
Rohan					
Rajesh					

Likes / Name	Dance	Read	Travel	Sing	Write
Amar				[illegible]	
Ravi	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Suresh				[illegible]	
Rohan				[illegible]	
Rajesh				[illegible]	

- Suresh wears red t-shirt and does not like reading/writing.

Colour / Name	Red	Yellow	Blue	White	Green
Amar	[illegible]				
Ravi	[illegible]	[illegible]			
Suresh	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rohan	[illegible]				
Rajesh	[illegible]				

Likes / Name	Dance	Read	Travel	Sing	Write
Amar				[illegible]	
Ravi	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Suresh	[illegible]			[illegible]	[illegible]
Rohan				[illegible]	
Rajesh				[illegible]	

- [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amit	[illegible]				
[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]		

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amit		[illegible]		[illegible]	
Kapil	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]		[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

- [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Amit	[illegible]	[illegible]			
Kapil	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Kapil	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Now we can easily answer the given questions with the help of above table.

Note: [illegible]

55. [illegible]

56. [illegible]

57. [illegible]

D

Section

Previous Years GATE & ESE Solved Questions

Previous Years GATE Solved Questions
(General Aptitude)

1. 25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is:
(a) 2
(b) 17
(c) 13
(d) 3

[2010, 1 Mark]

2. If 137 + 276 = 435 how much is 731 + 672?
(a) [illegible]
(b) [illegible]
(c) 1623
(d) [illegible]

[2010, 2 Marks]

3. 5 skilled workers can build a wall in 20 days; 8 semi-skilled workers can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semi-skilled and 5 unskilled workers, how long will it take to build the wall?
(a) 20 days
(b) 18 days
(c) 16 days
(d) 15 days

[2010, 2 Marks]

4. Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed?
(a) 50
(b) 51
(c) 52
(d) 54

[2010, 2 Marks]

5. Hari (H), Gita (G), Irfan (I) and Saira (S) are siblings (i.e. brothers and sisters). All were born on 1st January. The age difference between any two successive siblings (that is born one after another) is less than 3 years. Given the following facts:
   1. Hari's age + Gita's age > Irfan's age + Saira's age.
   2. The age difference between Gita and Saira is 1 year. However, Gita is not the oldest and Saira is not the youngest.
   3. There are no twins.

In what order were they born (oldest first)?
(a) HSIG
(b) SGHI
(c) IGSH
(d) IHSG

[2010, 2 Marks]

6. If $\log(P) = (1/2)\log(Q) = (1/3)\log(R)$, then which of the following options is TRUE?
(a) $P^2 = Q^3R^2$
(b) $Q^2 = PR$
(c) $Q^2 = R^3P$
(d) $R = P^2Q^2$

[CE, ME, CS 2011, 1 Mark (Set 1)]

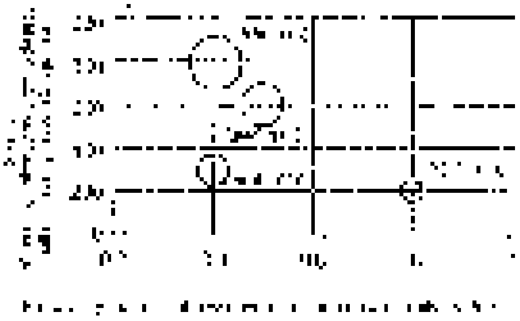
7. A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time. How much spirit is now left in the container?
(a) 7.58 litres
(b) 7.84 litres
(c) 7 litres
(d) 7.29 litres

[CE, ME, CS 2011, 2 Marks (Set 1)]

8. The variable cost (V) of manufacturing a product varies according to the equation V = 4q, where q is the quantity produced. The fixed cost (F) of production of same product reduces with q according to the equation F = 100/q. How many units should be produced to minimize the total cost (V + F)?
(a) 5
(b) 4
(c) 7
(d) 6

[CE, ME, CS 2011, 2 Marks (Set 1)]

9. P, Q, R and S are four types of dangerous microbes recently found in a human habitat. The area of each circle with its diameter printed in brackets represents the growth of a single microbe surviving human immunity system within 24 hours of entering the body. The danger to human beings varies proportionately with the toxicity, potency and growth attributed to a microbe shown in the figure below:



A pharmaceutical company is contemplating the development of a vaccine against the most dangerous microbe. Which microbe should the company target in its first attempt?

(a) P (b) Q

(c) R (d) S

[CE, ME, CS 2011, 2 Marks (Set-1)]

10. A transporter receives the same number of orders each day. Currently, he has some pending orders (backlog) to be shipped. If he uses 7 trucks, then at the end of the 4th day he can clear all the orders. Alternatively, if he uses only 3 trucks, then all the orders are cleared at the end of the 10th day. What is the minimum number of trucks required so that there will be no pending order at the end of the 5th day?

(a) 4 (b) 5

(c) 6 (d) 7

[CE, ME, CS 2011, 2 Marks (Set-1)]

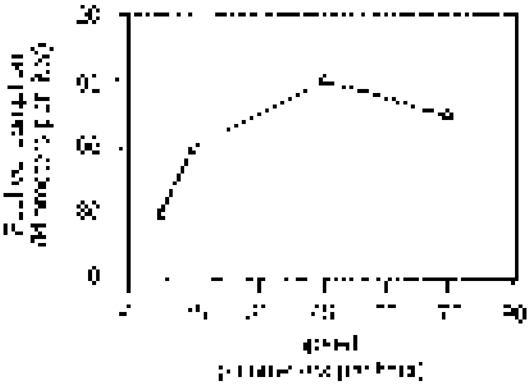
11. There were two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

(a) 100 (b) 110

(c) 90 (d) 95

[EE, EC 2011, 1 Mark (Set-2)]

12. The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



The distances covered during four laps of the journey are listed in the table below:

Lap	Distance (kilometres)	Average speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

(a) P (c) Q

(b) R (d) S

[EE, EC 2011, 2 Marks (Set-2)]

13. Three friends, R, S and T shared toffee from a bowl. R took 1/3rd of the toffees, but returned four to the bowl. S took 1/4th of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

(a) 38 (c) 31

(b) 48 (d) 41

[EE, EC 2011, 2 Marks (Set-2)]

14. Given that $f(y) = |y|/y$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is

(a) 0 (b) −1

(c) 1 (d) 2

[EE, EC 2011, 2 Marks (Set-2)]

15. The sum of n terms of the series $4 + 44 + 444 + \ldots$ is

(a) $(4/81)[10^{n+1} - 9n - 1]$

(b) $(4/81)[10^{n-1} - 9n - 1]$

(c) [illegible]

(d) [illegible]

[EE, EC 2011, 2 Marks (Set-2)]

16. The cost function for a product in a firm is given by $5q^2$, where q is the amount of production. The firm can sell the product at a market price of ₹50 per unit. The number of units to be produced by the firm such that the profit is maximized is

(a) 5 (b) 10

(c) 15 (d) 25

[CH, PI, CE 2012, 1 Mark (Set-1)]

17. A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation $y = 2x - 0.1x^2$ where y is the height of the arch in meters. The maximum possible height of the arch is

(a) 8 meters (b) 10 meters

(c) 12 meters (d) 14 meters

[CE, ME, CS 2012, 2 Marks (Set-1)]

18. An automobile plant contracted to buy shock absorbers from two suppliers X and Y. X supplies 60% and Y supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass the quality test are considered reliable. Of X's shock absorbers, 96% are reliable. Of Y's shock absorbers, 72% are reliable.

The probability that a randomly chosen shock absorber, which is found to be reliable, is made by Y is

(a) 0.288 (b) 0.334

(c) 0.667 (d) 0.720

[CE, ME, CS 2012, 2 Marks (Set-1)]

19. Which of the following assertions are CORRECT?

P: Adding 7 to each entry in a list adds 7 to the mean of the list

Q: Adding 7 to each entry in a list adds 7 to the standard deviation of the list

R: Doubling each entry in a list doubles the mean of the list

S: Doubling each entry in a list leaves the standard deviation of the list unchanged

(a) P, Q (b) Q, R

(c) P, R (d) R, S

[CE, ME, CS 2012, 2 Marks (Set-1)]

20. Given the sequence of terms, AD CG FK JP, the next term is

(a) OV (b) OW

(c) PV (d) PW

[CE, ME, CS 2012, 2 Marks (Set-1)]

21. If $(1.001)^{1259} = 3.52$ and $(1.001)^{2062} = 7.85$, then $(1.001)^{3321} =$

(a) 2.23 (b) 4.33

(c) 11.37 (d) 27.64

[EE, EC 2012, 1 Mark (Set-2)]

22. Raju has 14 currency notes in his pocket consisting of only ₹20 notes and ₹10 notes. The total money value of the notes is ₹230. The number of ₹10 notes that Raju has is

(a) 5 (b) 6

(c) 9 (d) 10

[EE, EC 2012, 2 Marks (Set-2)]

23. A and B are friends. They decide to meet between 1 PM and 2 PM on a given day. There is a condition that whoever arrives first will not wait for the other for more than 15 minutes. The probability that they will meet on that day is

(a) 1/4 (b) 1/16

(c) 7/16 (d) 9/16

[EE, EC 2012, 2 Marks (Set-2)]

24. The data given in the following table summarizes the monthly budget of an average household.

Category	Amount
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Others	1800

The approximate percentage of the monthly budget NOT spent on savings is

(a) 10% (b) 14%

(c) 81% (d) 86%

[EE, EC 2012, 2 Marks (Set-2)]

25. There are eight bags of rice looking alike, seven of which have equal weight and one is slightly heavier. The weighing balance is of unlimited capacity. Using this balance, the minimum number of weighings required to identify the heavier bag is

(a) 2 (b) 3

(c) 4 (d) 8

[EE, EC 2012, 2 Marks (Set-2)]

26. A number is as much greater than 75 as it is smaller than 117. The number is
(a) 91
(b) 93
(c) 89
(d) 96
[CE 2013, 1 Mark (Set-1)]

27. A Firm is selling its product at ₹60 per unit. The total cost of production is ₹100 and firm is earning total profit of ₹500. Later, the total cost increased by 30%. By what percentage the price should be increased to maintained the same profit level.
(a) 5
(b) 10
(c) 15
(d) 30
[CE 2013, 2 Marks (Set-1)]

28. Following table provides figures (in rupees) on annual expenditure of a firm for two years – 2010 and 2011.

Category	2010	2011
Raw material	5200	6240
Power & fuel	7000	9450
Salary & wages	9000	12600
Plant & machinery	20000	25000
Advertising	15000	19500
Research & Development	22000	26400

In 2011, which of the following two categories have registered increase by same percentage?
(a) Raw material and Salary and wages
(b) Salary and wages and Advertising
(c) Power and fuel and Advertising
(d) Raw material and Research and Development
[CE 2013, 2 Marks (Set-1)]

29. If |4X − 7| = 5 then the values of 2|X| − |−X| is:
(a) $2, \frac{1}{3}$
(b) $\frac{1}{2}, 3$
(c) $\frac{2}{3}, \frac{1}{9}$
(d) $\frac{2}{3}, 9$
[CE 2013, 2 Marks (Set-1)]

30. x and y be positive real numbers [illegible] constraint
2x + [illegible] ; x + [illegible] ≤ 6
For which of the values of (x, y) the function f(x, y) = 2x + [illegible] y will give maximum value?
(a) 4/3, 10/3
(b) [illegible]
(c) 8/3, 10/3
(d) 4/3, 20/3
[CE 2015, 2 Marks (Set-1)]

31. What will be the maximum sum of 44, 42, 40, ...?
(a) 502
(b) 504
(c) 506
(d) 500
[ME, PI & CS/IT 2013, 1 Mark (Set-2)]

32. Out of all the 2-digit integers between 1 and 100, a 2-digit number has to be selected at random. What is the probability that the selected number is not divisible by 7?
(a) 13/90
(b) 12/90
(c) 78/90
(d) 77/90
[ME, PI & CS/IT 2013, 2 Marks (Set-2)]

33. A tourist covers half of his journey by train at 60 km/h, half of the remainder by bus at 30 km/h and the rest by cycle at 10 km/h. The average speed of the tourist in km/h during his entire journey is
(a) 36
(b) 30
(c) 24
(d) 18
[ME, PI & CS/IT 2013, 2 Marks (Set-2)]

34. Find the sum of the expression

$$\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \ldots + \frac{1}{\sqrt{80}+\sqrt{81}}$$

(a) 7
(b) 8
(c) 9
(d) 10
[ME, PI & CS/IT 2013, 2 Marks (Set-2)]

35. The current erection cost of a structure is Rs. 13,200. If the labour wages per day increase by 1/5 of the current wages and the working hours decrease by 1/24 of the current period, then the new cost of erection in Rs. is
(a) 16,500
(b) 15,180
(c) 11,000
(d) 10,120
[ME, PI & CS/IT 2013, 2 Marks (Set-2)]

36. In the summer of 2012, in New Delhi, the mean temperature of Monday to Wednesday was 41°C and of Tuesday to Thursday was 43°C. If the temperature on Thursday was 15% higher than that of Monday, then the temperature in °C on Thursday was
(a) 40
(b) 43
(c) 46
(d) 49
[EE, EC, IN 2013, 1 Mark (Set-2)]

37. A car travels 8 km in the first quarter of an hour, 6 km in the second quarter and 16 km in the third quarter. The average speed of the car in km per hour over the entire journey is

(a) 30
(b) 36
(c) 40
(d) 24

[EE, EC, IN 2014, 2 Marks (Set-3)]

38. Find the sum to n terms of the series 10 + 84 + 734 + ...

(a) $\frac{9(9^n+1)}{10}+1$
(b) $\frac{9(9^n-1)}{8}+1$
(c) $\frac{9(9^n-1)}{8}+n$
(d) $\frac{9(9^n-1)}{8}+n^2$

[EE, EC, IN 2014, 2 Marks (Set-3)]

39. The set of values of p for which the roots of the equation $3x^2+2x+p(p-1)=0$ are of opposite sign is

(a) $(-\infty, 0)$
(b) $(0, 1)$
(c) $(1, \infty)$
(d) $(0, \infty)$

[EE, EC, IN 2014, 2 Marks (Set-3)]

40. What is the chance that a leap year, selected at random, will contain 53 Saturdays?

(a) $\frac{2}{7}$
(b) $\frac{3}{7}$
(c) $\frac{1}{7}$
(d) $\frac{5}{7}$

[EE, EC, IN 2014, 2 Marks (Set-3)]

41. The statistics of runs scored in a series by four batsmen are provided in the following table. Who is the most consistent batsman of these four?

Batsman	Average	Standard deviation
K	31.2	5.21
L	46.0	6.35
M	54.4	6.22
N	17.9	5.90

(a) K
(b) L
(c) M
(d) N

[EC, ME 2014, 1 Mark (Set-1)]

42. What is the next number in the series?

12 35 81 173 357 ____

[EC, ME 2014, 1 Mark (Set-1)]

43. Find the odd one from the following group:

W,E,K,O I,Q,W,A F,N,T,X N,V,B,D

(a) W,E,K,O
(b) I,Q,W,A
(c) F,N,T,X
(d) N,V,B,D

[EC, ME 2014, 2 Marks (Set-1)]

44. For submitting tax returns, all resident males with annual income below Rs 10 lakh should fill up Form P and all resident females with income below Rs 8 lakh should fill up Form Q. All people with incomes above Rs 10 lakh should fill up Form R, except non residents with income above Rs 15 lakhs, who should fill up Form S. All others should fill Form T. An example of a person who should fill Form T is

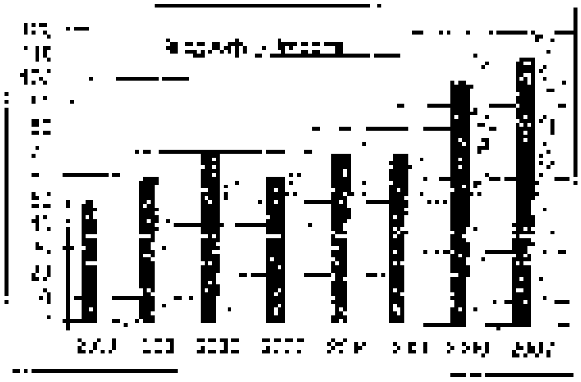
(a) a resident male with annual income Rs 9 lakh
(b) a resident female with annual income Rs 9 lakh
(c) a non-resident male with annual income Rs 16 lakh
(d) a non-resident female with annual income Rs 16 lakh

[EC, ME 2014, 2 Marks (Set-1)]

45. A train that is 280 metres long, travelling at a uniform speed, crosses a platform in 60 seconds and passes a man standing on the platform in 20 seconds. What is the length of the platform in metres?

[EC, ME 2014, 2 Marks (Set-1)]

46. The exports and imports (in crores of Rs.) of a country from 2000 to 2007 are given in the following bar chart. If the trade deficit is defined as excess of imports over exports, in which year is the trade deficit 1/5th of the exports?



(a) 2005
(b) 2004
(c) 2007
(d) 2006

[EC, ME 2014, 2 Marks (Set-1)]

47. You are given three coins: one has heads on both faces, the second has tails on both faces, and the third has a head on one face and a tail on the

other. You choose a coin at random and toss it, and it comes up heads. The probability that the other face is tails is
(a) 1/4 (b) 1/3
(c) 1/2 (d) 2/3
[EC, ME 2014, 2 Marks (Set-1)]

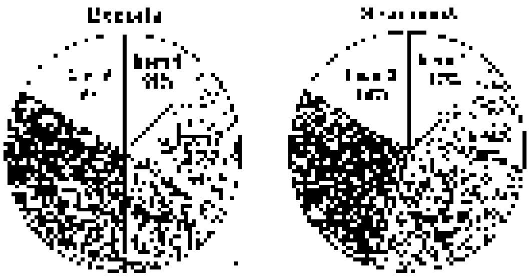
48. A regular die has six sides with numbers 1 to 6 marked on its sides. If a very large number of throws show the following frequencies of occurrence:
1 → 0.167; 2 → 0.167; 3 → 0.152; 4 → 0.166; 5 → 0.168; 6 → 0.180. We call this die
(a) irregular (b) biased
(c) Gaussian (d) insufficient
[EC, ME 2014, 1 Mark (Set-2)]

49. Fill in the missing number in the series.
2 3 6 15 ___ 157.5 630
[EC, ME 2014, 1 Mark (Set-2)]

50. Find the odd one in the following group:
QWZB, BHKM, WCGJ, MSVX,
(a) QWZB (b) BHKM
(c) WCGJ (d) MSVX
[EC, ME 2014, 2 Marks (Set-2)]

51. The sum of eight consecutive odd numbers is 656. The average of four consecutive even numbers is 87. What is the sum of the smallest odd number and second largest even number?
[EC, ME 2014, 2 Marks (Set-2)]

52. The total exports and revenues from the export of a country A is given in the two charts shown below. The pie chart for exports shows the quantity of each item exported as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 500 thousand tonnes and the total revenues are 250 crore rupees. Which item among the following has generated the maximum revenue per kg?



(a) Item 2 (b) Item 3
(c) Item 6 (d) Item 5
[EC, ME 2014, 2 Marks (Set-2)]

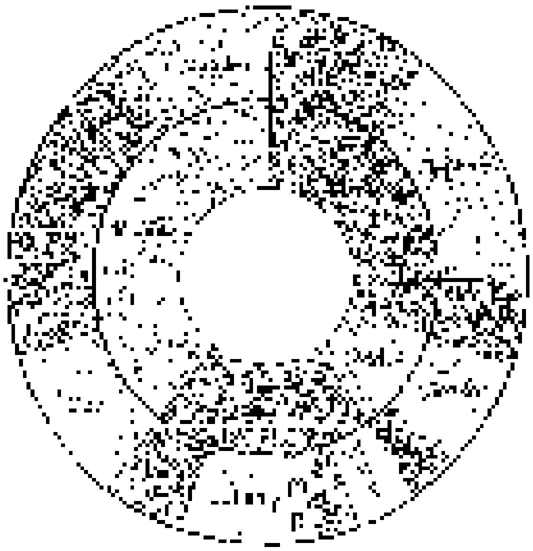
53. It takes 30 minutes to empty a half-full tank by draining it at a constant rate. It is decided to simultaneously pump water into the half-full tank while draining it. What is the rate at which water has to be pumped in so that it gets fully filled in 10 minutes?
(a) 4 times the draining rate
(b) 3 times the draining rate
(c) 2.5 times the draining rate
(d) 2 times the draining rate
[EC, ME 2014, 2 Marks (Set-2)]

54. The next term in the series 81, 54, 36, 24, ... is
___.
[EC, ME 2014, 1 Mark (Set-3)]

55. In which of the following options will the expression P < M be definitely true?
(a) M < R > P > S (b) M > S < P < F
(c) Q < M < F = P (d) P = A < R < M
[EC, ME 2014, 1 Mark (Set-3)]

56. Find the next term in the sequence:
7G, 11K, 13M, ___
(a) 15Q (b) 17Q
(c) 15P (d) 17P
[EC, ME 2014, 2 Marks (Set-3)]

57. The multi-level hierarchical pie chart shows the population of animals in a reserve forest. The correct conclusions from this information are:



(i) Butterflies are birds
(ii) There are more tigers in this forest than red ants
(iii) All reptiles in this forest are either snakes or crocodiles
(iv) Elephants are the largest mammals in this forest

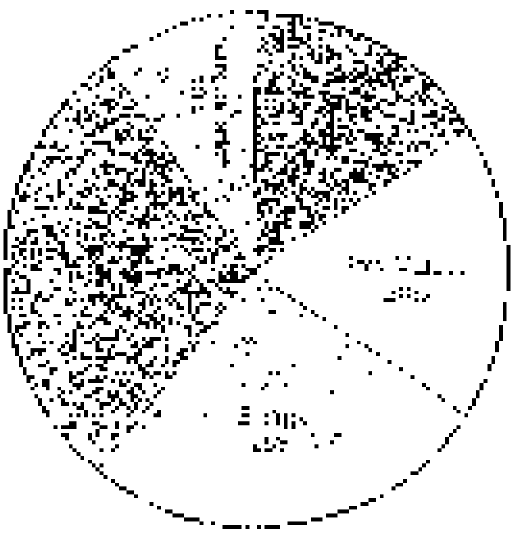
(a) (i) and (ii) only
(b) (i), (ii), (iii) and (iv)
(c) (i), (iii) and (iv) only
(d) (i), (ii) and (iii) only

[EC, ME 2014 : 2 Marks (Set-3)]

58. A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row downstream, then find the stream velocity in km per hour.

[EC, ME 2014 : 2 Marks (Set-3)]

59. A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. If the company registered a profit of Rs. 10 lakhs in 2012, at what price (in Rs.) was each air purifier sold?



[EC, ME 2014 : 2 Marks (Set-3)]

60. A batch of one hundred bulbs is inspected by testing four randomly chosen bulbs. The batch is rejected if even one of the bulbs is defective. A batch typically has five defective bulbs. The probability that the current batch is accepted is ____.

[EC, ME 2014 : 2 Marks (Set-3)]

61. Let $f(x, y) = x^n y^m = P$. If x is doubled and y is halved, the new value of f is

(a) $2^{n-m}P$
(b) $2^{m-n}P$
(c) $2(n-m)P$
(d) $2(m-n)P$

[EC, ME 2014 : 1 Mark (Set-4)]

62. In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?

[EC, ME 2014 : 1 Mark (Set-4)]

63. Find the next term in the sequence:
13M, 17Q, 19S, ____.

(a) 21W
(b) 21V
(c) 23W
(d) 23V

[EC, ME 2014 : 1 Mark (Set-4)]

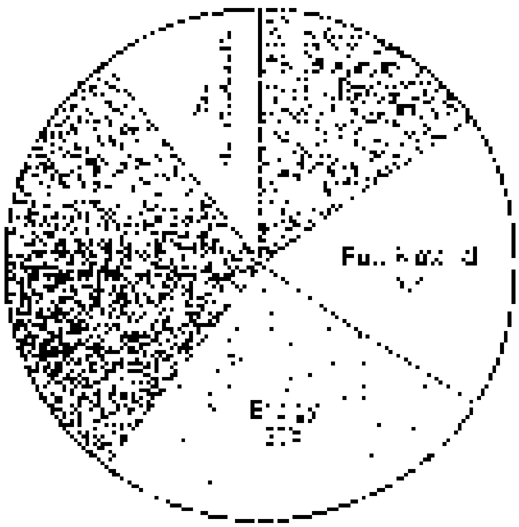
64. If 'KCLFTSB' stands for 'best of luck' and 'SHSWDG' stands for 'good wishes', which of the following indicates 'ace the exam'?

(a) MCHTX
(b) MXHTC
(c) XMHCT
(d) XMHTC

[EC, ME 2014 : 2 Marks (Set-4)]

65. Industrial consumption of power doubled from 2000-2001 to 2010-2011. Find the annual rate of increase in percent assuming it to be uniform over the years.
(a) 5.6 (b) 7.2
(c) 10.0 (d) 12.2
[EC, ME 2014, 2 Marks (Set-4)]

66. A firm producing air purifiers sold 200 units in 2012. The following pie chart presents the share of raw material, labour, energy, plant & machinery, and transportation costs in the total manufacturing cost of the firm in 2012. The expenditure on labour in 2012 is Rs. 4,50,000. In 2013, the raw material expenses increased by 30% and all other expenses increased by 20%. What is the percentage increase in total cost for the company in 2013?



[EC, ME 2014, 2 Marks (Set-4)]

67. A five digit number is formed using the digits 1, 3, 5, 7 and 9 without repeating any of them. What is the sum of all such possible five digit numbers?
(a) 6666660 (b) 6666600
(c) 6666666 (d) 6666606
[EC, ME 2014, 2 Marks (Set-4)]

68. If $\left(z+\frac{1}{z}\right)^2=98$, compute $\left(z^2+\frac{1}{z^2}\right)$.
[EE, CS 2014, 1 Mark (Set-1)]

69. The roots of $ax^2+bx+c=0$ are real and positive. a, b and c are real. Then $ax^2+b|x|+c=0$ has
(a) no roots (b) 2 real roots
(c) 3 real roots (d) 4 real roots
[EE, CS 2014, 1 Mark (Set-1)]

70. Round-trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round-trip tickets will be charged Rs ______.
[EE, CS 2014, 2 Marks (Set-1)]

71. In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
Own vehicle	Car	[illegible]	[illegible]
	Scooter	[illegible]	[illegible]
	Both	[illegible]	[illegible]
Do not own vehicle		[illegible]	[illegible]

[EE, CS 2014, 2 Marks (Set-1)]

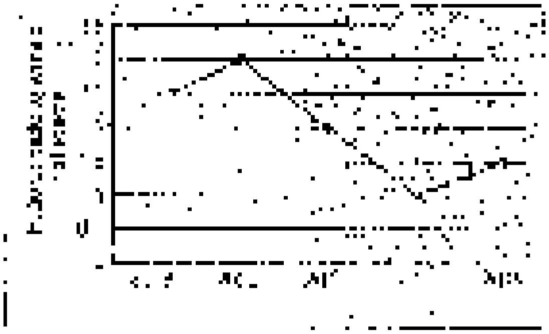
72. When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines?
[EE, CS 2014, 2 Marks (Set-1)]

73. What is the average of all multiples of 10 from 2 to 198?
(a) 90 (b) 100
(c) 110 (d) 120
[EE, CS 2014, 1 Mark (Set-2)]

74. The value of $\sqrt{12+\sqrt{12+\sqrt{12+\ldots}}}$ is
(a) 3.464 (b) 3.932
(c) 4.000 (d) 4.444
[EE, CS 2014, 1 Mark (Set-2)]

75. If x is real and $|x^2-2x+3|=11$, then possible values of $|-x^3+x^2-x|$ include
(a) 2, 4 (b) 2, 14
(c) 4, 52 (d) 14, 52
[EE, CS 2014, 2 Marks (Set-2)]

76. The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students doubled in 2009, by what percent did the number of male students increase in 2009?



