Solutions for SM1002106

Chapter – 1
(Simple Equations)

Concept Review Questions

1. $3(x + 4) + 8 = 5x \Rightarrow 3x + 20 = 5x$
$\Rightarrow x = 10.$ Ans: (10)

2. $12x - 10y - 2 = 0 \quad \rightarrow \quad (1)$
$10x - 10y + 20 = 0 \Rightarrow 10x = 10 (y - 2)$
Dividing both sides by 10, $x = y - 2 \quad \rightarrow \quad (2)$
Substituting x as $y - 2$ in equation (1),
$12(y - 2) - 10y - 2 = 0$
$\Rightarrow 12y - 24 - 10y - 2 = 0$
$\Rightarrow 2y = 26 \Rightarrow y = \frac{26}{2} = 13$.
From (2), $x = 11$. Choice (B)

3. Let the number be x. Given, $3x - \frac{3}{4}x = 36$
$\therefore x = 16.$ Ans: (16)

4. Let Ashok's present age be x years.
His age 30 years hence is twice his age 5 years ago
$\therefore x + 30 = 2 (x - 5)$
$x = 40$ Ans: (40)

5. Let the cost of each pen and each eraser be ₹x and ₹y respectively.
$3x + 4y = 18$
$4x + 3y = 17$
Adding both equations
$7x + 7y = 35$
Cost of 14 pens and 14 erasers
$= 14x + 14y = 2 (7x + 7y) = ₹70$ Choice (A)

6. Let the cost of each dosa and each idli be ₹d and ₹i respectively.
$2d + 3i = 46 \quad \rightarrow \quad (1)$
$d + 2i = 26 \quad \rightarrow \quad (2)$
$(1) - (2) : d + i = 20$
The cost of 4 idlis and 4 dosas viz $4(d + i) = 4(20)$, i.e., ₹80
Ans: (80)

7. The difference of a two digit number and the number formed by reversing its digits is given by 9 (difference of its digits). In the given problem, as the difference of the digits is 6, the difference of the number and its reverse = 9 (6) = 54.
Ans: (54)

8. The difference between a three-digit number and the number formed by reversing its digits is always divisible by 99 and hence by both 9 and 11. Choice (C)

9. The difference between a three-digit number and the number formed by reversing its digits = 99 (difference of its first and last digits). As the difference of its first and last digits is 4, the difference of the number and the number formed by reversing its digits = 99 (4) = 396.
Ans: (396)

10. Let the costs of each sharpener and each eraser be ₹s and ₹e respectively.
$5s + 6e = 28 \quad \rightarrow \quad (1)$
$6s + 5e = 27 \quad \rightarrow \quad (2)$
Adding both equations, $11 (s + e) = 55$
$\Rightarrow s + e = 5 \quad \rightarrow \quad (3)$
Subtracting (2) from (1), we get $- s + e = 1 \quad \rightarrow \quad (4)$
Adding (3) and (4), we get $e = 3$
Substituting $e = 3$ in (3) or (4), we get $s = 2$. Choice (B)

11. Multiplying the first equation by 3, we get $9x + 18y = 54$.
Combining this with the second equation, the conclusion is $54 = 57$ which can never be true.
$\therefore$ The given equations have no solution. Choice (C)

12. Multiplying the first equation by 3/2 the second equation is obtained.
$\therefore$ We have one equation with two unknowns.
$\therefore$ (x, y) has infinite values. Choice (C)

13. Two equations $a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$ where x and y are variables and a_1, b_1, a_2, b_2, c_1 and c_2 are all constants will have

(i) no solution if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$;

(ii) Infinite solutions if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ and

(iii) a unique solution if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$.

In the given problem, as $\frac{6}{8} \neq \frac{5}{7}$, the equations have a unique solution. Choice (B)

14. Le t the costs of each chocolate, each biscuit and each cake be ₹x, ₹y and ₹z respectively.
$3x + 4y + 5z = 34.$
$6x + 8y = 38 \Rightarrow 3x + 4y = 19$
$5z = 34 - (3x + 4y) = 15$
$z = 3$ Ans: (3)

15. Let the two-digit number be $10a + b$.
Given $(10a + b) + (10b + a) = k(a + b)$
$\Rightarrow 11(a + b) = k(a + b) \quad \Rightarrow k = 11 (\because a + b \neq 0)$.
Choice (C)

Exercise – 1(a)

1. $199x + 201y = 1001 \quad \rightarrow \quad (1)$
$201x + 199y = 999 \quad \rightarrow \quad (2)$
Adding (1) and (2)
$400 (x + y) = 2000 \Rightarrow x + y = 5 \rightarrow \quad (3)$
Subtracting (2) from (1);
$2(y - x) = 2 \Rightarrow y - x = 1 \quad \rightarrow \quad (4)$
Solving (3) and (4), we get $x = 2$, $y = 3$ Choice (A)

2. Let $= \frac{1}{2x + 3y} = u$ and $\frac{1}{3x + 2y} = v$
$\Rightarrow 16u - 7v = 1 \quad \rightarrow \quad (1)$
and $\frac{8u}{3} + 21v = \frac{10}{3}$
i.e., $8u + 63v = 10 \quad \rightarrow \quad (2)$
Solving (1) and (2),
$u = \frac{1}{8}, v = \frac{1}{7}$
$\therefore 2x + 3y = 8 \quad \rightarrow \quad (3)$
and $3x + 2y = 7 \quad \rightarrow \quad (4)$
Solving (3) and (4), we get; $x = 1$, $y = 2$ Choice (B)

3. Let x be the length of the longer piece.
$x + \frac{4}{7}x = 77 \Rightarrow x = 49.$
$\frac{3}{14}$ of 49 = 10.5.
$\therefore$ Required length is 10.5 m. Ans: (10.5)

4. Let the number of 10 paise coins be x and that of the 25 paise coins be y.
$x + y = 70 \quad \rightarrow \quad (1)$
$10x + 25y = 1000 \quad \rightarrow \quad (2)$
From (1) and (2) $x = 50$ and $y = 20$.
$\therefore$ He has twenty 25-paise coins with him. Choice (A)

5. Let the numbers be x and y. Let x^2 be greater than y^2.

$x + y = 200 \quad \rightarrow \quad (1)$
$x^2 - y^2 = 8000 \Rightarrow (x - y)(x + y) = 8000$
$\Rightarrow x - y = 40 \quad \rightarrow \quad (2)$
$\therefore x = 120$ and $y = 80$ Choice (C)

6. Let the numerator be x and the denominator be y.
Now, $\frac{x+1}{y+3} = 1/2 \quad \Rightarrow 2x - y = 5 \quad \rightarrow \quad (1)$
and, $\frac{x+2}{y+7} = \frac{2}{5} \Rightarrow 5x - 2y = 4 \quad \rightarrow \quad (2)$
Solving (1) and (2), we get x = 2 and y = 3
$\therefore$ The required fraction is 2/3. Choice (D)

7. Let the amount of money with Ajay be ₹x and that with Vijay be ₹y.
$x - 30 = y \Rightarrow x - y = 30 \quad \rightarrow \quad (1)$
and, $x + 20 = (y - 20) + 70$
$\Rightarrow x - y = 30 \quad \rightarrow \quad (2)$
Since, the two equations are the same, the value of x (or y) cannot be uniquely determined. Choice (D)

8. Given that, $(a + b) = 2(a - b) \rightarrow (1)$
a = 3b, a must be a multiple of 3 (as b is an integer). (a, b) can be (3, 1), (6, 2) or (9, 3). So, there are three numbers which satisfy the given condition.
Ans: (3)

9. Let the number be 10x + y
$x + y = 3(x - y)$ ($\because xy > yx$) $\Rightarrow 2x = 4y$
or, $x = 2y \quad \rightarrow \quad (1)$
Also, $(10x + y) - (10y + x) = 36$
$\Rightarrow 9x - 9y = 36 \Rightarrow x - y = 4 \quad \rightarrow \quad (2)$
$\therefore y = 4$ and $x = 8$
$\therefore$ The number is <u>84.</u> Ans: (84)

10. Let the three digit number be 100x + 10y + z
Now, $(100x + 10y + z) - (100z + 10y + x) = 297$
$\Rightarrow 99(x - z) = 297$
$\Rightarrow x - z = 3 \quad \rightarrow \quad (1)$
Also, $y + z = x - z = 3$
$x = 2z \quad \rightarrow \quad (3)$
Substituting (3) in (1) gives $z = 3 \Rightarrow x = 6$ and $y = 0$
$\therefore$ The required number is 603. Choice (C)

11. Let, the present age of the man be x years and that of the son be y years.
$x - 4 = 3(y - 4) \quad \Rightarrow x - 3y + 8 = 0 \quad \rightarrow \quad (1)$
and $x + 8 = 2(y + 8) \Rightarrow x - 2y - 8 = 0 \quad \rightarrow \quad (2)$
Solving (1) and (2), we get;
x = 40 and y = <u>16</u> Ans: (16)

12. Let the present ages of Ram, Sita and their daughter be r, s and d respectively.
$\frac{r + s + d}{3} = 35$
$\Rightarrow r + s + d = 105 \quad \rightarrow \quad (1)$
$s + 15 = r + d$
Substituting r + d as s + 15 in (1), we get $2s + 15 = 105$
$\Rightarrow 2s = 90 \Rightarrow s = 45$ years
Ans: (45)

13. Let the present age of 'X' be x years.
$\therefore$ present age of Y = (63 – x) years.
Present age of Y = past age of 'X' = 63 – x
The difference between their past and present ages
= x – (63 – x)
= 2x – 63
$\therefore$ Past age of Y = Present age of Y–difference of ages.
= (63 – x) – (2x – 63) = 126 – 3x
Present age of X = 2(past age of Y)
x = 2(126 – 3x) = 252 – 6x
$\Rightarrow 7x = 252 \Rightarrow x = 36$. Choice (C)

14. Let the present age of the person be f, and the son be s.
$(f - 6) = 2 + 5(s - 6) \Rightarrow f - 5s = -22 \quad \rightarrow \quad (1)$
$f + 4 = -2 + 3(s + 4)$
$f - 3s = 6 \rightarrow \quad (2)$
On solving, s = 14, f = 48
$f + s + 2x = 100$
$62 + 2x = 100 \Rightarrow x = 19$ Choice (C)

15. (a) The equation dependent on the first two given equations can be written as $(3x + 2y - 7z - 56) + k(5x + 3y + z - 16) = 0$. This can be written as
$x(3 + 5k) + y(2 + 3k) + z(-7 + k) + (-56 - 16k) = 0 \rightarrow (1)$
As the given equations are dependent, the corresponding coefficients of the third equation and equation (1) are proportional.
$$\frac{p}{3+5k} = \frac{12}{2+3k} = \frac{-19}{-7+k} = \frac{-200}{-(56+16k)}$$
$$\Rightarrow \frac{12}{2+3k} = \frac{-19}{-7+k} \Rightarrow k = 2/3.$$
Put the value of k in (1), we get,
$$x\left(3+\frac{10}{3}\right) + y\left(2+\frac{6}{3}\right) + z\left(-7+\frac{2}{3}\right) - \left(56+\frac{32}{3}\right) = 0.$$
$19x + 12y - 19z = 200$. So p = <u>19.</u> Ans: (19)

(b) For the equations to have infinitely many solutions.
$\frac{2}{k} = \frac{k-2}{12} = \frac{1}{3}$ must be satisfied
$\frac{2}{k} = \frac{1}{3} \Rightarrow k = 6$ Ans: (6)

(c) $4x + 5y = 32 \quad \rightarrow \quad (1)$
and $6x + 7.5y = k \quad \rightarrow \quad (2)$
As (1) and (2) are not inconsistent, i.e., consistent, equation (1) x 1.5 must be equal to equation (2).
$\therefore$ Value of $k = \frac{32 \times 3}{2} = 48$ Ans: (48)

16. Let, the cost of each ball, each bat and each pair of gloves be x, y and z respectively.
$2x + 3y + 8z = 2500$
$4x + 5y + 10z = 4000$
From the two equations, the value of y cannot be uniquely determined. Choice (D)

17. Let, the cost of each pen, each ruler and each refill be x, y and z respectively.
$3x + 4y + 5z = 75 \quad \rightarrow \quad (1)$
$6x + 7y + 10z = 138 \quad \rightarrow \quad (2)$
$2 \times (1) - (2); \quad \Rightarrow y = 12$
$\therefore 3x + y + 5z = (3x + 4y + 5z) - 3y$
$= 75 - 3 \times 12 = 75 - 36 = 39$ Choice (A)

18. $2P + E + 3S = 23 \quad \rightarrow \quad (1)$
$6P + 3E + 1S = 29 \quad \rightarrow \quad (2)$
$14P + 7E + 7S = 91 \quad \rightarrow \quad (3)$
$(1) \times 3 - (2)$
$8S = 40 \Rightarrow S = 5$
Substituting S in (3)
$14P + 7E = 56 \Rightarrow 2P + E = 8$
Also from $(1) \Rightarrow 2P + E = 8$
So, cannot be determined. Choice (D)

19. Let the number of ₹2, ₹5 and ₹10 notes in the bag be denoted by a, b and c respectively.
$a + b + c = 120 \quad \rightarrow \quad (1)$
$2a + 5b + 10c = 760 \quad \rightarrow \quad (2)$
$2a + 5(2b) + 10c = 960 \quad \rightarrow \quad (3)$
$\Rightarrow 2a + 10b + 10c = 960$
$\Rightarrow 2a + 10(120 - a) = 960$
$a = 30$
Subtracting (2) from (3),
$5b = 200$
$b = 40$
Substituting a and b in (1), c = <u>50.</u> Ans: (50)

Solutions for questions 20 and 21:

Let, the number of pens, erasers and rulers be p, e and r respectively.
$p > e > r$ and $p \geq 10$, $e \geq 10$, $r \geq 10$
$p + e + r = 35$
If r = 10, there are two possibilities, p = 14, e = 11 or p = 13, e = 12.
r cannot take a value greater than or equal to 11, since if r = 11, p + e = 24, which is not possible.
$\therefore$ r = 10

20. r = 10**.** Ans: (10)

21. Minimum amount spent
$= 13 \times 20 + 12 \times 5 + 10 \times 2 = \underline{340}$ Ans: (340)

Solutions for questions 22 and 23:

Let the number of toys actually sold be 10x + y.
Now, $10x + y - (10y + x) = 72$
$\Rightarrow x - y = 8$
$\therefore$ x = 9, y = 1 and x = 8, y = 0 are the only possible solution sets.

22. 10x + y can be 91. Choice (C)

23. Faulty selling price = 1577/19 ($\because \frac{1577}{8}$ is not an integer) = 83
$\therefore$ Actual selling price of each toy = ₹38 Choice (A)

24. Let the gambler start with an amount x and after the first round he had (3x – p).
After second round he had [2 (3x – p) – 3p]. After third round he had 4 [2 (3x – p) – 3p] – 2p viz 0 (given). $\rightarrow$ (1)

p + 2p + 3p = 360 (given) $\rightarrow$ (2)
from (2) $\Rightarrow$ p = ₹60 $\rightarrow$ (3)
From (3) and (1) x = $\underline{₹55}$ Ans: (55)

25. The duration from 2:00 a.m to 8: 00 a.m , which is 360 minutes, is the sum of 3 parts – t minutes, 40 minutes and 3t minutes.
$\therefore$ t + 40 + 3 t = 360 min
4t + 40 =360 min
4t = 320 min $\Rightarrow$ t = 80 min
Present time = 8:00 a.m – 80 min = 6:40 a.m
Choice (B)

26. Let the number of questions answered correctly, answered wrongly and unanswered by the student be C, W and U respectively.

$C + W + U = 120$ and $C - \frac{1}{3}W - \frac{1}{6}U = 60$.

$C + W + U - (C - \frac{1}{3}W - \frac{1}{6}U) = 120 - 60$ i.e. $\frac{4}{3}W + \frac{7}{6}U = 60$

Multiplying both sides by 6, we get 8W + 7U = 360.
As 360 is divisible by 8, 8W + 7U must also be divisible by 8.
$\therefore$ 7U must be divisible by 8. If U is not divisible by 8, 7U will not be divisible by 8. But 7U is divisible by 8.
$\therefore$ U must be divisible by 8 ------ (1)
7U cannot exceed 360.

$\therefore$ U cannot exceed $\frac{360}{7}$ i.e. $51\frac{3}{7}$ -------- (2)

From (1) and (2), maximum value of U is 48. Also when U is maximum, W is minimum.

$\therefore$ Min (W) = $\frac{360 - 7(48)}{8} = 3$. Ans: (3)

27. The left pan weighs 0.6 kg and the right one weighs 0.95 kg. When the pans level, the total weights on the two sides are equal.

The two weighings are shown in the tables below. Let the actual weight of the rice be r kg.

L	R	L	R
0.6	0.95	0.6	0.95
r	ab	ba + 18.7	r

'ab' is 0.35 less than r.
'ba' +18.7 is 0.35 more than r.
$\therefore$'ba' +18.7 is 0.7 more than ab
ie. 'ba' + 18 is equal to 'ab' (ie a>b)
$\therefore$ 10b + a + 18 = 10a + b
$\Rightarrow$ a–b = 2.
($\therefore$ ab could be 20 ,31,42,53,64,75,86, or 97)
The weight of the rice is ab + 0.35, ie., it could be 20.35, 31.35, ...or 97.35.
From the options given, it can be 53.35. Choice (D)

28. The number of chocolates with Balu at different stages can be tabulated as below.

	Numbers given	Balu has
		78
To eldest son half + 3	39 + 3	36
To second eldest son (one third + 4)	12 + 4	20
To youngest son (one fourth + 4)	5 + 4	11

After giving 4 more than one-fourth to the youngest son he is left with 11 which means that Balu was left with 4 less than three – fourths. (11 + 4) is three fourths and hence 5 is one fourth. He has 20 chocolates before giving to his youngest son. Similarly he has 36 and 78 before giving to his second eldest son and his eldest son respectively.
Choice (B)

29. Let the amounts with Prakash, Sameer, Ramesh and Tarun be ₹p, ₹s, ₹r and ₹t respectively.
p + s + r + t = 240

$p = \frac{1}{2}(s + r + t) = \frac{240 - p}{2}$

$p = \frac{1}{3}(240) = 80$

So half of the total amount with the others has become one-third of the total amount.

Similarly, $s = \frac{1}{4}(240) = 60$ and $r = \frac{1}{5}(240) = 48$

t = 240 – (p + s + r) = $\underline{52}$ Ans: (52)

30. Let the number of chocolates with first boy = f
Let the number of chocolates with last boy = l
Number of chocolates with the boys 2 to 9 = m
given f = l + m + 1 $\rightarrow$ (1)
and l + 9 = f – 4 $\rightarrow$ (2)
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(1) + (2) f + l + 9 = l + f + m – 3

$\Rightarrow$ m = 12 Ans: (12)

Exercise – 1(b)

1. $\frac{x}{2} + 2y = 14 \Rightarrow x + 4y = 28$ $\rightarrow$ (1)

$3x + \frac{y}{6} = 13 \Rightarrow 18x + y = 78$ $\rightarrow$ (2)

(2) $\times$ 4 – (1)

$x = \frac{284}{71}$ = 4 and substituting x in (1) we get y = 6

Choice (B)

2. $8(x + 5) + 7(y – 2) = –5$
$\Rightarrow 8x + 7y = –31 \quad \rightarrow \quad (1)$
$2(x + 6) – \frac{4 – y}{5} = 5$
$\Rightarrow 10x + y = –31 \quad \rightarrow \quad (2)$
10 $\times$ equation (1) – 8 $\times$ equation (2) : we get x = –3, Substituting x = –3 in (1) or (2) we get y = –1.
Choice (C)

3. $\frac{x}{4} + 2y = 7 \Rightarrow x + 8y = 28 \quad \rightarrow \quad (1)$
$\frac{19}{x + y/4} = 4 \Rightarrow 4x + y = 19 \quad \rightarrow \quad (2)$
8 (2) – (1):
$\Rightarrow$ x = 4 and substituting in (1) we get y = 3.
Choice (C)

4. Let the number of pencils with P and Q be 5x and 3x respectively.
Given $5x – 3x = 2x = 18 \Rightarrow x = 9$
$\therefore$ Total number of pencils = $5x + 3x = 8x = \underline{72}$
Ans: (72)

5. Let the number of questions he answered correctly be x. Then for 50 – x questions were answered wrongly.
Total marks scored by the student
$= x \times 3 – (50 – x)1 = 90 \Rightarrow x = \underline{35.}$ Ans: (35)

6. Let the sum of their ages today be 'x'
Sum 18 years ago = x – 36
$\therefore x – 36 = 1/2(x)$
x = 72
A + B = 72 and A = 2B
$\therefore$ A = 48 and B = 24. Ans: (48)

7. Let the number be x
$\frac{7}{3}x – \frac{3}{7}x = 1680 \Rightarrow \frac{40}{21}x = 1680$
$x = 42 \times 21 = 882$ Choice (A)

8. Let the number of 25 paise and 20 paise coins be a and b respectively.
25a + 20b= 1400
25b + 20a = 1300
Adding both equations, 45 (a + b) = 2700
$\Rightarrow$ a + b = $\underline{60}$ Ans: (60)

9. Let Ganesh's present age be g years.
Govind's present age = 4g years.
4g + 20 = 2 (g + 20)
g = 10 Choice (B)

10. Let Bharan's present age be b years.
Alok's age 5 years ago = 5 (b – 5) years.
Alok's present age = [5 (b – 5) + 5] years.
Alok's age 5 years hence,
5 (b – 5) + 5 + 5 = 3 (b + 5) (given).
$\therefore$ b = $\underline{15.}$ Ans: (15)

11. Let Praveen's present age be x years and that of Mahesh be y years.
$x = 2(y – 4) \Rightarrow x –2y + 8 = 0 \quad \rightarrow \quad (1)$
$x + 8 = 2y \Rightarrow x – 2y + 8 = 0 \quad \rightarrow \quad (2)$
Since the two equations are the same, the sum of their present ages cannot be uniquely determined.
Choice (D)

12. Let the age of Alok and Alakhnanda be A years and L years respectively.
$A = 5/3 (L) \quad \rightarrow \quad (1)$
$L = 3[L – (A – L)]$
$L = 6L – 3A \Rightarrow 5L = 3A \rightarrow \quad (2)$
(1) and (2) are dependent equations. Hence, more than one answer can be obtained. So, the given data is insufficient.
Choice (D)