[EC, CS 2014, 2 Marks (Set-[illegible])]

77. At what time between 6 a.m. and 7 a.m. will the minute hand and hour hand of a clock make an angle closest to 60°?
(a) 6:22 a.m. (b) 6:27 a.m.
(c) 6:38 a.m. (d) 6:45 a.m.

[EE, CS 2014, 2 Marks (Set-2)]

78. Which number does not belong in the series below?
2, 5, 10, 17, 26, 37, 50, 64
(a) 17 (b) 37
(c) 64 (d) 26

[EE, CS 2014, 1 Mark (Set-3)]

79. The table below has question-wise data on the performance of students in an examination. The marks for each question are also listed. There is no negative or partial marking in the examination.

Q No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	2	23	18	3

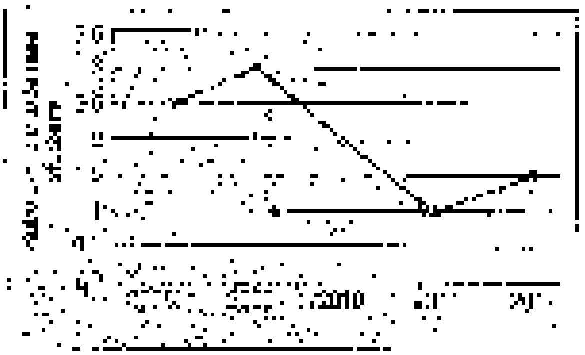
What is the average of the marks obtained by the class in the examination?
(a) 1.34 (b) 1.74
(c) 3.02 (d) 3.91

[EE, CS 2014, 1 Mark (Set 3)]

80. The Gross Domestic Product (GDP) in Rupees grew at 7% during 2012-2013. For international comparison, the GDP is compared in US Dollars (USD) after conversion based on the market exchange rate. During the period 2012-2013 the exchange rate for the USD increased from Rs. 50/USD to Rs. 60/USD. India's GDP in USD during the period 2012-2013
(a) increased by 5%
(b) decreased by 13%
(c) decreased by 20%
(d) decreased by 11%

[EE, CS 2014, 2 Marks (Set 3)]

81. The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students in 2011 and 2012 is equal, what is the ratio of male students in 2012 to male students in 2011?



(a) 1:1 (b) 2:1
(c) 1.5:1 (d) 2.5:1

[EE, CS 2014, 2 Marks (Set 3)]

82. Consider the equation: $(7526)_8 - (Y)_8 = (4364)_8$, where $(X)_N$ stands for X to the base N. Find Y.
(a) 1634 (b) 1737
(c) 3142 (d) 3162

[EE, CS 2014, 2 Marks (Set 3)]

83. If $y = 5x^2 + 3$, then the tangent at $x = 0$, $y = 3$
(a) passes through $x = 0$, $y = 0$
(b) has a slope of +1
(c) is parallel to the x-axis
(d) has a slope of −1

[CE 2014, 1 Mark (Set-1)]

84. A foundry has a fixed daily cost of Rs 50,000 whenever it operates and a variable cost of Rs 800Q, where Q is the daily production in tonnes. What is the cost of production in Rs per tonne for a daily production of 100 tonnes?

[CE 2014, 1 Mark (Set-1)]

85. Find the odd one in the following group: ALRVX, EPVZB, ITZDF, OYEIK
(a) ALRVX
(b) EPVZB
(c) ITZDF
(d) OYEIK

[CE 2014, 2 Marks (Set-1)]

86. Anuj, Bhola, Chandan, Dilip, Eswar and Faisal live on different floors in a six-storeyed building (the ground floor is numbered 1, the floor above it 2, and so on). Anuj lives on an even-numbered floor. Bhola does not live on an odd numbered floor. Chandan does not live on any of the floors below Faisal's floor. Dilip does not live on floor number 2. Eswar does not live on a floor immediately above or immediately below Bhola. Faisal lives three floors above Dilip. Which of the following floor-person combinations is correct?

	Anuj	Bhola	Chandan	Dilip	Eswar	Faisal
(a)	6	2	5	1	3	4
(b)	2	6	5	1	3	4
(c)	4	2	6	3	1	5
(d)	2	4	6	1	3	5

[CE 2014, 2 Marks (Set-1)]

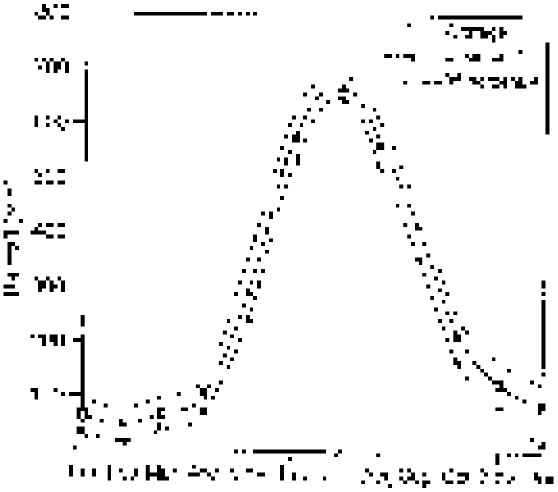
87. The smallest angle of a triangle is equal to two thirds of the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. The largest angle of the triangle is twice its smallest angle. What is the sum, in degrees, of the second largest angle of the triangle and the largest angle of the quadrilateral?

[CE 2014, 2 Marks (Set-1)]

88. One percent of the people of country X are taller than 6 ft. Two percent of the people of country Y are taller than 6 ft. There are thrice as many people in country X as in country Y. Taking both countries together, what is the percentage of people taller than 6 ft?
(a) 3.0
(b) 2.5
(c) 1.5
(d) 1.25

[CE 2014, 2 Marks (Set-1)]

89. The monthly rainfall chart based on 50 years of rainfall in Agra is shown in the following figure. Which of the following are true? (k percentile is the value such that k percent of the data fall below that value)



(i) On average, it rains more in July than in December
(ii) Every year, the amount of rainfall in August is more than that in January
(iii) July rainfall can be estimated with better confidence than February rainfall
(iv) In August, there is at least 500 mm of rainfall
(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (iii) and (iv)

[CE 2014, 2 Marks (Set-1)]

90. In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is ______ years.

[CE 2014, 1 Mark (Set-2)]

91. The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?
(a) 3-4 years
(b) 4-5 years
(c) 5-6 years
(d) 6-7 years

[CE 2014, 1 Mark (Set-2)]

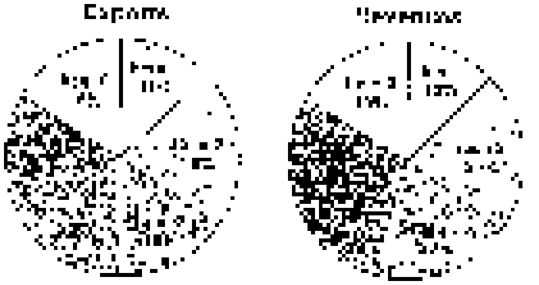
92. In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

Statements
1. Shiv is younger to Riaz.
2. Shiv is elder to Som.
(a) Statement 1 by itself determines the eldest child.
(b) Statement 2 by itself determines the eldest child.

(c) Statements 1 and 2 together are required to determine the area of triangle.
(d) Statements 1 and 2 are not sufficient to determine the area of triangle.

[CE, IN 2014, 2 Marks (Set-2)]

93. The total exports and revenues from the export of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?



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

[CE, IN 2014, 2 Marks (Set-2)]

94. X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?
(a) 1
(b) $\sqrt{2}$
(c) $\sqrt{3}$
(d) 2

[CE, IN 2014, 2 Marks (Set-2)]

95. 10% of the population in a town is HIV+. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV+ individuals 95% of the time, and HIV− individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is ______.

[CE, IN 2014, 2 Marks (Set-2)]

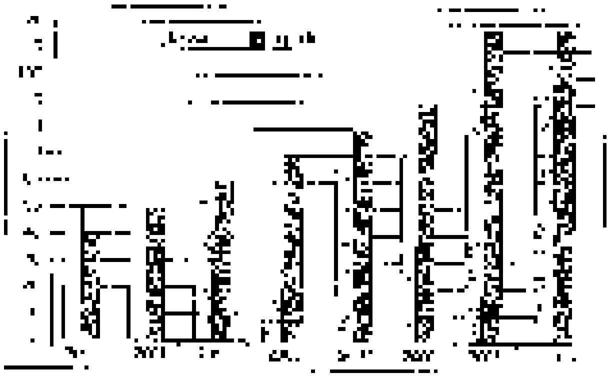
96. If ROAD is written as URDG, then SWAN should be written as
(a) VXDQ
(b) VZDQ
(c) VZDP
(d) UXDQ

[CE (Set-1), CS (Set-3) 2015, 1 Mark]

97. A function f(x) is linear and has a value of 29 at x = −2 and 39 at x = 3. Find its value at x = 5.
(a) 59
(b) 45
(c) 43
(d) 35

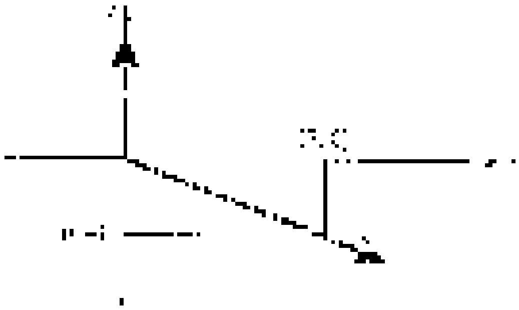
[CE (Set-1), CS (Set-3) 2015, 1 Mark]

98. The exports and imports (in crores of Rs.) of a country from the year 2000 to 2007 are given in the following bar chart. In which year is the combined percentage increase in imports and exports the highest?



[CE (Set-1), CS (Set-3) 2015, 2 Marks]

99. Choose the most appropriate equation for the function drawn as a thick line, in the plot below.



(a) $x = y - |y|$
(b) $x = -(y - |y|)$
(c) $x = y + |y|$
(d) $x = -(y + |y|)$

[CE (Set-1), CS (Set-3) 2015, 2 Marks]

100. The head of a newly formed government desires to appoint five of the six selected members P, Q, R, S, T and U to portfolios of Home, Power, Defense, Telecom, and Finance. U does not want any portfolio if S gets one of the five. R wants either Home or Finance or no portfolio. Q says that if S gets either Power or Telecom, then she must

[illegible] more than the other one. Three [illegible] in a portfolio. [illegible] are [illegible]

Which is the valid distribution of [illegible]?

(a) [illegible] Films, [illegible] Power, [illegible] Defence, [illegible] Telecom, [illegible] Trade

(b) [illegible] Films, [illegible] Power, [illegible] Defence, [illegible] Telecom, [illegible] Trade

(c) [illegible] Films, [illegible] Power, [illegible] Defence, [illegible] Telecom, [illegible] Trade

(d) [illegible] Films, [illegible] Power, [illegible] Defence, [illegible] Telecom, [illegible] Trade

[CS (Set-1), CS (Set-3) 2015, 2 Marks]

101. Four cards are randomly selected from a pack of 52 cards. If the first two cards are kings, what is the probability that the third card is a king?

(a) $\frac{4}{52}$ (b) $\frac{2}{50}$

(c) $\left(\frac{1}{52}\right)\times\left(\frac{1}{52}\right)$ (d) $\left(\frac{1}{52}\right)\times\left(\frac{1}{51}\right)\times\left(\frac{1}{50}\right)$

[CE 2015, 1 Mark (Set 2)]

102. Mr. Vivek walks 6 meters North-east, then turns and walks 6 meters South-east, both at 60 degrees to East. He further moves 2 meters South and 4 meters West. What is the straight distance in metres between the point he started from and the point he finally reached?

(a) $2\sqrt{2}$ (b) 2

(c) $\sqrt{2}$ (d) $\frac{1}{2\sqrt{2}}$

[CE 2015, 1 Mark (Set 2)]

103. Read the following table giving sales data of five types of items for years 2006 to 2012:

Year	Type I	Type II	Type III	Type IV	Type V
2006	75	144	114	102	108
2007	90	126	102	84	126
2008	96	114	75	105	135
2009	105	90	150	90	75
2010	90	75	135	75	90
2011	105	60	165	45	120
2012	115	85	160	100	145

Out of the following, which type of item has shown highest growth between the years 2006 and 2012?

(a) Type V (b) Type III

(c) Type II (d) Type I

[CE 2015, 2 Marks (Set-2)]

104. How many four digit numbers can be formed with the 10 digits 0, 1, 2, ..., 9 if no number can start with 0 and if repetitions are not allowed?

[CE 2015, 2 Marks (Set 2)]

105. Based on the given statements, select the most appropriate option to solve the given question.

Capacity of a solution tank A is 70% of the capacity of tank B. How many gallons of solution are in tank A and tank B?

Statements:

(I) Tank A is 80% full and tank B is 40% full.

(II) Tank A if full contains 14,000 gallons of solution.

(a) Statement I alone is sufficient.

(b) Statement II alone is sufficient.

(c) Either I or II alone is sufficient.

(d) Both the statements I and II together are sufficient.

[CE 2015, 2 Marks (Set 2)]

106. There are 16 teachers who can teach Thermodynamics (TD), 11 who can teach Electrical Sciences (ES), and 5 who can teach both TD and Engineering Mechanics (EM). There are a total of 40 teachers. 6 cannot teach any of the three subjects, i.e. EM, ES or TD. 6 can teach only ES. 4 can teach all three subjects, i.e. EM, ES and TD. 4 can teach ES and TD. How many can teach both ES and EM but not TD?

(a) 1 (b) 2

(c) 3 (d) 4

[CE 2015, 2 Marks (Set-2)]

107. Consider a function $f(x) = 1 - |x|$ on $-1 \le x \le 1$. The value of x at which the function attains a maximum and the maximum value of the function are:

(a) 0, −1 (b) −1, 0

(c) 0, 1 (d) −1, 2

[CS (Set-1), EE (Set-2) 2015, 1 Mark]

108. Based on the given statements, select the most appropriate option to solve the given question.

What will be the total weight of 10 poles each of same weight?

Statements:

(I) One fourth of the weight of a pole is 5 kg.

(II) The total weight of these poles is 160 kg more than the total weight of two poles.

(a) Statement I alone is sufficient
(b) Statement II alone is not sufficient
(c) Either I or II alone is sufficient
(d) Both statements I and II together are not sufficient

[CS (Set-1), EE (Set-2) 2015, 1 Mark]

109. If the list of letters, P, R, S, T, U is an arithmetic sequence, which of the following are also in arithmetic sequence?
I. 2P, 2R, 2S, 2T, 2U
II. P − 3, R − 3, S − 3, T − 3, U − 3
III. P^2, R^2, S^2, T^2, U^2
(a) I only
(b) I and II
(c) II and III
(d) I and III

[CS (Set-1), EE (Set-2) 2015, 1 Mark]

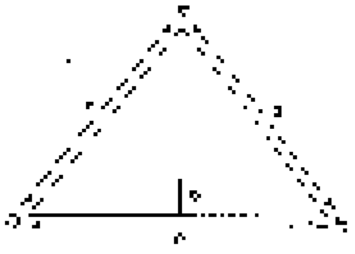
110. If p, q, r, s are distinct integers such that:
f(p, q, r, s) = max(p, q, r, s)
g(p, q, r, s) = min(p, q, r, s)
h(p, q, r, s) = remainder of (p × q)/(r × s) if (p × q) > (r × s) or remainder of (r × s)/(p × q) if (r × s) > (p × q).
Also a function fgh(p, q, r, s) = f(p, q, r, s) × g(p, q, r, s) × h(p, q, r, s).
Also the same operations are valid with two variable functions of the form f(p, q).
What is the value of fg(h(2, 5, 7, 3), 4, 6, 8)?

[CS (Set-1), EE (Set-2) 2015, 2 Marks]

111. Four branches of a company are located at M, N, O and P. M is north of N at a distance of 4 km, P is south of O at a distance of 2 km. N is southeast of O by 1 km. What is the distance between M and P in km?
(a) 5.34
(b) 6.74
(c) 28.5
(d) 45.49

[CS (Set-1), EE (Set-2) 2015, 2 Marks]

112. In a triangle PQR, PS is the angle bisector of ∠QPR and ∠QPS = 60°. What is the length of PS?



(a) $\frac{(q+r)}{qr}$
(b) $\frac{qr}{(q+r)}$
(c) $\sqrt{(q^2+r^2)}$
(d) $\frac{(q+r)^2}{qr}$

[CS (Set-1), EE (Set-2) 2015, 2 Marks]

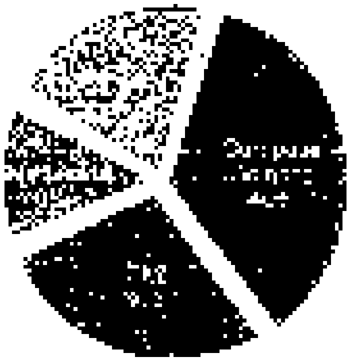
113. Based on the given statements, select the most appropriate option to solve the given question. If two floors in a certain building are 9 feet apart, how many steps are there in a set of stairs that extends from the first floor to the second floor of the building?
Statements:
(I) Each step is 3/4 foot high.
(II) Each step is 1 foot wide.
(a) Statement I alone is sufficient, but statement II alone is not sufficient.
(b) Statement II alone is sufficient, but statement I alone is not sufficient.
(c) Both statements together are sufficient, but neither statement alone is sufficient.
(d) Statement I and II together are not sufficient.

[CS (Set-2), EE (Set-1) 2015, 1 Mark]

114. Given Set A = {2, 3, 4, 5} and Set B = {11, 12, 13, 14, 15}, two numbers are randomly selected, one from each set. What is the probability that the sum of the two numbers equals 16?
(a) 0.20
(b) 0.25
(c) 0.30
(d) 0.33

[CS (Set-2), EE (Set-1) 2015, 1 Mark]

115. The pie chart below has the breakup of the number of students from different departments in an engineering college for the year 2012. The proportion of male to female students in each department is 5:4. There are 40 males in Electrical Engineering. What is the difference between the numbers of female students in the Civil department and the female students in the Mechanical department?



116. The probabilities that a student passes in Mathematics, Physics and Chemistry are m, p and c respectively. Of these subjects, the student has 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40%

chances of [illegible] exactly [illegible] following [illegible]

(i) p = q = r [illegible]

(ii) [illegible]

(iii) log [illegible]

(a) Only I and II are true

(b) Only II and III are true

(c) Both I and III are true

(d) Both II and III are true

[CS (Set-2), CE (Set-1) 2015, 2 Marks]

117. The number of students in a class who have answered correctly, wrongly, or not attempted each question in an exam, are listed in the table below. The marks for each question are also listed. There is no negative or partial marking.

Q No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	1	11	29	4
4	2	23	18	3
5	5	31	12	1

What is the average of the marks obtained by the class in the examination?

(a) 2.290　(b) 2.970

(c) 6.795　(d) 8.795

[CS (Set-2), ME (Set-1) 2015, 2 Marks]

118. If $\log_x(5/7) = -1/3$, then the value of x is

(a) 343/125　(b) 125/343

(c) −25/49　(d) −49/25

[EC 2015, 1 Mark (Set-1)]

119. Operators □, ◊ and → are defined by:

$a \,\square\, b = \frac{a-b}{a+b}$; $a \lozenge b = \frac{a+b}{a-b}$; $a \rightarrow b = ab$ and

the value of $(66 \,\square\, 6) \rightarrow (66 \lozenge 6)$ is

(a) −2　(b) −1

(c) 1　(d) 2

[EC 2015, 1 Mark (Set-2)]

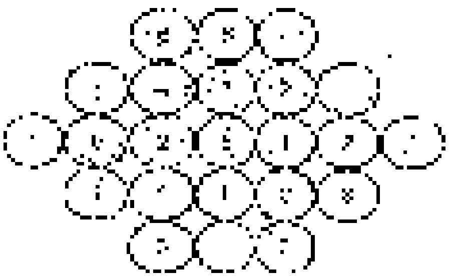
120. A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.

(a) 1 : 4　(b) 1 : 3

(c) 1 : 2　(d) 2 : 3

[EC 2015, 2 Marks (Set-1)]

121. Find the missing value.



[EC 2015, 2 Marks (Set-1)]

122. An electric bus has onboard instruments that report the total electricity consumed since the start of the trip as well as the total distance covered. During a single day of operation, the bus travels on stretches M, N, O and P, in that order. The cumulative distances travelled and the corresponding electricity consumption are shown in the Table below:

Stretch	Cumulative distance (km)	Electricity used (kWh)
M	20	12
N	45	25
O	75	45
P	100	57

The stretch where the electricity consumption per km is minimum is

(a) M　(b) N

(c) O　(d) P

[CS (Set-2), ME (Set-3) 2015, 1 Mark]

123. Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is 1/6 and that of Ramesh is 1/8. What is the probability that only one of them will be selected?

(a) 47/48　(b) 1/4

(c) 13/48　(d) 35/48

[CS (Set-2), ME (Set-3) 2015, 1 Mark]

124. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows.

Statements:

I. All film stars are playback singers.

II. All film directors are film stars.

Conclusions:

I. All film directors are playback singers.

II. Some film stars are film directors.

(a) Only conclusion I follows.

(b) Only conclusion II follows.

(c) Neither conclusion I nor II follows.

(d) Both conclusions I and II follow.

[EC (Set-2), ME (Set-3) 2015, 2 Marks]

125. If $a^2 + b^2 + c^2 = 1$, then $ab + bc + ac$ lies in the interval

(a) $[1, 2/3]$ (b) $[-1/2, 1]$

(c) $[-1, 1/2]$ (d) $[2, -4]$

[EC (Set-2), ME (Set-3) 2015, 2 Marks]

126. A tiger is 50 leaps of its own behind a deer. The tiger takes 5 leaps per minute to the deer's 4. If the tiger and the deer cover 8 metre and 5 metre per leap respectively, what distance in metres will the tiger have to run before it catches the deer?

[EC (Set-2), ME (Set-3) 2015, 2 Marks]

127. If $x > y > 1$, which of the following must be true?

(i) $\ln x > \ln y$ (ii) $e^x > e^y$

(iii) $y^x > x^y$ (iv) $\cos x > \cos y$

(a) (i) and (ii) (b) (i) and (iii)

(c) (iii) and (iv) (d) (ii) and (iv)

[EC (Set-3), ME (Set-2) 2015, 1 Mark]

128. Find the missing sequence in the letter series below:

A, CD, GHI, ?, UVWXY

(a) LMN (b) MNO

(c) MNOP (d) NOPQ

[EC (Set-3), ME (Set-3) 2015, 1 Mark]

129. Ms. X will be in Bagdogra from 01/05/2014 to 20/05/2014 and from 22/05/2014 to 31/05/2014. On the morning of 21/05/2014, she will reach Kochi via Mumbai.

Which one of the statements below is logically valid and can be inferred from the above sentences?

(a) Ms. X will be in Kochi for one day, only in May.

(b) Ms. X will be in Kochi for only one day in May.

(c) Ms. X will be only in Kochi for one day in May.

(d) Only Ms. X will be in Kochi for one day in May.

[EC (Set-3), ME (Set-3) 2015, 2 Marks]

130. $\log \tan 1° + \log \tan 2° + \ldots + \log \tan 89°$ is ____

(a) 1 (b) $\frac{1}{\sqrt{2}}$

(c) 0 (d) −1

[EC (Set-3), ME (Set-3) 2015, 2 Marks]

131. From a circular sheet of paper of radius 30 cm, a sector of 10% area is removed. If the remaining part is used to make a conical surface, then the ratio of the radius and height of the cone is ____

[EC (Set-3), ME (Set-3) 2015, 2 Marks]

132. Five teams have to compete in a league, with every team playing every other team exactly once, before going to the next round. How many matches will have to be held to complete the league round of matches?

(a) 20 (b) 10

(c) 8 (d) 5

[ME (Set-1), IN & PI 2015, 1 Mark]

133. Tanya is older than Eric.

Cliff is older than Tanya.

Eric is older than Cliff.

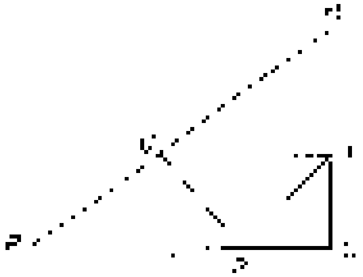
If the first two statements are true, then the third statement is:

(a) True (b) False

(c) Uncertain (d) Data insufficient

[ME (Set-1), IN & PI 2015, 1 Mark]

134. In the given figure angle Q is a right angle, PS : QS = 3 : 1, RT : QT = 5 : 2 and PU : UR = 1 : 1. If area of triangle QTS is 20 cm², then the area of triangle PQR in cm² is ____



[ME (Set-1), IN & PI 2015, 2 Marks]

135. Given below are two statements followed by two conclusions. Assuming these statements to be true, decide which one logically follows:

Statements:

I. No manager is a leader.

II. All leaders are executives.

Conclusions:

I. No manager is an executive.

II. No executive is a manager.

(a) Only conclusion I follows.

(b) Only conclusion II follows.

(c) Neither conclusion I nor II follows.

(d) Both conclusions I and II follow.

[ME (Set-1), IN & PI 2016, 2 Marks]

136. A coin is tossed thrice. Let X be the event that head occurs in each of the first two tosses. Let Y be the event that a tail occurs on the third toss. Let Z be the event that two consecutive tosses are tails. Based on the above information, which one of the following statements is TRUE?

(a) X and Y are not independent

(b) Y and Z are dependent

(c) Y and Z are independent

(d) X and Z are independent

[ME (Set-1), IN & PI 2016, 2 Marks]

137. Right triangle PQR is to be constructed in the xy-plane so that the right angle is at P and line PR is parallel to the x-axis. The x and y coordinates of P, Q and R are to be integers that satisfy the inequalities:

−4 ≤ x ≤ 5 and 6 ≤ y ≤ 16. How many different triangles could be constructed with these properties?

(a) 110 (b) 1100

(c) 9900 (d) 10000

[ME (Set-1), IN & PI 2016, 2 Marks]

138. In a huge pile of apples and oranges, both ripe and unripe mixed together, 15% are unripe fruits. Of the unripe fruits, 45% are apples. Of the ripe ones, 66% are oranges. If the pile contains a total of 5692000 fruits, how many of them are apples?

(a) 2029198 (b) 2467482

(c) 2789080 (d) 3577422

[EC, ME 2016, 1 Mark (Set-1)]

139. Michael lives 10 km away from where I live. Ahmed lives 5 km away and Susan lives 7 km away from where I live. Arun is farther away than Ahmed but closer than Susan from where I live. From the information provided here, what is one possible distance (in km) at which I live from Arun's place?

(a) 3.00 (b) 4.99

(c) 6.02 (d) 7.01

[EC, ME 2016, 1 Mark (Set-1)]

140. A person moving through a tuberculosis prone zone has a 50% probability of becoming infected. However, only 30% of infected people develop the disease. What percentage of people moving through a tuberculosis prone zone remains infected but does not show symptoms of disease?

(a) 15 (b) 33

(c) 35 (d) 37

[EC, ME 2016, 2 Marks (Set-1)]

141. Leela is older than her cousin Pavithra. Pavithra's brother Shiva is older than Leela. When Pavithra and Shiva are visiting Leela, all three like to play chess. Pavithra wins more often than Leela does. Which one of the following statements must be TRUE based on the above?