13. Let the present ages of Ajay and Bala be a years and b years respectively.
$a – 20 + b – 20 = \frac{5}{9}(a + b)$
$a + b = 90 \quad \rightarrow \quad (1)$
$a – b = 20 \quad \rightarrow \quad (2)$
Solving (1) and (2), a = $\underline{55}$ Ans: (55)

14. Let the present ages of the father and the son be F years and S years respectively.
$F – 10 = 6(S – 10) – 20 \Rightarrow F = 6S – 70$
$F + 10 = 3 (S +10) – 30 \Rightarrow F = 3S – 10$
$F = 6S – 70 = 3S – 10$
S = 20.F = 50
F + S = 70
For their combined age to become
90 years each person's age must increase by 10 years
$\therefore$ After 10 years their combined age will become 90 years.
Choice (B)

15. Let, the two –digit number be 10x + y
$10x + y = 8(x + y) –16$
$\Rightarrow 2x – 7y + 16 = 0 \rightarrow \quad (1)$
$y = \frac{2(x+8)}{7}$. The only possible value of y is 4.
This occurs when x is 6.
$\therefore$The required number is 64. Choice (C)

16. $14 + \frac{x}{4} + \frac{x}{4} = 4x$
$\Rightarrow 4x – \frac{x}{2} = 14$
$\Rightarrow \frac{7x}{2} = 14$
$\Rightarrow x = 4$
$\therefore$Present age = $14 + \frac{x}{4} = 15$
5x years from now, his age will be $15 + 5 \times 4 = \underline{35}$ years.
Ans: (35)

17. Let the counter price of each ticket be x.
Cost of 2 counter tickets = $2 \times x$.
Cost of 2 extra tickets = 2(x + 50)
Total amount = 4x + 100
Total money they spent = $4 \times 60 = 240$.
$\therefore$ 4x + 100 = 240.
$\Rightarrow$ x = 35. Ans: (35)

18. Let the two-digit numbers be 'ab' and 'pq'.
Given $a = \frac{3}{2}p$ and 10a + b + 10p + q = 158.
$\Rightarrow 158 > 10a + 10p > 140$
$\Rightarrow 158 > 25p > 140$
$\Rightarrow$ p = 6 and a = 9
Hence b + q = 8
$\therefore$ The numbers can be (60, 98) or (61, 97),.....(68, 90)
Hence the difference can be 38, 36, ..., 22
$\therefore$ The difference can be any even number from 22 to 38.
Choice (C)

19. Let 100a + 10b + c be the number
$\therefore$ a – b = b – c (or) a – b = c – b
$\Rightarrow$ a + c = 2b (or) a = c
When a + c = 2b and a + b + c = 9,b = 3 and a + c = 6.
Hence a can have values 1 to 6. i.e., six possible numbers.
When a = c, the possible numbers are 171, 252, 333 and 414, i.e. 4 possible numbers. But 333 is common to both.
The number of possible numbers = 6 + 4 –1 = 9
Ans: (9)

20. Let the number be abc.
$a + b + c = 18 \rightarrow \quad (1)$
a = 9c
$\therefore$ (a, c) = (9, 1)
From (1), abc = 981. Ans: (981)

21. Let the number of chocolates received by A, B, C and D be a, b, c, and d respectively.
$a + b + c + d = 225 \rightarrow$ (1)
$a + d = 2 (b + c)$
Substituting $a + d$ as $2(b + c)$ in equation (1) we get
$3 (b + c) = 225 \Rightarrow b + c = 75$
As $b = c + 15$,
$c + 15 + c = 75$
$c = \underline{30.}$ Ans: (30)

22. Let $\frac{x}{y}$ be the fraction.

$\frac{x+2}{y+1} = \frac{13}{15} \rightarrow$ (1)

and $\frac{x-4}{y-4} = \frac{4}{5} \rightarrow$ (2)

Solving (1) and (2) we get
$x = 24$ and $y = 29$
Alternative method : From answers, after verification, the fraction $\frac{24}{29}$ satisfies both the conditions. Choice (C)

23. Let the number of sons and daughters of Sharma be s and d respectively. $\therefore$ Ajay has $s - 1$ brothers and d sisters

$s - 1 = \frac{1}{2}d \rightarrow$ (1)

Sita has $d - 1$ sisters and s brothers
$s = d - 1$

Substituting $s = d - 1$ in equation (1), $d - 2 = \frac{1}{2}d$

$\Rightarrow 2d - 4 = d$
$d = 4$
$s = d - 1 = 3$
Number of children of Sharma = $s + d = 7$. Ans: (7)

24. Let the price per kg of Oranges, Mangoes, Bananas and Grapes be ₹R, ₹M, ₹B and ₹G respectively.
Given that

$5R + 2M = 310 \rightarrow$ (1)
$3M + 3.5B = 230 \rightarrow$ (2)
$1.5B + 5G = 160 \rightarrow$ (3)

(1) + (2) + (3) $\Rightarrow 5R + 5M + 5B + 5G = 700$
$\therefore 10R + 10M + 10B + 10G = 2 \times 700 = \underline{1400}$
Ans: (1400)

Solutions for questions 25 and 26:

Let the numbers of apples, bananas and oranges Arjun bought be a, b and r respectively.
$r > b > a \geq 13$
$a + b + r = 45$
$\therefore$ the possibilities for (a, b, r) are (13, 14, 18), (13, 15, 17) and (14, 15, 16)

25. $b < 15$
$\therefore r = 18$ Ans: (18)

26. Total expenditure = ₹ $(3r + 4b + 5a)$
$\therefore$ Its minimum value = 175
The total expenditure would be minimum when minimum possible number of the costliest fruits and maximum possible number of the cheapest fruits are bought. So, this happens for $a = 13$, $b = 14$, $r = 18$. Ans: (175)

27. $a + 7b + 3c + 5d = 0 \rightarrow$ (1)
$8a + 4b + 6c + 2d = -16 \rightarrow$ (2)
$2a + 6b + 4c + 8d = 16 \rightarrow$ (3)
$5a + 3b + 7c + d = -16 \rightarrow$ (4)
Adding (1) and (4), we have
$6(a + d) + 10(b + c) = -16$
Adding (2) and (3), we have $10(a + d) + 10(b + c) = 0$.
$\therefore a + d = 4$. And $(b + c) = -4$.
$\therefore (a + d)(b + c) = -16$. Choice (C)

28. (i) If the equations given have infinite solutions,

$\frac{p}{2} = \frac{q}{3} = \frac{66}{8}$

$\therefore p = \frac{66}{4}$ and $q = \frac{99}{4}$

$\therefore 4(p + q) = \underline{165.}$ Ans: (165)

(ii) The equation given will have no solution if

$\frac{p}{2} = \frac{q}{3}$ and neither $\frac{p}{2}$ nor $\frac{q}{3}$ is $\frac{66}{8}$

As $q = 9$, $p = 6$

Note : The equations given will have a unique solution if $\frac{p}{2} \neq \frac{q}{3}$. Ans: (6)

29. Let the four-digit number be abcd.
$b + c = a + d \rightarrow$ (1)
$b + d = 5(a + c) \rightarrow$ (2)
$\Rightarrow a + b + c + d = 6(a + c)$
Given that $a + b + c + d = 6(a + c) = 18$
$\Rightarrow a + c = 3 \Rightarrow b + d = 15$
$\Rightarrow$ (b, d) = (6, 9), (7, 8), (8, 7), (9, 6) and (a, c) = (1, 2), (2, 1), (3, 0) as $a \neq 0$.
But according to (1), we have $a + d = b + c$
$\Rightarrow$ (a, b, c, d) = (1, 7, 2, 8), (2, 8, 1, 7), (3, 9, 0, 6)
$\therefore$The hundreds digit can be 7, 8 or 9.
So, their sum is 7 + 8 + 9 = 24 Choice (B)

30. Let the number be ab
$ab = 4(a + b) - 12$
$10a + b = 4(a + b) - 12$
$2(a + 2) = b$
If $a = 1$, $b = 6$
If $a = 2$, $b = 8$
If $a \geq 3$, the digit b exceeds 9.
$\therefore$ab could be 16 or 28
Only 16 satisfies the second condition given.
Choice (A)

31. Let the number of chocolate boxes with Ramu in the beginning be x.
He sold $\left(\frac{1}{2}x + \frac{1}{2}\right)$ boxes to the first customer. He would be left with $\left(\frac{x}{2} - \frac{1}{2}\right)$ boxes. He sold $\frac{1}{2}\left(\frac{1}{2}x - \frac{1}{2}\right) + \frac{1}{2} = \left(\frac{1}{4}x + \frac{1}{4}\right)$ boxes to the second customer. He would be left with $\left(\frac{1}{4}x - \frac{3}{4}\right)$ boxes. He sold $\frac{1}{2}\left(\frac{1}{4}x - \frac{3}{4}\right) + \frac{1}{2} = \left(\frac{1}{8}x + \frac{1}{8}\right)$ boxes to the third customer. He would be left with $\left(\frac{1}{8}x - \frac{7}{8}\right)$ boxes.
It can be seen that to the n^{th} customer he would have sold $\left(\frac{1}{2}\right)^n (x+1)$ boxes. After that he would be left with $\left(\frac{1}{2}\right)^n x - \left(1 - \left(\frac{1}{2}\right)^n\right)$ boxes.

Since n = 10, $\frac{x}{1024} = 1 - \frac{1}{1024}$

$\Rightarrow x = 1023$ Choice (C)

32. All the amounts are in rupees. Let us assume that he started the game with rupees A. Amount with him at the end of the first round = Rupees $(2A - x)$.
Amount with him at the end of the second round = Rupees $2(2A - x) - x$ = Rupees $(4A - 3x)$
Amount with him at the end of the third round = rupees $2(4A - 3x) - x$ = rupees $(8A - 7x)$.

It can be seen that the amount with him at the end of the nth round = rupees $(2^n A - (2^n - 1)x)$

The amount with him at the end of the 10^{th} round $= 1024A - 1023\,x = 1023 \Rightarrow \frac{A}{x+1} = \frac{1023}{1024}$

$\therefore$ x + 1 must be divisible by 1024

$\therefore$ least possible value of x = 1023

Sum of its digits is 6. Ans: (6)

Solutions for questions 33 and 34:

Let the actual number of toys sold be 'ab'.

As the stock left showed 81 items more than what it actual was, the mistaken number of items sold must be 81 less than the actual number sold.

$\therefore$ 'ab' – 'ba' = 81 $\Rightarrow$ (10a + b) – (10b + a) = 81

$\Rightarrow$ a – b = 9

$\therefore$ a = 9 and b = 0

33. There is only one possibility. Ans: (1)

34. Actual selling price = reverse of $\frac{486}{\text{'ba'}}$

= Reverse of $\frac{486}{9}$ = ₹45 Ans: (45)

35. Let the amount with him at the start of the game be ₹A.

Amounts (in ₹) with him at the ends of the first, second and third rounds are 2A – X, 4A – 3X and 8A – 7X respectively.

Given, (8A – 7X) – (4A – 3X + 2A – X) = 140

2A – 3X = 140 $\rightarrow$ (1)

4A – 3X – (2A – X) = 160

A – X = 80 $\rightarrow$ (2)

Solving (1) and (2), X = 20 Choice (B)

36. Two equations $a_1 x + b_1 y + c_1 z = k_1$ and $a_2 x + b_2 y + c_2 z = k_2$ have a unique solution of z only if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

Combining the given equation with the equation in either statement, the above condition is not satisfied. Combining both statements, as we have three independent equations and three unknowns, a unique solution of z is possible.

Hence both statements taken together are sufficient.

Choice (C)

37. After the coins are exchanged the possible combinations of notes that Guru has are as follows.

₹50	₹100	Total
2	4	6
4	3	7
6	2	8
8	1	9

From statement I, It follows that he has two 50 rupee notes.

$\therefore$ Statement I alone is sufficient

From statement II, it follows that he has four, six, or eight 50-rupee notes.

$\therefore$ Statement II alone is not sufficient. Choice (A)

38. Let my current age be x years and my sister's current age be y years.

Using either statement, we get one equation in two unknowns.

$\therefore$ x cannot be found.

$\therefore$ Either statement alone is not sufficient.

Using both statements, as we have two equations in two unknowns, x and y can be found Choice (C)

39. Using statement I, I scored 16 marks. But we cannot determine the number of attempts from this information.

$\therefore$ Statement I is not sufficient.

Statement II is clearly not sufficient. (It gives no information about my attempts.)

Combining both statements, let x and y be the numbers of questions answered correctly and wrongly by me respectively.

$x - \frac{1}{4}y = 16$ …….(1)

x + y ≤ 25 …… (2)

Subtracting (1) from (2), $\frac{5}{4}y \leq 9$

$y \leq \frac{36}{5}$

For (1) to be satisfied y must be divisible by 4.

$\therefore$ y can be 0 or 4 only. If y =0, x = 16

If y = 4, x = 17.

$\therefore$ x + y is not unique. Choice (D)

40. Two equations $a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$ have a unique solution if and only if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$. Combining the given equation with the equation in statement I, the above condition is not satisfied. Combining it with equation in statement II, this condition is satisfied.

$\therefore$ Statement II alone is sufficient. Choice (A)

Chapter – 2
(Ratio – Proportion – Variation)

Concept Review Questions

1. Number of sweets that Rani got = $\frac{4}{7}(35) = 20$. Ans: (20)

2. $\frac{p}{q} = \frac{3}{4}$

$\frac{5p}{7q} = \frac{5}{7}\left(\frac{3}{4}\right) = \frac{15}{28}$ Choice (C)

3. Let the numbers be 3x and 5x.

3x + 5x = 40

x = 5

Smaller of the two numbers = 3x = 15

Alternately, smaller number = $\frac{3}{8}(40) = 15$. Ans: (15)

4. Let a = 7x and b = 3x.

a + b = 10x and a – b = 4x.

a + b : a – b = 10x : 4x = 5 : 2. Choice (A)

5. $\frac{a+b}{a-b} = \frac{3}{2} \Rightarrow 2a + 2b = 3a - 3b$

$5 = \frac{a}{b} \Rightarrow \frac{a}{b} = \frac{5}{1} \Rightarrow a : b = 5 : 1$ Choice (A)

6. Given that, $\frac{x+y}{2x+y} = \frac{4}{5}$

$\Rightarrow 5(x + y) = 4(2x + y)$

$\Rightarrow 5x + 5y = 8x + 4y \Rightarrow y = 3x$

Now, $\frac{2x+y}{3x+y} = \frac{2x+3x}{3x+3x} = \frac{5x}{6x} = \frac{5}{6}$. Choice (B)

7. $x = \frac{1}{2}y \Rightarrow \frac{x}{y} = \frac{1}{2}$

$y = \frac{2}{3}z \Rightarrow \frac{y}{z} = \frac{2}{3}$

So, x : y : z = 1 : 2 : 3

So, $z = \frac{3}{6} \times 120 = 60$. Ans: (60)

8. Given that a : b = 4 : 1.

$\frac{a}{b}=\frac{4}{1}$

$a = 4b$

$\frac{a-3b}{2a-b^2}=\frac{4b-3b}{2(4b)-b^2}$ ($\because a = 4b$)

$= \frac{b}{8b-b^2} = \frac{1}{8-b}$.

But as we don't know the value of 'b', the question cannot be answered. Choice (D)

9. (a) Duplicate ratio of a : b is $a^2 : b^2$

$\Rightarrow$ Duplicate ratio of 3 : 4 is $3^2 : 4^2 = 9 : 16$.

Choice (D)

(b) Triplicate ratio of a : b is $a^3 : b^3$

$\Rightarrow$ Triplicate ratio of 2 : 3 is $2^3 : 3^3 = 8 : 27$.

Choice (C)

(c) Sub-duplicate ratio of a : b is $\sqrt{a} : \sqrt{b}$

$\Rightarrow$ Sub-duplicate ratio of 16 : 9 is $\sqrt{16} : \sqrt{19} = 4 : 3$.

Choice (B)

(d) Mean proportion of a, b is $\sqrt{ab}$.

$\Rightarrow$ Mean proportion of 16, 4 is $\sqrt{16\times 4} = 8$.

Choice (C)

10. Let the numbers be a, b and c.

Given that a, b and c are in the ratio 3 : 2 : 4.

a : b : c = 3 : 2 : 4

Let, a = 3x, b = 2x and c = 4x

Given, (a + b) + (c – b) = 21

$\Rightarrow$ a + b + c – b = 21 $\Rightarrow$ a + c = 21

$\Rightarrow$ 3x + 4x = 21 $\Rightarrow$ 7x = 21

$\Rightarrow$ x = 3

a, b, c are 3x, 2x, 4x.

$\therefore$ a, b, c are 9, 6, 12. Choice (D)

11. Among the given options, 4 : 5 can't be the ratio of boys and girls because 30 is not divisible by (4 + 5) viz 9.

Choice (C)

12. $a : b : c = (5\times 2) : (5\times 3) : 7\times 3 = 10 : 15 : 21$.

Choice (A)

13. Number of gents at the party do not change.

It is = $\frac{4}{7}(28) = 16$.

Initial number of ladies = (3/7) 28 = 12

After x ladies join, the number of ladies would be 5/4 (Number of gents) = 20

$\therefore$ x = 20 – 12 = 8 Ans: (8)

14. Let the monthly salaries of X and Y be ₹3x and ₹4x respectively. Let the monthly expenditures of X and Y be ₹4y and ₹5y respectively.

Ratio of the monthly savings of X and Y

$= \frac{3x-4y}{4x-5y} = \frac{3\frac{x}{y}-4}{4\frac{x}{y}-5}$.

As $\frac{x}{y}$ is unknown, the ratio cannot be found.

Choice (D)

15. Let the present ages of Rohit and Sunil be 3x years and 5x years respectively. The ratio of their ages 10 years hence

$= \frac{3x+10}{5x+10}=\frac{4}{5}$

15x + 50 = 20x + 40

2 = x

Therefore Rohit's present age is 6 years. Ans: (6)

16. $x \alpha y^2$

$\frac{x_1}{y_1^2} = \frac{x_2}{y_2^2}$

$\frac{192}{(8)^2} = \frac{x_2}{(10)^2}$

$x_2 = 300$. Choice (C)

17. $a \alpha \frac{1}{b}$

$a_1b_1 = a_2b_2$

If $a_1 = 8$, $b_1 = 240$ and $a_2 = 6$,

$b_2 = \frac{a_1 b_1}{a_2} = \frac{(8)(240)}{6} = 320$ Ans: (320)

18. $A \alpha (B + C)$

Let A = K (B + C) where K is the proportionality constant.

If $B_2 = B_1 + 2$ and $C_2 = C_1 + 4$,

$A_1 = K (B_1 + C_1)$ and $A_2 = K (B_1 + 2 + C_1 + 4)$

$A_2 – A_1 = 6K$

As K is unknown, $A_2 – A_1$ cannot be found.

Choice (D)

19. $P \alpha \frac{1}{QR}$

$\frac{P_1}{P_2} = \frac{Q_2 R_2}{Q_1 R_1}$

If $P_1 = 75$, $Q_1 = 6$, $R_1 = 12$, $Q_2 = 5$

and $R_2 = 10$, $P_2 = \frac{P_1Q_1R_1}{Q_2R_2}$.

$= \frac{(75)(6)(12)}{(5)(10)} = 108$. Ans: (108)

20. Given that $A \alpha B$ and $A \alpha \frac{1}{C}$.

$A \alpha \frac{B}{C} \Rightarrow A = \frac{KB}{C}$

Given that A = 16 when B is 28 and C is 7.

So, $16 = K\times \frac{28}{7} \Rightarrow 16 = K\times 4 \Rightarrow K = 4$.