(a) When Shiva plays chess with Leela and Pavithra, he often loses.

(b) Leela is the oldest of the three.

(c) Shiva is a better chess player than Pavithra.

(d) Pavithra is the youngest of the three.

[EC, ME 2016, 2 Marks (Set-1)]

142. If $q^{-a} = \frac{1}{r}$ and $r^{-b} = \frac{1}{s}$ and $s^{-c} = \frac{1}{q}$, the value of abc is ______.

(a) $(rqs)^{-1}$ (b) 0

(c) 1 (d) r + q + s

[EC, ME 2016, 2 Marks (Set-1)]

143. P, Q, R and S are working on a project. Q can finish the task in 25 days, working alone for 12 hours a day. R can finish the task in 50 days, working alone for 12 hours per day. Q worked 12 hours a day but took sick leave in the beginning for two days. R worked 18 hours a day on all days. What is the ratio of work done by Q and R after 7 days from the start of the project?

(a) 10 : 11 (b) 11 : 10

(c) 20 : 21 (d) 21 : 20

[EC, ME 2016, 2 Marks (Set-1)]

144. Given $(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$, which one of the following statements is TRUE?

(a) 3 inches = 0.5 yards

(b) 9 inches = 1.5 yards

(c) 1 inch = [illegible] yards
(d) 1 inch = [illegible] yards

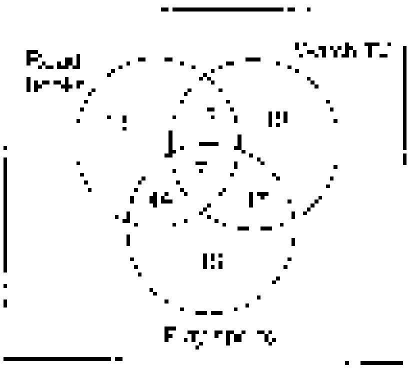
[EC (Set-2), ME (Set-3) 2016, 1 Mark]

145. P, Q, R and S are working on a project. Q can finish the task in 25 days, working alone for 12 hours a day. R can finish the task in 50 days, working alone for 12 hours per day. Q worked 12 hours a day but took sick leave in the beginning for two days. R worked 18 hours a day on all days. What is the ratio of work done by Q and R after 7 days from the start of the project?

(a) 10 : 11
(b) 11 : 10
(c) 20 : 21
(d) 21 : 20

[EC (Set-2), ME (Set-3) 2016, 1 Mark]

146. The Venn diagram shows the preference of the student population for leisure activities.



From the data given, the number of students who like to read books or play sports is ____.

(a) 44
(b) 51
(c) 79
(d) 108

[EC (Set-2), ME (Set-3) 2016, 2 Marks]

147. Two and a quarter hours back, when seen in a mirror, the reflection of a wall clock without number markings seemed to show 1:30. What is the actual current time shown by the clock?

(a) 8:15
(b) 11:15
(c) 12:15
(d) 12:45

[EC (Set-2), ME (Set-3) 2016, 2 Marks]

148. M and N start from the same location. M travels 10 km East and then 10 km North-East. N travels 5 km South and then 4 km South-East. What is the shortest distance (in km) between M and N at the end of their travel?

(a) 18.60
(b) 22.50
(c) 20.61
(d) 25.00

[EC (Set-2), ME (Set-3) 2016, 2 Marks]

149. A wire of length 340 mm is to be cut into two parts. One of the parts is to be made into a square and the other into a rectangle where sides are in the ratio of 1 : 2. What is the length of the side of the square (in mm) such that the combined area of the square and the rectangle is a MINIMUM?

(a) 30
(b) 40
(c) 120
(d) 180

[EC (Set-2), ME (Set-3) 2016, 2 Marks]

150. The number that least fits this set:
(324, 441, 97 and 64) is ____.

(a) 324
(b) 441
(c) 97
(d) 64

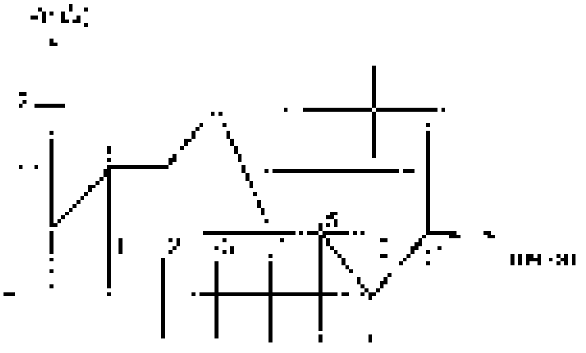
[EC (Set-3) & IN 2016, 1 Mark]

151. It takes 10 s and 15 s, respectively, for two trains travelling at different constant speeds to completely pass a telegraph post. The length of the first train is 120 m and that of the second train is 150 m. The magnitude of the difference in the speeds of the two trains (in m/s) is ____.

(a) 2.0
(b) 10.0
(c) 12.0
(d) 22.0

[EC (Set-3) & IN 2016, 1 Mark]

152. The velocity V of a vehicle along a straight line is measured in m/s and plotted as shown with respect to time in seconds. At the end of the 7 seconds, how much will the odometer reading increase by (in m)?



(a) 0
(b) 3
(c) 4
(d) 5

[EC (Set-3) & IN 2016, 2 Marks]

153. A flat is shared by four first year undergraduate students. They agreed to allow the oldest of them to enjoy some extra space in the flat. Manu is two months older than Sravan, who is three months younger than Trideep. Pavan is one month older than

[illegible] Who is [illegible] in the list?
(a) Mani (b) [illegible]
(c) Dilip (d) [illegible]
[EC (Set-3) & IN 2016, 2 Marks]

154. Find the area bounded by the lines $3x + 2y = 14$, $2x - 3y = 5$ in the first quadrant.
(a) 14.95 (b) 15.25
(c) 15.70 (d) 20.35
[EC (Set-3) & IN 2016, 2 Marks]

155. A straight line is fit to a data set ($\ln x$, y). This line intercepts the abscissa at $\ln x = 0.1$ and has a slope of -0.02. What is the value of y at $x = 5$ from the fit?
(a) −0.030 (b) −0.014
(c) 0.014 (d) 0.030
[EC (Set-3) & IN 2016, 2 Marks]

156. A cube is built using 64 cubic blocks of side one unit. After it is built, one cubic block is removed from every corner of the cube. The resulting surface area of the body (in square units) after the removal is ________.
(a) 56 (b) 64
(c) 72 (d) 96
[CE, CS 2016, 1 Mark (Set-1)]

157. A shaving set company sells 4 different types of razors, Elegance, Smooth, Soft and Executive. Elegance sells at Rs. 48, Smooth at Rs. 63, Soft at Rs. 78 and Executive at Rs. 173 per piece. The table below shows the numbers of each razor sold in each quarter of a year.

Quarter\Product	Elegance	Smooth	Soft	Executive
Q1	27300	20009	17602	9999
Q2	25222	19392	18445	8942
Q3	28976	22429	19544	10234
Q4	21012	18229	16595	10109

Which product contributes the greatest fraction to the revenue of the company in that year?
(a) Elegance (b) Executive
(c) Smooth (d) Soft
[CE, CS 2016, 2 Marks (Set-1)]

158. Consider the following statements relating to the level of poker play of four players P, Q, R and S. I. P always beats Q II. R always loses to S III. S loses to P only sometimes. IV. R always beats Q. Which of the following can be logically inferred from the above statements? (i) P is likely to beat all the three other players (ii) S is the absolute worst player in the set.
(a) (i) only (b) (ii) only
(c) (i) and (ii) (d) neither (i) nor (ii)
[CE, CS 2016, 2 Marks (Set-1)]

159. If $f(x) = 2x^7 + 3x - 5$, which of the following is a factor of $f(x)$?
(a) $(x^3 + 8)$ (b) $(x - 1)$
(c) $(2x - 5)$ (d) $(x + 1)$
[CE, CS 2016, 2 Marks (Set-1)]

160. In a process, the number of cycles to failure decreases exponentially with an increase in load. At a load of 80 units, it takes 100 cycles for failure. When the load is halved, it takes 10000 cycles for failure. The load for which the failure will happen in 5000 cycles is ________.
(a) 40.00 (b) 46.02
(c) 60.01 (d) 92.02
[CE, CS 2016, 2 Marks (Set-1)]

161. In a quadratic function, the value of the product of the roots (α, β) is 4. Find the value of

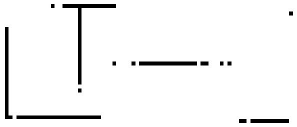
$$\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}}$$

(a) n^4 (b) 4^n
(c) 2^{2n-1} (d) 4^{n-1}
[EE (Set-1), CS (Set-2) 2016, 1 Mark]

162. Pick the odd one from the following options.
(a) CADBE (b) JHKIL
(c) XVYWZ (d) ONPMQ
[EE (Set-1), CS (Set-2) 2016, 1 Mark]

163. Among 150 faculty members in an institute, 55 are connected with each other through Facebook® and 85 are connected through WhatsApp®. 30 faculty members do not have Facebook® or WhatsApp® accounts. The number of faculty members connected only through Facebook® accounts is ________.
(a) 35 (b) 45
(c) 65 (d) 90
[EE (Set-1), CS (Set-2) 2016, 2 Marks]

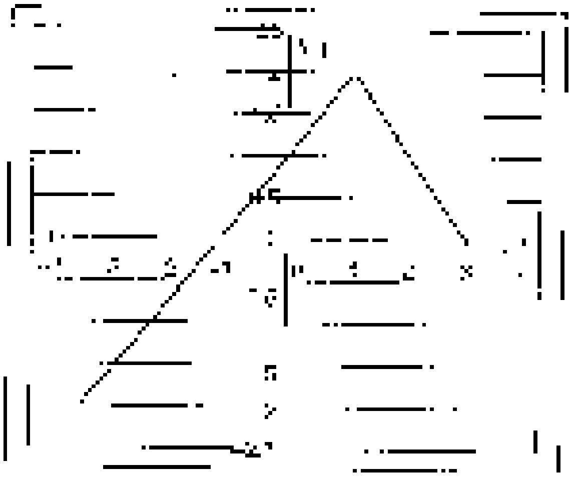
164. In a 2 × 4 rectangle grid shown below, each cell is a rectangle. How many rectangles can be observed in the grid?



(a) 21 (b) 27
(c) 30 (d) 36

[CE (Set-1), CS (Set-2) 2016, 2 Marks]

165. Choose the correct expression for f(x) given in the graph.



(a) $f(x) = 1 - |x - 1|$ (b) $f(x) = 1 + |x - 1|$
(c) $f(x) = 2 - |x - 1|$ (d) $f(x) = 2 + |x - 1|$

[EE (Set-1), CS (Set-2) 2016, 2 Marks]

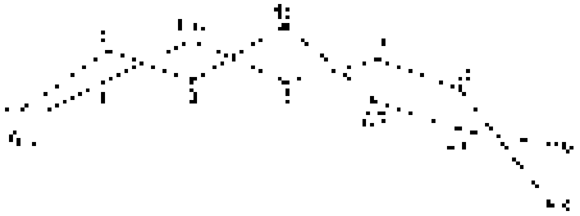
166. (x % of y) + (y % of x) is equivalent to ____
(a) 2% of xy (b) 2% of (xy/100)
(c) xy% of 100 (d) 100% of xy

[CE 2016, 1 Mark (Set-2)]

167. The sum of the digits of a two digit number is 12. If the new number formed by reversing the digits is greater than the original number by 54, find the original number.
(a) 39 (b) 57
(c) 66 (d) 93

[CE 2016, 1 Mark (Set-2)]

168. Two finance companies, P and Q, declared fixed annual rates of interest on the amounts invested with them. The rates of interest offered by these companies may differ from year to year. Year-wise annual rates of interest offered by these companies are shown by the line graph provided below.



If the amounts invested in the companies, P and Q, in 2006 are in the ratio 8 : 9, then the amounts received after one year as interests from companies P and Q would be in the ratio:
(a) 2 : 3 (b) 3 : 4
(c) 6 : 7 (d) 4 : 3

[CE 2016, 2 Marks (Set-2)]

169. Fact 1: Humans are mammals.
Fact 2: Some humans are engineers.
Fact 3: Engineers build houses.
If the above statements are facts, which of the following can be logically inferred?
I. All mammals build houses.
II. Engineers are mammals.
III. Some humans are not engineers.
(a) II only (b) III only
(c) I, II and III (d) I only

[CE 2016, 2 Marks (Set-2)]

170. A square pyramid has a base perimeter x, and the slant height is half of the perimeter. What is the lateral surface area of the pyramid?
(a) x^2 (b) $0.75x^2$
(c) $0.50x^2$ (d) $0.25x^2$

[CE 2016, 2 Marks (Set-2)]

171. Ananth takes 6 hours and Bharath takes 4 hours to read a book. Both started reading copies of the book at the same time. After how many hours is the number of pages to be read by Ananth, twice that to be read by Bharath? Assume Ananth and Bharath read all the pages with constant pace.
(a) 1 (b) 2
(c) 3 (d) 4

[CE 2016, 2 Marks (Set-2)]

172. Find the missing value in the following:
[illegible], 20, 29, 45, 77
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

[CE 2016, 1 Mark (Set-2)]

173. If $9y - 6 = 3$, then $y^2 - \frac{4y}{3}$ is ____.

(a) 0 (b) $+\frac{1}{3}$

(c) $-\frac{1}{3}$ (d) undefined

[EE 2016, 1 Mark (Set-2)]

174. Shaquille O' Neal is a 60% career free throw shooter, meaning that he successfully makes 60 free throws out of 100 attempts on average. What is the probability that he will successfully make exactly 6 free throws in 10 attempts?

(a) 0.2508 (b) 0.2816

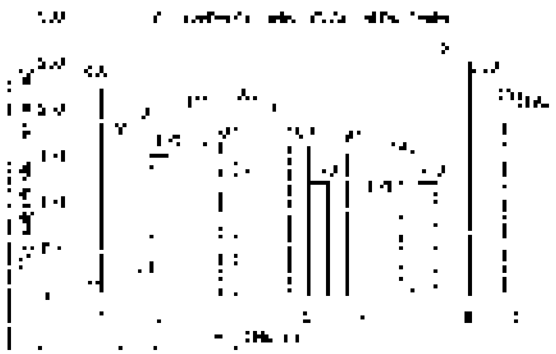
(c) 0.2934 (d) 0.6000

[EE 2016, 2 Marks (Set-2)]

175. Find the numeral in the units position of $211^{870} + 146^{127} \times 3^{424}$ is ____.

[EE 2016, 2 Marks (Set-2)]

176. The following graph represents the installed capacity for cement production (in tonnes) and the actual production (in tonnes) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is ____.



[EE 2016, 2 Marks (Set-2)]

177. Fact: If it rains, then the field is wet.

Read the following statements:

(i) It rains (iii) The field is wet

(ii) The field is not wet (iv) It did not rain

Which one of the options given below is NOT logically possible, based on the given fact?

(a) If (iii), then (iv). (b) If (i), then (iii).

(c) If (i), then (ii). (d) If (ii), then (iv).

[ME 2016, 1 Mark (Set-2)]

178. A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in m² is ____.

(a) 1.43 (b) 2.06

(c) 2.68 (d) 2.88

[ME 2016, 1 Mark (Set-2)]

179. Students taking an exam are divided into two groups, P and Q such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group P was 105, while that of group Q was 85. The standard deviation of group P was 25, while that of group Q was 5. Assuming that the marks were distributed on a normal distribution, which of the following statements will have the highest probability of being TRUE?

(a) No student in group Q scored less marks than any student in group P.

(b) No student in group P scored less marks than any student in group Q.

(c) Most students of group Q scored marks in a narrower range than students in group P.

(d) The median of the marks of group P is 100.

[ME 2016, 2 Marks (Set-2)]

180. Find the missing sequence in the letter series.

B, FH, LNP, _ _ _ _.

(a) SUWY (b) TUVW

(c) TVXZ (d) TWXZ

[ME 2016, 2 Marks (Set-2)]

181. The binary operation □ is defined as a □ b = ab + (a + b), where a and b are any two real numbers. The value of the identity element of this operation, defined as the number x such that a □ x = a, for any a, is ____.

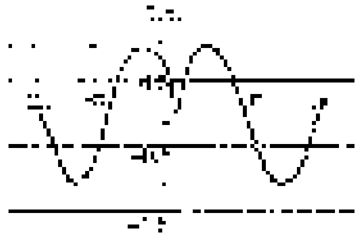
(a) 0 (b) 1

(c) 2 (d) 10

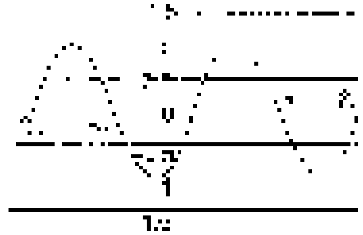
[ME 2016, 2 Marks (Set-2)]

182. Which of the following curves represents the function $y = \ln\left(\left|e^{[|\sin(|x|)|]}\right|\right)$ for $|x| < 2\pi$?
Here, x represents the abscissa and y represents the ordinate.

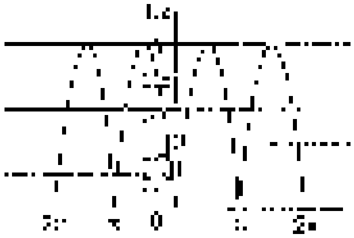
(a)



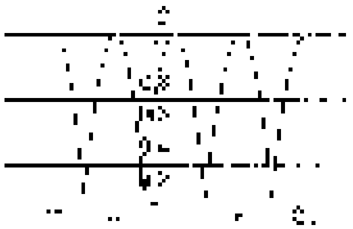
(b)



(c)



(d)



[ME 2016, 2 Marks (Set-2)]

183. The following sequence of numbers is arranged in increasing order: 1, x, x, x, y, y, 9, 16, 18. Given that the mean and median are equal, and are also equal to twice the mode, the value of y is
(a) 5
(b) 6
(c) 7
(d) 8

[CE 2017, 1 Mark (Set-1)]

184. Consider the following sentences:
All benches are beds. No bed is a bulb. Some bulbs are lamps.
Which of the following can be inferred?
(i) Some beds are lamps.
(ii) Some lamps are beds.
(a) Only (i)
(b) Only (ii)
(c) Both (i) and (ii)
(d) Neither (i) nor (ii)

[CE 2017, 1 Mark (Set-1)]

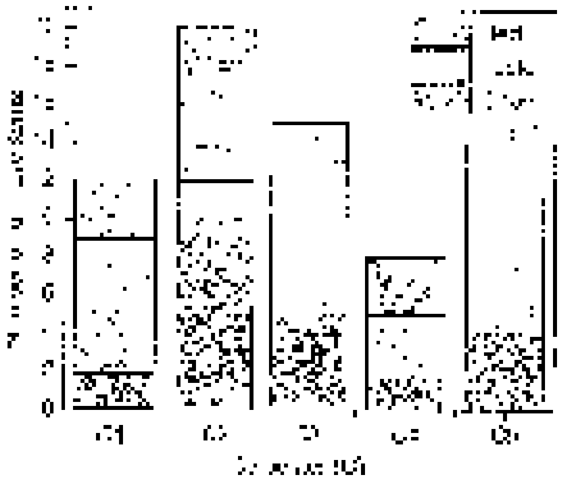
185. If the radius of a right circular cone is increased by 50%, its volume increases by
(a) 75%
(b) 100%
(c) 125%
(d) 237.5%

[CE 2017, 1 Mark (Set-1)]

186. Two machines M1 and M2 are able to execute any of four jobs P, Q, R and S. The machines can perform one job on one object at a time. Jobs P, Q, R and S take 30 minutes, 20 minutes, 60 minutes and 15 minutes each respectively. There are 10 objects each requiring exactly 1 job. Job P is to be performed on 2 objects. Job Q on 3 objects. Job R on 1 object and Job S on 4 objects. What is the minimum time needed to complete all the jobs?
(a) 2 hours
(b) 2.5 hours
(c) 3 hours
(d) 3.5 hours

[CE 2017, 1 Mark (Set-1)]

187. The bar graph below shows the output of five carpenters over one month, each of whom made different items of furniture: chairs, tables, and beds.



Consider the following statements

(i) The number of [illegible] (X) is exactly the same as [illegible] be [illegible]

(ii) The total number of [illegible] cannot be less than the total number of [illegible]

Which one of the following is true?

(a) Only (i)
(b) Only (ii)
(c) Both (i) and (ii)
(d) Neither (i) nor (ii)

[CE 2017, 2 Marks (Set-1)]

188. Students applying for hostel rooms are allotted rooms in order of seniority. Students already staying in a room will move if they get a room in their preference list. Preferences of lower ranked applicants are ignored during allocation.

Given the data below, which room will Ajit stay in?

Names	Student Seniority	Current room	Room preference list
Amar	1	P	R, S, Q
Akbar	2	None	R, S
Anthony	3	Q	P
Ajit	4	S	Q, P, R

(a) P
(b) Q
(c) R
(d) S

[CE 2017, 2 Marks (Set-1)]

189. The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is

(a) 0
(b) 1
(c) 2
(d) 3

[CE 2017, 2 Marks (Set-1)]

190. Two dice are thrown simultaneously. The probability that the product of the numbers appearing on the top faces is a prime number is

(a) $\frac{1}{3}$
(b) $\frac{1}{6}$
(c) $\frac{1}{9}$
(d) $\frac{1}{12}$

[CE, IN 2017, 1 Mark (Set-2)]

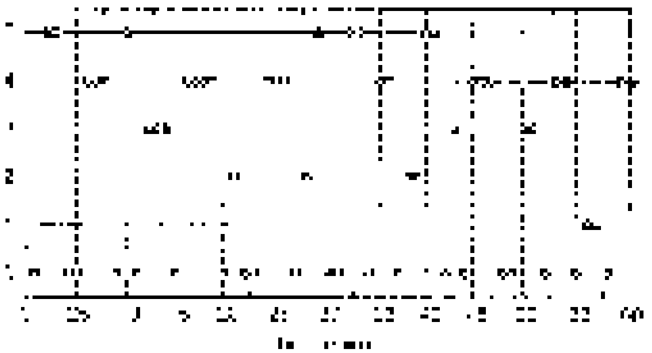
191. What is the value of x when

$$81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$$

(a) 1
(b) −1
(c) −2
(d) Cannot be determined

[CE, IN 2017, 1 Mark (Set-2)]

192. The points in the graph below represent the halts of a lift for durations of 1 minute, over a period of 1 hour.



Which of the following statements are correct?

(i) The elevator never moves directly from any non-ground floor to another non-ground floor over the one hour period

(ii) The elevator stays on the fourth floor for the longest duration over the one hour period

(a) Only (i)
(b) Only (ii)
(c) Both (i) and (ii)
(d) Neither (i) nor (ii)

[CE, IN 2017, 2 Marks (Set-2)]

193. Budhan covers a distance of 19 km in 2 hours by cycling one fourth of the time and walking the rest. The next day he cycles (at the same speed as before) for half the time and walks the rest (at the same speed as before) and covers 26 km in 2 hours. The speed in km/h at which Budhan walks is

(a) 1
(b) 4
(c) 5
(d) 6

[CE, IN 2017, 2 Marks (Set-2)]

194. A map shows the elevations of Darjeeling, Gangtok, Kalimpong, Pelling, and Siliguri. Kalimpong is at a lower elevation than Gangtok. Pelling is at a lower elevation than Gangtok. Pelling is at a higher elevation than Siliguri. Darjeeling is at a higher elevation than Gangtok. Which of the following statements can be inferred from the paragraph above?

(i) Pelling is at a higher elevation than Kalimpong
(ii) Kalimpong is at a lower elevation than Darjeeling
(iii) Kalimpong is at a higher elevation than Siliguri
(iv) Siliguri is at lower elevation than Gangtok
(a) Only (ii)   (b) Only (ii) and (iii)
(c) Only (ii) and (iv)   (d) Only (iii) and (iv)

[EC 2017, 2 Marks (Set-2)]

195. P, Q, R, S, T and U are seated around a circular table. R is seated two places to the right of Q. P is seated three places to the left of R. S is seated opposite U. If P and U now switch seats, which of the following must necessarily be true?
(a) P is immediately to the right of R
(b) T is immediately to the left of P
(c) T is immediately to the left of P or P is immediately to the right of Q
(d) U is immediately to the right of R or P is immediately to the left of T

[EC 2017, 2 Marks (Set-2)]

196. In the summer, water consumption is known to decrease overall by 25%. A Water Board official states that in the summer household consumption decreases by 20%, while other consumption increases by 70%.
Which of the following statements is correct?
(a) The ratio of household to other consumption is 8/17
(b) The ratio of household to other consumption is 1/17
(c) The ratio of household to other consumption is 17/8
(d) There are errors in the official's statement.