If B is 9 and C is 6, then

$A = K\frac{B}{C} = 4\times\frac{9}{6} = 6$. Choice (A)

Exercise – 2(a)

1. Given that $\frac{a}{b}=\frac{2}{3}$ and $\frac{p}{q}=\frac{3}{4}$

$a = \frac{2}{3}b$ and $p=\frac{3}{4}q$

$\therefore \frac{3ap-bq}{2ap+3bq} = \frac{3\left(\frac{2}{3}b\right)\left(\frac{3}{4}q\right)-bq}{2\left(\frac{2}{3}b\right)\left(\frac{3}{4}q\right)+3bq}$

$= \frac{\frac{3}{2}bq-bq}{bq+3bq} = \frac{bq\left(\frac{3}{2}-1\right)}{4bq}=\frac{1}{8}$. Choice (C)

2. $\frac{23x^3-11y^3}{10x^3+6y^3}=\frac{3}{4}$

$4(23x^3-11y^3) = 3(10x^3+6y^3)$

$92x^3-44y^3 = 30x^3+18y^3$

$62x^3 = 62y^3$

$x^3 = y^3$ (Dividing both sides by 62). $\Rightarrow$ x = y

$\frac{x+y}{2x-y} = \frac{y+y}{2y-y} = \frac{2}{1}$. Choice (A)

3. 2x + y – 5z = 0

$3x - 2y - 4z = 0$
$y = 5z - 2x$ and $2y = 3x - 4z$
$2y = 2(5z - 2x) = 3x - 4z$
$14z = 7x$
$x = 2z$
$\therefore y = z$
$x : y : z = 2z : z : z = 2 : 1 : 1$ Choice (D)

4. Let the required quantity be x
$(a + x) : (b + x) = p : q$
$\Rightarrow (a + x)q = (b + x)p \Rightarrow aq + qx = bp + px$
$\Rightarrow (p - q)x = aq - bp$
$\therefore x = \frac{aq - bp}{p - q}$ Choice (C)

5. $\frac{10a^2 + ab}{3ab - b^2} = \frac{10}{1}$
$\Rightarrow 10a^2 + ab = 30ab - 10b^2$
$\Rightarrow 10a^2 - 29ab + 10b^2 = 0$
$\Rightarrow 10a^2 - 25ab - 4ab + 10b^2 = 0$
$\Rightarrow 5a(2a - 5b) - 2b(2a - 5b) = 0$
$\Rightarrow (5a - 2b)(2a - 5b) = 0$
either, $5a - 2b = 0 \Rightarrow a : b = 2 : 5$
or $2a - 5b = 0 \Rightarrow a : b = 5 : 2$ Choice (C)

6. Number of boys $= \frac{8}{13} \times 650 = 400$
$\therefore$ Number of girls = 250
Let x more girls be admitted
$\therefore \frac{400}{250 + x} = \frac{4}{3}$
$\Rightarrow 1200 = 1000 + 4x \Rightarrow x = 50$ Ans: (50)

7. Taking reciprocals both sides, $\frac{b}{a} = \frac{d}{c}$
$\frac{a}{b} + \frac{b}{a} = \frac{c}{d} + \frac{d}{c}$
$\frac{a^2 + b^2}{ab} = \frac{c^2 + d^2}{cd}$
$\Rightarrow \frac{a^2 + b^2}{c^2 + d^2} = \frac{ab}{cd}$. Choice (C)

8. Let the present ages of A and B be a years and b years respectively. Given a > b
$\frac{a}{b} > \frac{a+7}{b+7} > \frac{a+12}{b+12}$,
But $\left(\frac{a+7}{b+7}\right)^2 > \left(\frac{a+7}{b+7}\right)$
$\Rightarrow \left(\frac{a+7}{b+7}\right)^2 > \frac{a+12}{b+12} \quad \Rightarrow X > Y$ Choice (C)

9. Let their present ages be 5x years and 4x years respectively.
Ratio of their ages 20 years ago
$= \frac{5x-20}{4x-20} = \frac{5(x-5)+5}{4(x-5)}$ which is more than $\frac{5}{4}$.
Only choice (D) violates this condition. Choice (D)

10. Let income be 5x and expenditure be 4x.
$\therefore$ Income, $5x = 18000 \Rightarrow x = 3600$
Savings = Income – expenditure = 5x – 4x = x
So, savings = ₹3600. Ans: (3600)

11. A : B = 1 : 3/4 = 4 : 3
B : C = 1 : 1/2 = 2 : 1
$\therefore$ A: B : C = 8 : 6 : 3
Given C's share = ₹420
A's share $= \frac{8}{3} \times 420 =$ ₹1120 Ans: (1120)

12. Let the number of one rupee 50 paise and 25 paise coins be k, 2k and 4k respectively.
Now, $1 \times k + 0.5 \times 2k + 0.25 \times 4k = 75$
$\Rightarrow 3k = 75 \Rightarrow k = 25$
$\therefore$ Number of 50 paise coins = 2k = 50 Ans: (50)

13. Let the present ages of the woman, her husband and her daughter be y years, x years and z years respectively.
$y + z = 60 \quad \rightarrow$ (1)
The woman would attain her husband's age after (x – y) years.
$\therefore \frac{x+x-y}{z+x-y} = 2$
$y = 2z \quad \rightarrow$ (2)
From (1) and (2), z = 20 Choice (C)

14. Let A's share be A, B's share be B and C's share be C
A = 1/2 (B + C) and B = A + C/3
$A = \frac{1}{2}\left(\frac{A+C}{3}\right) + C \Rightarrow \frac{A+4C}{6}$
A : C = 4 : 5
Let A = 4k; C = 5k
$\Rightarrow B = \frac{9k}{3} = 3k$
4k – 3k = 500
$\Rightarrow$ k = 500
$\therefore$ Sum distributed = 12k = ₹6000 Ans: (6000)

15. Let the quantities of milk in the glasses be 3x ml, 4x ml, 5x ml, 6x ml and 7x ml. Let the volume of each glass be 100 ml. Total volume of the glasses = 500 ml
$3x + 4x + 5x + 6x + 7x = 0.6(500)$
$\Rightarrow x = 12$
The quantities of milk in the glasses are 36 ml, 48 ml, 60 ml, 72 ml and 84 ml
i.e., each of 3 glasses are filled with milk to at least 50% of their capacity. Ans: (3)

16. $P = 3Q = 4R \quad \rightarrow$ (1)
$2Q = 5S = 12T \quad \rightarrow$ (2)
Multiplying (1) by 2 and (2) by 3 gives
$2P = 6Q = 8R = 15S = 36T \quad \rightarrow$ (3)
Each of the parts equated in (3) must be a multiple of LCM (2, 6, 8, 15, 36) = 360,
P = 180, Q = 60, R = 45, S = 24 and T = 10
Substituting each of these values in the choices, we see that neither part in (D) is an integer. Choice (D)

17. Number of students in college A = 2000 + 500
= 2500 Ans: (2500)

18. Number of girls in college A $= \frac{2}{5} \times 2500 = 1000$
Number of girls in college B $= \frac{1}{5} \times 2000 = 400$
$\therefore$ Total number of girls in the two colleges together = 1000 + 400 = 1400 Ans: (1400)

19. Let Ram and Shyam have ₹4S and ₹S respectively.
If Ram spends ₹4x everyday, Shyam earns ₹x every day.
Given, $\frac{4S - 40x}{S + 10x} = \frac{12}{13} \Rightarrow S = 16x$.
Let their amounts be in the ratio 4 : 31, n days from the start.
$\frac{64x - 4nx}{16x + nx} = \frac{4}{31} \Rightarrow n = 15$.
$\therefore$After 5 more days, the ratio will be 4:31 Choice (C)

20. $\frac{a}{b} = \frac{b}{c} = k$ (say)

$\frac{a}{c} = \left(\frac{a}{b}\right)\left(\frac{b}{c}\right) = k^2$

Choice A: $\frac{a^2}{b^2} = \left(\frac{a}{b}\right)^2 = k^2$

Choice B: $\frac{a^2+b^2}{b^2+c^2} = \frac{(bk)^2+b^2}{(ck)^2+c^2} = \frac{b^2(k^2+1)}{c^2(k^2+1)}$

$= \frac{b^2}{c^2} = k^2$ Choice (D)

21. $\frac{ka}{b+c} = \frac{kb}{c+a} = \frac{kc}{a+b} = \ell$

$\Rightarrow \frac{ka}{b+c} = \ell; \frac{kb}{c+a} = \ell; \frac{kc}{a+b} = \ell$

So, $ka = \ell b + \ell c$, $kb = \ell c + \ell a$, $kc = \ell a + \ell b$

Now, $k(a + b + c) = \ell(b + c + c + a + a + b)$

$\Rightarrow k(a + b + c) = 2\ell(a + b + c)$

$(k - 2\ell)(a + b + c) = 0$

As $a + b + c \neq 0$, $k - 2\ell = 0$

$\therefore \ell = \frac{k}{2}$ Choice (C)

22. $(x + y) \alpha (x - y)$

$\Rightarrow (x + y) = k(x - y)$, when k is a constant

$\Rightarrow \frac{x+y}{x-y} = k$

Applying componendo and dividendo,

$\frac{x}{y} = \frac{k+1}{k-1} = c$ (Say)

Squaring both sides; $x^2 / y^2 = c^2$

Applying componendo and dividendo

$\frac{x^2+y^2}{x^2-y^2} = \frac{c^2+1}{c^2-1}$

$\Rightarrow (x^2 + y^2) = (c^2 + 1/c^2 - 1)(x^2 - y^2)$

$\Rightarrow (x^2 + y^2) = (a\ constant)(x^2 - y^2)$

$\therefore (x^2 + y^2) \alpha (x^2 - y^2)$

Also, $\frac{x^2+y^2}{xy} = \frac{y^2\left(1+c^2\right)}{(cy)y}$ (Since x = cy)

$= \frac{1+c^2}{c}$

$\therefore x^2 + y^2 = (1 + c^2/c)xy = (a\ constant)\ xy$

$\therefore (x^2 + y^2) \alpha xy$

$\therefore$ Both (A) and (B) are true. Choice (C)

23. $d \alpha t^2$

$\Rightarrow \frac{d_1}{t_1^2} = \frac{d_2}{t_2^2}$

$\Rightarrow \frac{144}{(6)^2} = \frac{d_2}{(7)^2}$

$\Rightarrow d_2 = 49 \times 4 = 196$ m

$\therefore$ Distance travelled in the 7th second

$= 196 - 144 = 52$ m Ans: (52)

24. Let total income = I

I = A + B, where A is the fixed amount and B is the royalty that he gets per book.

$\therefore B \alpha n$, where n is the number of books.

$\Rightarrow B = kn$ $\therefore I = A + kn$

$A + 1000k = 30000$ $\rightarrow$ (1)

And, $A + 2000k = 50000$ $\rightarrow$ (2)

Solving (1) and (2)

A = 10,000

And k = 20

$\therefore$ Total income when 5000 books are sold

$= 10000 + 20 \times 5000 = 110000$

$\therefore$ Income per book = $\frac{110000}{5000}$ = ₹22 Ans: (22)

25. Let the fixed tariff be F and the number of outgoing calls be C. If C > 50, the charge is in the form K(C – 50).

$300 = F + K(48)$ $\rightarrow$ (1)

$450 = F + K(168)$ $\rightarrow$ (2)

Subtracting (1) from (2), $150 = 120$ K

$K = \frac{5}{4}$

Required monthly bill = F + K(110)

$= F + 48K + 62K$

$= 300 + 62\left(\frac{5}{4}\right)$ = ₹377.50 Ans: (377.5)

26. $A \alpha B + C \Rightarrow A = k(B + C)$

Also, $B \alpha x \Rightarrow B = k_1x$

and, $C \alpha 1/x$

$\Rightarrow C = \frac{k_2}{x}$

$\therefore A = kk_1x + \frac{kk_2}{x}$

$= p_1x + \frac{p_2}{x}$ (where p_1 and p_2 are constants)

$\Rightarrow 2p_1 + \frac{p_2}{2} = 6$

$\Rightarrow 4p_1 + p_2 = 12$ $\rightarrow$ (1)

and, $4p_1 + \frac{p_2}{4} = 9$

$\Rightarrow 16p_1 + p_2 = 36$ $\rightarrow$ (2)

Solving (1) and (2), we get; $p_1 = 2$

and, $p_2 = 4$

$\therefore A = 2x + \frac{4}{x}$

When x = 16, $A = 32 + ¼ = 32^1/_4$ Choice (D)

27. Let $T = Ar + Br^2$

$720 = 10A + 100B \Rightarrow A + 10B = 72$ $\rightarrow$ (1)

$2640 = 20A + 400B \Rightarrow A + 20B = 132$ $\rightarrow$ (2)

Required area = 15A + 225 B

$= 15(A + 15B)$

$= 15\left(\frac{2A+30B}{2}\right) = 15\left(\frac{72+132}{2}\right)$ ($\because$ From (1) and (2))

= 1530 Ans: (1530)

28. Let, $p = A + Bx + Cx^2$

$\therefore A + B + C = 13$ $\rightarrow$ (1)

$A + 2B + 4C = 36$ $\rightarrow$ (2)

$A + 3B + 9C = 79$ $\rightarrow$ (3)

$(2) - (1) \Rightarrow B + 3C = 23$ $\rightarrow$ (4)

$(3) - (2) \Rightarrow B + 5C = 43$ $\rightarrow$ (5)

$(5) - (4) \Rightarrow 2C = 20$

$\therefore C = 10 \Rightarrow B = -7$

$\therefore A - 7 + 10 = 13 \Rightarrow A = 10$ Ans: (10)

29. Let the weights be x, 2x and 3x grams.

Previously, the weight of the stone was x + 2x + 3x

= 6x gms

Cost of the stone before breaking = $k(6x)^3 = 216kx^3$

Cost of the stone after breaking = $k[x^3 + (2x)^3 + (3x)^3]$

$= 36kx^3$

Now, $216kx^3 - 36kx^3 = 80280$

$\Rightarrow kx^3 = \frac{80280}{180}$

$\therefore 216kx^3 = \frac{80280}{180} \times 216$ = ₹96336 Choice (B)

30. Let, consumption of fuel per hour be C ltrs and speed be V kmph.

$C \alpha V^2$

Or, $C = kV^2 \quad \Rightarrow 2 = k(50)^2$

$\Rightarrow k = \frac{2}{(50)^2} = \frac{1}{1250}$

$\therefore C = \frac{V^2}{1250}$

Let the required velocity be V kmph

Time taken to cover 500 km at V kmph = $\frac{500}{V}$ hours

$\therefore$ Consumption of petrol in 500/V hours = $\frac{500C}{V}$ ltrs

$\therefore$ Cost of petrol = $\frac{500C}{V} \times 30 = ₹\frac{15000C}{V}$

$= \frac{15000}{V} \times \frac{V^2}{1250} = 12V$

and other expenses = $\frac{500}{V} \times 60$

$\therefore$ Total expenditure (T) = $12\left(V + \frac{2500}{V}\right)$

Method 1

Product of V and $\frac{2500}{V}$ is a constant

$\Rightarrow$ sum is minimum when V = $\frac{2500}{V}$

$\Rightarrow V = 50 \Rightarrow$ Min (T) = $12 \times [50 + 50] = 1200$

Method 2

$T = 12\left(\left(\sqrt{V} - \frac{50}{\sqrt{V}}\right)^2 + 100\right)$

which would be minimum when $\sqrt{V} - \frac{50}{\sqrt{V}} = 0$

$\therefore$ Minimum expenditure = $12 \times 100 = ₹1200$

Choice (B)

Exercise – 2(b)

1. Let, a = 3k, b = 7k
$\therefore$ (5a + b) : (4a + 5b)
= (5 x 3k + 7k) : (4 x 3k + 5 x 7k)
= 22k : 47k = 22 : 47

Choice (D)

2. Let the number of students in A, B and C be 3x, 7x and 8x respectively.
3x + 7x + 8x = 180
$\Rightarrow$ x = 10 $\Rightarrow$ 3x = 30

Ans: (30)

3. Let's assume the bag has only ₹33 (10 + 15 + 8).
The value of one rupee coins $\Rightarrow$ ₹10 i.e. 10 coins
The value of 50ps. coins $\Rightarrow$ ₹15 i.e. 30 coins
The value of 25ps. coins $\Rightarrow$ ₹8 i.e. 32 coins
$\therefore$ Number of 50ps. coins are 30 [$\because$10 + 30 + 32 = 72]
Alternately

Ratio of number of coins = $\frac{\text{value}}{\text{face value}}$ $\Rightarrow$ Ratio of number of coins of 1 rupee, 50 paise, 25 paise = $\frac{10}{100} : \frac{15}{50} : \frac{8}{25}$

= 10 : 30 : 32.

$\therefore$ Number of 50 paise coins = $\frac{30(72)}{10+30+32} = 30$

Ans: (30)

4. Let the strength of the class be x.

Number of girls = $\frac{2}{5}x$. $\frac{3}{4}$ th of the girls travel to school by bus. $\therefore$ $\frac{1}{4}$th of them do not travel to school by bus.

$\therefore \frac{1}{4}\left(\frac{2}{5}x\right) = 12 \Rightarrow x = 120.$ Ans: (120)

5. Given that, the ratio of the ages of Geetha and Sita is 9 : 5.
Let their ages be 9x and 5x.
After 8 years Sita's age is equal to the present age of Geetha.
So 5x + 8 = 9x $\Rightarrow$ x = 2.
Ages of Sita and Geetha are 10 and 18 years respectively.

Choice (A)

6. Let the numbers be 3k and 5k, where k is a constant.
Sum of 3k and 5k is 8k.
Now 8k = 40 $\Rightarrow$ k = 5
$\therefore$ The greater number is 5×5 i.e., 25. Ans: (25)

7. Let their ages be 7x and 8x years respectively

$\frac{7x - 20}{8x - 20} = \frac{9}{11}$

$\Rightarrow$ x = 8
$\therefore$ The age of the older person is 8×8 i.e., 64 years

Choice (A)

8. Let the numbers be x and 78 – x

$\frac{5x}{4(78 - x)} = \frac{15}{14}$

$\Rightarrow 7x = 6 \times 78 - 6x$
$\Rightarrow 13x = 6 \times 78 \Rightarrow x = 36$
$\therefore$ The first part is 36 Ans: (36)

9. Given that a = $\frac{3}{4}$b , b = $\frac{3}{2}$c , d = $\frac{c}{4}$ or c = 4d

$a = \frac{3}{4} \times \frac{3}{2} c = \frac{3}{4} \times \frac{3}{2} \times 4d = \frac{9}{2}d$

$\therefore$ a : d = 9 : 2 Choice (B)

10. Let the numbers be 3x and 4x
Let, k be subtracted from both the numbers

$\frac{3x - k}{4x - k} = \frac{2}{3}$

Since, there are two unknowns x and k and only one equation, the value of k cannot be found.

Choice (D)

11. Let the final fraction obtained be $\frac{2a}{a}$

$\therefore \frac{P}{Q} = \frac{2a+1}{a+1}.$

$\therefore$ P + Q = 3a + 2
From the given options, only 8 can be expressed in the form 3a + 2. Choice (A)

12. Let k be subtracted

$\frac{a-k}{b-k} = \frac{b}{a}$, $a^2 - ak = b^2 - bk$, $a^2 - b^2$

$= k(a - b)$
$k(a - b) = a^2 - b^2$
$(a - b)(k - (a + b)) = 0$
$a \neq b$
$\therefore a - b \neq 0$
$\therefore$ k – (a + b) = 0 i.e k = a + b Choice (C)

13. Let x be the number $\frac{22-x}{37-x}=\frac{2}{7}$

$\Rightarrow 7(22-x) = 2(37-x)$
$\Rightarrow 154 - 7x = 74 - 2x$
$\Rightarrow 5x = 80 \Rightarrow x = 16$ Ans: (16)

14. $3x + y - 5z = 0 \quad \rightarrow \quad (1)$
$4x + 5y - 14z = 0 \quad \rightarrow \quad (2)$
Multiplying (1) by 5 and then
Subtracting (2) from it, we get $11x = 11z$
$\Rightarrow x = z.$
From (1), $y = 2z$
$\therefore x : y : z = 1 : 2 : 1$ Choice (C)

15. Here, only 4th option D is not representing the number of boys and girls, since 80 is not divisible by 7 (i.e., 6 + 1)
Choice (D)

16. Let marks scored by A and B be 6x and 5x respectively.
$6x - 5x = 25 \Rightarrow x = 25$
$\therefore$A and B scored 11x or 275 marks in total.
Given, $\frac{275}{\text{maximum marks}}=\frac{11}{8}$
$\Rightarrow$Maximum marks = 200 Ans: (200)

17. Let the maximum marks for each subject be 100.
$\therefore$The student scored an aggregate of 60%.
So, he scored 180 marks. Let the marks be 4x, 5x and 6x.
So, $4x + 5x + 6x = 180.$
$x = 12$
So, the marks in the three subjects are 48, 60 and 72.
So, only in one subject he scored more than 60%.
Ans: (1)

18. The ratio of the ages of A and B is 1 : 3.
Let their ages be x, 3x.
Given that $(x + 6) + (3x + 6) = 2(x + 3x)$
$\Rightarrow 4x + 12 = 2(4x) \Rightarrow 12 = 8x - 4x$
$x = 3.$
$\therefore$ Their present ages are 3 years and 9 years.
Choice (A)

19. Ratio of salaries earned by Mr. A in three months is 5 : 4 : 7.
Let the salaries be 5x, 4x and 7x.
Product of first and third month salaries is $5x \times 7x = 35x^2$.
Product of first and second month salaries is $5x \times 4x = 20x^2$.
So, $35x^2 - 20x^2 = 600000$
$15x^2 = 600000$
$x^2 = \frac{600000}{15}$
$x^2 = 40000 \quad \Rightarrow x = 200$
Third month salary is $7x = 7 \times 200 = ₹1400.$
Ans: (1400)

20. Let the hourly earnings of P and Q be ₹p and ₹q respectively.
$p = q - 3$
$\frac{p}{q}=\frac{4}{5}.$
Substituting $p = q - 3$ in the above equation
$\frac{q-3}{q}=\frac{4}{5}.$
$5(q - 3) = 4q$
$q = 15.$
Total earnings of both on a day on which both work for of 9 hours $= 9(q+\frac{4}{5}q)$
$= 9(\frac{9}{5}q) = ₹243.$ Ans: (243)

21. Let the present ages of A and B be 11x and 4x respectively.
15 years ago,
$(11x - 15) : (4x - 15) = 8 : 1 \Rightarrow x = 5$ years
5 years ago the age of B was 15 years
C's age 5 years ago was $\frac{2}{3}\times 15 = 10.$
C's present age is 10 + 5 = 15 years. Choice (A)

22. Let the number of ten rupee notes, five rupee notes and two rupee notes be 10x, 5x and 2x respectively.
Given $5(5x) - 2(2x) = 84 \Rightarrow x = 4.$
Required value = $10(10x) = ₹400.$ Ans: (400)

23. $\ell^2 + 8m^2 + 9n^2 = 4m(\ell + 3n)$
$\Rightarrow \ell^2 + 8m^2 + 9n^2 - 4m\ell - 12mn = 0$
$\Rightarrow (\ell^2 + 4m^2 - 4m\ell) + (4m^2 - 12mn + 9n^2) = 0$
$\Rightarrow (\ell - 2m)^2 + (2m - 3n)^2 = 0$
$\Rightarrow \ell - 2m = 0$ and $2m - 3n = 0$
So $\ell = 2m$ and $2m = 3n$
$\frac{\ell}{m}=\frac{2}{1}$ and $\frac{m}{n}=\frac{3}{2}$
$\ell : m = 2 : 1$ and $m : n = 3 : 2$
$\Rightarrow \ell : m = 6 : 3$ and $m : n = 3 : 2$
$\ell : m : n = 6 : 3 : 2.$ Choice (B)

24. Given $a^2 : b : : b : 9.$
$b^2 = 9a^2 \Rightarrow b/a = 3/1.$
$\therefore \frac{a^2+b^2}{b^2-a^2} = \frac{1+9}{9-1} = \frac{10}{8} = \frac{5}{4} = 1.25$ Ans: (1.25)

25. Given ad = bc
$\therefore \frac{(a-b)(a-c)}{a} = \frac{a^2-a(b+c)+bc}{a}$
$= \frac{a^2-a(b+c)+ad}{a}$ ($\because$ ad = bc)
$= a - (b + c) + d$ Choice (C)

26. As a, b and c are in continued proportion,
$a/b = b/c \Rightarrow b^2 = ac$
Choice (A)
$b^2 : a^2 = ac : a^2 = c : a$
$\therefore$ Choice (A) is true
Choice (B)
$b^2 - a^2 = a(c - a)$
$c^2 - b^2 = c(c - a)$
$c^2 - b^2 : b^2 - a^2 = c : a$
$\therefore$ Choice (B) is true
Choice (C)
$c^2 : b^2 = c^2 : ac = c : a$
$\therefore$ Choice (C) is true Choice (D)

27. $V \alpha r^3 \quad \Rightarrow V = kr^3$
$V_1 = k(3)^3 = 27k$
$V_2 = k(4)^3 = 64k$
$V_3 = k(5)^3 = 125k$
$\therefore$Volume of the resulting sphere
$= V_1 + V_2 + V_3 = (27 + 64 + 125)\, k = 216k$
$\therefore kr^3 = 216k \quad \Rightarrow r = 6$ Ans: (6)