[EC 2017, 1 Mark (Set-1)]

197. Some tables are shelves. Some shelves are chairs. All chairs are benches. Which of the following conclusions can be deduced from the preceding sentences?
(i) At least one bench is a table
(ii) At least one shelf is a bench
(iii) At least one chair is a table
(iv) All benches are chairs
(a) Only (i)   (b) Only (ii)
(c) Only (ii) and (iii)   (d) Only (iv)

[EC 2017, 1 Mark (Set-1)]

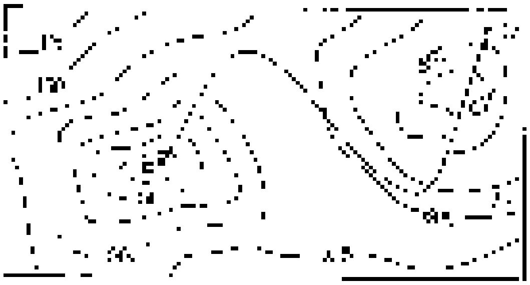
198. 40% of deaths on city roads may be attributed to drunken driving. The number of degrees needed to represent this as a slice of a pie chart is
(a) 120   (b) 144
(c) 160   (d) 212

[EC 2017, 1 Mark (Set-1)]

199. Trucks (10 m long) and cars (5 m long) go on a single lane bridge. There must be a gap of at least 20 m after each truck and a gap of at least 15 m after each car. Trucks and cars travel at a speed of 36 km/h. If cars and trucks go alternately, what is the maximum number of vehicles that can use the bridge in one hour?
(a) 1440   (b) 1200
(c) 720   (d) 600

[EC 2017, 2 Marks (Set-1)]

200. A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.



The path from P to Q is best described by
(a) Up-Down-Up-Down
(b) Down-Up-Down-Up
(c) Down-Up-Down
(d) Up-Down-Up

[EC 2017, 2 Marks (Set-1)]

201. There are 3 Indians and 3 Chinese in a group of 6 people. How many subgroups of this group can we choose so that every subgroup has at least one Indian?
(a) 56   (b) 52
(c) 48   (d) 44

[EC 2017, 2 Marks (Set-1)]

202. S, T, U, V, W, X, Y and Z are seated around a circular table. T's neighbours are Y and V. Z is seated third to the left of T and second to the right of S. U's neighbours are S and Y; and T and W are not seated opposite each other. Who is third to the left of V?
(a) X   (b) W
(c) U   (d) T

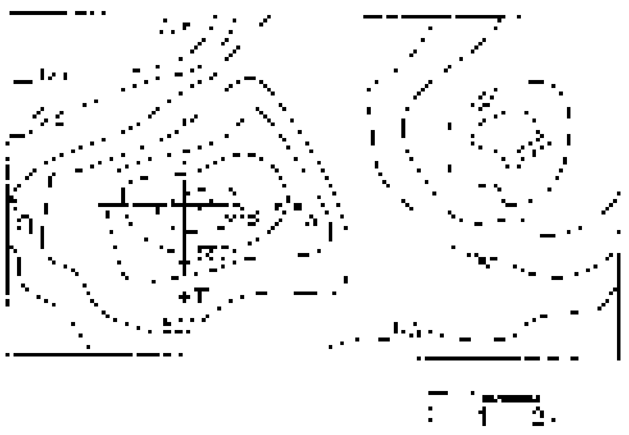
[EC 2017, 2 Marks (Set-1)]

203. A rule states that in order to drink beer, one must be over 18 years old. In a bar, there are 4 people. P is 16 years old, Q is 25 years old, R is drinking milkshake and S is drinking a beer. What must be checked to ensure that the rule is being followed?
(a) Only P's drink
(b) Only P's drink and S's age
(c) Only S's age
(d) Only P's drink, Q's drink and S's age
[EC 2017, 1 Mark (Set-2)]

204. Fatima starts from point P, goes North for 3 km and then East for 4 km to reach point Q. She then turns to face point P and goes 15 km in that direction. She then goes North for 6 km. How far is she from point P, and in which direction should she go to reach point P?
(a) 8 km, East
(b) 12 km, North
(c) 6 km, East
(d) 10 km, North
[EC 2017, 1 Mark (Set-2)]

205. 500 students are taking one or more courses out of Chemistry, Physics, and Mathematics. Registration records indicate course enrolment as follows: Chemistry (329), Physics (186), Mathematics (295), Chemistry and Physics (83), Chemistry and Mathematics (217), and Physics and Mathematics (63). How many students are taking all 3 subjects?
(a) 37
(b) 43
(c) 47
(d) 53
[EC 2017, 1 Mark (Set-2)]

206. A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot.



Which of the following is the steepest path leaving from P?
(a) P to Q
(b) P to R
(c) P to S
(d) P to T
[EC 2017, 2 Marks (Set-2)]

207. 1200 men and 500 women can build a bridge in 2 weeks. 900 men and 250 women will take 3 weeks to build the same bridge. How many men will be needed to build the bridge in one week?
(a) 3000
(b) 3300
(c) 3600
(d) 3900
[EC 2017, 2 Marks (Set-2)]

208. Each of P, Q, R, S, W, X, Y and Z has been married at most once. X and Y are married and have two children P and Q. Z is the grandfather of the daughter S of P. Further, Z and W are married and are parents of R. Which one of the following must necessarily be FALSE?
(a) X is the mother-in-law of R
(b) P and R are not married to each other
(c) P is a son of X and Y
(d) Q cannot be married to R
[EC 2017, 2 Marks (Set-2)]

209. [illegible]
(a) [illegible]
(b) 291
(c) [illegible]
(d) [illegible]
[EC 2017, 2 Marks (Set-2)]

210. The probability that a k-digit number does NOT contain the digits 0, 5, or 9 is
(a) 0.3^k
(b) 0.6^k
(c) 0.7^k
(d) 0.9^k
[CE, CS 2017, 1 Mark (Set-1)]

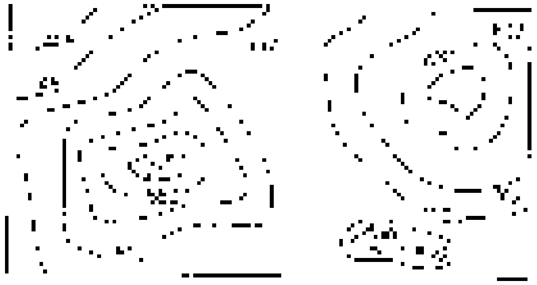
211. Find the smallest number y such that y × 162 is a perfect cube.
(a) 24
(b) 27
(c) 32
(d) 36
[CE, CS 2017, 1 Mark (Set-1)]

212. Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?
(a) Rahul and Murali
(b) Srinivas and Arul

(c) Srinivas and Murali
(d) Srinivas and Rahul

[EE, CS 2017, 1 Mark (Set-1)]

213. A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood, the water level rises to 525 m, which of the villages P, Q, R, S, T get submerged?



(a) P, Q
(b) P, Q, T
(c) R, S, T
(d) Q, R, S

[EE, CS 2017, 2 Marks (Set-1)]

214. The expression $\frac{(x+y)-|x-y|}{2}$ is equal to

(a) the maximum of x and y
(b) the minimum of x and y
(c) 1
(d) none of the above

[EE, CS 2017, 2 Marks (Set-1)]

215. Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?

(a) 21
(b) 18
(c) 16
(d) 14

[EE, CS 2017, 2 Marks (Set-1)]

216. Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

(a) 2
(b) 3
(c) 4
(d) Cannot be determined

[EE, CS 2017, 2 Marks (Set-1)]

217. There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is

(a) 1/5
(b) 7/30
(c) 1/4
(d) 4/15

[EE, CS 2017, 1 Mark (Set-2)]

218. There are five buildings called V, W, X, Y and Z in a row (not necessarily in that order). V is to the West of W. Z is to the East of X and the West of V. W is to the West of Y. Which is the building in the middle?

(a) V
(b) W
(c) X
(d) Y

[EE, CS 2017, 1 Mark (Set-2)]

219. A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

(a) 12
(b) 15
(c) 18
(d) 19

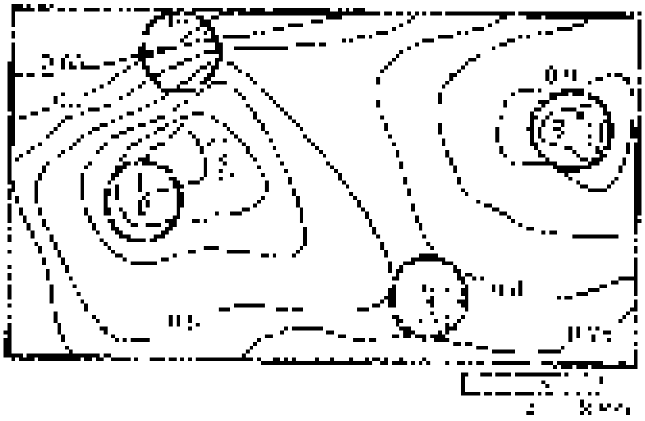
[EE, CS 2017, 1 Mark (Set-2)]

220. The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is

(a) 0
(b) 1
(c) 2
(d) 3

[EE, CS 2017, 2 Marks (Set-2)]

221. An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.



If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region,

[illegible] which of the following [illegible] least likely [illegible] decision?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) [illegible]

[CE, CS 2017, 2 Marks (Set-2)]

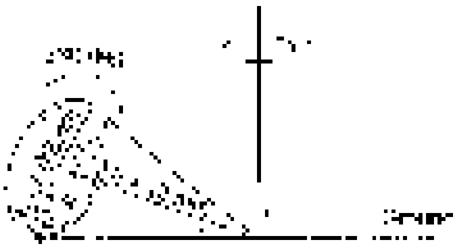
222. A is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number A^3 will have
(a) 90 digits (b) 91 digits
(c) 92 digits (d) 93 digits

[CE, CS 2017, 2 Marks (Set-2)]

223. There are three boxes. One contains apples and another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?
(a) The box labelled 'Apples'
(b) The box labelled 'Apples and Oranges'
(c) The box labelled 'Oranges'
(d) Cannot be determined

[EE, CS 2017, 2 Marks (Set-2)]

224. A right-angled cone (with base radius 5 cm and height 12 cm), as shown in the figure below, is rolled on the ground keeping the point P fixed until the point Q (at the base of the cone, as shown) touches the ground again.



By what angle (in radians) about P does the cone travel?
(a) $\frac{5\pi}{12}$ (b) $\frac{5\pi}{24}$
(c) $\frac{24\pi}{5}$ (d) $\frac{10\pi}{13}$

[ME, 2017, 1 Mark (Set-1)]

225. P, Q and R talk about S's car collection. P states that S has at least 3 cars. Q believes that S has less than 3 cars. R indicates that to his knowledge, S has at least one car. Only one of P, Q and R is right. The number of cars owned by S is
(a) 0 (b) 1
(c) 3 (d) Cannot be determined

[ME, 2017, 1 Mark (Set-1)]

226. In a company with 100 employees, 45 earn Rs. 20000 per month, 25 earn Rs. 30000, 20 earn Rs. 40000, 8 earn Rs. 60000 and 2 earn Rs. 150000. The median of the salaries is
(a) Rs. 20000 (b) Rs. 30000
(c) Rs. 32300 (d) Rs. 40000

[ME, 2017, 1 Mark (Set-1)]

227. What is the sum of the missing digits in the subtraction problem below?

$$\begin{array}{r} 5\_ \\ -48\_89 \\ 1111 \end{array}$$

(a) 8 (b) 10
(c) 11 (d) Cannot be determined

[ME, 2017, 2 Marks (Set-1)]

228. Let S_1 be the plane figure consisting of the points (x, y) given by the inequalities $|x - 1| \le 2$ and $|y + 2| \le 3$. Let S_2 be the plane figure given by the inequalities $x - y \ge -2$, $y \ge 1$, and $x \le 3$. Let S be the union of S_1 and S_2. The area of S is
(a) 26 (b) 28
(c) 32 (d) 34

[ME, 2017, 2 Marks (Set-1)]

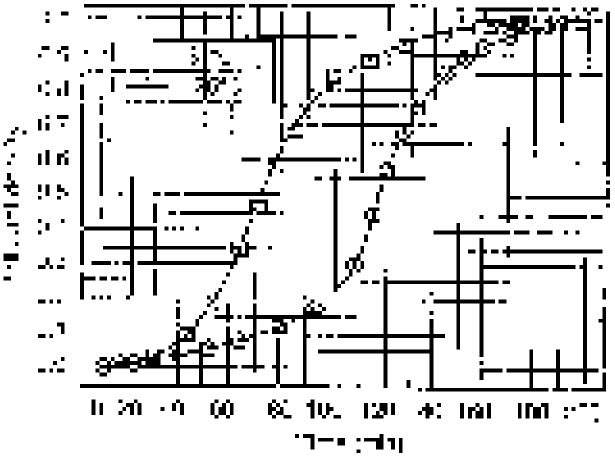
229. [illegible] According to this paragraph, which of the following statements is most consistent?
(a) [illegible]
(b) The Company [illegible] commanders [illegible]

(i) [illegible]

(ii) [illegible]

[ME, 2017, 2 Marks (Set-1)]

30. The growth of bacteria (lactobacillus) in milk leads to curd formation. A minimum bacterial population density of 0.8 (in suitable units) is needed to form curd. In the graph below, the population density of lactobacillus in 1 litre of milk is plotted as a function of time, at two different temperatures, 25°C and 37°C.



Consider the following statements based on the data shown above:

(i) The growth in bacterial population stops earlier at 37°C as compared to 25°C

(ii) The time taken for curd formation at 25°C is twice the time taken at 37°C

Which one of the following options is correct?

(a) Only (i) (b) Only (ii)

(c) Both (i) and (ii) (d) Neither (i) nor (ii)

[ME, 2017, 2 Marks (Set-1)]

31. If a and b are integers and a − b is even, which of the following must always be even?

(a) ab (b) $a^2 + b^2 + 1$

(c) $a^2 + b + 1$ (d) ab − b

[ME, 2017, 1 Mark (Set-2)]

22. [illegible]

(a) 0 (b) [illegible]

(c) 2 (d) cannot be determined

[ME, 2017, 1 Mark (Set-2)]

228. A couple has 2 children. The probability that both children are boys if the older one is a boy is

(a) [illegible] (b) 1/3

(c) [illegible] (d) 1

[ME, 2017, 1 Mark (Set-2)]

229. All people in a certain island are either 'Knights' or 'Knaves' and each person knows every other person's identity. Knights NEVER lie, and Knaves ALWAYS lie.

P says "Both of us are Knights". Q says "None of us are Knaves".

Which one of the following can be logically inferred from the above?

(a) Both P and Q are Knights

(b) P is a Knight; Q is a Knave

(c) Both P and Q are Knaves

(d) The identities of P, Q cannot be determined

[ME, 2017, 2 Marks (Set-2)]

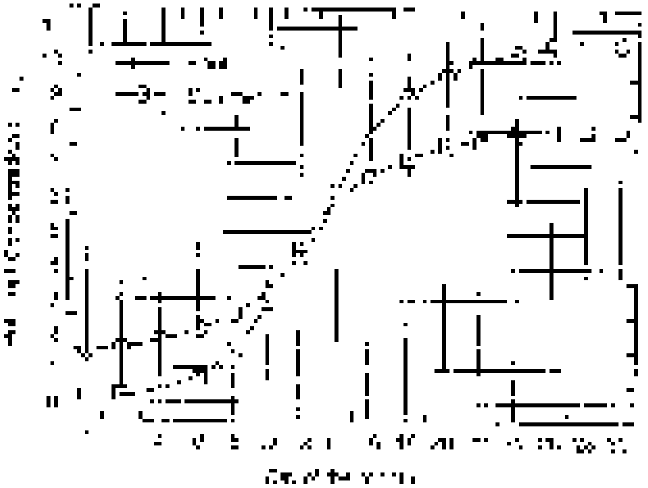
22E There are 4 women P, Q, R, S and 5 men V, W, X, Y, Z in a group. We are required to form pairs each consisting of one woman and one man. P is not to be paired with Z, and Y must necessarily be paired with someone. In how many ways can 4 such pairs be formed?

(a) 74 (b) 76

(c) 78 (d) 80

[ME, 2017, 2 Marks (Set-2)]

230. In the graph below, the concentration of a particular pollutant in a lake is plotted over (alternate) days of a month in winter (average temperature 10°C) and a month in summer (average temperature 30°C).



[illegible]

(i) Over the given months, the difference between the maximum and the minimum pollutant concentrations is the maximum for [illegible]

(ii) There are at least four [illegible] in the data set [illegible] the pollutant concentrations [illegible] the corresponding days in the [illegible] month.

Which of the following options is correct?

(a) Only i
(b) Only ii
(c) Both i and ii
(d) Neither i nor ii

[ME, 2017, 2 Marks (Set-2)]

237. X bullocks and Y tractors take 8 days to plough a field. If we halve the number of bullocks and double the number of tractors, it takes 5 days to plough the same field. How many days will it take X bullocks alone to plough the field?

(a) 30
(b) 35
(c) 40
(d) 45

[ME, 2017, 2 Marks (Set-2)]

238. "If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters."

Which of the following is closest in meaning to 'cleaving'?

(a) Deteriorating
(b) Arguing
(c) Departing
(d) Splitting

[ME, 2017, 2 Marks (Set-2)]

239. The temperature T in a room varies as a function of the outside temperature T_0 and the number of persons in the room p, according to the relation $T = K(\theta p + T_0)$, where θ and K are constants. What would be the value of θ given the following data?

T_0	p	T
25	2	32.4
30	5	42.0

(a) 0.8
(b) 1.0
(c) 2.0
(d) 10.0

[CE, 2018, 1 Mark (Set-1)]

240. Tower A is 90 m tall and tower B is 140 m tall. They are 100 m apart. A horizontal skywalk connects the floors at 70 m in both the towers. If a taut rope connects the top of tower A to the bottom of tower B, at what distance (in meters) from tower A will the rope intersect the skywalk?

[CE, 2018, 1 Mark (Set-1)]

241. Hema's age is 5 years more than twice Hari's age. Suresh's age is 13 years less than 10 times Hari's age. If Suresh is 3 times as old as Hema, how old is Hema?

(a) 14
(b) 17
(c) 18
(d) 19

[CE, 2018, 1 Mark (Set-2)]

242. Consider a sequence of numbers $a_1, a_2, a_3, \ldots, a_n$ where $a_n = \frac{1}{n} - \frac{1}{n+2}$, for each integer $n > 0$. What is the sum of the first 50 terms?

(a) $\left(1 + \frac{1}{2}\right) - \frac{1}{50}$

(b) $\left(1 + \frac{1}{2}\right) + \frac{1}{50}$

(c) $\left(1 + \frac{1}{2}\right) - \left(\frac{1}{51} + \frac{1}{52}\right)$

(d) $1 - \left(\frac{1}{51} + \frac{1}{52}\right)$

[CE, 2018, 2 Marks (Set-1)]

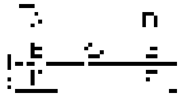
243. A fruit seller sold a basket of fruits at 12.5% loss. Had he sold it for Rs. 108 more, he would have made a 10% gain. What is the loss in Rupees incurred by the fruit seller?

(a) 48
(b) 52
(c) 60
(d) 108

[CE, 2018, 2 Marks (Set-1)]

244. Each of the letters arranged as below represents a unique integer from 1 to 9. The letters are positioned in the figure such that (A × B × C), (B × G × E)

are (D × E × F) are equal. Which integer among the following choices cannot be represented by the letters A, B, C, D, E, F or G?



(a) 4 (b) 5

(c) 6 (d) 9

[CE, 2018, 2 Marks (Set-1)]

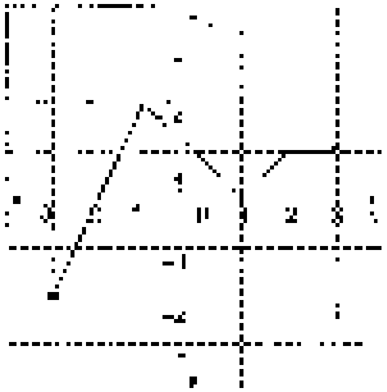
245. The price of a wire made of a super alloy material is proportional to the square of its length. The price of 10 m length of the wire is Rs. 1600. What would be the total price (in Rs.) of two wires of lengths 4 m and 6 m?

(a) 768 (b) 832

(c) 1440 (d) 1600

[CE, 2018, 2 Marks (Set-1)]

246. Which of the following function(s) is an accurate description of the graph for the range(s) indicated?



(i) $y = 2x + 4$ for $-3 \le x \le -1$

(ii) $y = |x - 1|$ for $-1 \le x \le 2$

(iii) $y = ||x| - 1|$ for $-1 \le x \le 2$

(iv) $y = 1$ for $2 \le x \le 3$

(a) (i), (ii) and (iii) only (b) (i), (ii) and (iv) only

(c) (i) and (iv) only (d) (ii) and (iv) only

[CE, 2018, 2 Marks (Set-1)]

247. A three member committee has to be formed from a group of 9 people. How many such distinct committees can be formed?

(a) 27 (b) 72

(c) 81 (d) 84

[CE, 2018, 1 Mark (Set-2)]

248. For non-negative integers a, b, c, what would be the value of a + b + c if log a + log b + log c = 0?

(a) 3 (b) 1

(c) 0 (d) −1

[CE, 2018, 1 Mark (Set-2)]

249. $\underbrace{a + a + a + \dots + a}_{n\text{ times}} = a^2 b$ and

$\underbrace{b + b + b + \dots + b}_{m\text{ times}} = ab^2$, where a, b, n and m are natural numbers. What is the value of

$\left(\underbrace{m + m + m + \dots + m}_{n\text{ times}}\right)\left(\underbrace{n + n + n + \dots + n}_{m\text{ times}}\right)$?

(a) $2a^2b^2$ (b) a^4b^4

(c) $ab(a + b)$ (d) $a^2 + b^2$

[CE, 2016, 1 Mark (Set-2)]

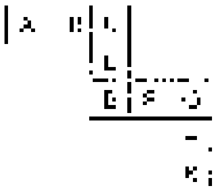
250. In manufacturing industries, loss is usually taken to be proportional to the square of the deviation from a target. If the loss is Rs. 4900 for a deviation of 7 units, what would be the loss in Rupees for a deviation of 4 units from the target?

(a) 400 (b) 1200

(c) 1600 (d) 2800

[CE, 2016, 2 Marks (Set-2)]

251. Each of the letters in the figure below represents a unique integer from 1 to 9. The letters are positioned in the figure such that each of (A + B + C), (C + D + E), (E + F + G) and (G + H + K) is equal to 13. Which integer does E represent?

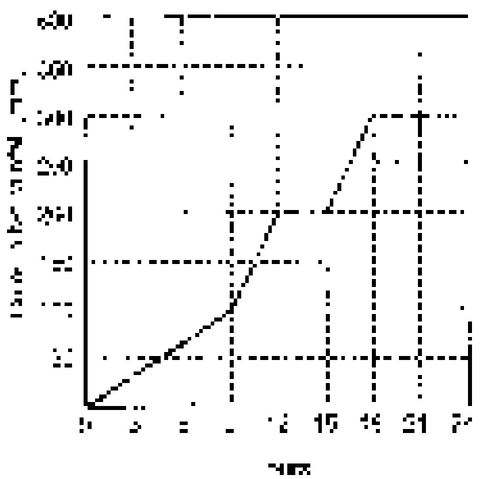


(a) 1 (b) 4

(c) 6 (d) 7

[CE, 2018, 2 Marks (Set-2)]

252. The annual average rainfall in a tropical city is 1000 mm. On a particular rainy day (24-hour period), the cumulative rainfall experienced by the city is shown in the graph. Over the 24-hour period, 50% of the rainfall falling on a rooftop, which had an obstruction-free area of 50 m², was harvested into a tank. What is the total volume of water collected in the tank in liters?



(a) [illegible] (b) [illegible]
(c) 7,500 (d) [illegible]

[CE, 2018, 2 Marks (Set-2)]

253. Given that $\frac{\log P}{y-z} = \frac{\log Q}{z-x} = \frac{\log R}{x-y} = 10$ for $x \neq y \neq z$, what is the value of the product PQR?

(a) 0 (b) 1
(c) xyz (d) 10^{xyz}

[CE, 2018, 2 Marks (Set-II)]

254. A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9 AM on 11th July. What will be the correct time to the nearest minute when the clock shows 2 PM on 15th July of the same year?

(a) 12:45 PM (b) 12:58 PM
(c) 1:00 PM (d) 2:00 PM

[CE, 2018, 2 Marks (Set-2)]

255. What is the missing number in the following sequence?

2, 12, 60, 240, 720, 1440, ___, 0

(a) 2880 (b) 1440
(c) 720 (d) 0

[CS, 2018, 1 Mark]

256. What is the smallest natural number which when divided either by 20 or by 42 or by 76 leaves a remainder of 7 in each case?

(a) 3047 (b) 6047
(c) 7987 (d) 63847

[CS, 2018, 1 Mark]

257. The area of a square is d. What is the area of the circle which has the diagonal of the square as its diameter?

(a) πd (b) πd^2
(c) $\frac{1}{4}\pi d^2$ (d) $\frac{1}{2}\pi d$

[CS, 2018, 1 Mark]

258. If $pqr \neq 0$ and $p^{-x} = \frac{1}{q}$, $q^{-y} = \frac{1}{r}$, $r^{-z} = \frac{1}{p}$, what is the value of the product xyz?

(a) -1 (b) $\frac{1}{pqr}$
(c) 1 (d) pqr

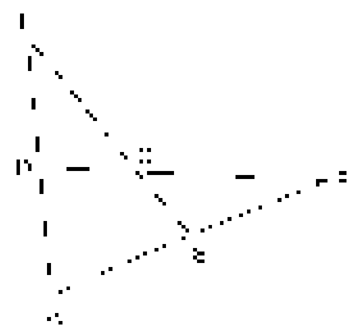
[CS, 2018, 2 Marks]

259. In appreciation of the social improvements completed in a town, a wealthy philanthropist decided to gift Rs 750 to each male senior citizen in the town and Rs 1000 to each female senior citizen. Altogether, there were 300 senior citizens eligible for this gift. However, only 8/9th of the eligible men and 2/3rd of the eligible women claimed the gift. How much money (in Rupees) did the philanthropist give away in total?

(a) 1,50,000 (b) 2,00,000
(c) 1,75,000 (d) 1,51,000

[CS, 2018, 2 Marks]

260. In the figure below, $\angle DEC + \angle BFC$ is equal to ____.



(a) $\angle BCD - \angle BAD$ (b) $\angle BAD + \angle BCF$
(c) $\angle BAD + \angle BCD$ (d) $\angle CBA + \angle ADC$

[CS, 2018, 2 Marks]

261. A six sided unbiased die with four green faces and two red faces is rolled seven times. Which of the following combinations is the most likely outcome of the experiment?

(a) Three green faces and four red faces
(b) Four green faces and three red faces

(c) The green lanes are very [illegible]

(d) [illegible]

[CS, 2018, 2 Marks]

262. In a party, 60% of the invited guests are male and 40% are female. If 80% of the invited guests attended the party and if all the invited female guests attended, what would be the ratio of males to females among the attendees in the party?

(a) 2 : 3 (b) 1 : 1

(c) 3 : 2 (d) 2 : 1

[CS, 2018, 2 Marks]

263. What is the value of $1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \cdots$?

(a) 2 (b) $\frac{7}{4}$

(c) $\frac{3}{2}$ (d) $\frac{4}{3}$

[EC, 2018, 1 Mark]

264. A 1.5 m tall person is standing at a distance of 3 m from a lamp post. The light from the lamp at the top of the post casts her shadow. The length of the shadow is twice her height. What is the height of the lamp post in meters?

(a) 1.5 (b) 3

(c) 4.5 (d) 6

[EC, 2018, 1 Mark]

265. If the number 715 ▪ 423 is divisible by 3 (▪ denotes the missing digit in the thousand's place), then the smallest whole number in the place of ▪ is

(a) 0 (b) 2

(c) 5 (d) 6

[EC, 2018, 1 Mark]

266. Two alloys A and B contain gold and copper in the ratios of 2 : 3 and 3 : 7 by mass, respectively. Equal masses of alloys A and B are melted to make an alloy C. The ratio of gold to copper in alloy C is ____

(a) 5 : 10 (b) 7 : 13

(c) 6 : 11 (d) 9 : 13

[EC, 2018, 2 Marks]

267. Leila aspires to buy a car worth Rs. 10,00,000 after 5 years. What is the minimum amount in Rupees that she should deposit now in a bank which offers 10% annual rate of interest, if the interest was compounded annually?

(a) 5,00,000 (b) 6,21,000

(c) 6,66,667 (d) 7,50,000

[EC, 2018, 2 Marks]

268. A cab was involved in a hit and run accident at night. You are given the following data about the cabs in the city and the accident.

(i) 85% of cabs in the city are green and the remaining cabs are blue.

(ii) A witness identified the cab involved in the accident as blue.

(iii) It is known that a witness can correctly identify the cab colour only 80% of the time.

Which of the following options is closest to the probability that the accident was caused by a blue cab?

(a) 12% (b) 15%

(c) 41% (d) 80%

[EC, 2018, 2 Marks]

269. A coastal region with unparalleled beauty is home to many species of animals. It is dotted with coral reefs and unspoilt white sandy beaches. It has remained inaccessible to tourists due to poor connectivity and lack of accommodation. A company has spotted the opportunity and is planning to develop a luxury resort with helicopter service to the nearest major city airport. Environmentalists are upset that this would lead to the region becoming crowded and polluted like any other major beach resorts.

Which one of the following statements can be logically inferred from the information given in the above paragraph?

(a) The culture and tradition of the local people will be influenced by the tourists.

(b) The region will become crowded and polluted due to tourism.

(c) The coral reefs are on the decline and could soon vanish.

(d) Helicopter connectivity would lead to an increase in tourists coming to the region.

[EC, 2018, 2 Marks]

270. The Cricket Board has long recognized John's potential as a leader of the team. However, his [illegible] has always been a cause of concern for [illegible] in those days. [illegible]

aggression has filled stadia with die-hard fans, it has taken a toll on his own batting. Until recently, it appeared that he found it difficult to convert his aggression into big scores. Over the past three seasons though, that picture of John has been replaced by a cerebral, calculative and successful batsman-captain. After many years, it appears that the team has finally found a complete captain.

Which of the following statements can be logically inferred from the above paragraph?