28. $V \alpha hA$
$\Rightarrow \frac{V_1}{h_1A_1} = \frac{V_2}{h_2A_2}$
$\Rightarrow \frac{160}{15\times 32} = \frac{240}{h_2\times 50} \Rightarrow h_2 = 14^2/_5\,m$ Choice (A)

29. Let $A = Kr^2$ where K is a proportionality constant.
Let the radius of the circle drawn be X cm.
Area of the circle $= KX^2 = K(9^2 + 12^2 + 20^2).$
$\Rightarrow X = 25$ Ans: (25)

30. Let $D = Kt^2$ where K is a proportionality constant.

Distance that the body fell in the 10^{th} second
= Distance that it fell in the first 10 seconds – Distance that it fell in the first 9 seconds
= K $(10^2 - 9^2)$ = 19K = 95, K = 5
Required distance = K $(14^2 - 13^2)$ = 27 K = 135 m.
Ans: (135)

31. Let the fixed amount be F and the variable amount be KB, where K is a proportionality constant.
Total income = F + KB
22000 = F + 6000K → (1)
46000 = F + 18000K → (2)
Solving (1) and (2), K = 2 and F = 10000
Required income = $\frac{10000 + 25000\,(2)}{25000}$ = ₹2.40
Ans: (2.40)

32. $\frac{L_1}{A_1 V_1^{\,2}} = \frac{L_2}{A_2 V_2^{\,2}}$ (Since L α AV^2)
$\frac{128}{4 \times (3)^2} = \frac{L_2}{(4 \times 9) \times (4)^2}$
$\Rightarrow L_2 = 16 \times 128 = 2048$ lb Choice (D)

33. $X \propto Y Z$
$\frac{X_1}{X_2} = \frac{Y_1 Z_1}{Y_2 Z_2}$
If $X_1 = 200$, $Y_1 = 45$, $Z_1 = 20$,
$Y_2 = 90$ and $Z_2 = 30$,
$X_2 = \frac{X_1\, Y_2\, Z_2}{Y_1\, Z_1} = \frac{(200)(90)(30)}{(45)(20)} = 600$. Ans: (600)

34. If a month has D working days and Ashok's salary in that month is ₹S, S α D.
$\frac{S_1}{S_2} = \frac{D_1}{D_2}$
If $S_1 = 9000$, $D_1 = 20$ and $D_2 = 21$,
$S_2 = \frac{S_1 D_2}{D_1} = \frac{(9000)(21)}{20}$ = ₹9450. Choice (B)

35. $\frac{x_1^{\,3}}{y_1} = \frac{x_{12}^{\,3}}{y_2}$
$\Rightarrow \frac{4}{(2)^3} = \frac{32}{(y_2)^3}$
$\Rightarrow (y_2)^3 = 64 \Rightarrow y_2 = 4$ Ans: (4)

36. Let $V = K\sqrt{w}$ where K is a proportionality constant.
Let the weights of the pieces be x, 4x and 4x units.
Gain = $K\left(\sqrt{x} + \sqrt{4x} + \sqrt{4x} - \sqrt{x+4x+4x}\right)$
= $2K\sqrt{x}$ = 12000
Initial value = $3K\sqrt{x}$ = 18000 Choice (D)

37. V α 1/P, when T is constant
V α T, when P is constant ⇒ V α T/P
$\Rightarrow \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$
$\Rightarrow \frac{64 \times 200}{40} = \frac{P_2 \times 400}{50}$
$\Rightarrow P_2 = 40$ Choice (B)

38. W α r^2, when 'h' is constant
and, W α h, when 'r' is constant
$\Rightarrow$ W α $r^2 h$
$\Rightarrow \frac{W_1}{r_1^{\,2} h_1} = \frac{W_2}{r_2^{\,2} h_2}$
$\frac{12}{(2)^2 \times 4} = \frac{W_2}{(4)^2 \times 3}$
$\Rightarrow W_2 = \frac{12}{(2)^2 \times 4} \times (4)^2 \times 3 = 36$ kg Ans: (36)

39. Let the kinetic energy of a body, its mass and its velocity be denoted by K joules, M kg and V m/sec respectively.
K α MV
$\frac{K_1}{K_2} = \frac{M_1}{M_2}\frac{V_1^{\,2}}{V_2}$
Taking $K_1 = 0.144$, $M_1 = 7.2$, $V_1 = 0.2$, $M_2 = 3.6$ and $V_2 = 0.8$ and substituting them in the equation above, $K_2 = 1.152$ joules. Ans: (1.152)

40. Let the fixed expense be ₹x and the variable expense be ₹y per head.
$x + 20y = 20 \times 650 \Rightarrow x + 20y = 13000$ → (1)
and, $x + 25y = 25 \times 600 \Rightarrow x + 25y = 15000$ → (2)
From (1) and (2), we get;
x = 5000 and y = 400
Let, the required number of occupants be n.
5000 + 400n = 500n
$\Rightarrow$ 100n = 5000 $\Rightarrow$ n = 50 Choice (D)

41. Using either of the statements, we cannot find the ratio of profits as the data about sales and expenditures are given in different statements.
Combining both statements, let 4a and 5a be the sales and let 3b and 4b be the expenditures.
$\therefore$ Ratio of profits = $\frac{4a - 3b}{5a - 4b} = \frac{(5a - 4b) - (a - b)}{5a - 4b}$
= $1 - \frac{a - b}{5a - 4b}$.
$\frac{a - b}{5a - 4b}$ may or may not be positive, depending on whether a > b or a < b ($\because$ 4a ≥ 3b). So, the ratio of profits may or may not be greater than 1 and hence, which company got a higher profit can't be determined even using both the statements together. Choice (D)

42. Neither statement alone is sufficient as the information about income and expenditure is given in different statements. Combining both statements, let 4x and 5x be the incomes and let 4y and 5y be the expenditures.
$\therefore$ Ratio of savings = (4x – 4y) : (5x – 5y) = 4(x – y) : 5(x – y)
= 4 : 5 Choice (C)

43. Dividing both numerator and denominator of $\frac{7a + 9b}{4a + 5b}$ by b, it becomes $\frac{7\frac{a}{b} + 9}{4\frac{a}{b} + 5}$. Value of $\frac{a}{b}$ is sufficient to find $\frac{7a + 9b}{4a + 5b}$.
From statement I, we have $b + a = \frac{1}{2}(6a - b)$
$\Rightarrow$ a/b= 3/4
$\therefore$ Statement I is sufficient.
From statement II, we have 3a + 4b = 5.
By simplifying 3a + 4b = 5, $\frac{a}{b}$ cannot be found.
$\therefore$ Statement II is not sufficient. Choice (A)

44. Using statement I, $y^2 = xz$. From this we cannot find the ratio of x, y, z.
$\therefore$ Statement I alone is not sufficient.
For a similar reason as above statement II alone is not sufficient.

Combining both the statements, $\frac{x}{y}=\frac{y}{z}=\frac{z}{x}$ = k (say)

$x = yk = (zk)k = (xk)k^2 = k^3x$.

$\Rightarrow k^3 = 1$

$\Rightarrow k = 1$

$\therefore x : y : z = 1 : 1 : 1$. Choice (C)

45. Using statement I, price of petrol = 2 (price of diesel) = 3 (price of CNG). As the quantities of the fuels bought is unknown, total money spent cannot be found.
$\therefore$ Statement I is not sufficient.
Using statement II, equal quantities of each fuel were purchased. As the price of any fuel is not known, total money spent cannot be found.
$\therefore$ Statement II is not sufficient.
Combining both statements, since ₹510 is spent on diesel, money spent on petrol is (2) (510) = ₹1020 and money spent on CNG is (1/3) (1020) = ₹340.
Total money spent = ₹1870. Choice (C)

Chapter – 3
(Percentages – Profit & Loss – Partnerships)

Concept Review Questions

1. (i) 37.5% of 976

$= \frac{37.5}{100}\times 976 = \frac{375}{1000}\times 976 = \frac{3}{8}\times 976$

$= 3 \times 122 = 366$. Ans: (366)

(ii) 57.14% of 784

$= \frac{57.14}{100}\times 784 = \frac{4}{7}\times 784$

$= 4 \times 112 = 448$ Ans: (448)

(iii) $11\frac{1}{9}\%$ of 918

$= \frac{100}{9}\%$ of 918

$= \frac{100}{9}\times\frac{1}{100}\times 918 = 102$ Ans: (102)

2. Let the required percent be x%.
x% of 125 = 16

$\Rightarrow \frac{x}{100}\times 125 = 16$

$\Rightarrow x = \frac{1600}{125} = \frac{64}{5} = 12\frac{4}{5}$ Choice (B)

3. Let x percent of 64 be 80

$\therefore 64 \times \frac{x}{100} = 80$

$\Rightarrow x = \frac{80\times 100}{64} \Rightarrow x = 125$

$\therefore$ 80 is 125% of 64. Ans: (125)

4. Let the number be x.

30% of x = $\frac{30}{100}\times x = \frac{3x}{10}$

20% of x = $\frac{20}{100}\times x = \frac{x}{5} = \frac{2x}{10}$

Given that $\frac{3x}{10}-\frac{2x}{10} = 18$

$\Rightarrow \frac{3x-2x}{10} = 18 \Rightarrow x = 180$

Required number is 180. Choice (C)

5. 35% of $\frac{3n}{5} = \frac{35}{100}\times\frac{3n}{5} = \frac{21n}{100}$

10% of 110 = $\frac{10}{100}\times 110 = 11$

According to the problem $\frac{21n}{100} - 11 = 10$

$\Rightarrow \frac{21n}{100} = 21 \Rightarrow n = 100$

$\therefore$ 10% of n is 10. Ans: (10)

6. Let the payment per hour initially be ₹100 / per hour and the initial working time be 100 hours.
Initial total income = ₹10000
Now, payment per hour = ₹130
New working time = 70 hours
New total income = ₹9100.

Percentage decrease in income = $\frac{900}{10000}\times 100\%$ = 9%.

Choice (C)

7. Karan's score was less than Kiran's score by (50 – 40) or 10 percentage points. Ans: (10)

8. Let the original price of sugar be ₹x per kg.

Increase in the price = $\frac{45}{100}x = ₹\frac{9x}{20}$

The final price is $x + \frac{9x}{20} = 7\cdot 25 \Rightarrow x = 5$ Choice (A)

9. Production of rice in 2006 = 480 – 20% of 480 = 480 – 96
384 million tonnes. Choice (A)

10. Let the original price of the tube of toothpaste be ₹x.
Decrease in its price = ₹0.2x
x – 0.2x = 20 $\Rightarrow$ x = 25. Ans: (25)

11. Let the population of India last year be 100.
Population of India this year = 200.

Percentage increase = $\frac{200-100}{100}(100)\% = 100\%$.

Ans: (100)

12. Let the initial price of the walkman be ₹100. Increase in the price = ₹20.
Final price = ₹120

Price must decrease by $\frac{20}{120}(100) = 16\frac{2}{3}\%$

Choice (D)

13. Required percentage = $\frac{25}{125}\times 100$ = 20% Ans: (20)

14. Let the initial monthly salary of each person be ₹100.
After the changes, monthly salary of one of them becomes ₹20 more while that of the other becomes ₹20 less.
$\therefore$ There is no change in the total salary of the 2 persons.
Percentage change = 0%. Ans: (0)

15. Let the initial price of Q be ₹q per kg. Initial price of P = ₹2q per kg.
Decrease in the price of P = ₹0.50q per kg
Final price of P = ₹1.50q per kg
Increase in the price of Q = ₹0.50q per kg
Final price of Q = ₹1.50q per kg
Final sum of the prices of P and Q
= Initial sum of the prices of P and Q.
$\therefore$ Percentage increase = 0% Ans: (0)

16. Let the initial total salaries of the 10 employees and the remaining 30 employees be ₹x and ₹y respectively.
Increase in the total salaries of the 10 employees = ₹0.1x

Increase in the total salaries of the remaining 30 employees = ₹0.3y

Percentage increase = $\left(\frac{0\cdot1x+0\cdot3y}{x+y}\right)(100)$ %

$= \left(\frac{0\cdot1\frac{x}{y}+0\cdot3}{\frac{x}{y}+1}\right)(100)\%$

As $\frac{x}{y}$ is unknown, this cannot be found. Choice (D)

17. Let the family's total income initially be ₹100.
Family's monthly savings = ₹20
Family's monthly expenditure on food becomes ₹30

Required percentage = $\frac{30}{20}(100)\% = 150\%$.

Choice (B)

18. Let the family's total income initially be ₹x; Kiran's salary before the increment = ₹0.4x
Kiran's increment = ₹0.1x
Kiran's salary after the increment = ₹0.5x
Family's total income after the increment = ₹1.1x

Required percentage = $\frac{0.5x}{1.1x}(100)\% = 45\frac{5}{11}\%$

Choice (D)

19. Let Satish's marks be 100.
Raja got 25 more marks than Satish
Raja's marks = 125
Percentage by which Satish's marks are less

$= \frac{25}{125}(100)\% = 20\%$. Choice (C)

20. Let the price of the article be ₹100.
20% of 100 = 20.
New price 100 + 20 = ₹120

Required percentage = $\frac{120-100}{120}\times100$

$= \frac{20}{120}\times100 = \frac{50}{3} = 16\frac{2}{3}$. Choice (A)

21. Girish's profit = ₹300

Girish's profit percentage = $\frac{300}{600}(100)\% = 50\%$

Ans: (50)

22. Let the selling price of the TV be ₹100. Cost price of the TV = ₹60
Profit = ₹40

Profit percentage = $\frac{40}{60}(100)\% = 66\frac{2}{3}\%$ Choice (D)

23. Let the cost price of each shirt be ₹100
Profit on 1 shirt = ₹20
Loss on the other shirt = ₹10
An overall profit of ₹10 is made

Profit percentage = $\frac{10}{200}(100)\% = 5\%$ Ans: (5)

Note: If two articles are bought for the same price and one is sold at x% profit and the other is sold at y% loss, then

(i) an overall profit of $\frac{x-y}{2}$% is made if x > y.

(ii) an overall loss of $\frac{y-x}{2}$% is made if x < y.

(iii) neither profit nor loss is made if x = y.

24. Let the cost price of the calculator be ₹x.

Profit = ₹$\frac{x}{3}$

$x+\frac{x}{3} = 120$

x = 90

To gain 40%, he must gain 40% of 90 = ₹36. He must sell it for ₹126. Choice (D)

25. Rohit's profit = ₹8
Rohit's selling price = ₹48
Rakesh's cost price = ₹48
Rakesh's profit = ₹16
Rakesh's selling price = ₹64
Suresh's cost price = ₹64 Ans: (64)

26. Let the cost price of each metre be ₹x
Cost price of 20 m = ₹20x.
Profit made in selling 20 m = cost price of 5 m = ₹5x.

Profit percentage = $\frac{5x}{20x}(100)\% = 25\%$ Choice (C)

27. Gain percentage = $\frac{\text{C.P of 20 oranges}}{\text{C.P of 80 oranges}}\times100$

$= \frac{20}{80}\times100 = 25\%$ Ans: (25)

28. C.P. of 60 oranges = S.P of 60 oranges – Gain on 60 oranges
= S.P of 60 oranges – S.P of 20 oranges
= S.P of 40 oranges

$\therefore$Gain percentage = $\frac{20SP_1}{40SP_1}\times100 = 50\%$ Ans: (50)

29. Total cost price of 80 hats = (80) (12) = ₹960

Overall profit = $\frac{9}{2}(80) = ₹360$

Total selling price = ₹1320
If the selling price of each of the remaining hats is ₹x,
(30) (14) + 50x = 1320
$\Rightarrow$ x = 18 Choice (D)

30. Let the marked price be ₹x
Discount = ₹0.1x
Selling price = ₹0.9x
0.9x = 330 + 30 = 360
$\Rightarrow$ x = 400 Ans: (400)

31. Let C.P. of the product = ₹x.

$\therefore$ M.P. is 175% of x = ₹$\frac{7x}{4}$

Difference of the selling prices when discount is decreased from 50% to 25% is ₹210.

i.e. $\frac{7x}{4}\left(\frac{75}{100}\right)-\frac{7x}{4}\left(\frac{50}{100}\right)=210$

$\Rightarrow \frac{7x}{4}\left(\frac{25}{100}\right)=210$

$\Rightarrow$ x = $\frac{(210)(16)}{7}$ = Rs.480 Choice (D)

32. Company's profit percentage = $\frac{80-64}{64}(100)\% = 25\%$

Choice (A)

33. The shopkeeper got a profit of ₹22. The dealer got a profit of ₹18. The company got a profit of ₹16. The shopkeeper got the highest profit. Choice (B)

34. Part I:

C.P. of plot of land = ₹120000
Profit on plot of land = 12% of ₹120000
$= \frac{12}{100}(120000) = ₹14400$

Part II:

C.P. of house = ₹320000
Loss on house = 4.5% of ₹320000
$= \frac{4.5}{100}(320000)$
$= 4.5(3200) = ₹14400$
Clearly no profit and no loss in the overall transaction.
Choice (D)

35. Let the C.P. be x
S.P. = 110% of x = $\frac{11x}{10}$ [$\because$ profit = 10%]
New C.P. = ₹ (x + 20) and new S.P = ₹$\left(\frac{11x}{10}+10\right)$
New percentage of profit = $1\frac{1}{9}$%
$\therefore$ Profit = $\left(\frac{11x}{10}+10\right) - (x + 20) = ₹\left(\frac{x}{10}-10\right)$
Percentage of profit = $\frac{\left(\frac{x}{10}-10\right)}{(x+20)}\times 100 = 1\frac{1}{9}$
$\Rightarrow \frac{(x-100)}{(x+20)} = \frac{10}{9} \Rightarrow 9x - 900 = x + 20$
$\Rightarrow 8x = 920 \Rightarrow x = 115$
$\therefore$ Original cost price = ₹115 Choice (C)

36. Let the cost price of the watch before the increase be y.
$\frac{25}{100}y + 50 = \frac{25}{100}(x+y)$
200 = x

Alternate method:
Extra profit $= \frac{25}{100}$ (Increase in the cost price)
$= \frac{25}{100}x(\text{say}) = 50$.
x = 200 Choice (D)

37. Let the cost price of the table for Sreenivas be ₹x and given that cost price of the table for Mahesh = ₹2178.
$\Rightarrow$ (90%) of 110% of x = ₹2178.
$\Rightarrow \left(\frac{90}{100}\right)\left(\frac{110}{100}\right)x = 2178$
$\Rightarrow x = \frac{2178\times 100}{9\times 11} \Rightarrow x = ₹2200$ Ans: (2200)

38. Let C.P. of an article = ₹100
$\therefore$ M.P. = ₹120
discount = 20%
S.P. = $MP\left(\frac{100-\%d}{100}\right) = 120\left(\frac{80}{100}\right) =$ ₹96
Clearly, the trader incurs 4% loss. Choice (A)

39. The ratio of investments of A, B and C is 5 : 6 : 7.
The ratio of shares of A, B and C is 5 : 9 : 14
$\therefore$ Ratio of their periods of investments is
$\left(\frac{5}{5}\right):\left(\frac{9}{6}\right):\left(\frac{14}{7}\right) = 1:\frac{3}{2}:2$ = 2 : 3 : 4 Choice (A)

40. Ratio of the profit shares of Ramesh and Suresh = 3 : 2.
Ramesh's share = $\frac{3}{5}(6000) = ₹3600$ Choice (C)

41. Ratio of Anil's and Sunil's profits = Ratio of time periods of Anil and Sunil = 8 : 12 = 2 : 3
Anil's share = $\frac{2}{5}(2000) = ₹800$ Ans: (800)

42. Ratio of profits of Sameer and Tarun
$= (9000\times 12) : (12000\times 9) = 1 : 1$
Sameer's share = $\frac{6000}{2} = ₹3000$ Ans: (3000)

43. Ratio of investments of 'P' and 'Q' is 2 : 5
Total salary claimed by 'P' = 12×5000 = ₹60000.
Total profit = ₹2 lakhs.
$\therefore$ Profit is to be shared = ₹140000
Share of P = $\left(\frac{2}{7}\right)140000$ = ₹40000
$\therefore$ Share of Q = ₹100000
Total earnings of P = ₹ (60000 + 40000) = ₹100000
$\therefore$ Ratio of their earnings = 1 : 1 Choice (D)

44. Ratio of profits of Ganesh, Harish and Raghu = Ratio of investments of Ganesh, Harish and Raghu = 5 : 6 : 7.
Profit share of Ganesh = $\frac{5}{18}\times 5400$ = ₹1500
Profit share of Harish = $\frac{6}{18}\times 5400$ = ₹1800
Profit share of Raghu = $\frac{5}{18}\times 5400$ = ₹2100

Alternate method:
When the investments of three partners are in arithmetic progression, profit share at the end of 1 year of the partner whose investment is neither the least nor the greatest will always be $\frac{1}{3}$(Total profit at the end of one year). The investments of the three partners are in arithmetic progression.
$\therefore$ Profit share of Harish = ₹1800.
Ratio of profits must be equal to ratio of investments and total profit must be ₹5400. Only Choice (A) satisfies all these conditions. Choice (A)

45. The person would get ₹10 as income annually for every unit of stock he buys. His annual income
$= \frac{10000\ (10)}{100} =$ ₹1000. Ans: (1000)

46. Cost of each unit of stock = face value + premium = ₹100 + ₹5·50 = ₹105·50
Annual income of the person = $\frac{10550}{105\cdot 50}(7) = ₹700$
Choice (B)

47. Cost of each unit of stock = Face value – Discount = ₹100 – ₹3·5 = ₹96·50.
Annual income of the person = $\frac{19300}{96\cdot 50}(6) = ₹1200$
Ans: (1200)

48. Number of units of stock he purchased = $\frac{18600}{93} = 200$
If he sells each unit at ₹105,
His profit = 200 (105 – 93) = ₹2400 Ans: (2400)

49. Annual income of Ajay = $\frac{2650}{106}(15) = ₹375$
Annual income of Vijay = $\frac{3060}{102}(12) = ₹360$
$\therefore$ Ajay's annual income is higher. Choice (A)

50. The man would have to invest ₹86 for an annual income of ₹5.
His yield percent = $\frac{5}{86}(100)\% \approx 5\cdot 81\%$. Choice (C)