(i) Even as a junior cricketer, John was considered a good captain.
(ii) Finding a complete captain is a challenge.
(iii) Fans and the Cricket Board have differing views on what they want in a captain.
(iv) Over the past three seasons John has accumulated big scores.

(a) (i), (ii) and (iii) only
(b) (iii) and (iv) only
(c) (ii) and (iv) only
(d) (i), (ii), (iii) and (iv)

[EE, 2018, 2 Marks]

271. For what values of k given below is $\frac{(k+2)^2}{k-3}$ an integer?

(a) 4, 8, 18 (b) 4, 10, 16
(c) 4, 8, 28 (d) 8, 26, 28

[EE, 2018, 1 Mark]

272. The three roots of the equation f(x) = 0 are x = {−2, 0, 3}. What are the three values of x for which f(x − 3) = 0?

(a) −5, −3, 0 (b) −2, 0, 3
(c) 0, 6, 8 (d) 1, 3, 6

[EE, 2018, 1 Mark]

273. Functions F(a, b) and G(a, b) are defined as follows:

F(a, b) = (a − b)² and G(a, b) = |a − b|, where

|x| represents the absolute value of x. What would be the value of G(F(1, 3), G(1, 3))?

(a) 2 (b) 4
(c) 6 (d) 36

[EE, 2018, 1 Mark]

274. In a certain code, AMCF is written as EQGJ and NKUF is written as ROYJ. How will DHLP be written in that code?

(a) RSTN (b) TLPH
(c) HLPT (d) XSVR

[EE, 2018, 2 Marks]

275. An e-mail password must contain three characters. The password has to contain one numeral from 0 to 9, one upper case and one lower case character from the English alphabet. How many distinct passwords are possible?

(a) 6,760 (b) 13,520
(c) 40,560 (d) 1,05,456

[EE, 2018, 2 Marks]

276. A designer uses marbles of four different colours for his designs. The cost of each marble is the same, irrespective of the colour. The table below shows the percentage of marbles of each colour used in the current design. The cost of each marble increased by 25%. Therefore, the designer decided to reduce equal numbers of marbles of each colour to keep the total cost unchanged. What is the percentage of blue marbles in the new design?

Blue	Black	Red	Yellow
40%	25%	20%	15%

(a) 35.75 (b) 40.25
(c) 43.75 (d) 46.25

[EE, 2018, 2 Marks]

277. P, Q, R and S crossed a lake in a boat that can hold a maximum of two persons, with only one set of oars. The following additional facts are available.

(i) The boat held two persons on each of the three forward trips across the lake and one person on each of the two return trips.
(ii) P is unable to row when someone else is in the boat.
(iii) Q is unable to row with anyone else except R.
(iv) Each person rowed for at least one trip.
(v) Only one person can row during a trip.

Who rowed twice?

(a) P (b) Q
(c) R (d) S

[EE, 2018, 2 Marks]

278. [illegible] more good than bad?

(a) 0 (b) [illegible]

(c) [illegible] (d) $\frac{5}{12}$

[IN, 2016, 2 Marks]

279. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

[IN, 2019, 1 Mark]

280. Arrange the following three-dimensional objects in the descending order of their volumes:

(i) A cuboid with dimensions 10 cm, 8 cm and 6 cm

(ii) A cube of side 8 cm

(iii) A cylinder with base radius 7 cm and height 7 cm

(iv) A sphere of radius 7 cm

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

[IN, 2019, 1 Mark]

281. The area of an equilateral triangle is $\sqrt{3}$. What is the perimeter of the triangle?

(a) 2 (b) 4

(c) 6 (d) 8

[IN, 2016, 1 Mark]

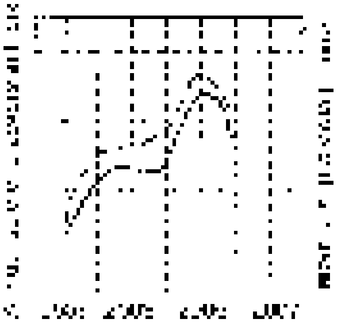
282. An automobile travels from city A to city B and returns to city A by the same route. The speed of the vehicle during the onward and return journeys were constant at 60 km/h and 90 km/h, respectively. What is the average speed in km/h for the entire journey?

(a) 72 (b) 73

(c) 74 (d) 75

[IN, 2018, 2 Marks]

283. [illegible]



(a) There is a strong correlation between [illegible] and [illegible] sales.

(b) [illegible]

(c) [illegible]

(d) [illegible] will cause an increase in the [illegible].

[IN, 2016, 2 Marks]

284. [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) 5

[IN, 2016, 2 Marks]

285. To pass a test, a candidate needs to answer at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question A was correctly answered by 3,30,000 candidates. Question B was answered correctly by 2,50,000 candidates. Question C was answered correctly by 2,60,000 candidates. Both questions A and B were answered correctly by 1,00,000 candidates. Both questions B and C were answered correctly by 90,000 candidates. Both questions A and C were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number

[illegible] to sit the test?
(a) 30,000 (b) [illegible]
(c) 3,90,000 (d) [illegible]

[IN, 2018, 2 Marks]

286. A set of 4 parallel lines intersect with another set of 5 parallel lines. How many parallelograms are formed?
(a) 20 (b) 48
(c) 60 (d) 72

[IN, 2018, 2 Marks]

287. A rectangle becomes a square when its length and breadth are reduced by 10 m and 5 m, respectively. During this process, the rectangle loses 650 m² of area. What is the area of the original rectangle in square meters?
(a) 1125 (b) 2250
(c) 2924 (d) 1500

[ME, 2019, 1 Mark (Set-1)]

288. A number consists of two digits. The sum of the digits is 9. If 45 is subtracted from the number, its digits are interchanged. What is the number?
(a) 63 (b) 72
(c) 81 (d) 90

[ME, 2019, 1 Mark (Set-1)]

289. Seven machines take 7 minutes to make 7 identical toys. At the same rate, how many minutes would it take for 100 machines to make 100 toys?
(a) 1 (b) 7
(c) 100 (d) 700

[ME, 2018, 1 Mark (Set-1)]

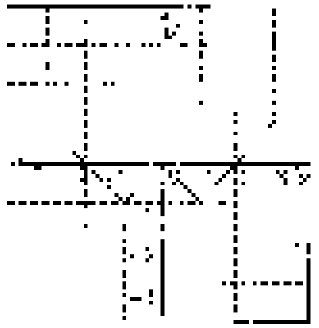
290. Given that a and b are integers and $a + a^2b^3$ is odd, which one of the following statements is correct?
(a) a and b are both odd
(b) a and b are both even
(c) a is even and b is odd
(d) a is odd and b is even

[ME, 2019, 2 Marks (Set-1)]

291. Consider the following three statements:
(i) Some roses are red.
(ii) All red flowers fade quickly.
(iii) Some roses fade quickly.
Which of the following statements can be logically inferred from the above statements?
(a) If (i) is true and (ii) is false, then (iii) is false.
(b) If (i) is true and (ii) is false, then (iii) is true.
(c) If (i) and (ii) are true, then (iii) is true.
(d) If (i) and (ii) are false, then (iii) is false.

[ME, 2019, 2 Marks (Set-1)]

292. Which of the following functions describe the graph shown in the below figure?



(a) $y = ||x| + 1| - 2$ (b) $y = ||x| - 1| - 1$
(c) $y = ||x| + 1| - 1$ (d) $y = ||x - 1| - 1|$

[ME, 2019, 2 Marks (Set-1)]

293. For [illegible], what could be the minimum and maximum values respectively of [illegible]?
(a) [illegible] (b) [illegible]
(c) [illegible] (d) 1 and 3

[ME, 2019, 2 Marks (Set-1)]

294. From the time the front of a train enters a platform, it takes 25 seconds for the back of the train to leave the platform, while travelling at a constant speed of 54 km/h. At the same speed, it takes 14 seconds to pass a man running at 9 km/h in the same direction as the train. What is the length of the train and that of the platform in meters, respectively?
(a) 210 and 140 (b) 162.5 and 187.5
(c) 245 and 130 (d) 175 and 200

[ME, 2018, 2 Marks (Set-1)]

295. What is the missing group of letters in the following series?
BC, FGH, LMNOP, ____
(a) UVWXY (b) TUVWX
(c) STUVW (d) RSTUV

[ME, 2018, 1 Mark (Set-2)]

296. The perimeters of a circle, a square and an equilateral triangle are equal. Which one of the following statements is true?
(a) The circle has the largest area
(b) The square has the largest area
(c) The equilateral triangle has the largest area
(d) All the three shapes have the same area
[ME, 2018, 1 Mark (Set 2)]

297. The value of the expression

$$\frac{1}{1+\log_u vw}+\frac{1}{1+\log_v wu}+\frac{1}{1+\log_w uv}$$ is

(a) −1 (b) 0
(c) 1 (d) 3
[ME, 2018, 1 Mark (Set 2)]

298. An unbiased coin is tossed six times in a row and four different such trials are conducted. One trial implies six tosses of the coin. If H stands for head and T stands for tail, the following are the observations from the four trials:
(1) HTHTHT (2) TTHHHT (3) HTTHHT (4) HHHT__.

Which statement describing the last two coin tosses of the fourth trial has the highest probability of being correct?
(a) Two T will occur
(b) One H and one T will occur
(c) Two H will occur
(d) One H will be followed by one T
[ME, 2018, 2 Marks (Set 2)]

299. A contract is to be completed in 52 days and 125 identical robots were employed, each operational for 7 hours a day. After 39 days, five-seventh of the work was completed. How many additional robots would be required to complete the work on time, if each robot is now operational for 8 hours a day?
(a) 50 (b) 89
(c) 146 (d) 175
[ME, 2019, 2 Marks (Set-2)]

300. Forty students watched films A, B and C over a week. Each student watched either only one film or all three. Thirteen students watched film A, sixteen students watched film B and nineteen students watched film C. How many students watched all three films?
(a) 0 (b) 2
(c) 4 (d) 8
[ME, 2019, 2 Marks (Set-2)]

301. A wire would enclose an area of 1936 m², if it is bent into a square. The wire is cut into two pieces. The longer piece is thrice as long as the shorter piece. The long and the short pieces are bent into a square and a circle, respectively. Which of the following choices is closest to the sum of the areas enclosed by the two pieces in square meters?
(a) 1096 (b) 1111
(c) 1243 (d) 1201
[ME, 2019, 2 Marks (Set-2)]

302. A house has a number which needs to be identified. The following three statements are given that can help in identifying the house number.
1. If the house number is a multiple of 3, then it is a number from 50 to 59.
2. If the house number is NOT a multiple of 4, then it is a number from 60 to 69.
3. If the house number is NOT a multiple of 6, then it is a number from 70 to 79.

What is the house number?
(a) 54 (b) 65
(c) 66 (d) 76
[ME, 2019, 2 Marks (Set-2)]

ANSWERS

[illegible]

EXPLANATIONS

1. (a)

Using set theory formula,

n(H) = Number of people who play hockey = 15

n(F) = Number of people who play football = 17

n(H ∩ F) = Persons who play both hockey and football = 10

n(H ∪ F) = Persons who play either hockey or football or both

Using the formula,

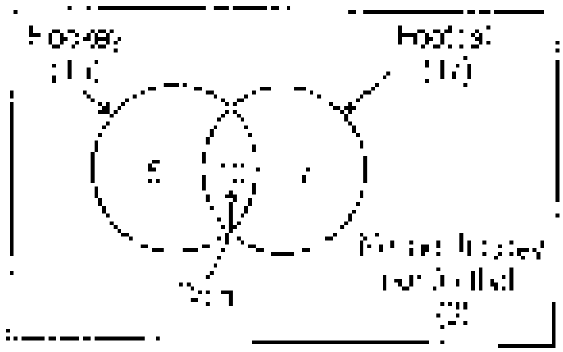
n(H ∪ F) = n(H) + n(F) − n(H ∩ F)

n(H ∪ F) = 15 + 17 − 10 = 22

Thus people who play neither hockey nor football = 25 − 22 = 3

Alternative Method

Below is venn diagram representation



Number of people playing neither of the two games is equal to 3.

2. (c)

[illegible] = 435

This shows that the base 6

Hence (437 − [illegible])₆ = [illegible]

Alternative Method

[illegible]

$(1??)_6$

$-(276)_6$

$(???)_6$

$(1??)_6$

$-(672)_6$

$(1??5)_6$

Hence [illegible] base 6 [illegible]

3. (c)

Per day work of each of 5 skilled workers = $\frac{1}{20}$

⇒ Per day work of each of one skilled worker

$= \frac{1}{5 \times 20} = \frac{1}{100}$

Similarly per day work of each of 8 semi-skilled

workers = $\frac{1}{25}$

⇒ Per day work of each semi-skilled worker

$\frac{1}{8 \times 25} = \frac{1}{200}$

And per day work of each of 10 unskilled workers

$= \frac{1}{30}$

⇒ Per day work of each unskilled worker

$= \frac{1}{10 \times 30} = \frac{1}{300}$

Thus, total per day work of 2 skilled, 6 semi-skilled and 5 unskilled workers

$= \frac{2}{100} + \frac{6}{200} + \frac{5}{300} = \frac{12 + 18 + 10}{600}$

$= \frac{40}{600} = \frac{1}{15}$

Time taken to complete the work is 15 days.

Alternative Method

Let the daily wages of skilled, semi-skilled and unskilled workers be x, y, z respectively.

5x × 20 = 8y × 25 = 10z × 30 = Total work

$100x = 200y = 300z$

$y = [illegible]$

⇒ $y = \frac{x}{2}$ and $z = \frac{x}{3}$

Given that 2 skilled, [illegible] semi-skilled and [illegible] unskilled workers are working. Let they finish the work in x days.

[illegible] = Total units of work

$\left(2a + 2a + \frac{?}{5}a\right)x = [illegible] \times 20$

$\frac{20a}{?}x = [illegible] \times 20$

x = [illegible] days

4. (a)

We need to find 4-digit numbers, so the number should be greater than 3000. Two cases are possible:

Case (1) thousand's digit is 3

Remaining three digits may be any of 2, 2, 3; [illegible]

(a) Using 2, 2, 3
→ 223, 232, 322

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(b) Using 2, 2, 4 → 224, 242, 422

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(c) Using 2, 3, 3 → 233, 323, 332

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(d) Using 2, 3, 4 → 234, 243, 324, 342, 423, 432

3! = 6 numbers are possible.

(e) Using 2, 4, 4 → 244, 424, 442

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(f) Using 3, 3, 4 → 334, 343, 433

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(g) Using 3, 4, 4 → 344, 434, 443

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(h) Using 4, 4, 4 → 444

$\left(\frac{3!}{3!} = 1 \text{ number is possible}\right)$

Total 4 digit numbers in case 1 = 3 + 3 + 3 + 6 + 3 + 3 + 3 + 1 = 25

Case (2) thousand's digit is 4, then remaining three digits may be any of 2, 2, 3; [illegible] 3, 4, 4

(a) Using 2, 2, 3 → 223, 232, 322

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(b) Using 2, 2, 4 → 224, 242, 422

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(c) Using 3, 3, 2 → 332, 323, 233

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(d) Using 2, 3, 4 → 234, 243, 324, 342, 423, 432

$\left(\frac{3!}{?} = 6 \text{ numbers are possible}\right)$

(e) Using 2, 4, 4 → 244, 424, 442

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(f) Using 3, 3, 3 → 333

$\left(\frac{3!}{3!} = 1 \text{ number is possible}\right)$

(g) Using 3, 3, 4 → 334, 343, 433

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(h) Using 3, 4, 4 → 344, 434, 443

$\left(\frac{3!}{2!} = 3 \text{ numbers are possible}\right)$

(i) Using 4, 4, 4 → 444

$\left(\frac{3!}{3!} = 1 \text{ number is possible}\right)$

Total 4 digit numbers in case 2 = 3 + 3 + 3 + 6 + 3 + 1 + 3 + 3 + 1 = 26

Thus total 4 digit numbers using case (1) and case (2)

= 25 + 26 = 51

Alternative Method / Shortcut method

As the number is greater than 3000, so thousand's place can be 3 and 4.

Let's consider the following cases:

Case (i) when thousand's place is 3

3 _ _ _

If there is no restriction on number of twos, 3's and 4's. Then each of a, b, c can be filled with 2 or 3 or 4 each in 3 ways.
So 3 × 3 × 3 = 27 numbers are there. Out of which 3222, 3333 are invalid as 2 can be used twice & three thrice only so number of such valid numbers beginning with 3 are 27 – 2 = 25. ...(i)

Case (ii) When thousand's place is 4
4 _ _ _
When the restriction on number of 2's, 3's and 4's is not there as explained in case (i) can be filled in 27 ways
Out of these 27 numbers, 4222 is only invalid as two can be used twice only.
So valid numbers are 27 – 1 = 26 ...(ii)
Total numbers from Case (i) & Case (ii) = 25 + 26 = 51.

5. (b)
[illegible]
[illegible]
- P + Q > R + S
- Using Statement (a) both [illegible] or [illegible] Q and R be older and S can't be the youngest.
- There are 4 cases by using statement (a) either QS or SQ possible
(A) PQRS not possible as there is [illegible] and S which is not possible using statement (a)
(B) SQPR order is possible. [illegible] and Q + R > S + P (possible) because [illegible]
(C) SRQP: according to this [illegible] Q and S > [illegible] so adding these two inequalities we get [illegible] S > [illegible] which is opposite of statement (a) thus not possible.
(D) SQRP: according to this [illegible] and S > [illegible] these adding both inequalities [illegible] which is opposite of statement (a) hence not possible.

6. (b)

$$\log(P) = \frac{1}{2}\log(Q) = \frac{1}{3}\log(R)$$

$$\Rightarrow \log(Q) = \log(P)^2$$
$$= \log(R)^{2/3}$$
$$\Rightarrow Q = P^2 = (R)^{2/3} = K$$
$$\Rightarrow P = k, \; Q = k^2, \; R = k^3 \qquad \text{...(i)}$$
Now check option (b) $Q^2 = PR$ condition
$$Q^2 = (k^2)^2 = k^4 \qquad \text{From (i)}$$
$$PR = k \times k^3 = k^4 \qquad \text{From (i)}$$
Here $Q^2 = PR$ holds true

7. (d)
Shortcut Method
Every time if we take 1 litre of mixture out and replace with water quantity of spirit reduced every time by 10%.
So final quantity of spirit after 3rd operation are
$$10 \times 0.9 \times 0.9 \times 0.9 = 7.29 \text{ litres}$$
Alternate Solution
$$\frac{\text{Quantity of spirit left after } n^{th} \text{ operation}}{\text{Initial quantity of spirit}} = \left(\frac{a-b}{a}\right)^n = \left(1-\frac{b}{a}\right)^n$$
where 'a' is initial quantity of mixture and 'b' is quantity taken out and replaced every time.
Hence quantity of spirit left after 3rd operation
$$= \text{initial quantity} \times \left(1-\frac{1}{10}\right)^3$$
$$= 10 \times 0.9 \times 0.9 \times 0.9$$
$$= 7.29 \text{ litres}$$

8. (a)
(TC) Total cost = [illegible]
$$TC = \left[4q + \frac{100}{q}\right]$$
As we have to minimize the cost.
Using options
$$(a)\; q = 5,\; TC = 4 \times 5 + \frac{100}{5} = 40$$
$$(b)\; q = 4,\; TC = 4 \times 4 + \frac{100}{4} = 41$$
$$(c)\; q = 7,\; TC = 4 \times 7 + \frac{100}{7} = 42.285$$
$$(d)\; q = 6,\; TC = 4 \times 6 + \frac{100}{6} = 40.66$$
Hence TC is minimum for q = 5. (a) ans.
Rather than put options in given answer test.

Alternate Solution

[illegible]

[illegible] $\frac{d}{dq}\left(4q + \frac{[illegible]}{q}\right) = 0$

$\Rightarrow$ p = 25 and q = 5

$\frac{d}{dq}\left(4q + \frac{100}{q}\right) = 0$

Hence [illegible] (Total cost) is minimum at q = 5

(B) ans

9. (a)

As we can understand [illegible] dangerous [illegible] [illegible]

[illegible] where [illegible] are the [illegible]

[illegible]

[illegible] (i)

[illegible]

[illegible] will be maximum [illegible]

[illegible]

[illegible]

10. (c)

Let [illegible] number of [illegible] each day.

So as per conditions given equation

[illegible] (i)

[illegible] (ii)

Solving (i) and (ii)

[illegible]

[illegible]

[illegible]

[illegible]

$[illegible] = \frac{5x - y}{5} = [illegible] = \frac{3}{5}$

[illegible]

11. (c)

[illegible]

[illegible] = 0.048

[illegible]

Hence, x = 104.

[illegible]

Alternate Solution

[illegible]

[illegible]

P	Q
40	60
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	= 5[illegible]

[illegible] 2. Hence [illegible]

12. (b)

[illegible] will be maximum [illegible]

[illegible]

[illegible] mileage was higher and fuel consumption per kilometre was less.

13. [illegible]

Shortcut Method

[illegible] multiple of 3. [illegible]

Alternate Solution

Using options

[illegible]

Always solve such questions by options.

14. (d)

$$f(y) = \frac{|y|}{y}$$

As we know,

$$|y| = \begin{cases} y & y \geq 0 \\ -y & y < 0 \end{cases} \quad \ldots(i)$$

So from (i)

$$f(y) = \frac{y}{y} = 1 \quad \text{if } y > 0$$

$$f(y) = \frac{-y}{y} = -1 \quad \text{if } y < 0$$

Hence $|f(q) - f(-q)| = |1 - (-1)| = 2$

Alternate Solution

Given that $f(y) = \frac{|y|}{y}$

$$f(1) = \frac{|1|}{1} = 1$$

$$f(-1) = \frac{|-1|}{-1} = -1$$

[illegible] $|f(q) - f(-q)|$

[illegible] $q = [illegible]$

$|f(1) - f(-1)| = |1 - (-1)| = 2$

15. [illegible]

$4 + 44 + 444 + \ldots\ldots\ldots\ldots$

The sum of first term of series = 4

Hence sum up to first term is also = 4

Put n = 1 in the given options [illegible]

$$\frac{4}{81}[10^{1+1} - 9 \times 1 - 10] = \frac{4}{81}[100 - 9 - 10]$$

$$= \frac{4}{81} \times 81 = 4$$

Hence option [illegible] is correct answer. Always solve these questions by putting values.

Alternate Solution

$4 + 44 + 444 + \ldots\ldots$

$$\frac{4}{9}[9 + 99 + 999 + \ldots\ldots]$$

$$= \frac{4}{9}[(10 - 1) + (10^2 - 1) + (10^3 - 1) + \ldots]$$

$$= \frac{4}{9}[(10 + 10^2 + 10^3 + \ldots) - (1 + 1 + \ldots)]$$

$$= \frac{4}{81}[10^{n+1} - 9n - 10]$$

16. (a)

Total cost C = $5q^2$

Total Sales Revenue

R = 50q

Profit $\pi = R - C = 50q - 5q^2$

At the point it needs to be maximized

$\pi = 50q - 5q^2$

Using options

(a) q = 5

$\pi = 50 \times 5 - 5 \times 5^2 = 125$

(b) q = 10

$\pi = 50 \times 10 - 5 \times 10^2 = 0$

(c) q = 15

$\pi = 50 \times 15 - 5 \times 15^2 = [illegible]$

(d) q = 25

$\pi = 50 \times 25 - 5 \times 25^2 = [illegible]$

Hence maximum profit will be at q = 5

Alternative solution

$$\pi = 50q - 5q^2$$

For maximum $\frac{d\pi}{dq} = 0$

$\Rightarrow \quad 50 - 10q = 0$

$q = [illegible]$

$$\frac{d^2y}{dx^2}\Big|_{[illegible]} = [illegible] \text{ which is negative}$$

Hence maximum [illegible] will [illegible]

$x = [illegible]$

17. (b)

$y = 2x - 0.1x^2$

For y (height) to be maximum, $\frac{dy}{dx} = 0$

$\frac{dy}{dx} = 2 - 0.2x = 0$

$\Rightarrow \quad x = 10$

$\frac{d^2y}{dx^2}\Big]_{x=10} = -0.2 \ [illegible] \quad \frac{d^2y}{dx^2} < 0$

Hence maximum height will be at x = 10

$y = 2 \times 10 - 0.1 \times (10)^2 = 10$

Maximum height = 10 meters.

18. (b)

Let total 100 analyses are sampled

so X samples = [illegible] of 100

Y samples = [illegible] of 100

Reliable supply by X = 96% of [illegible] = 57.6

Reliable supply by Y = 72% of [illegible] = 28.8

So the required probability that a random [illegible] reliable [illegible] is made by Y is

required probability

$$= \frac{28.8}{57.6 + 28.8} = 0.333$$

≈ 0.33

19. (a)

Adding [illegible] to each and every observation by constant increases the arithmetic mean by [illegible] the [illegible]. After multiplying each and every observation by constant [illegible] will [illegible] by same constant. While the standard deviation will not [illegible]

Alternative Solution:

$$\frac{x_1 + x_2 + \dots + x_n}{N} = \bar{x}$$

$$\frac{(x_1 + c) + (x_2 + c) + \dots}{N} = \frac{[illegible]}{N} + \frac{Nc}{N} = \bar{x} + c$$

and $\frac{3x_1 + 3x_2 + \dots + 3x_n}{N} = 3\bar{x}$

Hence only [illegible] are correct.

20. (c)

AD, CG, FK, JP are given terms. First letter of each term A, C, F, J are respectively 1, 3, 6, 10 letters of alphabetical sequence.

A = 1st letter of alphabetical sequence

C = 1 + 2 = 3rd letter of alphabetical sequence

F = 1 + 2 + 3 = 6th letter of alphabetical sequence

J = 1 + 2 + 3 + 4 = 10th letter of alphabetical sequence

The next term should begin with 1 + 2 + 3 + 4 + 5 = 15th letter of alphabetical sequence, that is letter O. Also in the series AD, CG, FK, JP the two letters in each term are separated by 2, 3, 4, 5 letters in between them respectively. Hence next term should be OV as there are 6 letters [illegible] in between O and V.

Hence answer is OV.

21. (d)

$(1.001)^{[illegible]} = 3.52$ and $(1.001)^{[illegible]} = 7.85$

$(1.001)^{[illegible]} = (1.001)^{[illegible]}$

$3.52 \times 7.85 \ [illegible]$

Hence $(1.001)^{[illegible]} = 27.63 \ [illegible]$

22. (d)

Let the number of ₹20 notes be x and ₹10 notes be y respectively

So $x + y = 11$

$20x + 10y = [illegible]$

on solving [illegible]

[illegible]

Alternative Solution:

[illegible]

Number of ₹10 notes are 5.

₹10 × 5 = ₹50

[illegible] ₹20 notes

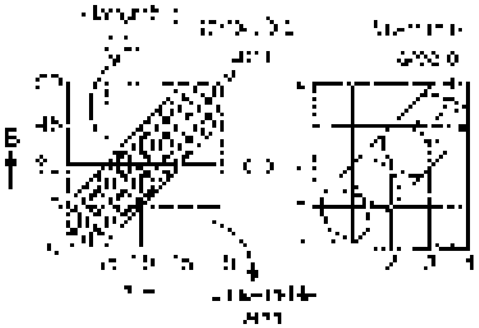
[illegible] = 100

and hence 50 + 150 = 200 [illegible]

[illegible]

23. (c)

[illegible]



Required probability

$$= \frac{\text{Shaded area}}{\text{Total area}} = \frac{7}{16}$$

24. (d)

Category	Amount
Food	4000
Clothing	1200
Rent	2000
Savings	1500
Other	1800
Total	10500

The total expenditure is 10,500.

Expenses excluding savings are 9,000

Hence required percentage

$$= \frac{2000}{9000} \times 100 = 22.22\% \approx 22\%$$

25. (a)

Divide 8 bags into three parts 3, 3 and 2 respectively. Now two cases arise.

Case (i): Firstly, if we compare the 3, 3 bags on pan of the balance. We can identify on which side is the lighter bag placed. And then we will need one more weighing for identifying faulty bag. So only two weighing are required.

Case (ii): Secondly, if the 3, 3 compared bags are equal then we need to find faulty bag from among the remaining two bags. So one more weighing is required to find out faulty bag from those two bags. Hence, two weighings are required.

Thus in both cases only two weighings are required.

Alternative Solution:

In case all weighing has to be done (i.e. linear search), the following model can be observed

2 – 3 → 1 weighing required

4 – 9 → 2 weighing required

10 – 27 → 3 weighing required

28 – 81 → 4 weighing required

and the process will go on.

As there are eight objects, the minimum number of weighings required will be only two.

28. (d)

% of raw material and salary and wages

$$= \frac{[illegible]}{5200} \times 100 = 75\%$$

% of raw material and research and development

$$= \frac{25400 - 22000}{[illegible]} \times 100 = 20\%$$

29. (d)

$$|4x - 7| = 5$$

$$4x - 7 = 5$$

and $4x - 7 = -5$

$\Rightarrow$ $x = 3$

and $x = \frac{1}{2}$

$\therefore$ $2|x| - |-x| = 2 \times 3 - 3 = 3$

and $2|x| - |-x| = 2 \times \frac{1}{2} - \frac{1}{2} = \frac{1}{2}$

$\Rightarrow$ $3, \frac{1}{2}$

30. (a)

$$2x - y = 8$$

$$x - 2y = 5$$

$$x = 1.33$$

$$y = 3.33$$

$\therefore$ option (b) and (c) is rejected because $x > 1.33$.

Option (d) is rejected $x > 1.33$

31. (c)

For sum to be maximum we will consider only positive terms

$$44 + 42 + \ldots + 2$$

$\therefore$ $2 + 4 + 6$ .... $42 + 44$

$2[1 + 2 + 3$ .... $22]$

$$= \frac{2[22 \times 23]}{2} = 506$$

Alternate:

Sum of even Natural numbers

$2 + 4 + 6 \ldots 44 = n(n + 1)$

$22 \times 23 = 506$

32. (a)

There are ninety (90) two digited numbers between 10 and 100 (exclusive 10 & 100). Among these [illegible] divisible by 7 are (14, 21, ... 98), only 14 numbers.

$$\left[\because \left[\frac{100}{7}\right] = 14\right]$$

So, required probability that the number is not divisible by 7

[illegible]

33. (c)

Average speed = $\frac{\text{Total distance}}{\text{Total time}}$

= [illegible] km/h

34. (b)

[illegible]

$\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} \ldots \frac{1}{\sqrt{80}+\sqrt{81}}$

Rationalise each term by multiplying it with its conjugate in both numerator and denominator

[illegible]

Which can be rewritten as

$(\sqrt{2}-1) + (\sqrt{3}-\sqrt{2}) \ldots\ldots (\sqrt{81}-\sqrt{80})$

(as denominator in each term will become 1)

Now cancelling like terms we will be left with

$\sqrt{81}-1 = (9-1) = 8$

35. (b)

[illegible]

$= 13210\left[\frac{6}{?}\right]\times\left[\frac{23}{24}\right]$

= [illegible]

36. (c)

$\frac{M + Tom + W}{3} = $ [illegible]

→ M + Tom + W = [illegible] ...(i)

$\frac{Tom + W - 3}{?} = $ [illegible]

→ Tom + W = [illegible] ...(ii)

From eq. (i) and (ii)

Tom − M = 6

Also Tom = 1.75 M

1.75 M − M = 6

⇒ 0.75 M = 6

⇒ M = 8

[illegible]

→ [illegible]

→ [illegible]

37. (c)

Average speed = $\frac{\text{Total distance}}{\text{Total time}}$

$\frac{\text{Total distance}}{\text{Total time}} = $ [illegible]

[illegible] km/h

38. (c)

[illegible]

Alternate Method:

Put n = 1 in all options and check the actual sum [illegible]

39. (b)

[illegible]

[illegible] will be negative.

[illegible]

40. (a)

Every leap year will have 366 days

1 leap year = 366 days

= 52 × 7 + 2 days

Every leap year will have 52 complete weeks, [illegible] 7 possible cases

Fri	Sat	2 favourable cases
Sat	Sun	
Sun	Mon	
Mon	Tue	
Tue	Wed	
Wed	Thu	
Thu	Fri	

Required probability $= \frac{2}{7}$

42. Solution :

12, 35, 81, 173, 357, ___

Differences between consecutive terms of the series are 23, 46, 92, 184, ___

35 − 12 = 23 = 23 × 1

81 − 35 = 46 = 23 × 2

173 − 81 = 92 = 23 × 4

357 − 173 = 184 = 23 × 8

So the next difference have to be 23 × 16 = 368.

Therefore next term have to 357 + 368

= 725

= 23 × 16

725 − 357 = 368 = 23 × 16

43. (d)

[illegible]

44. (b)

[illegible] 7, 8, 9 respectively.

45. Solution :

Let the length of platform be x and velocity of train is v

Distance = Velocity × time

(280 + x) = V × 60 ...(i)

280 = V × 20 ...(ii)

From equation (i) and (ii) we get

x = 560 m

46. (d)

[illegible]

$$\text{Deficit} = \frac{\text{Imports} - \text{Exports}}{\text{Imports}}$$

$$= \frac{120 - 100}{100} = \frac{20}{100} = \frac{1}{5}$$

47. (b)

[illegible]

48. (b)

[illegible] probability [illegible]

49. Solution :

2, 3, 6, 15, ___, 157.5, 630

2 × 1.5 = 3

3 × 2 = 6

6 × 2.5 = 15

15 × 3 = 45

45 × 3.5 = 157.5

157.5 × 4 = 630

Hence the answer is 45.

45 is missing term of the series.

50. (c)

[illegible]

51. Solution :

Let eight consecutive odd numbers be

a, a + 2, ..., a + 14

and 5 consecutive even numbers be

b, b + 2, b + 4, b + 6, b + 8

Given (8a + 56) [illegible]

[illegible]

a = [illegible]

Answer

[illegible]

= [illegible]

[illegible] = [illegible]

[illegible]

[illegible]

= [illegible]

= 75 − (84 − 1) = [illegible]

62. (c)

[illegible]

A. Item 2 = $\frac{20\% \text{ of } 250}{20\% \text{ of } 500}$ = 0.5

B. Item 3 = $\frac{25\% \text{ of } 250}{18\% \text{ of } 500}$ = 0.6

C. Item 5 = $\frac{11\% \text{ of } 250}{13\% \text{ of } 500}$ = [illegible]

D. Item 6 = $\frac{20\% \text{ of } 250}{12\% \text{ of } 500}$ = [illegible]

Clearly item [illegible] is largest.

63. (a)

[illegible]

Alternatively

[illegible]

$$[illegible]\left|\frac{1}{x} - \frac{1}{60}\right| = \frac{1}{[illegible]}$$

x = [illegible] minutes

[illegible]

64. Solution :

01, 04, 36, 24

[illegible]

[illegible] = 16

65. (d)

Y = A × B × M

[illegible]

66. (b)

Y, Q, L, H, K, [illegible]

[illegible]

[illegible]

67. (d)

[illegible]

[illegible]

58. Solution :

[illegible]

$$t = \frac{x}{[illegible]} \qquad \text{(i)}$$

[illegible]

$$t = \frac{x}{3 - V} \qquad \text{...(ii)}$$

[illegible] equation (i) by (ii) we get

V = 4 [illegible]

59. Solution :

Since,

∴ 12% = 1,80,000

∴ 100% = $\frac{1,80,000 \times 100}{12}$

= [illegible]

Selling price [illegible]

$$= \frac{[illegible] - 15,00,000}{[illegible]}$$

= [illegible]

60. Solution :

Probability [illegible] = $\frac{3}{[illegible]}$

= [illegible]

Probability [illegible]

= 1 − [illegible]

= 0.95

Probability [illegible]

= [illegible]

[illegible]

= [illegible] − [illegible]

= [illegible]

61. (a)

$$[illegible] = [illegible] \times \left(\frac{[illegible]}{[illegible]}\right)^{[illegible]} [illegible]$$

62. Solution :

Let the 5 consecutive odd numbers be

a, a + 2, a + 4, a + 6, a + 8 [illegible]

Sum of first five (a) + (a + 2) + (a + 4) + (a + 6) + (a + 8) = 125

5a + 20 = 125 ⇒ a = 21

Sum of next five (a + 10) + [illegible] (a + 18) [illegible] (a + 20) + (a + 22) [illegible]

[illegible]

63. (c)

[illegible]

Among options only W[illegible] is [illegible] in English language.

64. (b)

[illegible]

So answer is [illegible]

65. (b)

The rate of doubling [illegible] is

$$2 = 1\left(1 + \frac{r}{100}\right)^{n}$$

$$[illegible] = [illegible]\left(1 + \frac{9}{[illegible]}\right)^{[illegible]}$$

$$[illegible]$$

Alternate :

Simple growth rate for a quantity to double in 10 years will be 10%. For compounded growth rate it has to be less than 10. Among options, option (b) is correct as [illegible] has to be less than 10.

So, [illegible] compound growth rate has to be less than 10.

66. (22 to 22)

In 2018 total cost,

$$= \frac{[illegible]}{13}$$

= [illegible]

Cost of [illegible] in 2018

$$= [illegible] \times \frac{20}{100}$$

= 3,00,000

Cost of [illegible] in 2018

$$= [illegible] \times \frac{[illegible]}{100}$$

= 7,00,000

[illegible]

= [illegible]

= [illegible]

[illegible]

$$= [illegible] \times \frac{[illegible]}{100}$$

= [illegible]

Total cost in 2019

= [illegible] + 78000

= [illegible]

% increase [illegible]

$$= \frac{[illegible] - [illegible]}{[illegible]} \times 100$$

= [illegible]%

67. (a)

Overall there will be = [illegible] numbers. [illegible] appears [illegible] times each. [illegible] due to all 1s will be 4 × (1 + 10 + 100 + 1000 + 10000) = 4 × [illegible]

Similarly [illegible]

[illegible] + 5000 + [illegible]

Similarly for digits [illegible]

So, overall sum [illegible] due to all digits

= 4 × [illegible] 1111 (1 + 3 + 5 + 7 + 9)

= 24 × 1111 (25) = [illegible]

68. (38 to 38)

$$\left(z - \frac{1}{z}\right)^2 = 36$$

$$\text{So,} \quad z^2 + \frac{1}{z^2} = 38$$

69. (c)

Given $ax^2 - bx + c = 0$

[illegible] and positive

Similarly,

$x^2 - 5x + 6 = 0$ roots are 2, 3

then roots of [illegible]

then roots of [illegible]

∴ $|x|^2 - 5|x| + 6 = 0$

[illegible] $x^2 - 5x + 6 = 0$

$(x-2)(x-3) = 0$ [illegible] $x = 2, 3$ [illegible]

[illegible] $x^2 + 5x + 6 = 0$

[illegible] $= 0$ [illegible]

So if [illegible] real roots

then $|x|^2 - 5|x|$ [illegible] four real roots

[illegible] real roots

then [illegible] roots.

70. (850 to 850)

[illegible] $= 100$

[illegible]

[illegible]

[illegible] 15% [illegible]

[illegible]

$1000 \times 0.85 = 850$ [illegible]

71. (45 to 45)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] $\times 100$ [illegible] $= 45$ [illegible]

72. (3 to 3)

3

73. [illegible]

[illegible]

[illegible]

Average [illegible]

[illegible] $= 13$ [illegible]

[illegible] $= 13$ [illegible]

[illegible]

74. [illegible]

Let [illegible]

So $y = \sqrt{12 + y}$

[illegible] $y^2 =$ [illegible]

[illegible] $= 0$

$y = 4$

[illegible]

75. [illegible]

[illegible]

[illegible] $= 11$

[illegible] $= 11$

[illegible] $= 0$

[illegible]

[illegible]

[illegible] $= 0$

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

76. (140)

[illegible] 2.5 [illegible] year [illegible]

[illegible] 200.

[illegible] $= 2.5$

Now % female population in 2008
Number of females in 2008 = 2 × 200 = 400

$\frac{M}{F}$ ratio in 2008 is 3

$$\frac{M}{400} = 3$$

⇒ $M = 1200$
So number of males in 2008 is 1200
% increase in number of males from 2006 to 2008

$$\% \text{ increase} = \frac{1200 - 800}{800} \times 100 = 50\%$$

77. (a)
The angle at a given time by hour hand and minute hand is

$$\left| 30H - \left(\frac{11}{2}\right)M \right| = \theta$$

Between 4 and 5 pm angle should be 60°
Taking H = 4 and θ = 60°

$$\left| 30 \times 4 - \frac{11}{2}M \right| = 60 \Rightarrow M = 10\frac{10}{11}$$

So at $4:10\frac{10}{11}$ angle between minute and hour hand is 60°.
In given options the angle nearest to 60°
selected option is 4 : 10.

78. (c)
2, 5, 10, 17, 26, 37, 50, 64
$2 = 1^2 + 1$, $5 = 2^2 + 1$, $10 = 3^2 + 1$,
$17 = 4^2 + 1$, $26 = 5^2 + 1$, $37 = 6^2 + 1$,
$50 = 7^2 + 1$, $64 = 8^2$
So 64 is the odd one out.

79. (c)

Q.No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted	Total Students
1	2	21	17	6	44
2	3	15	27	2	44
3	2	23	18	3	44

$$\text{Average} = \frac{\text{Total marks secured}}{\text{Total number of students}}$$

$$= \frac{21 \times 2 + 15 \times 3 + 23 \times 2}{44} = 3.022727$$

≈ 3.02

80. (d)
For GDP growth rate of 7% in 2013 for India,
During 2012-2013 GDP increased by 7%.
So, GDP in year 2012-2013 = 107 Rs.
Now exchange rate for US$ changed from
Rs. 50 (US$) to Rs. 60 (US$)

So value of Rs. with respect to US$ is $\frac{5}{6}$ of original value

$$\text{So new GDP in US\$} = 107 \times \frac{5}{6} = 89.16$$

% relative change = (89.16 − 100)/100 × 100
= −10.83% decrease ≈ 11% decrease

81. (c)
Ratio of male to female in 2011 is given.
In 2011 there were 100 males and 100 females in 2011.
Now number of females in 2012 is same as number
of females in 2011 as given in question.
So female in 2012 = 100
Ratio of males to females in 2012 is 1.5

$$\frac{M}{F} = 1.5$$

$$\Rightarrow \frac{M}{F} = 1.5$$

$$\Rightarrow M = 150$$

So increase 150 males in 2012
Ratio of male in 2012 to male in 2011

$$= \frac{150}{100} = \frac{1.5}{1}$$

82. (d)
[illegible] $(Y)_8$ = [illegible]
So Y = [illegible]
= [illegible]
= [illegible]

83. (c)

$$f(x, y) = [illegible]$$

$$\left.\frac{dy}{dx}\right|_{(0, 3)} = 0$$

Equation of tangent

$$(y - 3) = 0\,(x - 0)$$

$$y = 3$$

It is parallel to x-axis.

[illegible] Solution:

Total cost of [illegible]

= [illegible]

= ₹ [illegible]0050

[illegible] = $\frac{[illegible]30000}{100}$ = ₹ [illegible]

67 Solution

[illegible]

[illegible] (c)

Let the [illegible] [illegible] & [illegible]

∴ Population [illegible] [illegible] & [illegible]

[illegible]

[illegible]

= [illegible] [illegible]

[illegible] Solution:

Average [illegible] = 7 – $\frac{[illegible]}{[illegible]}$ = [illegible] years

[illegible] (c)

[illegible] = [illegible]$\left[[illegible] \frac{[illegible]}{30} \right]$

⇒ 10 [illegible] $\left(1 - \frac{2[illegible]}{100} \right)$

⇒ [illegible] = [illegible]

⇒ $\frac{\log 2}{\log [illegible]}$ [illegible]

⇒ [illegible] year

93. (d)

[illegible] quantity of [illegible] = 5 [illegible] tonnes

Quantity of [illegible] item 1

= [illegible] × 5 = [illegible]55 [illegible] tonnes

Quantity of [illegible] = [illegible]

= [illegible] tonnes

[illegible] revenues generated from [illegible]

= 250 × 0.12 = 30 crore

Total revenues generated from [illegible]

= 0.0[illegible] × 250 = 15 crore

Revenue generated [illegible] [illegible]

[illegible] = $\frac{30 \times 100000[illegible]}{0.55 \times 1000000}$

[illegible] = [illegible]kg

Revenue generated through [illegible]

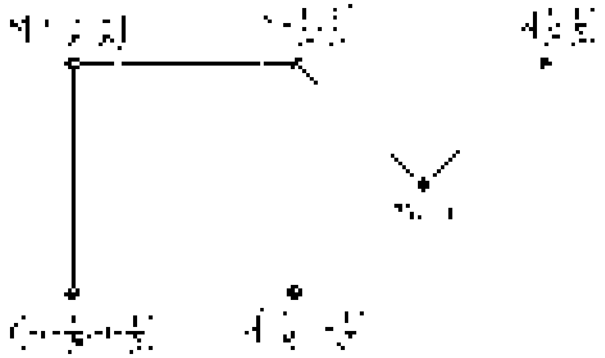
[illegible] = $\frac{15 \times 10^{[illegible]}}{[illegible] \times 10^{[illegible]}}$

[illegible] = [illegible]kg

R.G. item 1 [illegible]

R.G. item 1 [illegible]

84. (c)



[illegible] = $\sqrt{\left(\frac{[illegible]}{\sqrt{2}} [illegible] \frac{1}{\sqrt{2}} \right)^2 [illegible]}$

= $\sqrt{[illegible]}$

[illegible]. Solution:

10% HIV [illegible] correct

[illegible] incorrect

90% [illegible] [illegible] correct

[illegible] incorrect

[illegible]

[illegible] = [illegible]

= [illegible]

[illegible] = [illegible] × 0.85

= [illegible]

[illegible] = $\frac{[illegible]}{[illegible]}$ = [illegible]

95. (c)

$$\begin{array}{ccccccc} R & & O & & A & & D \\ 3\big| & +3 & & +3 & & 3\big| & \\ U & & R & & D & & G \end{array}$$

Add 3 to respective letters.

So,

$$\begin{array}{ccccccc} S & & W & & A & & N \\ 3\big| & +3 & & +3 & & 3\big| & \\ V & & Z & & D & & Q \end{array}$$

97. (c)

⇒ [illegible] 10 = [illegible] (given in question)

[illegible] = −2, [illegible] = 23

⇒ [illegible] 2x + 5 = 23 ...(i)

[illegible] = 4, [illegible] = 23

⇒ 2x + 5 = 23 [illegible] = 32

Given, [illegible] = 2x + [illegible]

⇒ [illegible] = 4

98. **Solution**

Combined percentage increase in imports and exports for year 2001

$$= \frac{(60+50)-(50+40)}{(50+40)} \times 100 = 22.22\%$$

Combined percentage increase in imports and exports for year 2002

$$= \frac{(70+60)-(60+50)}{60+50} \times 100 = 18.18\%$$

Combined percentage increase in imports and exports for year 2003

$$= \frac{(70+60)-(60+70)}{70+60} \times 100 = 0$$

Combined percentage increase in imports and exports for year 2004

$$= \frac{(70+80)-(70+60)}{60+70} \times 100 = 15.38\%$$

Combined percentage increase in imports and exports for year 2005

$$= \frac{(80+80)-(70+80)}{70+80} \times 100 = 6.67\%$$

Combined percentage increase in imports and exports for year 2006

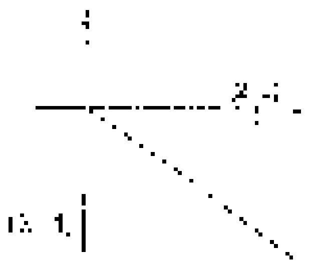
$$= \frac{(100+120)-(80+80)}{80+80} \times 100 = 37.5\%$$

Combined percentage increase in imports and exports for year 2007

$$= \left[\frac{(110+120)-(100+120)}{100+120} \times 100\right] = 4.54\%$$

∴ year 2006 has shown the highest percentage combined growth in imports and exports.

99. (b)



Option (a) is not possible.

∵ [illegible] y = 0 for no value of y in graph.

Option (c) is not possible as it has three values of x at [illegible] respectively.

Option (d) is also not possible as it has [illegible] which is not possible in the given graph.

100. (b)

Option (a) is not correct as [illegible] the given statement. As given in question B certainly [illegible] form.

Option (c) is not correct as it is stated [illegible] (same reasons as above).

Option (d) is not possible because B & D cannot [illegible] together in the question.

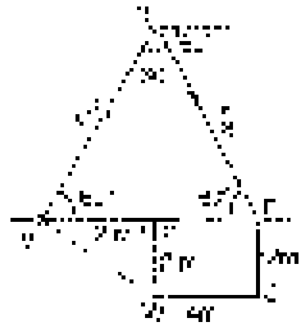
So, only option (b) is possible.

101. (b)

Select three people from [illegible] among the remaining 50 people.

$$\text{Probability} = \frac{{}^{[illegible]}C_{2}}{[illegible]} = \frac{2}{51}$$

102. (a)



ΔWMC is similar to ΔA [illegible]

So, ME = 1

Also, WY = WC − YC = 6 − 4 = 2

WZ = 2, MW = 2

So, $WY = \sqrt{(\ )^2 + (\ )^2}$

$= 2\sqrt{2}$

105. (d)

Type I

$= \left(\frac{[illegible]}{75}\right) \times 100 = [illegible]\%$

Type II

$= \left(\frac{95 - [illegible]}{[illegible]}\right) \times 100 = [illegible]\%$

Type III

$= \left(\frac{[illegible]}{[illegible]}\right) \times 100 = [illegible]\%$

Type IV

$= \left(\frac{125 - 108}{[illegible]}\right) \times 100 = 14.28\%$

Type V

$= \left(\frac{[illegible] - 112}{112}\right) \times 100 = [illegible]\%$

So maximum for Type I

104. Solution

A, B, C, D, E [illegible]

∴ A can [illegible]

9 [illegible] values.

= 9 × 8 × [illegible] = [illegible]

105. (d)

Both the tanks will be [illegible] capacity [illegible] capacity [illegible] is [illegible].

[illegible] tank A = 14000

So capacity [illegible] $\left(= \frac{[illegible]}{7}\right)$

But [illegible] getting [illegible] of [illegible]

[illegible]

[illegible] B is 40% [illegible]

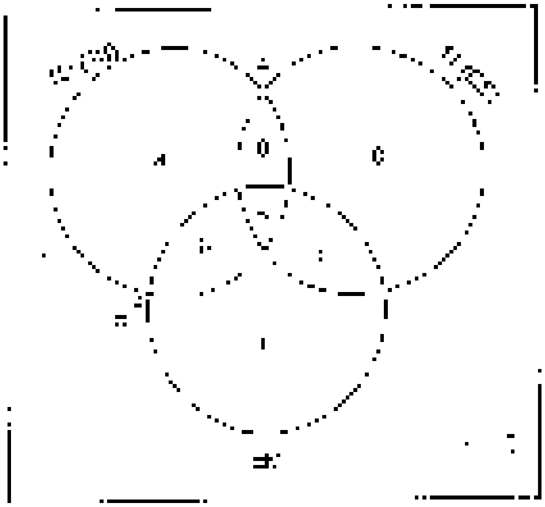
[illegible] = 80% of 14000

= 11,200

[illegible] = 40% [illegible] = 8000

[illegible] both [illegible] in A [illegible] respectively.

106. (a)



40

[illegible] 20

[illegible] = 11

= 1

No. of [illegible]

[illegible]

107. (a)

[illegible]

[illegible] = 0 [illegible] minimum value

109. (b)

[illegible] common difference of [illegible]

110. (d)

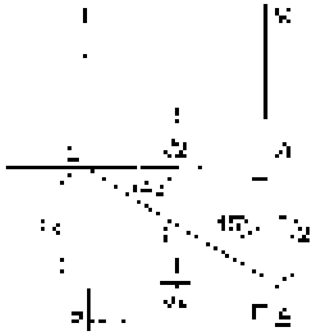
[illegible]

[illegible]

[illegible]

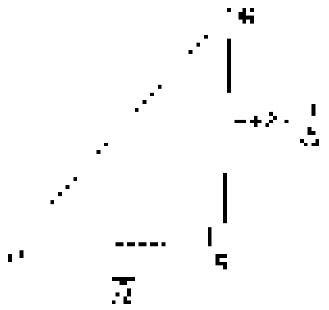
111. (a)

[illegible] the figure below

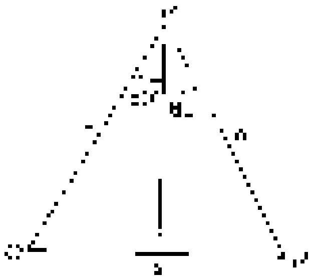


As OM = 1, [illegible] $= \frac{[illegible]}{\sqrt{2}}$ [illegible]

[illegible]



112. (a)



[illegible]

[illegible]

[illegible]

113. (c)

[illegible] We can get the number of [illegible] height [illegible] is given in the question.

114. (c)

A = {2, 3, 4, [illegible]}, B = {[illegible], 15, [illegible]}

Sample space will contain 4 × 5 = 20 events

favourable events [illegible]

Required probability $= \frac{4}{20} = \frac{1}{5} = 0.2$

115. (32)

[illegible]

$8 \times \frac{9}{[illegible]}$ [illegible] = 72

[illegible]

$\Rightarrow$ [illegible] = 72 $\Rightarrow$ [illegible]

[illegible]

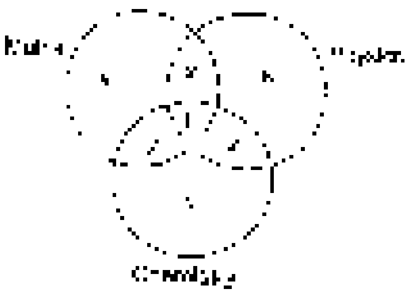
$\Rightarrow$ [illegible] $\times 360 \times \frac{4}{9} = 48$

[illegible]

$\Rightarrow$ [illegible] $\times 360 \times \frac{1}{[illegible]} = 16$

Difference = 48 − 16 = 32

116. (c)



According to question

[illegible]

Also x + y + z + [illegible] = 50%

[illegible]

[illegible]

[illegible]

[illegible] $= \frac{27}{50}$

117. (c)

[illegible]

$$\text{Average marks} = \frac{\text{Total marks}}{\text{No. of students}}$$

[illegible]

$= \frac{[illegible]}{[illegible]} = 6.[illegible]$

118. (a)

[illegible]

$[illegible] = \frac{[illegible]}{[illegible]}$

$[illegible]$

$[illegible]\left(\frac{5}{7}\right) = -\frac{[illegible]}{3}$

$\Rightarrow [illegible] = \frac{[illegible]}{7}$

$\Rightarrow x = \left(\frac{7}{5}\right)^{3}$

$\Rightarrow x = \frac{343}{125}$

119. (b)

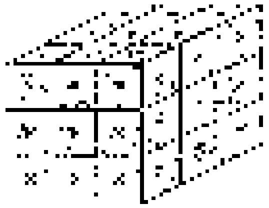
(88 − 8) × (88 ^ 8)

$\left(\frac{88-8}{88+8}\right) \times \left(\frac{88-8}{88 [illegible]}\right) = [illegible]$

120. (c)

Number of [illegible] = 9 × 6 = 54

(9 on each face, 6 faces)



Total cubes = 27 [illegible]

Total sides = Total cubes × 6 [illegible]

= 27 × 6 [illegible] × 6 = [illegible]

Required ratio = $\frac{[illegible]}{[illegible]} = \frac{54}{[illegible]} = \frac{1}{[illegible]}$

121. (3)

[illegible] $\left(\frac{[illegible]}{2}\right)$ [illegible]

[illegible] $\frac{5 [illegible]}{2}$ [illegible]

Second row middle term is $\left(\frac{[illegible]}{2}\right)$ [illegible]

[illegible] $\frac{7+4 [illegible] 9+1}{2}$ = 7 is equal to middle term [illegible]

Similarly [illegible]

$[illegible] = \frac{[illegible]}{2} = 9$

So the [illegible] middle [illegible] = $\frac{[illegible]}{2}$ = [illegible]

122. (d)

Following [illegible] cumulative chart:

[illegible]	Distance	Electricity used	
M	30	[illegible]	1250 × 0.8
N	45	25	1325 × 0.57
O	75	40	2050 × 0.65
P	100	57	1226 × 0.45

Hence [illegible]

123. (c)

Required probability

$= [illegible] \left(\frac{[illegible]}{[illegible]}\right) + \frac{[illegible]}{2} \times \left(\frac{[illegible]}{3}\right) \times \frac{[illegible]}{16} = \frac{1}{4}$

124. (a)

Only conclusion I and II follows.