Exercise – 3(a)

1. Let the number of employees in the office be 100.
The men/women, married/unmarried break-up is shown below.

	Men	Women	
Unmarried	12	22	
Married	18	48	66
	30	70	

The percentage of women who are unmarried is
$\frac{22}{70} = \frac{11}{35} = \frac{1100}{35}\% = \frac{220\%}{7} = 31\frac{3}{7}\%$ Choice (C)

2. Let the pass marks be x.
$1.05x = 273$
$\Rightarrow x = 260$
$\therefore$ Required percentage $= \frac{312-260}{260} \times 100$
$= \frac{52}{260} \times 100 = 20\%$ Choice (A)

3. Let the number of mangoes with A be 100
$\therefore$ Number of mangoes with B $= 0.9 \times 100 = 90$ and number of mangoes with C $= 0.8 \times 100 = 80$
$\therefore$ Required percent $= \frac{90-80}{80} \times 100 = 12.5\%$
Ans: (12.5)

4. Let shyam's salary last year be ₹100
He spent ₹60 (60% of 100) every month
$\therefore$ His saving's $= 100 - 60 =$ ₹40
Shyam's salary this year $= 1.25 \times 100 =$ ₹125
Expenditure this year $= 1.20 \times 60 =$ ₹72
$\therefore$ Savings this year $= 125 - 72 =$ ₹53
$\therefore$ Percentage increase in savings $= \frac{53-40}{40} \times 100$
$= 32.5\%$ Ans: (32.5)

5. Let the initial total cost of S be ₹100
Initial costs of P, Q and R are ₹20, ₹10 and ₹10 respectively
Increase in the cost of S = ₹10
Final cost of S = ₹110
Increase in the costs of P, Q and R are ₹4, ₹2 and ₹2 respectively.
Final total cost of P, Q and R = 20 +10 +10 + 4 + 2 + 2 = ₹48
Required percentage $= \frac{48}{110}(100)\% = 43\frac{7}{11}\%$
Choice (B)

6. Let the price of sugar initially be ₹100, initial consumption = 1 kg
Price first came down to $(1 - 0.2) \times 100$ i.e., ₹80 and then increased to $(1 + 0.5) \times 80$ i.e., ₹120
Let new consumption be x
$100 \times 1 = 120 \times x$ (Since expenditure is constant)
$x = 5/6$
So reduction is 1/6 kg or $16^2/_3\%$ Choice (B)

7. Let initial price be x
Let initial consumption be y.
$\therefore$ Expenditure = xy
New price = 1.25 x
New expenditure = 1.08 xy
$\therefore$ New consumption $= \frac{1.08\,xy}{1.25x} = \frac{108}{125}\,y$
y = initial consumption = 25 kg (given)
$\therefore$ New consumption $= \frac{108}{125} \times 25 = 21.6$ kg Ans: (21.6)

8. Let the initial prices of P and Q be p and q respectively.
$p = 0.81\,q$
After two months, the prices are $p(1 + X)^2$ and $q(1 - y)^2$ respectively.
$\therefore p(1 + X)^2 \geq q(1 - Y)^2$.
$\Rightarrow 0.81 (1 + X)^2 \geq (1 - Y)^2$
$\Rightarrow 0.9 (1 + X) \geq 1 - Y \Rightarrow 1 - Y \leq 0.9(1.05)$
$\Rightarrow 1 - Y \leq 0.945$
$\Rightarrow Y \geq 0.055$
The least value of Y is 0.055 or 5.5% Choice (A)

9. Let the cost of Bar-Choco be 'a' then the cost of Bar-Milk will be '1.4a.'
Let m and n be the number of Bar-Milk and Bar-Choco's ordered by Bablu respectively.
The cost would be 1.4 am + an
The shopkeeper swapped the numbers. The cost of what he gave was 1.4 an + am. This is 10% less.
$\therefore \frac{1.4\,a(m-n) + a(n-m)}{1.4\,am + an} = \frac{10}{100} = \frac{1}{10}$
$\Rightarrow \frac{0.4m - 0.4n}{1.4m + n} = \frac{1}{10} \Rightarrow 4m - 4n = 1.4m + n$
$\Rightarrow 2.6m = 5n \Rightarrow \frac{m}{n} = \frac{25}{13}$ Choice (A)

10. Price of the radio at the end of the first year
$= 3000\left(1+\frac{x}{100}\right)\left(1-\frac{y}{100}\right)$
Price of the radio at the end of the next year
$= 3000\left(1+\frac{x}{100}\right)\left(1-\frac{y}{100}\right)\left(1+\frac{x}{100}\right)\left(1-\frac{y}{100}\right)$
$= 3000\left(1+\frac{x}{100}\right)^2\left(1-\frac{y}{100}\right)^2$
This equals 3000, when, x = y, this price equals
$3000\left[\left(1+\frac{y}{100}\right)\left(1-\frac{y}{100}\right)\right]^2$
$3000\left[1-\left(\frac{y}{100}\right)^2\right]^2$ i.e. less than 3000.
$\therefore$ For this price to equal 3000, x > y must hold true.
Choice (A)

11. Let the initial price of the jewel be ₹P.
$P\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right) = P - 100$
$P - \frac{Px^2}{100} = P - 100$
$\frac{Px^2}{100} = 100 \rightarrow (1)$
$(P-100)\left(1+\frac{x/2}{100}\right)\left(1+\frac{x/2}{100}\right) = 2376$
$(P-100)\left(1-\frac{x^2}{400}\right) = 2376 \rightarrow (2)$
From (1) $\frac{x^2}{400} = \frac{25}{P}$
(1) and (2)
$\Rightarrow (P - 100)\left(1-\frac{25}{P}\right) = 2376$
$\Rightarrow (P - 100)(P - 25) = 2376\,P$
$\Rightarrow P^2 - 2501\,P + 2500 = 0 \Rightarrow P = 2500$ or 1
As P > 2376, P = 2500 Choice (C)

12. Number of females $= 0.42 \times 7500 = 3150$
$\therefore$ Number of males $= 7500 - 3150 = 4350$
Let the number of literate males and females be x and y respectively

∴The number of illiterate males and females will be (4350 – x) and (3150 – y) respectively
Now, x + y = 2370 → (1)
And (4350 –x) – (3150 – y) = 90
⇒ 1200 + y – x = 90
⇒ x – y = 1110 → (2)
Solving (1) and (2), we get;
x = 1740

∴ Required percentage = $\frac{1740}{4350} \times 100 = 40\%$

Ans: (40)

13. Let us assume that there were 100 voters. Before the debate, 70 favoured Bush and 30 favoured Clinton.
Number of voters who shifted their loyalty to Bush
= 20% of 70 = 14
Number of voters who shifted their loyalty to Clinton
= 20% of 30 = 6
∴ After the debate, Clinton would have 70 – 14 + 6 = 62 supporters and Bush would have 30 – 6 + 14 = 38 supporters.
∴ 12% of the supporters must shift from Clinton to Bush, so that both have equal number of supporters. Ans: (12)

14. Let the amount the school needed for the new building be `T. Let the total of people already solicited and to be solicited be N.

$\frac{60}{100}T = 300\left(\frac{80}{100}N\right) \rightarrow$ (1)

If the average donation the school should receive from the remaining people to be solicited is ₹x,

$\frac{40}{100}T = x\left(\frac{20}{100}N\right)$ → (2)

Dividing (2) by (1),

$\frac{2}{3} = \frac{x}{300}\left(\frac{1}{4}\right)$

⇒ x = 800 Choice (C)

15. $\frac{40}{100} \times 25 = 10$

∴ So far the Indian cricket team has won 10 matches. The minimum number of matches would be in the situation where India wins all the remaining matches. Let, there be x number of matches required to achieve the target.

∴ $\frac{10 + x}{25 + x} = \frac{75}{100}$

i.e., $\frac{10 + x}{25 + x} = \frac{3}{4}$

⇒ 40 + 4x = 75 + 3x
⇒ x = 35 Ans: (35)

16. Let the total sales be worth ₹x

$2000 + \frac{5}{100}(x - 10{,}000) - \frac{8}{100}x = 540$

$\Rightarrow 2000 + \frac{5}{100}x - 500 - \frac{8}{100}x = 540$

$\Rightarrow \frac{3}{100}x = 960$

⇒ x = 32000. Choice (C)

17. I can buy 20 oranges with $\frac{20}{50} \times 100$ i.e., 40% of the money.

I am now left with (80 – 40) i.e., 40% of the money.
With 40% of the money, I can purchase

$\frac{40}{100} \times 40 = 16$ apples Ans: (16)

18. $\frac{a}{100}(1000) + \frac{b}{100}(3000 - 1000) = 900$ → (1)

$\frac{a}{100}(1000) + \frac{b}{100}(4000 - 1000) = 1300$ → (2)

Subtracting (1) from (2) $\frac{b}{100}1000 = 400$

$\frac{b}{100} = 0.4$

Substituting $\frac{b}{100}$ in (1) or (2),

a = 10. Ans: (10)

19. $\frac{20}{100} \times C.P = 104$

$\Rightarrow C.P = 104 \times \frac{100}{20} = ₹520$ Choice (B)

20. S.P of 150 kg = C.P of 120 kg
⇒ S.P of 150 kg = (15 × 120)
∴ S.P of 1 kg of sugar = $\frac{15 \times 120}{150} = ₹12$ Ans: (12)

21. C.P of first article = $\frac{5060}{1.1} = ₹4600$

C.P of second article = $\frac{5060}{0.92} = ₹5500$

Overall S.P = ₹10120
Overall C.P = ₹10100
∴ Profit = ₹20 Choice (B)

22. Number of apples that can be sold = (1 – 0.3) 40,000
= 28,000
Selling price of 28,000 apples = (40,000 × 7) × 1.25
∴ Selling price of each apple
= $\frac{40000 \times 7 \times 1.25}{28000} = ₹12.5$ Choice (D)

23. Let shopkeeper have ₹100
He buys goods worth 1.2 × 100 = ₹120
He sells goods worth 0.8 × 100 = ₹80

∴ Profit = $\frac{40}{80} \times 100 = 50\%$ Ans: (50)

24. Let shopkeeper have ₹100.
He buys goods worth 1.2 × 100 = ₹120.
He sells goods worth $\frac{100}{1.2} = \frac{100 \times 5}{6} = ₹\frac{250}{3}$

∴ Profit % = $\frac{120 - \frac{250}{3}}{\frac{250}{3}} \times 100$

= $\frac{110}{250} \times 100 = 44\%$ Ans: (44)

Solutions for questions 25 and 26:

Let the cost of the item be ₹100
Raw materials – ₹40
Labour charges – ₹20
Fixed charges – ₹20
Miscellaneous expenses – ₹20
∴ Selling price = 1.25 × 100 = ₹125
After the increase the following expenditures are incurred;
Raw materials -1.15 × 40 = ₹46
Labour charges -1.2 × 20 = ₹24
Fixed charges = ₹20
Miscellaneous expenses = 1.5 × 20 = ₹30
∴ Total cost of the item = ₹120

25. Required profit percentage = $\frac{125 - 120}{120} \times 100$

= $4\frac{1}{6}\%$ Choice (C)

26. New cost price of the item

$= \frac{125}{100 + 13\frac{7}{11} = 100 + \frac{150}{11} = \frac{1250}{11}} \times 100 = 110$

Reduction in expenditure on raw materials required = ₹10

$\therefore$ Percentage reduction required = $\frac{10}{46} \times 100$

$= 21^{17}/_{23}\%$ Choice (C)

27. Let the listed price of the trouser be x.

$\frac{40}{100} x = 320 \Rightarrow x = 800$

$\therefore$ I paid 800 – 320 = ₹480 for the trouser. Ans: (480)

28. Let marked price be ₹x.

$(1 - 0.5) \times (1 - 0.3)x = 448$

$\Rightarrow x = \frac{448}{0.5 \times 0.7} = \frac{896}{0.7} = 1280$ Ans: (1280)

29. Let the marked price of each merchant be ₹100
Discount offered by A = ₹30
Selling price of A = ₹70
First discount offered by B = ₹10
Price after discount = ₹90
Second discount = ₹9
Price after second discount = ₹81
Third discount offered by B = ₹8·10
Selling price of B = ₹72·90
It can be similarly shown that the selling price of C = ₹72·675
$\therefore$ Ascending order of the selling prices is ACB.
Choice (A)

30. $20000 - 1000 \times 12 = 8000$ = A's share of profit other than salary
Let B's share of the profit = x

$\frac{8000}{x} = \frac{32000}{56000} \Rightarrow x$ = ₹14000 Ans: (14000)

31. Had the profits been divided in the ratio of their investments, then profit of A would have been
(16,800 – 5,200) i.e., ₹11600 and that of
B (11,200 + 5,200) i.e., ₹16400
$\therefore$ Ratio of their investments = 11,600 : 16,800

$\therefore$ A's investment = $\frac{29}{41} \times 82{,}000$ = ₹58000 Choice (B)

32. The ratio in which the profit would be divided among A, B and C = $(12000 \times 2 + 8000 \times 8) : (16000 \times 4 + 12000 \times 7) : (10000 \times 12)$ = 22 : 37 : 30

$\therefore$ B's share = $\frac{37}{89} \times 267000$

A's share = $\frac{22}{89} \times 267000$

$\therefore$ B's share is more than A's share by $\frac{37 - 22}{89} \times 267000$

$= 15 \times 3000$ = ₹45000 Choice (C)

33. Number of shares purchased = $\frac{37800}{108} = 350$

Total income from the shares = 350×4 = ₹1400

$\therefore$ Yield % = $\frac{1400}{37800} \times 100 = 3\frac{19}{27}\%$ Choice (D)

34. The income from 12% stock at 112 is ₹12 every ₹112 or 12/112. Similarly for B, C and D it would be 15/120, 4/108 and 8/104 respectively.
Of these fractions 15/120 is the greatest and hence 15% stock at 120 is the best investment. Choice (B)

35. Let the entire sum of money be 3x.

$\left(\frac{3x}{99} \times 8\right) - \left(\frac{2x}{100} \times 4 + \frac{x}{120} \times 5\right) = 845$

$\Rightarrow$ (24/99 – 4/55 – 1/24) x = 845

$\Rightarrow \frac{169}{1320} x = 845$

$\Rightarrow x = \frac{845 \times 1320}{169} = 6600$

$\therefore$ Amount invested in the 4% stock = 2×6600
= ₹13,200 Choice (B)

Exercise – 3(b)

1. Let the number of students in the previous year = x.

30% of x = $\frac{30}{100} \times x = \frac{3x}{10}$.

$\therefore x + \frac{3x}{10} = 1976$

$\Rightarrow \frac{13x}{10} = 1976 \Rightarrow x = \frac{19760}{13} = 1520$ Ans: (1520)

2. Let the population of the town in 1995 be x.
Given population in 2005 is 37800
i.e., x + 25% of x = 37800

$\Rightarrow x + \frac{25}{100} x = 37800 \quad \Rightarrow x = \frac{37800 \times 100}{125}$

$\Rightarrow$ x = 30240 Choice (A)

3. Let the time periods for which X, Y and Z invested be x, y and z respectively
$\therefore$ 4x : 7y : 11z = 24 : 35 : 77
Let 4x = 24k, 7y = 35k, 11z = 77k

x : y : z = $\frac{24k}{4} : \frac{35k}{7} : \frac{77k}{11}$ = 6 : 5 : 7 Choice (D)

4. The man gets ₹6 as return upon investing ₹120. His yield per cent = $\frac{6}{120}(100) = 5\%$ Ans: (5)

5. A. Investing ₹120 earns ₹10 as return.
To earn ₹1 as return, the required investment
= ₹ $\frac{120}{10}(1)$ = ₹12

B. To earn ₹1 as return, the required investment = ₹$11^2/_3$.

C. To earn ₹1 as return, the required investment
= ₹$11^7/_{13} \cong$ ₹11.53.

D. To earn ₹1 as return, the required investment = ₹$11^3/_7$.

To earn ₹1 as return, the least investment is required in scheme D. Scheme D is the best investment.
Choice (D)

6. Given P : Q : R = $\frac{1}{4} : \frac{1}{5} : \frac{1}{6}$

= 15 : 12 : 10
P + R is 13 more than Q.
$\therefore$ Percent by which (P + R) is more than Q

= $\frac{13}{25} \times 100 = 52\%$ Ans: (52)

7. Let the total number of votes polled be x.
Majority = 18924
i.e., 62% of x – 38% of x = 18924
$\Rightarrow$ 24% of x = 18924

$\Rightarrow \frac{24}{100} \times x = 18924 \quad \Rightarrow x = \frac{18924 \times 100}{24}$

$\Rightarrow$x = 78850
$\therefore$ The total number of votes polled were 78850.
Ans: (78850)

8. Given the pass mark is 35, which is 40% more than annual exam marks.
Let the annual exam marks of the student be x.

$\Rightarrow$ x + 40% of x = 35 $\Rightarrow$ $x + \frac{40}{100} \times x = 35$

$\Rightarrow$ $x + \frac{2x}{5} = 35 \Rightarrow x = 25$ Choice (B)

9. Value of Ram's flat after 2 years(in lakhs of rupees)
$= 2\left(1+\frac{25}{100}\right)^2 = ₹3.125$

Value of Shyam's flat after 2 years = $2.5\left(1+\frac{20}{100}\right)^2 = 3.6$

$\therefore$ Ram has to pay Shyam ₹0.475 lakhs i.e. ₹47500.
Choice (A)

10. Let the required percentage increase be x%.
512 (1 + x/100)(1 + x/100)(1 + x/100)(1 + x/100) = 1250
$\Rightarrow (1 + x/100)^4 = 1250/512$
$= \frac{625}{256} = (5/4)^4$

$\Rightarrow 1 + \frac{x}{100} = 1 + 1/4 \Rightarrow x = \frac{100}{4} = 25\%$ Choice (D)

11. C.S.A of sphere = $4\pi r^2$
New C.S.A of sphere = $4\pi r^2$ x (1.44) = $[4\pi (1.2r)^2]$
$\therefore$ The radius has changed from 'r' to '1.2r'
Volume = $4/3\pi r^3$

New volume = $\frac{4}{3}\pi (1.2r)^3 = \frac{4}{3}\pi r^3 (1.728)$

$\therefore$ Percentage increase in the volume
$= \frac{4/3\pi r^3[1.728 - 1]}{4/3\pi r^3} \times 100 = 72.8\%$ Choice (C)

12. Salary in 1998 = ₹22000
Salary in 1999 = $1.1 \times 22{,}000$ = ₹24200
Salary in 2000 = $1.1 \times 24{,}200 = 24200 + 2420$ = ₹26620
Salary in 2001 = $1.1 \times 26{,}620$
= 26620 + 2662 = ₹29282 Choice (B)

13. Let us say previously the payment per hour of the employee was ₹100 and his working time was 10 hours
$\therefore$ His income was 100×10 = ₹1000
Present payment per hour of the employee
$= 1.25 \times 100$ = ₹125
Total working time = $0.8 \times 10 = 8$ hours
$\therefore$ His income now is 125×8 = ₹1000
$\therefore$ There is no change in his income
(OR)
x ₹/hr, y hrs income = ₹xy
1.25x ₹/hr, 0.8 y hrs, income = ₹xy. No change in the income occurs. Ans : (0)

14. Let us say the minimum number of matches that should be played is x. In the first 30 matches, the Indian team won $\frac{40}{100}$ (30) matches, i.e. 12 matches.
As the team wanted a success rate of 80%, this can be achieved by the minimum number of additional matches played only if all these matches are won.

$\therefore 12 + x = \frac{80}{100}(30 + x)$

x = 60 Ans: (60)

15. Let the total sales for the last month be ₹S.

Commission obtained last month = ₹ $\frac{12}{100}$S .

Commission obtained this month = $\frac{8}{100}(S - 16000) + 4680$

$\frac{8}{100}(S - 16000) + 4680 = \frac{12}{100}S + 1000$

S = 60000 Choice (C)

16. Let the annual salary of Ram be ₹100.
The amount spent by Ram = ₹80
Savings of Ram = 100 – 80 = ₹20.
If his annual salary increased by 14% and his expenditure increased by 10%, his annual salary would become ₹114 and his expenditure would become ₹88. His new savings = 114 – 88 = ₹26.

Percentage increase in his savings = $\frac{6}{20} \times 100\% = 30\%$

Ans: (30)

17. Let the family's total income initially be ₹100.
Total expenditure of the family before Raju's increment = ₹64
Income of Raju before the increment = ₹36
Increment of Raju = ₹18
New total savings of the family will be ₹18 more as its expenditure remained unchanged.

Required percentage = $\frac{36+18}{100+18}(100)\% = 45\frac{45}{59}\%$

Choice (C)

18. Number of males = 6800
Number of females = 3200
If x males are literates, 6000 – x females are literates.
Number of male illiterates = 6800 – x.
Number of female illiterates = 3200 – (6000 – x)
= x – 2800.
$\therefore$ 6800 – x = x – 2800 + 1200
x = 4200

Percentage of female illiterates = $\frac{x-2800}{3200}(100)$

$= \frac{1400}{3200}(100) = 43.75\%$ Ans: (43.75)

19. Let the prices of a pen, an eraser and a sharpener be ₹p, ₹e and ₹s respectively.
p = 2e
e = 3s
Prices of a pen, an eraser and a sharpener after the percentage increases would be 2e(1.1) = 2.2e, e(1.3)
= 1.3 e and $\frac{e}{3}(1.2) = 0.4e$ respectively.

Percentage increase in the price of 30 pencils, 30 erasers and 30 sharpeners

$$= \frac{30\left[(2.2e + 1.3e + 0.4e) - \left(2e + e + \frac{e}{3}\right)\right]}{30\left(2e + e + \frac{e}{3}\right)} = 17\%$$

Choice (B)

20. Selling price = ₹210 = ₹$350\left(1 - \frac{20}{100}\right)\left(1 - \frac{d}{100}\right)$

$210 = 350\left(\frac{4}{5}\right)\left(1 - \frac{d}{100}\right)$

$\frac{3}{4} = 1 - \frac{d}{100}$
d = 25 Ans: (25)

21. Let the cost price be ₹x

Loss made in selling it at 25% loss = ₹ $\frac{x}{4}$

$400 - x = \frac{x}{4}$
x = 320
Discount = ₹100
Marked price of David = ₹500

Percentage at which his marked price was above his cost price = 56.25% Ans: (56.25)

22. 70 % of the apples purchased were sold.