125. (c)

We know,

$(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

$(a+b+c)^2 - 1 = 2(ab + bc + ca)$

[as $a^2 + b^2 + c^2 = 1$]

[illegible]

[illegible] $= -\frac{1}{2}$

[illegible] $a + b + c = 0$]

Only option (c) [illegible] value as $-\frac{1}{2}$.

126. (600)

[illegible] 8 m. [illegible]

$[illegible] = 50 \times 8 = 400$ m [illegible]

Tiger gives 5 leaps [illegible] 5 × 8 = 40 m/min.

Deer gives 4 leaps in a minute which is equal to 4 × 5 = 20 m/min.

Hence distance of 400 m [illegible] (40 − 20) = 20 m/min.

Required time = $\frac{400 \text{ m}}{(40 - 20) \text{ m/min}}$

$\frac{\text{(Distance)}}{\text{(Relative speed)}}$ = 30 min

Distance travelled by tiger

$\frac{[illegible]}{\text{min}}$ × [illegible] = [illegible] m/min

127. (a)

[illegible]

128. (a)

[illegible]

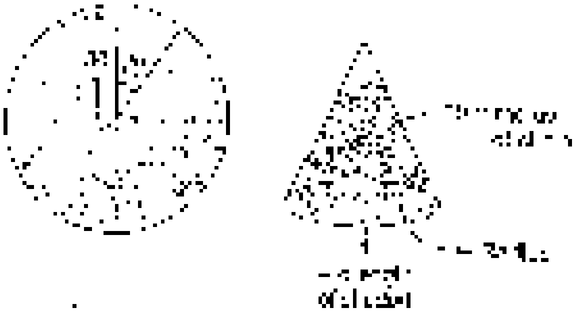
[illegible]

[illegible]. (a)

[illegible]

131. (2.084)

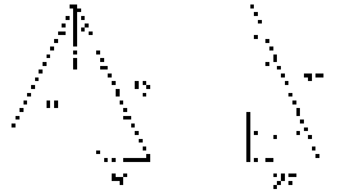
The shape of [illegible] of circular sheet is folded into a cone (Figure below)



$2\pi r = \frac{9}{[illegible]} 2\pi \times 30$ ⇒ r = 27

$h = \sqrt{30^2 - 27^2} = \sqrt{900 - 729}$

$= \sqrt{171}$



Required time = $\frac{27}{[illegible]}$

$= \frac{27}{[illegible]} = 2.034$

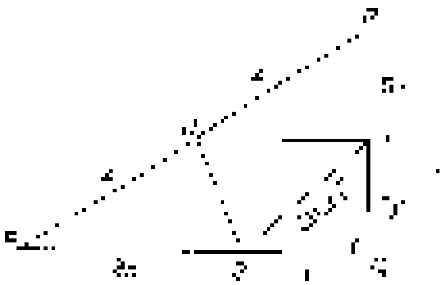
132. (b)

Total number of matches $S_{[illegible]}$ = [illegible]

133. (c)

[illegible]

134. (280)



Area ΔQTS = $\frac{1}{2}$ SQ × QT sin 90°

$20 = \frac{1}{2}$ × [illegible] × x

→ xy = 2[illegible]

Now Area of ΔPQR = $\frac{1}{2}$ PQ × QR × sin 150°

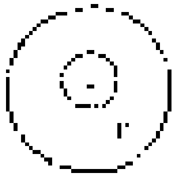
$= \frac{1}{2}$ × [illegible] sin 150°

= 14 xy = 280 cm²

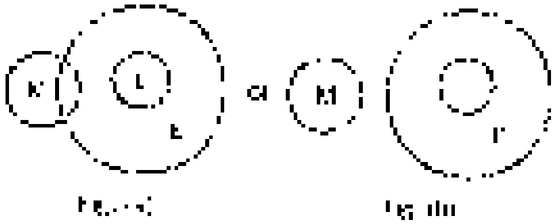
135. (a)

S1:

S2.



Therefore [illegible] diagram is true

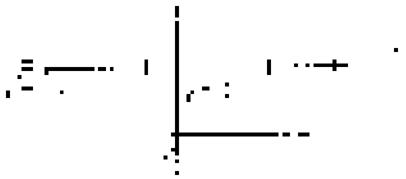


1. [illegible]
2. [illegible]

137. (c)

[illegible] parallel to x axis

[illegible]

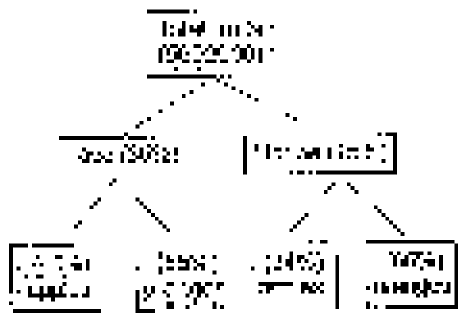


[illegible]

Alternate Method :

[illegible]

136. (4)

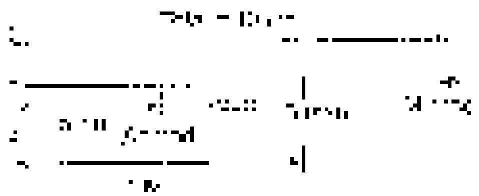


Total number of apples = [illegible]

= [illegible]

138. (c)

[illegible]



[illegible]

140. (c)

The required probability =

$0.5 \times$ [illegible]

141. (d)

[illegible]

[illegible]

So [illegible]

142. (c)

[illegible]

[illegible]

[illegible]

[illegible]

So [illegible] $= 1$

143. (c)

[illegible] $= 300$ [illegible]

[illegible]

So [illegible]

[illegible]

[illegible]

[illegible]

While [illegible]

So [illegible] $18 \times 7 = 126$ [illegible]

[illegible]

He will [illegible] $\left[\frac{126}{600}\right]$ [illegible]

So required ratio $\frac{1}{5} : \frac{126}{600}$

120 : 126

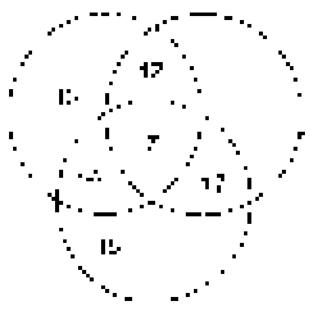
20 : 21

145. (c)

[illegible]

Ratio [illegible] $= 1 : 2$

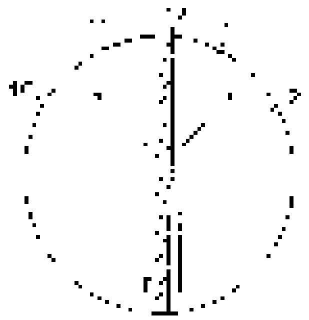
146. (108)



[illegible]

$= 108$

147. (d)

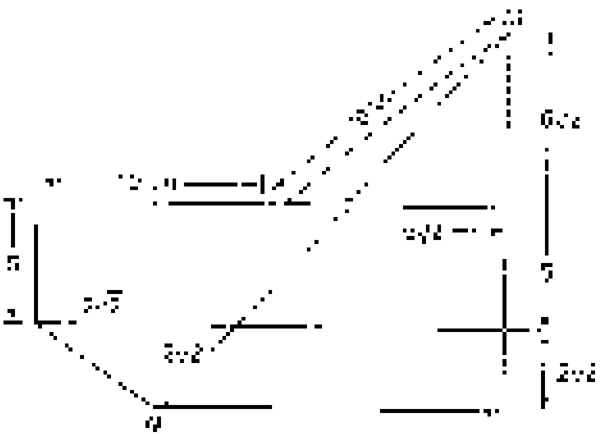


[illegible]

[illegible]

[illegible] 45

148. (c)



See the adjoining figure [illegible]

[illegible]

[illegible]

[illegible]

$=$ [illegible] $= 20.87$

149. (b)

[illegible]

[illegible] 540 [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Area of rectangle is [illegible]

So combined area is $\left[\frac{x^2}{16}+\frac{[illegible]}{16}\right]$ (2)

Since combined [illegible] [illegible] using equation (1) in (2) we get

[illegible] $= 0$

[illegible] $= 0$

[illegible]

and length of side of square is

$= 40$ cm

156. (c)

It is a perfect square.

157. (c)

The controller [illegible] increases [illegible] second [illegible]

[illegible]

Magnitude [illegible] per second

1st sec → triangle $= \frac{1}{2}\times 1\times 1 = \frac{1}{2}$

2nd sec → square $= 1\times 1 = 1$

3rd sec → square + triangle $= 1 + \frac{1}{2}\times 1\times 1 = 1\frac{1}{2}$

4th sec → triangle $= \frac{1}{2}\times 1\times 2 = 1$

5th sec → straight line $= 0$

6th sec → triangle $= \frac{1}{2}\times 1\times 1 = \frac{1}{2}$

7th sec → triangle $= \frac{1}{2}\times 1\times 1 = \frac{1}{2}$

Total distance moved in 7 seconds is

$= \frac{1}{2} + 1 + 1\frac{1}{2} + 1 + 0 + \frac{1}{2} + \frac{1}{2} = 5$

158. (c)

[illegible] age − Sister's age = 2 months

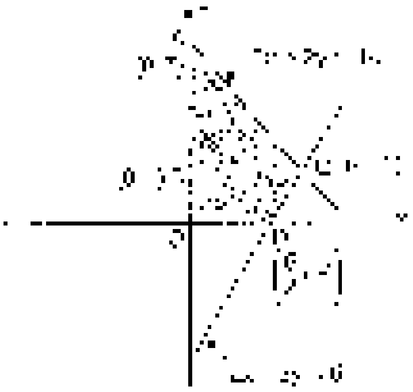
[illegible] age − [illegible] age = [illegible] months

[illegible] age − Sister's age = [illegible] month

[illegible]

[illegible]

154. (a)



Required area = Area of ΔABC + Area of [illegible]

$= \frac{1}{2}\times 4\times [illegible] + \frac{1}{2}\times [illegible]\times 1$

$= 12 + [illegible] = [illegible]$ sq units

155. (a)

Straight line equation $y = mx + c$

m = slope = −0.02 [illegible]

[illegible]

$y = -0.02\times [illegible] + c$

$c = [illegible]$

$= 0.002$ [illegible]

156. (c)

Original surface area $= 6(4^2) = 96$

If corner cubes are removed, three exposed surfaces are removed which will create 3 new surfaces in original [illegible]. So surface area will be unchanged, i.e. 96.

157. (b)

Elegance

[illegible] = A

Executive

[illegible] = B

Smooth

[illegible] = C

Soft

[illegible] = D

[illegible] highest for B [illegible]

[illegible]

[illegible]

173. (c)

[illegible]

174. [illegible]

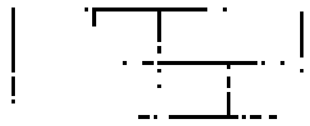
[illegible]

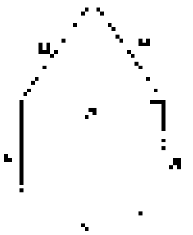
175. Sol.

[illegible]

176. [illegible]

Following figure can be drawn:





Perimeter of [illegible]

$3a = 6$ [illegible]

$a = 2$ [illegible]

[illegible] Area of square

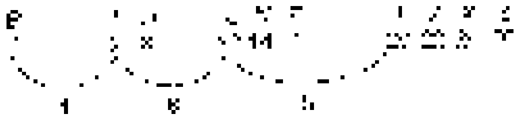
+ Area of [illegible]

$= (2)^2 + \frac{\sqrt{3}}{4} \times (2)^2 = 2.09$ [illegible]

179. (a)

[illegible] for good [illegible] that the [illegible] group [illegible] and hence [illegible] the range of marks scored in group [illegible] group [illegible] other [illegible]

180. (c)



[illegible] distinct [illegible] 20 [illegible] common [illegible] shown in [illegible]

181. (a)

[illegible] satisfies

[illegible]

[illegible] $= (2 + 1) =$ [illegible]

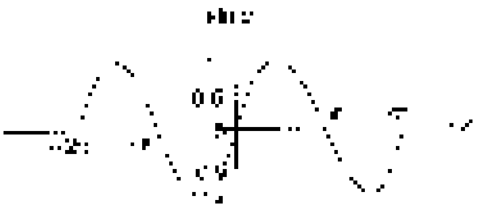
[illegible] satisfied for $a = 0$

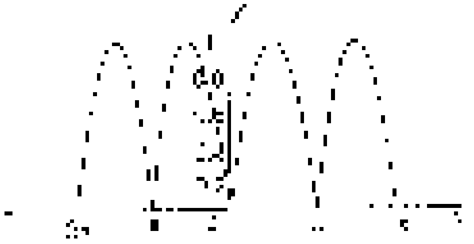
182. (c)

[illegible]

[illegible] $= 0$

[illegible] $= 0$





183. (d)

[illegible] 9, 10, 11

Mean [illegible]

Median [illegible] middle [illegible]

Mode [illegible] number [illegible]

[illegible] Mean = [illegible] Mode

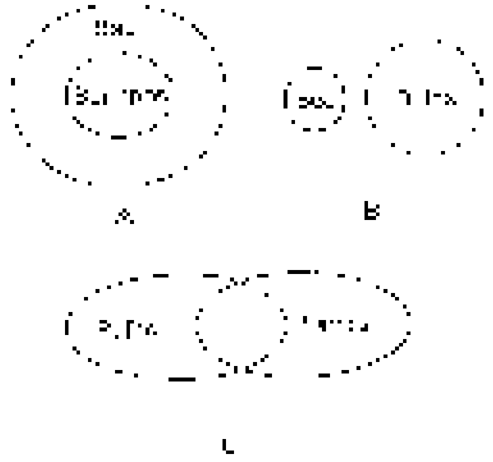
[illegible] ...(ii)

From equation (i) and (ii), we get

$x = 2, y = 1$

[illegible] is 0

184. (d)



[illegible] given [illegible] and [illegible] will be correct.

185. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

186. (c)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 2 km

[illegible] 2 km

187. (b)

Clearly we can say [illegible] (i) and (ii)

[illegible] follows.

188. (b)

Amena — [illegible]

Ambar ——— 5

Abhaya — [illegible]

Ajay — [illegible]

As per the preferences given.

189. (c)

[illegible]

[illegible]

190. (b)

Sample space = 6 × 6 = 36 events = total chances

[illegible] 2 dice move to perfect square = Favourable chances

= [illegible] = 8 events

Probability = $\frac{\text{Favourable chances}}{\text{Total chances}} = \frac{8}{36} = \frac{2}{9}$

191. (b)

[illegible]

Option (b) is correct.

192. (d)

(i) is incorrect as it has more [illegible]

(ii) is incorrect as [illegible]

193. (d)

Let walking speed = [illegible]

and walking [illegible] = [illegible]

[illegible] ...(i)

[illegible] ...(ii)

On solving eq. (i) and (ii) we get,

[illegible]

194. (c)

Following information is given

[illegible]

From these it can be inferred

[illegible]

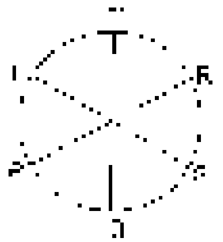
[illegible]

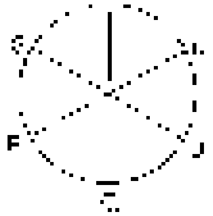
[illegible] is given

So (i) and (ii) follows.

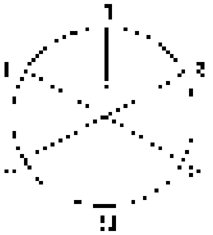
195. (c)

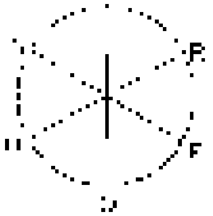
Following two possibilities can be drawn





Given [illegible] diagrams can be drawn.





Now only (c) only follows.

196. (d)

Let [illegible] assumption and [illegible]

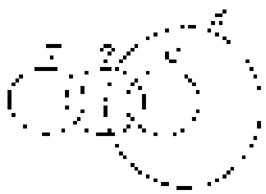
[illegible]

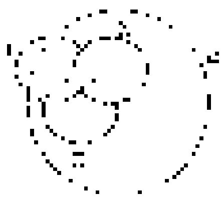
[illegible]

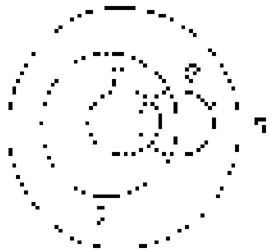
According to given conditions

[illegible] is negative

197. (c)







Only [illegible] follows.

198. (b)

[illegible] = $\frac{[illegible]}{[illegible]}$ [illegible] = 144°

So, the angle subtended [illegible] = 144°.

199. (c)

Length of [illegible] = [illegible]

Length of [illegible] = [illegible]

Alternate [illegible] Trucks and Cars

50 + 30 = 80 m

Let n be the number of [illegible]

Cars in 1 hour (3600 secs)

Given speed = [illegible]

[illegible]

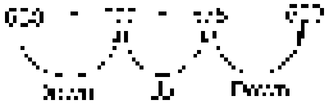
[illegible]

n = $\frac{[illegible]}{80}$ = 720 [illegible]

So, [illegible] = 720 [illegible] vehicles

200. (c)

[illegible] height.



Down [illegible]

201. (a)

Subgroups containing only [illegible]

= $^3C_1$ [illegible] = 3 [illegible] = 7

[illegible]

[illegible]

= 3[3 + 3 + 1] = 21

Subgroups containing [illegible]

[illegible] = 21

Subgroups containing [illegible]

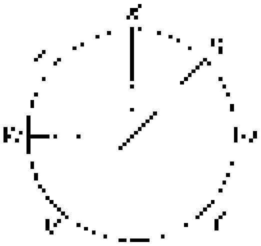
[illegible] = 7

Total number of subgroups

= 7 + 21 + 21 + 7 = 56

202. (d)

Following circular seating arrangement [illegible] drawn.



[illegible] arrangement can be drawn. The person [illegible] is A.

203. (b)

204. (a)

205. (d)

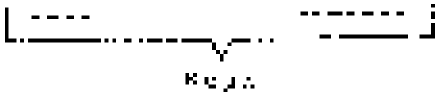
206. (c)

207. (c)

208. (b)

209. (c)

210. (a)



[illegible] digit can be filled in [illegible] ways [illegible] and 9 [illegible], so we have [illegible] filled by 1, 2, 5, 7, 8, [illegible]

possibility is [illegible]

211. (d)

[illegible] × 450 = a perfect cube

Option

[illegible] not perfect cube

[illegible] not perfect cube

[illegible] not perfect cube

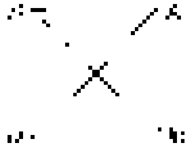
[illegible]

[illegible] cube

Hence the answer [illegible]

212. (c)

Following seating [illegible] can be drawn.



The [illegible]

213. (c)

[illegible] As [illegible] is between 500 and 625. It will get [illegible] among option (c) and (d). It is possible in only option (c).

214. (b)

$$\frac{(x+2)}{2} = [illegible] \quad (i)$$

[illegible]

Now if x and y [illegible] equation (i) becomes

[illegible]

Now if y = x

[illegible]

As x = y

Therefore correct answer is option (b).

Alternate solution:

Use easy values

x = 1 and y = −2

Now [illegible]

Or [illegible] and x = 1

[illegible]

which is [illegible] (x, y).

Therefore correct answer is option (b).

215. (d)

As there are [illegible] A, C, M [illegible] ways [illegible] 4 = 8

Now [illegible] Red and Green [illegible] ways

Therefore correct answer should be option (d).

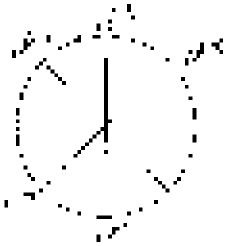
Alternate solution:

Only one option is less than [illegible].

Therefore correct answer should be option (d).

216. (a)

[illegible]



[illegible]

Here [illegible]

Therefore answer should be only [illegible].

224. (d)

Distance travelled by [illegible] = [illegible] (i)

⇒ [illegible] again after going [illegible] distance.

[illegible] height [illegible] radius

$R = [illegible]$ (Radius of [illegible] complete revolution)

$2\pi R = [illegible]$ (ii)

[illegible] angle [illegible] will be [illegible]

[illegible] radians

225. (a)

P says [illegible]

Q says [illegible]

R says [illegible]

[illegible]

[illegible]

[illegible] answer is (a).

226. (c)

[illegible] → 2[illegible]

[illegible] → 35K

5p → 10K

8p → 10K

2p → 150K

[illegible]

[illegible]

[illegible]

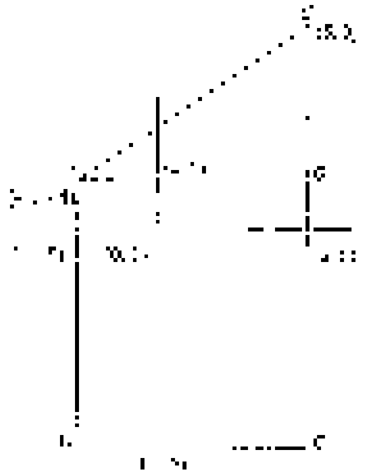
$\frac{8000 - 3000}{5}$ = Rs. 5000

227. (b)

The following two possibilities exist:

[illegible]

228. (c)



[illegible]

[illegible]

[illegible]

= Area of ΔADE

[illegible]

230. (a)

[illegible]

231. (d)

P → Married

R → Unmarried

[illegible]

[illegible]

[illegible]

[illegible]

1. Let O be married

[illegible]

[illegible]

[illegible]

[illegible]

2. Let O be unmarried

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

237. (a)

x → Bricks

y → Tractors

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

d = [illegible]

d = 50 days

238. (d)

[illegible]

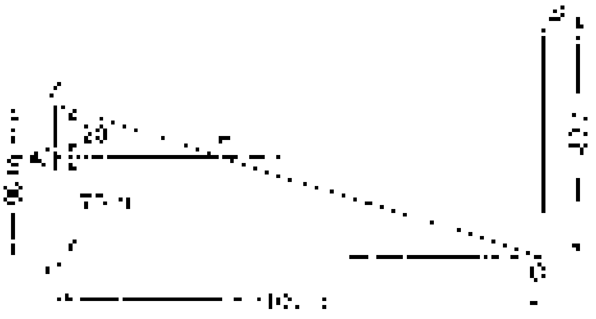
239. (c)

[illegible] ...(i)

[illegible] ...(ii)

[illegible]

240. (22.82)



ΔADE ~ ΔABC

[illegible]

[illegible]

[illegible]

241. (d)

[illegible]

[illegible]

[illegible] } [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Alternate Method

[illegible]

[illegible] = 10 [illegible] Hence

[illegible]

[illegible]

242. (c)

[illegible]

[illegible]

243. (b)

[illegible]

$x = \frac{[illegible]}{22.5}$

[illegible] $\frac{[illegible]}{22.5}$ [illegible]

244. (b)

[illegible]

[illegible]

[illegible]

245. (c)

[illegible]

[illegible]

$\Rightarrow$ [illegible]

[illegible]

[illegible]

[illegible]

246. (b)

[illegible]

[illegible]

[illegible]

[illegible]

247. (c)

$$[illegible] = \frac{[illegible]}{6} = 84$$

248. (a)

[illegible]

[illegible]

[illegible]

$\Rightarrow$ [illegible]

[illegible]

[illegible]

Hence [illegible]

Alternate Method

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

249. (b)

[illegible]

$\Rightarrow$ [illegible] ...(i)

[illegible]

$\Rightarrow$ [illegible] ...(ii)

So, [illegible]

[illegible] = [illegible]

[illegible] = [illegible]

So, result [illegible]

250. (c)

[illegible] For duration of 7 [illegible]

[illegible] × 5 = 100

[illegible] For duration of 4 [illegible]

= [illegible] = 10%

251. (b)

A = B + [illegible] = 3 ...(i)

C = D + E = 3 ...(ii)

E + F = G = 3 ...(iii)

G + H = 6 = 13 ...(iv)

Adding (i) + (ii) + (iii) = [illegible]

A + B + C + D + E + F + G + H = [illegible] + (C + E + G) = 13 × 4 = [illegible] ...(v)

Also, A, B, C, D, E, F, G, H are [illegible] natural numbers from 1 to 8.

Their sum will be given by $\frac{8(8+1)}{2} = 36$

Substituting (v) C + E + G = 7 ...(vi)

Only possibility for sum 7 will be (1, 2, 4)

Now, C, E cannot be (1 and 2)

As from (ii) C + D + E = 8

[illegible] will become equal to [illegible] not possible because digits 1 to 8 given.

C & E can be either [illegible] ...(vii)

If C = [illegible] then C + E + G = 7

Now E + G = 3

[illegible] possibilities [illegible] = 10

= 10 which is not possible

So from eq. (vi) only possibility [illegible] is E = 2.

252. (c)

Seasonal rainfall = 200 mm

50% of rainfall = $200 \times \frac{50}{100}$ = 100 mm

Area = 90 m²

∴ Water collected in tank = [illegible]

= [illegible]

253. (b)

log 7 = [illegible] ...(i)

log 11 = [illegible] ...(ii)

log 5 = [illegible] ...(iii)

log 7 + log 11 + log 5 = b

log(385) = log 1

385 = 1

254. (c)

Start of [illegible] 2 PM on 1st July = 101 hours

$\left(24 + \frac{5}{60}\right)$ hours of incorrect clock = 24 hours of correct clock.

$\left(24 + \frac{1}{12}\right)$ hours of IC

= 24 hours of correct clock

1 hour of IC = $\frac{[illegible]}{[illegible]}$ hours of correct clock

101 hours of IC = $\frac{88}{[illegible]}$ × 101 hours of correct clock

= 99.359 hours [illegible]

= 99 hours + 0.35978 × 60 minutes of correct clock

= 99 hours = 57 [illegible] minutes

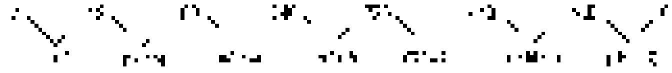
= 99 hours and approx 58 minutes

So, correct time will be

2 PM, 1st July + 99 hours and 58 minutes

[illegible] 58 [illegible] 5th July

255. (a)



So, 1440 must be answer.