SP of each apple = $14 \times \frac{5}{4}$ = ₹17.5

Number of apples sold = $\frac{4,90,000}{17.5}$ = 28,000.

Number of apples purchased = $\frac{28,000}{0.7}$ = 40,000

Ans: (40,000)

23. The shopkeeper gets a profit of 20% on selling using a false weight and a loss of 10% by selling at a lower price than cost price.

SP = 1.2×0.9CP = 1.08CP

Hence 8% profit. Choice (A)

24. C.P of the article = 816/0.8 = 1020

∴ Required S.P = 1.1×1020 = ₹1122 Ans: (1122)

25. The total number of radios sold = 60

The total revenue obtained = $\frac{2}{3}(60x)$ = ₹40x

Loss incurred = ₹10x.

∴ 40x + 10x = 60(3000)

⇒ x = 3600 Ans: (3600)

26. C.P of each item = 12/15

S.P of each item = 15/12

∴ Profit percentage = $\frac{\frac{15}{12}-\frac{12}{15}}{\frac{12}{15}} \times 100 = 56.25\%$

Choice (D)

27. Let, M.P = x and, C.P = y

0.88x = 1.1y

⇒ x = $\frac{1.1}{0.88}$ y ⇒ x = 1.25y

∴ The article was marked up by 25%. Ans: (25)

28. Let the shopkeeper's cost prices be x and y. The selling price of each item will be ₹6000.

x = $\frac{6000}{1.4}$ = 4285.7

y = $\frac{6000}{1.6}$ = 3750 Ans: (3750)

29. Let the correct weight be 100 gm.

Quantity bought = 110 gms

Quantity sold = 90 gms

∴ C.P. $_{110\ gms}$ = S.P. $_{90\ gms}$

Let C.P.$_{1gm}$ = ₹1

C.P. $_{90\ gms}$ = 90

S.P.$_{90\ gms}$ = C.P. $_{110\ gms}$= ₹110

Profit obtained by selling 90 gms = ₹20

Profit percentage = $\frac{20}{90}(100) = 22\frac{2}{9}\%$ Choice (B)

30. Let the correct weight be 100 gms.

Quantity bought = 110 gms

Let the quantity sold be x gms.

$x + \frac{10}{100}(x) = 100$

$x = \frac{1000}{11}$gms

∴ C.P.$_{110\ gms}$ = S.P. $_{\frac{1000}{11}gms}$

Let C.P$_{1\ gm}$ = ₹ 1

C.P. $_{\frac{1000}{11}gms}$ = $\frac{1000}{11}$

S.P. $_{\frac{1000}{11}gms}$ = C.P. $_{110\ gms}$ = 110

Profit in selling $\frac{1000}{11}$gms = $110 - \frac{1000}{11}$ = ₹ $\frac{210}{11}$

Profit per cent = $\frac{\frac{210}{11}}{\frac{1000}{11}}(100) = 21\%$ Choice (D)

31. Let the correct weight be 100 gms.

Let the weight sold by the shopkeeper be x gms.

S.P.$_{xgms}$ = C.P.$_{100gms}$

Let C.P.$_{1\ gm}$ = ₹1

S.P$_{xgms}$ = C.P$_{100\ gms}$ = ₹100, C.P. $_{x\ gms}$ = ₹x

% Profit = $\frac{100-x}{x}(100) = 25$

x = 80

The shopkeeper realized 85% (100) = ₹85

Actual profit per cent = $\frac{85-80}{80}(100)$ = 6.25%

Choice (C)

32. Total Selling Price = Total Cost Price + Total Profit

= (90000) (6) + $\frac{25}{100}$ (90000) (6)

= ₹ $\frac{125}{100}$ (90000) (6)

Selling price of each apple = $\frac{\frac{125}{100}(90000)(6)}{\frac{60}{100}(90000)}$

= ₹12.50. Choice (B)

33. Let the cost prices of the first item and the second item be ₹F and ₹S respectively.

Selling price of each item = ₹9000.

Loss on the first item = ₹0.5F

Loss on the second item = 0.4S

F – 0.5F = 9000

F = 18000

S – 0.4S = 9000

S = 15000 Ans: (3000)

34. Let the marked price of the trouser be ₹T.

Discount = ₹0.3T

0.3T = 120

T = ₹400. Ans: (400)

35. C.P = 225

M.P = 1.4×225 = 315

S.P = 0.8×315 = 252

∴Profit = 252 – 225 = ₹27 Ans: (27)

36. Old Profit = $12 - \left(9 + \frac{10}{100}(9)\right)$ = ₹2.10

New Profit = $\left(12 - \left(9 + \frac{10}{100}(12)\right)\right) = ₹180$

Percentage decrease in Ashok's profit

= $\frac{2.10-1.80}{2.10}(100\ \%) = 14\frac{2}{7}\%$ Choice (C)

37. Let the cost price of Amar be ₹ x.

Profit made by Amar = ₹ $\frac{x}{5}$.

Selling price of Amar = Bhavan's cost price = ₹ $\frac{6x}{5}$.

Loss made by Bhavan = ₹ $\frac{9x}{25}$.

Selling price of Bhavan = Cost price of Chetan = ₹ $\frac{21x}{25}$

= ₹840.

x = 1000

But Amar sold the camera to Bhavan at 30% loss, his loss = ₹300.

Selling price of Amar = Bhavan's cost price = ₹700.

If Bhavan sold the camera to Chetan at 20% profit, profit made by him = ₹ 140.

Selling price of Bhavan = Cost price of Chetan = ₹840.

Alternate method:

Bhavan's cost price = $\frac{120}{100}$. (Amar's cost price)

Chetan's cost price = $\frac{70}{100}$ (Bhavan's cost price)

= $\frac{70}{100}\ \frac{120}{100}$. (Amar's cost price) = 840.

Under the given conditions, Chetan's cost price similary can be shown to be $\frac{120}{100}\ \frac{70}{100}$ (Amar's cost price) = 840.

Ans: (840)

38. Total expenses incurred by Ashwin at the end of the first year = ₹120000.

Value of machine at the end of the first year

= $\frac{75}{100}$ 120000 = ₹90000.

As he sold it at an amount less than this, he made a loss.

His loss = ₹10000

His loss percentage = $11\frac{1}{9}$% Choice (D)

39. Profit shared by both = $\frac{90}{100}$ (7000) = ₹6300

Akbar and Birbal share this in the ratio 3 : 4.

Difference in profit shares of both is $\frac{1}{7}(6300)$

= ₹900. Ans: (900)

40. As Prasad started with ₹2000 and invested ₹300 at the end of every month, his capital at the end of the 12^{th} month

= 2000 + 11 × 300 = 5,300

Satish started with ₹5300 and withdraw ₹300 at the end of every month. So his capital at the end of the 11^{th} month

= 5,300 – 11 × 300 = 2,000.

∴ ratio in which profits are shared = 1 : 1 Choice (B)

41. Let us say B stayed invested for x months

54 × 12 = 81 × x

$\Rightarrow x = \frac{54 \times 12}{81} = 8$

∴B invested for 4 months less than A.

Choice (B)

42. Selling Price

= $\left(\frac{100-10}{100}\right)\left(\frac{100-15}{100}\right)\left(\frac{100-20}{100}\right)\left(\frac{100-25}{100}\right)(4000)$

= ₹1836.

If Anwar had sold the article at 30% discount, selling price would have been $\frac{70}{100}(4000) =$ ₹2800

∴ He would have realized ₹964 more. Choice (B)

43. Let the production cost be ₹100, before the currencies become costlier.

Cost of X = ₹20

Cost of Y = ₹40

Selling price of the machine = ₹125.

After the currencies become costlier, increase in the cost of X = 40% of 20 = ₹8. Increase in the cost of Y = 30% of 40 = ₹12.

∴Product cost increases by ₹20 to become ₹120. Selling price of the machine becomes 8% more i.e. ₹10 more i.e. ₹135.

Profit percentage now = $\frac{135-120}{120}(100)$ % = 12.5%

Choice (B)

44. Let the annual profit be ₹P.

A's salary = ₹0.4P

A's share in profit = $\frac{P-0.4P}{2}$ = ₹0.3P

A's total share = ₹0.7P

B's share = 0.3P

0.3P = 2100 $\Rightarrow$ P = 7000

0.7P = 4900

If the entire profit is divided in the ratio of their investments,

A's share = 4900 – 900 = ₹4000.

B's share = 7000 – 4000 = ₹3000.

∴ A's investment = $\frac{4000}{3000} \times 45000 = 60000$.

Choice (B)

45. Let us say the first man invested ₹x in each stock and the second man ₹y in each stock

2x – 2y = 960 $\Rightarrow$ x – y = 480 $\rightarrow$ (1)

[(x/96) × 4 + (x/102) × 5) – {(y/120) × 8 + (y/125 × 3)}] = 44

$\Rightarrow \frac{37x}{408} - \frac{34y}{375} = 44$

$\Rightarrow$ 4625x – 4624y = 2244000 $\rightarrow$ (2)

Solving (1) and (2), we get; x = 24,480 and y = 24,000

∴The investment made by the first man = 2 × 24,480

= ₹48960 Choice (B)

46. Either of the statements alone is not sufficient as the information about P, Q and R is not given in one statement. Using both statements, let total sum be ₹x

P's share = $\frac{10}{100}$ x = $\frac{x}{10}$

Q's share = $\frac{80}{100}$ R's share = $\frac{4}{5}$R's share.

Q's share + R's share = $x - \frac{x}{10} = \frac{9x}{10}$

$\frac{4}{5}$R's share + R's share = $\frac{9x}{10}$, So R's share = $\frac{x}{2}$

Q's share = $\frac{x}{2} \times \frac{4}{5} = \frac{2x}{5}$

So P gets the least share. Choice (C)

47. Either statement alone is not sufficient as the information about test 1 and test 2 is not given in one statement. Using both statements, in test 2 he scored 70 marks but we do not know the maximum marks in test 1 and test 2. Hence, the question cannot be answered. Choice (D)

48. From statement I, 50% of CP = 40% of SP.

CP : SP = 4 : 5

Let CP = 4x, SP = 5x

Profit percent = (x/4x) × 100% = 25%

Statement I alone is sufficient.

From statement II, CP = 80% of SP

CP : SP = 4 : 5

So profit percent can be calculated.

Statement II alone is sufficient. Choice (B)

49. From statement I, CP of one dozen bananas = x/12 and SP of one dozen bananas = x/8
As we know CP and SP we can find profit percentage
(Percentage profit = $\frac{\frac{x}{8}-\frac{x}{12}}{\frac{x}{12}} \times 100\% = 50\%$)
Statement I alone is sufficient
From statement II we have
SP – CP = ₹300 i.e.,
$x \times x - x \times y = 300$ (where y is the cost price)
$\Rightarrow x(x-y) = 300$
As we do not know x and y values or their relationship, we cannot answer the question. Choice (A)

50. From statement I, we do not know the cost price or selling price of each house. Hence we cannot find the profit percent.
Statement I alone is not sufficient.
From statement II, only by knowing the cost prices, we can't find the profit percent.
Using both the statements, let the cost price of each house be ₹x.
Total selling price of two houses = 120x/100 + 80x/100 = 2x
Total cost price is ₹2x and total selling price is ₹2x, so the profit percent is zero. Choice (C)

51. From statement I, we don't have any information about the selling price, so we can't find the discount percent.
Statement I alone is not sufficient.
From statement II, let the marked price and the selling price be ₹8x and ₹5x respectively.
Discount percent = $\frac{8x-5x}{8x} \times 100\% = 37.5\%$
Statement II alone is sufficient. Choice (A)

52. The coat was marked at ₹600 above the cost price. Using statement I, we know that if there is a discount of 50%, a loss of ₹200 is incurred. Let the cost price of the coat be ₹x.
i.e. $(x + 600)\frac{1}{2} = x - 200.$
i.e. x = 1000, but we can't find the profit as we do not know the selling price.
Statement I alone is not sufficient.
From statement II, selling price was ₹200 less than the marked price.
∴Profit = 600 – 200 = ₹400.
Statement (II) alone is sufficient. Choice (A)

53. From statement I,
$\frac{20}{100}x = \frac{35}{100}y$
$\Rightarrow 4x = 7y \Rightarrow \frac{x}{y} = \frac{7}{4}$
So x is greater than y as x and y are positive.
Statement I alone is sufficient
From statement II,
$\frac{12}{100}x < \frac{8}{100}y \Rightarrow 3x < 2y$
x and y are positive. So x is less than y.
Statement II alone is sufficient. Choice (B)

54. There are totally 240 employees in TEAM
From statement I, 40% of the employees work as the marketing employees (i.e. $\frac{40}{100} \times 240 = 96$ employees)
Of these 25% work in material department
i.e. $\frac{96 \times 25}{100} = 24$
24 employees work in material development section.
Statement I alone is sufficient.
From statement II let the total number of employees in material department be x. Number of employees in other departments is 240 – x.
Given $\left[\left(\frac{240-x}{240}\right)-\left(\frac{180-x}{180}\right)\right] \times 100 = 20.$
x can be found x is unique
Hence, statement II alone is sufficient . Choice (B)

55. From statement I, let side of square be x units.
∴ area = x^2 sq. units.
When the side is increased by 10%, then area of square
$= \left(\frac{110}{100}x\right)^2 = 1.21x^2$
Percentage increase in area = $\frac{1.21x^2 - x^2}{x^2} \times 100\% = 21\%$
Statement I alone is sufficient.
From Statement II, let the length of diagonal be d units.
Area of square = $\frac{1}{2}d^2$ sq. units.
When diagonal increased by 10% then the area of the square
$= 1/2\left(\frac{110}{100}d\right)^2 = \frac{1.21}{2}d^2$
Percentage increase in area
$= \frac{\frac{1.21}{2}d^2 - \frac{10d^2}{20}}{\frac{1}{2}d^2} \times 100\% = 21\%$
Statement II alone is sufficient Choice (B)

Chapter – 4
(Simple Interest and Compound Interest)

Concept Review Questions

1. Simple interest = (20000) (2) $\left(\frac{10}{100}\right)$ = ₹4000
Ans: (4000)

2. Let the rate of interest be R% p.a.
Interest = 2500 – 2000 = ₹500
$500 = 2000\ (2)\left(\frac{R}{100}\right)$
R = 12.5 Choice (D)

3. A sum lent at simple interest has the same interest on it each year. Sum of the interests accrued on it in the 6th, 7th and 8th years = 3 (3000) = ₹9000 Ans: (9000)

4. The interest becomes equal to the sum in 8 years. For the sum to become 4 times the original sum, the interest must be thrice the sum. Time taken for this= 3(8) = 24 years.
Ans: (24)

5. Present value = $\frac{3000}{1+\frac{(5)(10)}{100}}$ = ₹2000 Choice (C)

6. Compound interest = (20000) $\left(\left(1+\frac{10}{100}\right)^2 - 1\right)$
= ₹4200 Ans: (4200)

7. Let the rate of interest be R% p.a.
$2000\left(1+\frac{R}{100}\right)^2 = 2880$

$\left(1+\frac{R}{100}\right)^2 = 1.44 = (1.2)^2$

$1 + \frac{R}{100} = 1.2$

$\Rightarrow R = 20$ Choice (B)

8. Half yearly rate of interest = $\frac{20\%}{2} = 10\%$

Interest earned in the first year = total interest earned in two half years

$= 400\left(\left(1+\frac{20}{2}\right)^2 - 1\right) = ₹84$ Ans: (84)

9. Under compound interest, at the end of each year the principal amount increases.
$\therefore$The interest in n^{th} year will be greater than that in $(n-1)^{th}$ year.
Also this difference increases as the value of n increases.
$\therefore$ Only when p > q, the given situation arises.
Choice (A)

10. Effective rate of interest = 5% for half a year

$= \left(\left(1+\frac{5}{100}\right)^2 - 1\right)100 = 10.25\%$ p.a. Ans: (10.25)

11. Let the sum be ₹P. Let the rate of interest be R% p.a.

$P\left[\left(1+\frac{R}{100}\right)^3 - \left(1+\frac{R}{100}\right)^2\right] = 1440$

$P\left(1+\frac{R}{100}\right)\left[\left(1+\frac{R}{100}\right)^2 - \left(1+\frac{R}{100}\right)\right] = 1440$

$\left(1+\frac{R}{100}\right)\left[P\left[\left(1+\frac{R}{100}\right)^2 - \left(1+\frac{R}{100}\right)\right]\right] = 1440$

$\left(1+\frac{R}{100}\right)(1200) = 1440$, R = 20% Choice (C)

12. When a sum is lent / borrowed at compound interest, the amount at the end of a year forms the principal for the next year.
Let the rate of interest be R% p.a.

$1331\left(1+\frac{R}{100}\right) = 1464.10$

R = 10 Choice (A)

13. For the sum to become 4 times the original sum it can be considered as the sum getting doubled and then getting doubled again. As the sum takes 8 years to get doubled, the time taken for it to become 4 times = 2 (8) = 16 years.
Ans: (16)

14. When a certain sum is lent for a certain time at R% p.a, the interest yielded, when the interests are compounded monthly, compounded quarterly, compounded half yearly and annually will be in the descending order.
Choice (A)

15. Sum lent = $\frac{1200}{1+\frac{20}{100}} + \frac{1440}{\left(1+\frac{20}{100}\right)^2} = 1000 + 1000$

= ₹2000 Choice (C)

Exercise – 4(a)

1. Interest from the fifth year to the eighth year, i.e., for a period of four years = 4080 – 2480 = 1600
$\therefore$Principal = Amount at the end of four years – Interest for four years = 2480 – 1600 = ₹880 Choice (D)

2. Let the loan amount be ₹100

$\therefore$Amount to be repaid = $100 + \frac{100 \times 8 \times 5}{100}$ = ₹140

If the amount to be repaid is `140, then the loan amount is `100
$\therefore$When the amount to be repaid is ₹10640, the loan amount will be $10640 \times \frac{100}{140}$ = ₹7600

Alternative method:

$P\left(1+\frac{8\times5}{100}\right) = 10{,}640$

$P = 10640 \times \frac{5}{7} = 7600$

Choice (D)

3. Let ₹x be the savings

$\frac{(1/2)}{100}x = 884$

$\Rightarrow x = (884)\left(\frac{100}{1/2}\right) = 176800.$

Ans: (176800)

4. As it is S.I., one year interest = 2p – 3p/2 = p/2
Interest for 20 years = 20 × p/2 = 10p
After 20 years he will receive 10p + p = 11p

Note: The data that ₹p amounted to ₹$\frac{5}{2}$p after 3 years is redundant.
Choice (C)

5. Total interest payable

$= \frac{50000\times8\times2}{100} + \frac{50000\times10\times3}{100} + \frac{50000\times5\times2}{100} + \frac{50000\times7\times1}{100}$

= ₹31500
$\therefore$Amount payable = 50000 + 31500 = ₹81500
"or"
The effective rate of interest becomes equivalent to (8 × 2 + 10 × 3 + 5 × 2 + 7 × 1)
i.e., 63% for 1 year
$\therefore$Interest = $\frac{50000 \times 63}{100}$ = 31,500
$\therefore$Amount = 50000 + 31500 = ₹81500 Ans: (81500)

6. Let the installment be x

$\left(x + \frac{x \times 10 \times 2}{100}\right) + \left(x + \frac{x \times 10 \times 1}{100}\right) + x$

$= 1815 \Rightarrow 3.3x = 1815 \Rightarrow x = ₹550$ Ans: (550)

7. Let the sum be P
$P(1 + r/100)^7 = 1980 \quad \rightarrow \quad (1)$
$P(1 + r/100)^5 = 1375 \quad \rightarrow \quad (2)$
(1) ÷ (2): $(1 + r/100)^2 = \frac{36}{25}$

$\Rightarrow 1 + \frac{r}{100} = \frac{6}{5}$

$\Rightarrow \frac{r}{100} = \frac{1}{5} \therefore r = 20\%$ Ans: (20)

8. Let, principal = p
Amount = 2p
$\therefore p(1 + r/100)^4 = 2p$
$\Rightarrow (1 + r/100)^4 = 2$
Now, if the amount is 16p then;
$p(1 + r/100)^t = 16p$
$\Rightarrow (1 + r/100)^t = 16 = 2^4 = [(1 + r/100)^4]^4$
$\therefore t = 16$

Alternate method:

The sum doubles in 4 years

	sum	in years
doubles	x – 2x	4
	2x – 4x	4
	4x – 8x	4
	8x – 16x	4
	x – 16x	16 years

Ans: (16)

9. At the end of the first year the loan amounts to ₹88000 (at 10% per annum)
Let x be the amount repaid at the end of the first year.
Then (88000 – x) (1.1) = 55000
$\Rightarrow$ 1.1x = 41800
$\Rightarrow$ x = 38,000
$\therefore$ ₹38000 was repaid at the end of the first year.
Choice (A)

10. Let P be the sum and r be rate of interest (as a fraction rather than a percentage figure)
Interest for the 4th year will be
$P(1 + r)^4 – P(1 + r)^3 = 2000$ ---------- (1)
Interest for the 7th year will be
$P(1 + r)^7 – P(1 + r)^6 = 2662$ ------- (2)
(2) / (1) give
$(1 + r)^3 = 1.331$
$\Rightarrow 1 + r = 1.1$
$r = 0.1 = \frac{10}{100} = 10\%$. Choice (B)

11. Rate of interest = $\frac{691.2 - 576}{576} \times 100 = 20\%$
Let the sum be 100
$\therefore$ Interest earned on the third year
$= 100 \times (1.2)^3 – 100\ (1.2)^2 = ₹28.8$
When interest is ₹28.8, sum is ₹100
When interest is ₹576, sum would be $\frac{100}{28.8} \times 576$
= ₹2000 Ans: (2000)

12. Rate of interest = $\frac{(2178 - 1980) \times 100}{1980} = 10\%$
Let the interest earned in the first year be x.
1.1x = 1980 $\Rightarrow$ x = 1800 Ans: (1800)

13. If the interest increased from r to 3r, the interest earned in the first year would be 3 times the present interest, which then would have earned interest at the rate of 3r, implying that the difference would become 3 $\times$ 3 i.e., 9 times the previous difference.
$\therefore$ New difference = 9 $\times$ 140 = `1260 Ans: (1260)

14. $2x = x\left(1 + \frac{r}{100}\right)$

$2 = 1 + \frac{r}{100}$

$\frac{r}{100} = 1$

Amount at the end of 1½ years $= x\left(1 + \frac{\frac{3}{2}(100)}{100}\right) = ₹\frac{5x}{2}$
Choice (B)