256. (c)

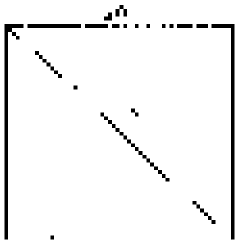
Number is divided by [illegible] 28 [illegible]

[illegible] LCM [illegible] constant difference

= [illegible] natural number

[illegible] number will be [illegible]

257. (?)



Area of square = [illegible]

Side of the side of square = [illegible]

Diagonal distance = [illegible] = [illegible]

Area of circle = [illegible]

$$= \pi\left(\frac{\sqrt{2}a}{2}\right)^2$$

$$= [illegible]$$

$$= \frac{1}{2}[illegible]$$

279. (c)

$$p^x = \frac{1}{q},\; q^y = \frac{1}{r},\; r^z = \frac{1}{p}$$

[illegible] $x = [illegible]$

$$[illegible]$$

$$[illegible]$$

[illegible]

$$[illegible]$$

So [illegible]

Alternate Solution:

$$p^x = q$$

$$q^y = r$$

$$r^z = p$$

$$x \log p = \log q$$

$$y \log q = \log r$$

$$z \log r = \log p$$

$$x = \frac{\log q}{\log p}$$

$$y = \frac{\log r}{\log q}$$

$$z = \frac{\log p}{\log r}$$

$$\therefore xyz = 1$$

280. (b)

[illegible] = [illegible] ...(i)

Total money = [illegible]

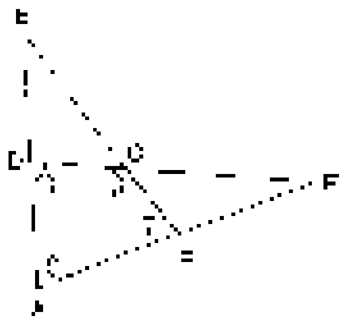
$$= \frac{6000}{9}M \quad \frac{6000}{9}$$

$$= \frac{6000}{9}[illegible]$$

From equation (i)

$$[illegible] = \frac{6000}{9}[illegible] = 2,00,000$$

281. (a)



[illegible]

[illegible] = 55 ...(i)

[illegible] = 180 ...(ii)

[illegible] ...(iii)

Equation (ii) + (iii) = [illegible]

[illegible] + [illegible] + β [illegible]

[illegible] = α

282. (b)

Four green, two red [illegible]

$$P(G) = \frac{4}{6} = \frac{2}{3}$$

$$P(R) = \frac{2}{6} = \frac{1}{3}$$

Option (a) [illegible] $\left(\frac{2}{3}\right)^{[illegible]}\left(\frac{1}{3}\right)^{[illegible]}$

$$= \frac{[illegible]\times 2^{[illegible]}}{(3)^{[illegible]}} = \frac{[illegible]\times 2^{[illegible]}}{(3)^{[illegible]}}$$

(2) [illegible] $\left(\frac{2}{3}\right)^4 \times \left(\frac{1}{3}\right)^2$

$$= \frac{[illegible]\times 2^4}{(3)^6} = \frac{[illegible]\times 2^4}{(3)^6}$$

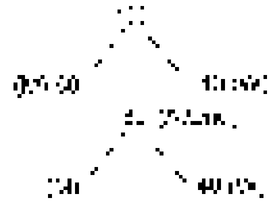
(3) [illegible] $\left(\frac{2}{3}\right)^{[illegible]} \times \left(\frac{1}{3}\right)^2$

$$= \frac{[illegible]\times 2^{[illegible]}}{(3)^6} = \frac{12\times 2^{[illegible]}}{(3)^6}$$

[illegible]

262. (b)

[illegible] = 100



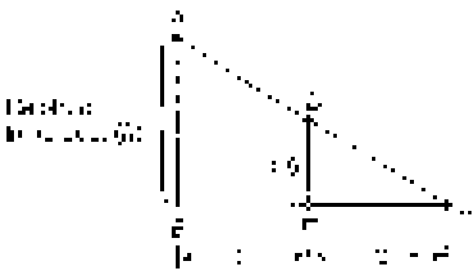
[illegible]

40 : 40

263. (c)

[illegible]

264. (c)



[illegible]

265. (b)

[illegible]

7 + 1 + 6 + 1 + [illegible]

[illegible]

266. (c)

[illegible]

	Gold	Copper	
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

267. (b)

[illegible]

268. (c)

[illegible]

[illegible]

Witness identifies [illegible]

$$\text{Probability} = \frac{\text{Favoured}}{\text{Total}} = [illegible]$$

268. (d)

(d) is beyond the scope of given [illegible]

270. [illegible]

[illegible]

Statement [illegible]

271. (c)

[illegible]

272. [illegible]

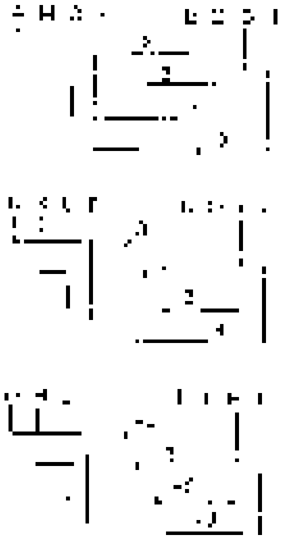
$f(x) = 0$

[illegible]

273. [illegible]

[illegible]

274. (c)



275. (c)

[illegible]

276. [illegible]

[illegible]

Now, (x) + x + 25 + x + 20 − x − 15 − x = 80

100 − x = 95

x = 5

∴ [illegible] bias in newspaper [illegible]

$= \frac{20}{80} \times 100 = [illegible] = 0.755$

277. (c)

(i) C and B moves from [illegible]
[illegible] forward [illegible] B moves
[illegible] triple [illegible]

(ii) C and D moves in [illegible]
[illegible] forward [illegible]
D moves [illegible]

(iii) [illegible] and C moves in [illegible]
[illegible] forward [illegible]
D moves back

278. (b)

$B + G = 12$

$B - G = 2$

$\Rightarrow B = 7$

$G = 5$

7 boys and 5 girls and there is 12 total [illegible]

Among 3 students [illegible] must be more than girls.

So only two cases are:

B	G
3	0
2	1
3	0

In case (i)

$$GGG \rightarrow \frac{5}{12} \times \frac{5}{12} \times \frac{5}{12}$$

$$\text{case (ii)} \left.\begin{matrix} G & G & B \\ G & B & G \\ B & G & G \end{matrix}\right] \rightarrow 3 \times \frac{5}{12} \times \frac{5}{12} \times \frac{7}{12}$$

$$\text{Required prob.} = \left(\frac{5}{12}\right)^3 + 3\left(\frac{5}{12}\right)^2 \times \left(\frac{7}{12}\right)$$

$$= \frac{550}{1728} = \frac{275}{864}$$

$= 0.072 + [illegible]$

Alternative method:

There are 7B and 5G

The [illegible] of question [illegible] selecting 3 students [illegible] at random.

This can [illegible] possible ways to approach it.

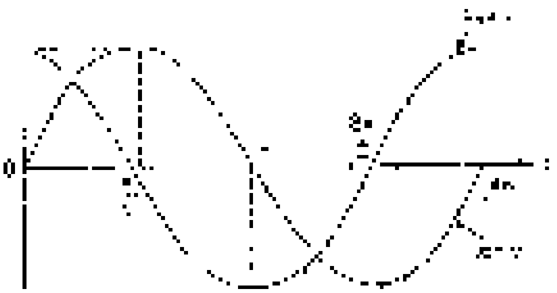
B	G
3	0
2	1
1	2

$$= \frac{{}^5C_3 \times {}^7C_0 + {}^5C_2 \times {}^7C_1}{{}^{12}C_3}$$

$$= \frac{10 \times 1 + 10 \times 7}{\frac{12 \times 11 \times 10}{6}} = \frac{80}{220} = \frac{4}{11}$$

$= 0.3636$

279. (a)



The graph of [illegible] both are decreasing in the interval $\left(\frac{\pi}{2}, \pi\right)$.

280. (a)

(i) Cuboid volume = 6 × 10 × 8 = 480 cm³

(ii) Cube volume = 8 × 8 × 8 = 512 cm³

(iii) Cylinder volume = πr²h

$= \frac{22}{7} \times 7 \times 7 \times 7 = 1078 \text{ cm}^3$

(iv) Sphere volume

$= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (7)^3 = 1436.76 \text{ cm}^3$

Hence, the ascending order [illegible] is (i), (ii), (iii), (iv)

281. (a)

Area of equilateral triangle = √3

$\frac{\sqrt{3}}{4} s^2 = \sqrt{3}$

$s^2 = 4$

$s = 2$

Perimeter = 3a = 3 × 2 = 6

282. (a)

Total distance = x

Onward journey S_1 = [illegible] km/h

Return journey S_2 = 40 km/h

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

[illegible]

$$= \frac{2 \times 90 \times [illegible]}{\pi} = [illegible]\text{ m}$$

284. (c)

$$x^2 + x - 1 = 0$$

$$x(x + 1) = 1$$

$$x + 1 = \frac{1}{x}$$

$$\left(x - \frac{1}{x}\right) = (-1)$$

Squaring above equation

$$x^2 + \frac{1}{x^2} - 2 = 1$$

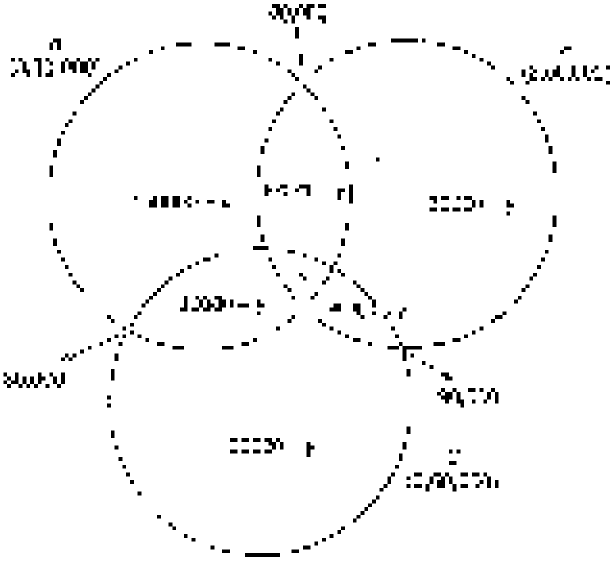
$$x^2 + \frac{1}{x^2} = 3$$

Squaring above equation

$$x^4 + \frac{1}{x^4} + 2 = 9$$

$$x^4 + \frac{1}{x^4} = 7$$

285. (c)



6,00,000 = 6y + [illegible] − 100000 + 80000 + 60000 + 10000 + 30000

6,00,000 − 5,70,000 = 6y

y = 5000

Students who failed to clear [illegible] = [illegible]

30000 + 30000 + 4y

= 30000 + 4 × 5000

Students who [illegible] = 420000

286. (c)

Number of parallelogram

$$= {}^4C_2 \times {}^5C_2$$

$$= 6 \times 10 = 60$$

287. (b)

Rectangle initial length = l and breadth = b. If l is reduced by 10 m and breadth reduced by 5 m then it becomes square.

So, l − 10 = b − 5

l − b = 5

Given, initial area = l × b = A ...(i)

2nd condition

[illegible]

[illegible]

[illegible]

[illegible] = 720

[illegible] = 720

[illegible] = 200

[illegible] = 25

[illegible] ⇒ [illegible]

[illegible]

Area of the original rectangle = [illegible] m²

288. (b)

Let tens digit be x, unit digit be y

x + y = 9 ...(i)

10x + y − 45 = 10y + x

9x − 9y = 45

x − y = 5 ...(ii)

Adding (i) and (ii)

x = 7

Subtracting (i) and (ii)

y = 2

Therefore the number = 72.

289. (b)

2 machines → 2 toys in 2 minutes

1 machine → 1 toy in 2 minutes

Because one machine takes 2 minutes for making 1 toy.

So, 100 machines will take 2 minutes for making 100 toys.

290. (c)

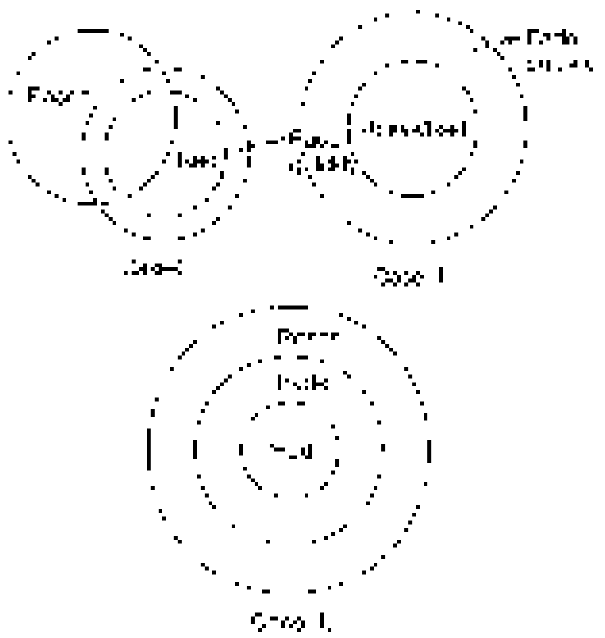
Given m and n as integer

[illegible] is odd

[illegible] is odd

Multiplication of odd and odd number is odd
So, A is odd and [illegible] is odd.
[illegible] odd and [illegible] will be even
[illegible] must
be even
So, A is odd and B is even.

231. (c)



292. (b)

x	0	1	2
y	0	[illegible]	[illegible]

Taking from graph [illegible]

(a) y = [illegible]

Putting x = [illegible]
y = 2 [illegible] = 0 Not satisfied

(b) y = ||x| – 1|

Putting x = [illegible]
y = |[illegible]|
y = [illegible] Satisfied

(c) y = ||x| + 1|

Putting x = [illegible]
y = |[illegible]|
y = [illegible] Not satisfied

(d) y = [illegible]

Putting x = [illegible]
y = |0 – 1| = 1
y = |0 – 1|
y = 1 Not satisfied

293. (c)

Given that log|x| + log|y| = 0
∴ possible only
If |x| and |y| are equal to 1
So, [illegible] (respectively)
For minimum value [illegible] negative
So, minimum value = –3
For maximum value all three will be positive
So, maximum value = [illegible]

294. (c)

Train speed = [illegible]
time = [illegible] length
[illegible] length [illegible]
Man speed = [illegible]
Speed of train w.r.t. man = [illegible]
[illegible] = 14 sec
[illegible] speed

= [illegible] × 5/18

Length of train = 35 × 5 = 175 m
Length of platform = length [illegible] speed × time

= [illegible] × 5/18 × [illegible] = [illegible] m
Length of platform = [illegible] – 175 = [illegible] m

295. (b)

DG, TGH, LMNO [illegible]

296. (c)

[illegible]

Area of circle = π/4 [illegible]

Area of square = a²

[illegible] 16 [illegible] 8

Area of triangle = √3/4 [illegible]

= [illegible]

[illegible]

So, [illegible] from the original area

297. [illegible]

[illegible]

298. [illegible]

[illegible] highest probability [illegible]

[illegible]

Out of [illegible] possible cases [illegible] probability [illegible]

299. [illegible]

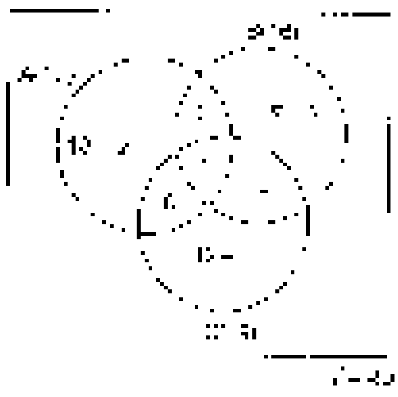
[illegible]

[illegible] = 10000 [illegible]

[illegible]

= [illegible] 8.25 [illegible]

300. [illegible]



Total students = 40

[illegible]

301. [illegible]

[illegible] = [illegible] m²

a² = 1936 m²

a = 44 m

Length of wire = 4a

= 4 × 44 = 176 m

[illegible] length

= [illegible] 44 = 132 m

[illegible]

So, 4a = 132

a = 33 m

Area of square = 33² = 1089 m²

[illegible]

So [illegible] = 44

[illegible]

Area of circle = [illegible]

= 153.94 m²

[illegible]

= Area of square [illegible]

= 1089 [illegible] 153.94

= [illegible] m²

302. [illegible]

By condition 1 →

Possible numbers are → 51, 54, 57

By condition 2 →

Possible numbers are [illegible] 93

By condition 3 →

Possible numbers are [illegible] 77, 79

→ [illegible] 52. [illegible] not the answer.

→ [illegible] not the answer.

→ [illegible] satisfied. So [illegible] the answer.

→ [illegible] All three conditions are satisfied. So it is the answer.

Previous Year ESE Prelims Solved Questions

(General Aptitude)

1. Three hundred parked [illegible] white, silver and black cars [illegible] carrying 0, 1, 2 and 3 passengers respectively. [illegible] number of white and silver cars is equal [illegible] there is only one black car [illegible] the total number of [illegible]?
(a) [illegible]
(b) 50
(c) 51
(d) 56
[ESE Pre-2017 : 2 Marks]

2. The present ages [illegible] 10 years [illegible] the sum of their ages [illegible]?
(a) 17, [illegible] and [illegible]
(b) 15, 20 and 25
(c) 21, 28 and 35
(d) 14, 22 and 16
[ESE Pre-2017 : 2 Marks]

3. A total of 324 [illegible] comprising [illegible] The number of [illegible] is
(a) 200
(b) 125
(c) 144
(d) 116
[ESE Pre-2017 : 2 Marks]

4. [illegible] building in 20 days [illegible] the same building in 25 days and 10 boys [illegible] in 40 days. [illegible]
to paint the building?
(a) 12 days
(b) [illegible] days
(c) 13 days
(d) 15 days
[ESE Pre-2017 : 2 Marks]

5. [illegible] 12% of his salary [illegible] 20% [illegible] his savings [illegible] ₹ 2,200, then his monthly salary is
(a) ₹ [illegible]
(b) ₹ [illegible]
(c) ₹ [illegible]
(d) ₹ 11,000
[ESE Pre-2017 : 2 Marks]

6. A group of [illegible] work in [illegible] days, but [illegible]
[illegible] the number of [illegible] present [illegible] the team originally is
(a) 40
(b) 45
(c) 35
(d) 50
[ESE Pre-2017 : 2 Marks]

7. The sum of [illegible] will be
(a) 1197
(b) 1224
(c) 1284
(d) 1294
[ESE Pre-2018 : 2 Marks]

8. Given that 0.2 is [illegible] root of the equation [illegible] The other roots of the equation will be
(a) [illegible] and [illegible]
(b) 1.2 and 1.4
(c) [illegible] and [illegible]
(d) 1.1 and 1.4
[ESE Pre-2018 : 2 Marks]

9. The equation [illegible] $= 0$ [illegible] roots. Which [illegible] of this equation?
(a) 2
(b) [illegible]
(c) [illegible]
(d) 15
[ESE Pre-2018 : 2 Marks]

10. Circle A [illegible] diameter [illegible] the areas of both A and [illegible] circles A and B respectively?
(a) [illegible] and [illegible]
(b) [illegible] and [illegible]
(c) [illegible] and [illegible]
(d) [illegible] and 2.21
[ESE Pre-2018 : 2 Marks]

11. The 12 digits [illegible] of a clock are to be [illegible]

[illegible] the positive [illegible] sign, which [illegible] How many [illegible] would [illegible]?

(a) 3 (b) [illegible]

(c) 4 (d) 6

[ESE Pre-2018 : 2 Marks]

12. In a [illegible] the marks scored by 4 candidates A, B, C and D are as follows:

- Marks obtained by A and B add to 100
- Marks obtained by C and D add to those of A and B
- B scores 4 times [illegible]
- D scores 10 marks less than C

The marks obtained by D will be

(a) 30 (b) 15

(c) 3[illegible] (d) 2[illegible]

[ESE Pre-2018 : 2 Marks]

13. What is the form of the function f(x) for the following data?

x	[illegible]	[illegible]	[illegible]
f(x)	[illegible]	[illegible]	[illegible]

(a) $x^2 - 2x + 3$ (b) $x^2 - 2x + 2$

(c) [illegible] (d) [illegible]

14. What is the maximum value of z = [illegible] subject to the constraints [illegible]

(a) 63 (b) [illegible]

(c) [illegible] (d) 40

[ESE Pre-2018 : 2 Marks]

15. Let the sum of the squares of consecutive integers 1, 2, 3, ..., n be denoted by S_n [illegible] increases [illegible] sequence

$\frac{0}{1}, \frac{2}{2}, \frac{9}{6}, \frac{15}{7}, \frac{30}{12}$ [illegible] What will be the [illegible] for n = 8?

(a) $\frac{[illegible]}{[illegible]}$ (b) $\frac{[illegible]}{[illegible]}$

(c) $\frac{[illegible]}{15}$ (d) $\frac{[illegible]}{15}$

[ESE Pre-2018 : 2 Marks]

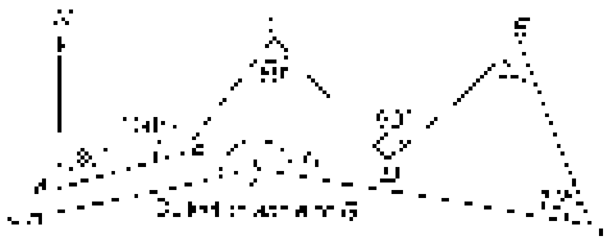
16. A wall [illegible] perimeter of [illegible] m. If the length of its diagonal is [illegible] m, what is the area of the wall?

(a) 224 m² (b) [illegible]

(c) 572 m² (d) 608 m²

[ESE Pre-2018 : 2 Marks]

17. [illegible] angles A, B, C [illegible] A = B = C [illegible] What would be the magnitude of [illegible] angle [illegible]?



(a) 180° (b) 21[illegible]

(c) 205° (d) 22[illegible]

[ESE Pre-2018 : 2 Marks]

18. The objective function z = [illegible] is to be maximized subject to constraints

$x_1 + 2x_2 \le [illegible]$

$x_1 + x_2 \le [illegible]$

$x_1, x_2 \ge 0$

The values of x_1 and x_2 in the optimal [illegible] respectively

(a) 100 and 7[illegible] (b) 125 and 75

(c) 100 and 50 (d) 1[illegible] and [illegible]

[ESE Pre-2018 : 2 Marks]

19. Consider that a group of [illegible] the sum of the [illegible] of the [illegible] and [illegible] is equal to [illegible]

(a) [illegible] (b) [illegible]

(c) [illegible] (d) [illegible]

[ESE Pre-2018 : 2 Marks]

20. [illegible]

(a) [illegible]% (c) 2.15%

(b) [illegible]% (d) [illegible]%

(ESE Pre 2016 : 2 Marks)

■■■■

ANSWERS KEY

1. [illegible] 2. [illegible] 3. [illegible] 4. [illegible] 5. [illegible] 6. [illegible] 7. [illegible] 8. [illegible] 9. [illegible]

10. [illegible] 11. [illegible] 12. [illegible] 13. [illegible] 14. [illegible] 15. [illegible] 16. [illegible] 17. [illegible] 18. [illegible]

19. [illegible] 20. [illegible]

EXPLANATIONS

1. [illegible]

[illegible]

2. [illegible]

[illegible]

3. [illegible]

[illegible]

$x + y = 324$ ...(i)

$20x + 50y = 12{,}[illegible]$ ...(ii)

Solving the 2 equations we get [illegible] = 125

[illegible]

4. (d)

[illegible]

5. [illegible]

[illegible]

6. [illegible]

[illegible]

[illegible] we can form [illegible]

[illegible] W = (W − 5) [illegible] which gives W = [illegible]

7. (d)

Apply formula [illegible] required [illegible]

[illegible]

= 1150 [illegible] 120 = [illegible]

8. (c)

Use the formulae for sum and product of roots [illegible]

Let the roots of this equation be α, β, γ

α + β + γ = [illegible] 0.6 ...(i)

αβ + βγ + γα = [illegible] ...(ii)

αβγ = [illegible] ...(iii)

[illegible] can be placed [illegible] numerically greater value should have negative sign.

9. (a)

Use the formulae for sum and product of roots

Given equation [illegible] = 0

Let the roots of this equation be α, β, γ

With one root as 3 − 4i [illegible] is conjugate [illegible]

α + β + γ = [illegible] ...(i)

This gives the third root [illegible] 2

10. (c)

Circumference of circle A [illegible] its diameter = [illegible]

and Area of circle A = 4π or $\frac{16}{4}\pi$

Circumference of circle [illegible] its diameter = [illegible]

and Area of circle B = $\left(\frac{5}{2}\right)^2\pi = \frac{25}{4}\pi$

Circumference of circle C = Circumference of circle A + Circumference of circle B = [illegible]

Diameter of circle C = 9 cm

Area of circle C = $\left(\frac{9}{2}\right)^2\pi = \frac{81}{4}\pi$

Ratio of area of circle C [illegible] circle A and [illegible]

[illegible]

11. (c)

[illegible] given conditions [illegible]

[illegible]

12. (d)

[illegible]

Solving these equations we get [illegible]

13. (c)

This question can be solved by just putting values given in answer choices.

14. (a)

This question can be solved by finding points of intersection of the 2 lines representing the equations.

[illegible]

which is x = 2 and y = [illegible]

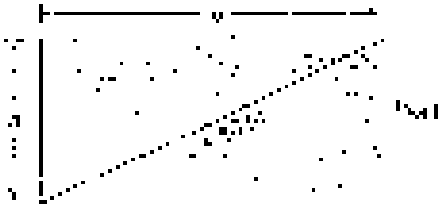
Putting this value in the given objective function [illegible] we get maximum value of Z = [illegible]

15. (a)

[illegible]

Putting [illegible] = 0, we get [illegible]

16 (b)



Perimeter = 72 m

⇒ [illegible] × 2 = 72 m (i)

[illegible] = 36 m

[illegible]

⇒ [illegible] (ii)

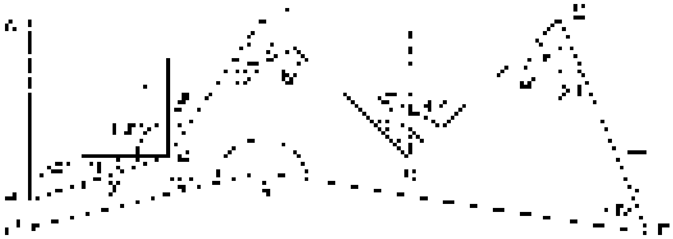
Area [illegible] (iii)

[illegible]

⇒ [illegible] = [illegible] × (Area)

⇒ Area = [illegible] m²

17 (a)



∠[illegible] = [illegible]°

[illegible] in question.

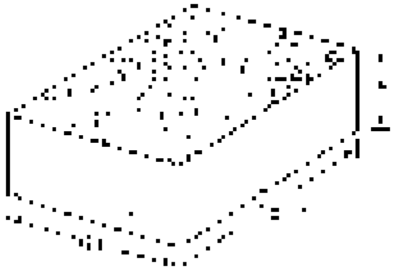
18 (c)

[illegible]

and [illegible]

which is [illegible]

19 (a)



Given information is:

Area of floor + Area of ceiling = Sum of areas of four walls

⇒ [illegible] × 15 [illegible]

⇒ [illegible]

⇒ [illegible]

Volume of room = [illegible]

= [illegible]

20. (a)

[illegible] hours per week

= [illegible] hours

[illegible]

= [illegible] hours

[illegible]

[illegible] = [illegible]

[illegible]