15. Let the first, second and the third sums be P_1, P_2, P_3 respectively
Each sum amounted to the same value. Let us say each sum amounted to A

$P_1\left(1 + \frac{8}{100}\right) = P_2\left(1 + \frac{8}{100}\right)^2 = P_3\left(1 + \frac{8}{100}\right)^3 = A$

$P_1 = \frac{A}{1.08}$, $P_2 = \frac{A}{(1.08)^2}$, $P_3 = \frac{A}{(1.08)^3}$

$P_1 : P_2 : P_3 = \frac{27}{25} : \frac{25^2}{27^2} : \frac{25^3}{27^3} = 1 : \frac{25}{27} : \frac{25^2}{27^2}$
= 729 : 675 : 625. Choice (A)

16. Let R be the rate of interest p.a.
$\therefore$ The effective rate of interest = $\left\{\left(1 + \frac{R}{4 \times 100}\right)^4 - 1\right\} \times 100$
And it will be constant for every year.
(A) is true.
Under compound interest, the ratio of the interest for the $(k + 1)^{th}$ year and k^{th} year will be same for any value of k.
$\therefore$ (B) is true. Choice (C)

17. Let the sum be 100.
S.I for the two years = 2 $\times$ 8 = 16
C.I for the two years = $8 + 8 + \frac{8}{100} \times 8 = 16.64$
When the difference is 0.64, principal is ₹100
$\therefore$ When the difference is ₹25.6, the principal will be
$\frac{100}{0.64} \times 25.6 = ₹4000$ Ans: (4000)

18. Let, P = 100
C. I = $100(1.08)^2 – 100 = 16.64$
S.I = $2 \times \frac{13}{200} \times 100 = 13$
When the difference is ₹3.64, the sum is ₹100
When the difference is ₹1820, the sum is
$\frac{100}{3.64} \times 1820 = ₹50000$

Alternative method:

$P\left(\left(1 + \frac{8}{100}\right)^2 - 1\right) - \frac{P \times 2 \times 13}{100 \times 2} = 1820$

$\Rightarrow$ P = 50,000 Ans: (50,000)

19. Let the sum be x
$x\ [(1 + r/100)^2 – 1] – \frac{x \times 2 \times r}{100} = 160$
$\Rightarrow x\ \frac{r^2}{100^2} = 160 \quad \rightarrow \quad (1)$
Also, $x\ [(1 + r/100)^3 – 1] – \frac{x \times 3 \times r}{100} = 488$
$\Rightarrow x\left(\frac{r^3}{(100)^3} + \frac{3r^2}{100^2}\right) = 488 \quad \rightarrow \quad (2)$
(1) $\div$ (2);
$\Rightarrow \frac{r^2/100^2}{r^3/(100)^3 + 3r^2/100^2} = \frac{160}{488}$
$\Rightarrow \frac{1}{\frac{r}{100} + 3} = \frac{20}{61}$
$\Rightarrow \frac{r}{100} + 3 = \frac{61}{20}$
$\Rightarrow \frac{r}{100} = \frac{1}{20} \Rightarrow r = 5\%$
Now, $x \times \frac{5^2}{100^2} = 160 \Rightarrow x = ₹64000$

Alternative method:
Let sum be x.
Difference between interests after 2 years
$= x(2r + r^2) - x(2x) = xr^2 = ₹160$ -------- (1)
Difference after 3 years $= x(r^3 + 3r^2 + 3r) - x(3r)$
$= x(3r^2 + r^3) = ₹488$ --------- (2)
(2) / (1) $\Rightarrow r + 3 = 3.05 \Rightarrow r = 5\%$
$\therefore x = \frac{160}{(0.05)^2} = 64{,}000$ Choice (D)

20. $P(1 + r/100)^3 = 1.728P$
$\Rightarrow (1 + r/100)^3 = (1.2)^3$
$\Rightarrow 1 + \frac{r}{100} = 1.2 \Rightarrow r = 20\%$
Let, the required time period be t years
$\frac{P \times 20 \times t}{100} = 3P$ (since, interest = 4P – P = 3P)
$\Rightarrow t = \frac{300}{20} = 15$ years Choice (D)

21. The value that the sum of ₹2000 would have amounted to at the end of 3 years $= 2000\left(1+\frac{10}{100}\right)\left(1+\frac{20}{100}\right)\left(1+\frac{30}{100}\right)$
$= 2000(1.716)$
The value that the sum would have amounted to at the end of 3 years had it been lent at 20% pa simple interest $= 2000\left(1+\frac{3(20)}{100}\right) = 2000(1.6)$
The difference of the interests in the two cases = The difference of the amounts in the two cases = 2000 (1.716 – 1.6) = 2000 (0.116) = 232
The sum amounts to a higher value when lent at compound interest than when lent at simple interest
Had the sum been lent at 20% pa simple interest for 3 years, the interest realized would have been ₹232 less. Choice (C)

22. Let the rate at which Somu borrowed be R
Let the sums borrowed by Ramu and Somu be P_1 and P_2 respectively
Amount repaid by Ramu $= P_1\left(1+\frac{26}{100}\right) = 1.26P_1$
$1.26P_1 = 50400 \Rightarrow P_1 = 40000$
$P_1 + P_2 = 71500$, $P_2 = 31500$
$31500\left(1+\frac{R5}{100}\right) = 5040 \Rightarrow R = 12.$ Ans: (12)

23. Let the present worth be ₹x
$x(1 + 8/100)^2 = 1749.6$
$\Rightarrow x = \frac{1749.6}{(1.08)^2} = 1500$ Choice (C)

24. The down payment was 105000. The remaining amount paid in installments = 755000 – 105000 = 650000.
Let each installment be e.
$e = \frac{65000\left(\frac{14}{100}\right)}{1-\left(\frac{1}{1.14}\right)^3} \approx \frac{65000\left(\frac{14}{100}\right)}{1-0.675} = 280000.$
Ans: (280000)

25. Present value of the first installment $= \frac{2400}{1+\frac{20}{100}} = 2000$
Present value of the second installment $= \frac{2304}{\left(1+\frac{20}{100}\right)^2} = 1600$
Present value of the third installment $= \frac{5184}{\left(1+\frac{20}{100}\right)^3} = 3000$
Sum borrowed = Total of the present values of the three installments = 2000 + 1600 + 3000 = 6600.
Ans: (6600)

Exercise – 4(b)

1. $A = P\left(1+\frac{Nr}{100}\right)$
$1200 = 750\left(1+\frac{5r}{100}\right)$
$\frac{120}{75} = 1+\frac{5r}{100}$, $\frac{24}{15}-1=\frac{5r}{100}$
$\frac{9}{15}=\frac{r}{20}$, $r=\frac{9\times20}{15}$ = 12% p.a. Choice (D)

2. Principal = 1000
Rate = 10% p.a
Period, N = 5 years
Amount, $A = P + \frac{PNR}{100}$
Amount $= 1000+\frac{1000\times5\times10}{100} = ₹1500$ Choice (C)

3. Let each be ₹x.
1 year interest on ₹x at 14% p.a. under CI or SI $= \frac{(x)(14)}{100} = 0.14x$
1 year interest on ₹x at 16% p.a. under CI or SI $= \frac{(x)(16)}{100} = 0.16x$
0.14x + 0.16x = 2250
x = 7500. Choice (B)

4. Let the rate of interest be R% p.a. and the sum of money be ₹P.
$P\left(1+\frac{R}{100}\right)^3 = 1140$
$P\left(1+\frac{R}{100}\right)^3 = 1710$
$P\left(1+\frac{R}{100}\right)^2\left(1+\frac{R}{100}\right) = 1710$
$1140\left(1+\frac{R}{100}\right) = 1710$, R = 50

Alternate method:
The amount resulting when a sum of money is invested at compound interest at the end of a certain year forms the principal for the next year.
If the rate of interest is R% p.a.
$1140\left(1+\frac{R}{100}\right) = 1710 \Rightarrow R = 50$ Ans: (50)

5. $A = P\left(1+\frac{TR}{100}\right)$
$14112 = P\left(1+\frac{12\times8}{100}\right)$
$P = \frac{14112}{196}\times100 = ₹7200$ Ans: (7200)

6. Let the sum be ₹P

$$\frac{P\times 2\times 10}{100}+\frac{P\times 3\times 12}{100}+\frac{P\times 2\times 15}{100}=5332$$

$$\frac{20P}{100}+\frac{36P}{100}+\frac{30P}{100}=5332$$

$$\frac{86P}{100}=5332$$

$$P=5332\times\frac{100}{86}=\text{Rs.}6200$$ Ans: (6200)

7. Let the principal be ₹P. It becomes ₹8P in 12 years
∴ simple interest is 8P – P = 7P

$$7P=\frac{P\times 12\times R}{100}$$

$$R=\frac{700}{12}\%\text{ p.a i.e.,}\frac{175}{3}\%\text{ p.a.}$$

When it becomes 15P, interest is 14P

$$14P=\frac{P\times T\times 175/3}{100}$$

$$T=\frac{1400}{175}\times 3=24\text{ years}$$ Choice (D)

8. Let sum be ₹P and rate of interest be x% p.a

$$P\left(1+\frac{x}{100}\right)^5=1694$$

$$P\left(1+\frac{x}{100}\right)^7=2016$$

$$\frac{P\left(1+\frac{x}{100}\right)^7}{P\left(1+\frac{x}{100}\right)^5}=\frac{2016}{1694}$$

$$\left(1+\frac{x}{100}\right)^2=\frac{2016}{1694}$$

$$\left(1+\frac{x}{100}\right)^2=\left(\frac{12}{11}\right)^2$$

$$1+\frac{x}{100}=\frac{12}{11}\Rightarrow x=9\frac{1}{11}\%\text{ p.a}$$ Choice (A)

9. Let the principal be P.

$$P\left(1+\frac{18}{100}\right)^2-P\left(1+\frac{18}{100}\right)=2655$$

$$\left(\frac{118}{100}\right)^2P-\left(\frac{118}{100}\right)P=2655$$

$$\frac{118P}{100}\left(\frac{118}{100}-1\right)=2655$$

$$\frac{118P}{100}\times\frac{18}{100}=2655$$

$$P=\frac{2655\times 100\times 100}{118\times 18}$$

P = ₹12500. Choice (C)

10. Let P = ₹100
S.I for two years = 2 × 12 = ₹24
C.I for two years = 12 + 12 + 1.44 = ₹25.44
When the difference is 1.44, P = ₹100
When the difference is 126.72,

$$P=\frac{100}{1.44}\times 126.72=₹8800$$ Ans: (8800)

11. He invested ₹20000 at S.I. for 2 years. at 10%

$$A=20000\left(1+\frac{2\times 10}{100}\right)=20{,}000\ (1.2)=24{,}000$$

Then he invested this total amount in another bank which is giving a rate of interest r% p.a. compounded annually. After two years he received 2460 more than the investment.
24000 + 2460 = 26460

$$24000\left(1+\frac{r}{100}\right)^2=26460$$

$$\left(1+\frac{r}{100}\right)^2=\frac{26460}{24000}\Rightarrow\left(1+\frac{r}{100}\right)^2=\frac{441}{400}$$

$$\left(1+\frac{r}{100}\right)^2=\left(\frac{21}{20}\right)^2$$

$$=1+\frac{r}{100}=\frac{21}{20},\ \frac{r}{100}=\frac{1}{20}$$

r = 5% p.a. Ans: (5)

12. $$P\left(1+\frac{r}{2\times 100}\right)^{1\times 2}=P\left(1+\frac{5r}{100}\right)$$

$$\left(1+\frac{r}{200}\right)^2=1+\frac{5r}{100}=1+\frac{r}{20}$$

$$1+\frac{r^2}{200^2}+\frac{2r}{200}=1+\frac{r}{20}$$

r = 1600% p.a. Ans: (1600)

13. $$P_1\left(1+\frac{40}{4\times 100}\right)^{nx4}=P_2\left(1+\frac{20}{2\times 100}\right)^{nx2}$$

$$\frac{P_2}{P_1}=\frac{(1+0.1)^{4n}}{(1+0.1)^{2n}}=(1.1)^{2n}$$

$$\left(\frac{P_2}{P_1}\right)^{1/n}=1.21$$ Ans: (1.21)

14. Let sum = ₹P
1512 –1260 = ₹252 is the interest on ₹1260 for 1 year.

So rate of interest = $\frac{100\times 252}{1260\times 1}$ = 20% p.a.

$$P\left(1+\frac{20}{100}\right)^3-P\left(1+\frac{20}{100}\right)^2=1260$$

$$\Rightarrow P\left(\frac{6}{5}\right)^3-P\left(\frac{6}{5}\right)^2=1260\Rightarrow\frac{216P}{125}-\frac{36P}{25}=1260$$

$$\Rightarrow P=\frac{1260\times 125}{36}=₹4375$$ Choice (B)

15. Given that $100\left(1+\frac{r}{100}\right)^n=100\left(1+\frac{n.2r}{100}\right)$

$$\left(1+\frac{r}{100}\right)^n=\left(1+\frac{nr}{50}\right)$$

Since, the value of r is not known, n cannot be found. So the data is insufficient and it can't be determined.
Choice (D)

16. The difference between the C.I. and S.I. is 120 for 2 years for a principal of ₹12,000 =

$$\left[p\left(1+\frac{r}{100}\right)^2-p\right]-\left[p\left(1+\frac{2r}{100}\right)-p\right]=120$$

$$p\left[1+\frac{r^2}{100}+\frac{2r}{100}-1\right]-\left[p\left(\frac{2r}{100}\right)\right]=120$$

$$p\left[\frac{r^2}{100^2}+\frac{2r}{100}-\frac{2r}{100}\right]=120$$

$$p\left[\frac{r^2}{100^2}\right]=120$$

But p = 12000

$$12000\times\frac{r^2}{100\times100}=120$$

$$r^2=\frac{120\times100\times100}{12000}=100$$

r = 10% p.a.

The rate of interest = 10%

Alternative method:

The difference between S.I. and C.I. for two years on sum ₹p at the rate of r% per annum

$$=\frac{pr^2}{100^2}$$

$$\therefore\ \frac{12000\times r^2}{100^2}=120$$

r = 10% Ans: (10)

17. R = 10%

After two years the sum amounts to $10000\times1.1\times1.05\times1.05$

$$=10000\times\frac{11}{10}\times\frac{21}{20}\times\frac{21}{20}=₹12127.5$$ Ans: (12127.5)

18. Principal = P

$$P\left(1+\frac{r}{100}\right)^2-P\left(1+\frac{2r}{100}\right)=4P$$

$$P\left[1+\frac{r^2}{100^2}+\frac{r}{50}-1-\frac{2r}{100}\right]=4P$$

$$P\left[\frac{r^2}{100^2}\right]=4P$$

$$\frac{r^2}{100^2}=4$$

$r^2 = 4\times100\times100$

$r = 2\times100 = 200\%$ Choice (C)

19. A person has invested half of the money he has at C.I. at 10% p.a. and the other half at S.I. at a rate of 20% p.a. for 2 years.

$$\Rightarrow\frac{P}{2}[1.1]^2+\frac{P}{2}[1.4]=2610$$

$$\Rightarrow\frac{P}{2}[1.21]+\frac{P}{2}[1.4]=2610$$

$$\Rightarrow\frac{P}{2}[1.21+1.4]=2610$$

$$\Rightarrow P[2.61]=5220\Rightarrow P=\frac{5220}{2.61}=2000$$

So, at the end of 3rd year he will receive

$$=\frac{2000}{2}(1.1)^3+\frac{2000}{2}(1.6)$$

$= 1000\times1.331+1000\times1.6 = ₹2931$ Choice (B)

20. The simple interest for the first and the second years is ₹80 and ₹80 respectively. So the compound interest for the first and the second year is ₹80 and ₹90 respectively.
So 90 – 80 = 10 is the interest on ₹80 for 1 year.

So rate of interest = $\frac{100\times10}{80\times1}$ = 12.5% p.a. Ans: (12.5)

21. P = 91.3
A = 5000
$A = P.e^{nr/100}$

$$5000=91.3.e^{n\times\frac{100}{100}}$$

$$\frac{5000}{91.3}=e^n$$

$= (2.72)^n = 54.76 = (2.72)^n = (2.72)^4$

n = 4 years Choice (B)

22. $$\left(\frac{25}{16}\right)=\frac{p\left(1+\frac{r}{100}\right)^2}{p\left(1+\frac{2r}{100}\right)}$$

$$\left(\frac{4}{5}\right)^2=1-\frac{r^2}{(100+r)^2}$$

$$1-\frac{16}{25}=\frac{r^2}{(100+r)^2}=\frac{r^2}{(100+r)^2}=\frac{9}{25}$$

$$\left(\frac{r}{100+r}\right)^2=\left(\frac{3}{5}\right)^2$$

$$\frac{r}{100+r}=\frac{3}{5}$$

$5r = 300 + 3r$

$2r = 300 \Rightarrow r = 150\%$ p.a. Ans: (150)

23. Let rate of interest at CI be r% p.a.

$$P\left(1+\frac{r}{100}\right)^2=P\left(1+\frac{2\times2r}{100}\right)$$

$$P\left(1+\frac{r}{100}\right)^2=P\left(1+\frac{4r}{100}\right)$$

$$\left(1+\frac{r}{100}\right)^2=\left(1+\frac{r}{25}\right)$$

$$1+\frac{r^2}{100^2}+\frac{2r}{100}=1+\frac{r}{25}$$

$$\frac{r^2}{100^2}=\frac{r}{25}-\frac{r}{50}$$

$$\frac{r^2}{100^2}=\frac{2r-r}{50}=\frac{r}{50}$$

$$r=\frac{100\times100}{50}\Rightarrow r=200$$ Ans: (200)

24. Average rate of interest she paid

$$=\frac{6120\times100}{72000\times1}=8.5\%$$

By alligation method

12% 7%

8.5%

1.5 3.5

The ratio of sums borrowed = 1.5 : 3.5
= 3 : 7

Sum borrowed from Kalyani = $\frac{7}{10}\times72000$ = ₹50400

Choice (B)

25. ₹10000 becomes $\frac{34560}{2}$ = 17280 at 20% p.a. C.I in n_1 years. ₹11520 becomes ₹17280 at 25% p.a. S.I in n_2 years.

$17280 = 10000\left(1+\frac{20}{100}\right)^{n_1}$

$17280 = 10000\left(\frac{6}{5}\right)^{n_1}$

$\left(\frac{6}{5}\right)^{n_1} = 1.728$

$(1.2)^{n_1} = (1.2)^3 \Rightarrow n_1 = 3$ years

$17280 - 11520 = \frac{11520\times n_2\times 25}{100}$

$\Rightarrow 5760 = \frac{11520\times n_2\times 25}{100}$

$\Rightarrow n_2 = 2$ years Choice (A)

26. Amount outstanding at the end of the first year
$= 1.2 \times 25000 = 30{,}000$
Amount outstanding before the second year
$= 30000 - 8000 =$ ₹22000
Amount outstanding at the end of the second year
$= 1.2 \times 22000 =$ ₹26400
Amount outstanding before the third year
$= 26400 - 8000 =$ ₹18400
Amount outstanding at the end of the third year
$= 1.2 \times 18400 =$ ₹22080. Choice (D)

27. Amount at the end of two years $= 20{,}000\left[1+\frac{20}{100}\right]^2$

$= 20000\ (1.2)^2 =$ ₹28800
But after two years he returned 12,800
∴ Remaining balance = 28800 – 12800 = 16000
For this 16000 there is a interest of 20% p.a.
At the end of 3rd year he has to pay
= 16000(1.2) = ₹19200 Choice (C)

28. Value of the motor cycle at the end of first year
$= 80000 \times \frac{80}{100} =$ ₹64000
Value of the motor cycle at the end of second year
$= 64000 \times \frac{80}{100} = 51200$
Profit = 53600 – 51200 = ₹2400 Choice (B)

29. Let each installment be ₹x

$x + \frac{x\times 3\times 20}{100} + x + \frac{x\times 2\times 20}{100} + x + \frac{x\times 1\times 20}{100} + x = 717.60$

$\Rightarrow 4x + \frac{3x}{5} + \frac{2x}{5} + \frac{x}{5} = 717.60$

$\Rightarrow 4x + \frac{6x}{5} = 717.6 \Rightarrow 26x = 717.60 \times 5$

$\Rightarrow x = 138$ Ans: (138)

30. Let the sum borrowed be ₹P.
Given, (1.1 P – 2662) 1.1 = 2662
$\Rightarrow 1.21P = 2.1 \times 2662$
$\Rightarrow P = 4620$ Choice (B)

31. $20000\left(1+\frac{10\times n}{100}\right) - 18000\left(1+\frac{10}{100}\right)^n = 2042$

$20000\left(\frac{10+n}{10}\right) - 18000\ (1.1)^n = 2042$

From options, n = 3 satisfies the equation. So n = 3
Ans: (3)

32. $P\left(1+\frac{20}{100}\right)\left(1+\frac{10}{100}\right)\left(1+\frac{10}{100}\right) -$

$P\left(1+\frac{10}{100}\right)\left(1+\frac{10}{100}\right) = 4840$

P(1.2) (1.21) – P(1.21) = 4840
P(1.21) (1.2 – 1) = 4840
P(1.21)(0.2) = 4840
P = 20000
For the 4th year rate of interest is 30% p.a
So amount at the end of the 4 years = P(1.30) (1.2)(1.21).
$= 20000 \times 1.3 \times 1.2 \times 1.21 = 37752$ Choice (A)

33. Each annual instalment (x) $= \frac{P.r}{100\left[1-\left\{\frac{100}{100+r}\right\}^n\right]}$

x = 2662, r = 10% and n = 3, so

$2662 = \frac{P\times 10}{100\left[1-\left(\frac{100}{100+10}\right)^3\right]}$

$\Rightarrow 2662 = \frac{P}{10\left(1-\left(\frac{10}{11}\right)^3\right)} \Rightarrow 2662 = \frac{P}{10\left(\frac{331}{1331}\right)}$

$\Rightarrow P = \frac{2662\times 10\times 331}{1331} \Rightarrow P =$ ₹6620 Ans: (6620)

34. Sum = P

$8P = P\left(1+\frac{r}{100}\right)^3$

$8 = \left(1+\frac{r}{100}\right)^3$

$2 = 1+\frac{r}{100} = r = 100\%$ p.a.

If it had been compounded half yearly,

$P\left(1+\frac{100}{2\times 100}\right)^{3\times 2} = P\ (3/2)^6 \cong 11.4\ P$

∴ if compounding is done annually the sum amounts to 8P
If compounding is done half yearly the sum amounts to 11.4 P
∴ The extra amount he would have received
= 11.4P – 8P = 3.4 P (approx) Choice (C)

35. Each annual instalment (x) $= \frac{4000}{2} = 2000$

We have $x = \frac{pr}{100\left[1-\left(\frac{100}{100+r}\right)^n\right]}$

So $2000 = \frac{p\times 20}{100\left[\frac{100}{100+20}\right]^2}$

$$2000 = \frac{p \times 20}{100\left[1-\left(\frac{10}{12}\right)^2\right]}$$

$$100 \times 100 = \frac{p}{\left[\frac{144-100}{144}\right]}$$

$$\frac{10000 \times 44}{144} = p$$

p = 3056.

Interest paid = 4000 – 3056 = ₹944. Choice (B)

36. Statement I says the down payment is 40% of the total amount paid by the customer. But we do not know about the instalment.

Statement II says ₹1272 is the value of each instalment.

5 instalments add upto ₹1272 x 5 = ₹6360. But we do not know the down payment. Hence statement II is also insufficient.

If we combine both statements we can determine the total amount paid by the customer. Choice (C)

37. From statement I, we do not know anything about the interest rate. ∴ Statement I alone is not sufficient.

From statement II, we do not know the interest earned.

∴ statement II alone is not sufficient.

By combining (I) and (II),

$$P\left(1+\frac{10}{100}\right)^2 - P = 4830$$

Hence we can find the value of P Choice (C)

38. To find out the total money Sohini invested we need to know the interest earned.

From statement I, the interest she earns from each of her investments is the same. This alone is insufficient.

From statement II, the total interest she earned is ₹1200. But considering this statement alone we can not solve the problem. Hence statement II alone is not sufficient.

If we consider both statements I and II, we know that $\frac{1200}{3}$ = ₹400 is earned on each investment.

Hence combining both I and II we get the answer.

Choice (C)

39. The CI earned on ₹20000 for 2 years depends on the rate of interest. Let us assume rate of interest is r.

From statement (I),

$$P\left[\left(1+\frac{r+3}{100}\right)^2 - \left(1+\frac{r}{100}\right)^2\right]$$

= ₹1302.

$$\Rightarrow 20000\left[\left(2+\frac{2r+3}{100}\right)\left(\frac{3}{100}\right)\right] = ₹1302$$

$$\Rightarrow 2+\frac{2r+3}{100} = \frac{1302}{600} \Rightarrow \frac{2r+3}{100} = \frac{102}{600}$$

$\Rightarrow 2r + 3 = 17 \Rightarrow 2r = 14 \Rightarrow r = 7$

∴ Statement I alone is sufficient.

From statement II,

$$P\left(1+\frac{r}{100}\right)^2 - P - \frac{P(2r)}{100} = 98.$$

$$\therefore \left(1+\frac{r}{100}\right)^2 - \left(1+\frac{2r}{100}\right) = \frac{98}{20{,}000}$$

$$\Rightarrow 1+\frac{2r}{100} + \frac{r^2}{10000} - 1 - \frac{2r}{100} = \frac{49}{10{,}000}$$

$\Rightarrow r^2 = 49$ or r = 7.

Hence statement II alone is also sufficient. Choice (B)

40. Let P be the amount lent, P = 12000

$$\Rightarrow 12000\left[\left(1+\frac{r}{100k}\right)^{2k} - 1 - \frac{2r}{100}\right] = 30$$

where k is the frequency of compounding.

But we do not know at what frequency the interest is being compounded.

∴ Statement I alone is not sufficient

II is not sufficient as it gives no numerical data

By combining I and II, we get 12000

$$\left[\left(1+\frac{r}{100}\right)^2 - \frac{2r}{100} - 1\right] = 30 \Rightarrow \left(\frac{r}{100}\right)^2 = \frac{1}{400}$$

$\Rightarrow r = 5$ Choice (C)

Chapter – 5
(Time and Distance)

Concept Review Questions

1. As he travelled for equal time durations at different average speeds, his average speed for the journey happens to be the average of the average speeds i.e., $\frac{40+50}{2}$ = 45 kmph.

Ans: (45)

2. Suppose the car takes t hours to reach B if it arrives on time.

60(t + 1) = 80(t – 1)

t = 7

Required average speed = $\frac{60(t+1)}{t} = \frac{60(7+1)}{7}$

$= \frac{480}{7}$ kmph . Choice (C)

3. Time of travel = $\frac{125}{100}$ (Usual time of travel)

∴ His average speed = $\frac{4}{5}$ (Usual speed) Choice (B)

4. Average speed $\alpha \frac{1}{\text{Time}}$

∴ Time taken would be $\frac{4}{3}$rd of the usual time.

Choice (B)

5. Speed $\alpha \frac{1}{\text{Time}}$

Ratio of the times = $\frac{1}{3} : \frac{1}{4} : \frac{1}{6} = 4 : 3 : 2$ Choice (D)

6. Since the ratio of this speeds is 3 : 7. The ratio of the times taken to cover the same distance is 7 : 3.

Let the times taken by A and B be 7t min and 3t min respectively

Given that, 7t – 3t = 20

$\Rightarrow t = 5$

∴ A takes 7 × 5 i.e., 35 minutes to cover the distance.

Ans: (35)

7. Let the distance be d km and usual speed be 5x kmph.

$$\frac{d}{3x} - \frac{d}{5x} = \frac{20}{60}$$

$$\Rightarrow \frac{5d-3d}{15x} = \frac{1}{3}$$

$\Rightarrow 2d = 5x.$

Usual time taken = $\frac{d}{5x} = \frac{d}{2d} = \frac{1}{2}$ hour $= 30$ min .

Ans: (30)

8. Let the distances between city A to B and B to C be 2x km and 3x km respectively.
Total time taken to cover from A to C
$= \frac{2x}{40} + \frac{3x}{60} = \frac{6x+6x}{120} = \frac{12x}{120} = \frac{x}{10}$

Average speed = $\frac{2x+3x}{\frac{x}{10}} = 50$ kmph. Choice (B)

9. Let the time taken to cover the distance from P to Q be 't' hours and the distance between P and Q = 40t km

He covered $\frac{3}{5}$ of 40t in $\frac{2}{3}$t

So he has to cover $\frac{2}{5}$ of 40t i.e., 16t in $\frac{1}{3}$t

Required speed = $\frac{16t}{\frac{1}{3}t} = 48$kmph. Ans: (48)

10. Let the total distance be x km

Total time taken = $\frac{\frac{x}{4}}{16} + \frac{\frac{3x}{4}}{24}$

$= \frac{x}{64} + \frac{x}{32} = \frac{3x}{64}$

Average speed = $\frac{x}{\frac{3x}{64}} = \frac{64}{3}$kmph $= 21\frac{1}{3}$kmph.

Choice (B)

11. Let the distance to be travelled to catch the bus be x km

$\frac{x}{30} - \frac{x}{40} = \frac{30}{60}$

$\frac{4x-3x}{120} = \frac{1}{2}$

$\Rightarrow$ x = 60km

By travelling at 30 kmph, time taken = $\frac{60}{30} = 2$ hours.

By taking 2 hours, he is late by 40 min. So he has to cover 60km in at most 1 hour 20 min.

Min. required speed = $\frac{60}{\frac{4}{3}} = 45$kmph. Ans: (45)

12. Let us say they meet 't' hours after 9.30am.
So, 25 (t + 1·5) = 37·5 (t)
$\Rightarrow$ 2 (t + 1·5) = 3t $\Rightarrow$ 2t + 3 = 3t $\Rightarrow$ t = 3
So, they meet at 12·30 pm. Karuna travels for 3 hours and meets Haritha. So, they meet $3 \times 37{\cdot}5 = 112{\cdot}5$ km away from starting point. Choice (C)

13. Time taken by A and B to meet = $\frac{400}{30+70}$ = 4 hours.

Meeting time = 11:00 a.m. Choice (D)

14. Distance that A would have covered by 9:00 a.m. = 60 km At 9:00 a.m., A and B would be 300 km apart. Time that A and B would take to meet = $\frac{300}{60+40}$ = 3 hours.

Meeting time = 12:00 noon Choice (B)

15. Let the speeds of A and B be 3x kmph and 7x kmph respectively. Distance that A would have run by 11:00 a.m. = 3(x) (4) = 12x km.
Time from then that A and B would take to meet
= $\frac{12x}{7x-3x}$ = 3 hours

Meeting time = 2:00 p.m. Choice (B)

16. If two persons start simultaneously from P and Q to reach Q and P respectively, the time they would take to meet.

$= \sqrt{\text{Product of times to reach their destinations from their meeting point}}$

In the given problem, as both start simultaneously, their meeting time = 9:00 a.m. + $\sqrt{(9)(16)}$ minutes.
= 9:12 a.m. Choice (C)

17. As both the cars are travelling in the same direction, and they started from the same point, they will meet after travelling equal distances.
$\therefore$ The required ratio is 1 : 1. Choice (A)

18. Time taken = $\frac{400+600}{(36)\left(\frac{5}{18}\right)}$ = 100 seconds Ans: (100)

19. As the trains are moving in the opposite direction, in order to cross each other they together have to travel a distance which is sum of their lengths.
i.e., 500 + 600 = 1100 m Choice (B)

20. As they are moving in the same direction, in order to overtake the slower train, the faster train will have to travel a distance which 1100 m more than the distance travelled by the slower train.
As we don't know the speed of the slower train or their relative speed we cannot answer the question.
Choice (D)

21. From the above solution, we can say that the answer is 1100 m.
Choice (B)

22. In 10 hours, distance covered upstream
$= \frac{22}{4} \times 10 = 55$km

Downstream = $\frac{45}{6} \times 10 = 75$km ; 75 – 55 = 20

So the distance covered downstream in 10 hours is 20 km more. Ans: (20)

23. Downstream speed of Anand = 10 kmph.

Required time = $\frac{30}{10}$ = 3 hours. Ans: (3)

24. Required ratio = $\frac{\frac{30}{4}+\frac{30}{8}}{2} : \frac{\frac{30}{4}-\frac{30}{8}}{2}$

$= \frac{30}{2}\left(\frac{3}{8}\right) : \frac{30}{2}\left(\frac{1}{8}\right) = 3 : 1$ Ans: (3)

25. Let the speeds of the boat in still water and the stream be x kmph and y kmph respectively.

$x - y = \frac{8}{4} = 2 \quad \rightarrow$ (1)

$x + y = \frac{20}{2} = 10 \quad \rightarrow$ (2)

Solving (1) and (2), we get x = 6 and y = 4
Note : Speed of the boat in still water is the average of the downstream and upstream speeds. Speed of the stream is $\frac{1}{2}$ (Difference of the upstream and downstream speeds).

Choice (B)

26. Ratio of speeds of Ganesh and Girish = 2 : 1.
$\therefore$ Ganesh will complete as many more rounds than Girish as the number of rounds Girish completes in an hour.

Required number = $\frac{(4)(3600)}{600} = 24$. Ans: (24)

27. (i) Time taken = $\frac{1000}{5-3}$ = 500 seconds. Ans: (500)

(ii) Time taken = $\frac{1000}{5+3}$ = 125 seconds. Ans: (125)

28. Time taken = LCM $\left(\frac{900}{15-10}, \frac{900}{20-10}\right)$ = 180 seconds.

Choice (B)

29. Time taken = LCM $\left(\frac{900}{10}, \frac{900}{15}, \frac{900}{20}\right)$ = 180 seconds.

Ans (180)

30. The sum of the speeds of P and Q remains unchanged when they exchange their speeds.

$\therefore$ P and Q would meet for the second time after $\frac{800}{8}$

= 100 seconds after their first meeting.

Choice (B)

31. Since the ratio of the speeds of P and Q is 1 : 2, for every 1 round covered by P, Q covers 2 rounds and they meet at the starting point. They meet for the first time after 60 minutes. Q reversing his direction after 60 minutes is redundant.

Ans: (60)

32. Ratio of the speeds of P and Q = 1000 : 1000 – 125 = 8 : 7.
Q's speed = $\frac{7}{8}$ (1.6) = 1.4 m/sec.

Ans : (1.4)

33. When A ran 100 m, B would have run 90 m.
$\therefore$ B's speed is 0.9 (A's speed).
Similarly, C's speed is 0.9 (B's speed) i.e. 0.81(A's speed).
$\therefore$ A beats C by 0.19 (length of the race) = 19 m.

Ans: (19)

34. Ratio of the speeds of A and B
= 800 : 800 – 100 = 8 : 7. Choice (A)

35. Ratio of the speeds of A and B
= 200 : 200 – (10 + 10) = 10 : 9. Choice (C)

36. B takes 2 seconds to run the first 10 m.

$\therefore$ B's speed = $\frac{10}{2}$ = 5 m/sec.

B takes $\frac{100-10}{5}$=18 seconds to run the race from the point he was at when A starts the race.

$\therefore$ A's speed = $\frac{100}{18} = 5\frac{5}{9}$ m/sec Choice (B)

37. B takes 2 seconds to run the last 10 m.

B's speed = $\frac{10}{2}$=5 m/sec

B takes $\frac{100}{5}$ = 20 seconds to run the race.

$\therefore$ A's speed = $\frac{100}{20-2} = 5\frac{5}{9}$ m/sec Choice (C)

38. Angle covered from 12:00 noon to 2:30 p.m. by the minute hand = (Angle covered in 2 hours) + (Angle covered in 30 minutes) = (2) (0) + 30(6) = 180°.

Similarly, angle covered from 12:00 noon to 2:30 p.m. by the hour hand = 75°.
Angle between the hands at 2:30 p.m. = 105°.

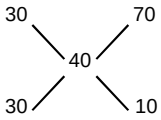
Ans: (105)

39. Time interval = $32\frac{8}{11}$ minutes. Choice (C)

40. 22 times.
Note : The hands of a clock are separated by any angle other than 0°and 180°44 times in a day. Ans: (22)

Exercise – 5(a)

1. Average speed = 160/4 = 40km/hr
Using the rule of alligation



The ratio of times travelled at each speed is 3 : 1.
$\therefore$ Total time that the bus travelled at 70 km/hr is
$\frac{1}{4} \times 4$ = 1 hour Choice (B)

2. Let the time taken by Bunty be t . At the speed u, Pandu takes t + 2, At the speed 2u, he takes t – 3, i.e., 5 hours less.(i.e., at the lower speed Pandu takes 10 hours and at the higher speed he takes 5 hours) $\therefore$ t + 2 = 10 $\Rightarrow$ t = 8.
Choice (A)

3. Let the total distance be x
Speed of riding be V_r and Speed of walking be V_w

$20\ \frac{x/3}{V_r} = \frac{2x/3}{V_w}$

$10V_w = V_r$

$\frac{V_r}{V_w} = \frac{10}{1}$ = 10 Ans: (10)

4. Stoppage time per hour
= $\frac{(60-48)}{60} \times 60$ minutes = 12 minutes Choice (B)

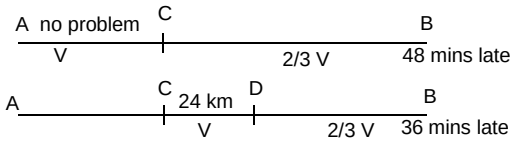
5. Time taken for the first part of the journey = 40/50 = 4/5 hours
Time taken for the second part of the journey = 70/35 = 2 hours

$\therefore$ Total time taken for the journey = $\frac{4}{5} + 2 + \frac{1}{5}$ = 3 hours

and total distance = $3 \times 52 = 156$
Let the last stretch be x km
$\Rightarrow$ distance travelled in the last stretch
= 156 – (40 + 70) = 46 km Ans: (46)

6. $5t_1^2 + 5t_1t_2 = 1500$
$5t_1 (t_1 + t_2) = 1500$
$150\ t_1 = 1500$; $t_1 = 10$ Ans: (10)

7.



In the second case, the 12 minutes it makes is made up over CD.

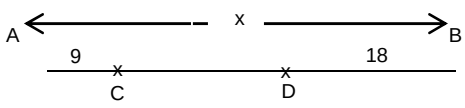
$\therefore\ \frac{24}{2/3V} - \frac{24}{V} = \frac{12}{60}$

V = 60 kmph
Over 24 km it makes up 12 minutes the entire 48 minutes, it can make up over BC.
$\therefore$ BC = 4×24 = 96 km
$\therefore$ AC = 150 – 96 = 54 km Choice (D)

8. Let the distance between X and Y be d. Let 't' hours be the time after which they meet for the second time
54 t + 72 t = 3 d (By the first meeting, X and Y together cover d and by the second meeting they together cover 3d, since the ratio of the speeds lies between 0.5 and 2)
$\Rightarrow$ 72 t – 54 t = 36 $\Rightarrow$ 18 t = 36 $\Rightarrow$ t = 2
2(54 + 72) = 3 d $\Rightarrow$ d = 84 Choice (D)

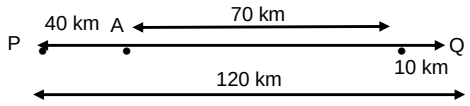
9. From the data, the time at P is ahead of the time at Q,(P is to the east of Q). Let P be x hours ahead of Q. The speeds of both flights are the same ($\because$Distances traveled by the two flights are the same). The travel times from city Q to city P and from city P to city Q are (13 + x) hours and (20 – x) hours respectively.
700 (20 – x) = 700 (13 +x)
2x = 7 $\Rightarrow$ x = 3.5
Distance between P and Q = 700 (20 – 3.5)km
= 11,550 km Choice (A)

10.



When they meet for the first time at C the man starting from B has covered 18 km and both men have together covered x km. By the time they meet at D. The two men have together covered 3x km.
$\therefore$ the man starting from B would have covered
$3 \times 18 = 54$ km
But we know he had gone to A and come back 9 km
i.e. (x + 9)km
$\therefore$ x + 9 = 54 $\Rightarrow$ x = 45 km Choice (B)

11. At 10:15 a.m.



They will meet after $\frac{120 - 50}{80}$

$= \frac{70}{80} = \frac{7}{8}$ hrs $= \frac{7}{8} \times 60$ minutes

$\frac{105}{2}$ = 52 minutes 30 seconds

They will meet at 10:15 a.m. + 52 minutes 30 sec i.e. 11:07:30 a.m. Choice (C)

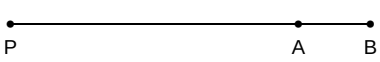
12. In 5 minutes the police party travels $\frac{5}{60} \times 60 = 5$ km

The thief travels $\frac{5}{60} \times 48 = 4$ km

So, the thief has a lead of 9 km. This lead has to be covered by the police party with a relative velocity of
60 – 48 = 12 kmph
It will take $\frac{9}{12} \times 60 = 45$ min

Totally 45 + 5 = 50 minutes from the time the police party spotted the thief. Ans: (50)

13.



Had the person remained at A after hearing the first explosion, he would have heard the second explosion after 40 minutes. i.e. to travel from A to B sound takes 1 minute. But the person took 41 minutes.
$\therefore$ the distance between A and B = speed of sound $\times$ time taken for travel from A to B
$= 331 \times 60 = 19860$ m Ans: (19860)

14. Let the length of the train be L_1
$\frac{L_1}{(72 - 36) \times 5/18} = 20$
$L_1 = 200$ m
When the train meets the second motorcyclist the time is 4:30:20
Distance between the first motorcyclist and the second motorcyclist at 4 : 30 : 20
$= [(30 \times 60 \times 20) + (20 \times 20)] - [(30 \times 60 \times 10) + 20 \times 10)]$
(Distance covered by the first train) (Distance covered by the motor cyclist)
$= (20 \times 20)[30 \times 3 + 1] - (20 \times 10)[30 \times 3 + 1]$
$= 91[400 - 200] = 91 \times 200$
This has to be covered by a relative velocity of
36 kmph + 36 kmph
= 20 m/s
T = $\frac{91 \times 200}{20}$ = 910 sec = $\frac{91}{6}$ min = 15 min 10 sec
They will meet at 4 : 45 : 30 p.m Choice (D)

15. Speed of the first train = 36 kmph = 10 m/s
It will clear the tunnel in $\frac{200 + 300}{10}$ = 50s
Speed of the second train = 18 kmph = 5 m/s
It will clear the tunnel in $\frac{100 + 300}{5}$ = 80s
So, the tunnel will be free of traffic in 80s. Ans: (80)

16. Let the length of the tunnel be x m. Let the speeds of the train and the dog be t m/sec and d m/sec respectively.
Let us say that the train is approaching the tunnel from P, and would be ym from P initially.

$\frac{y}{t} = \frac{\frac{5}{11}x}{d} \rightarrow$ (1)

$\frac{y + x}{t} = \frac{\frac{6}{11}x}{d} \rightarrow$ (2)

Dividing (2) by (1)
$\frac{y + x}{y} = \frac{6}{5}$
y = 5x
$\frac{t}{d} = \frac{y}{\frac{5}{11}x} = 11 : 1$ Choice (C)

17. $\frac{30}{V + x} + \frac{30}{V - x} = 8$
where V and x are speed of the boat and water current respectively.
V = 4x
$\frac{30}{5x} + \frac{30}{3x} = 8$
$\frac{6}{x} + \frac{10}{x} = 8$
x = 2 kmph Ans: (2)

18. Let V_b be the speed of the boat in still water and V_S be the velocity of the stream.
$\frac{6V_s}{V_b - V_s} + \frac{6V_s}{V_b + V_s} = \frac{9}{2}$

$\Rightarrow \frac{1}{\frac{V_b}{V_s} - 1} + \frac{1}{\frac{V_b}{V_s} + 1} = \frac{3}{4}$

$$\frac{2\frac{V_b}{V_s}}{\left(\frac{V_b}{V_s}\right)^2-1}=\frac{3}{4}$$

Let $\frac{V_b}{V_s}=x$

$$\frac{2x}{x^2-1}=\frac{3}{4}$$

$3x^2 - 8x - 3 = 0$

$(3x + 1)(x - 3) = 0$

$x = 3$ ($\because x > 0$)

$\frac{V_b}{V_s} = 3$ Choice (B)

19. Let the speeds of his boat in still water and the speed of the river be x kmph and y kmph respectively.

$$\frac{40}{x+y}+\frac{40}{x-y}=12$$

$$\frac{40(2x)}{x^2-y^2}=12 \quad \rightarrow \quad (1)$$

$$\frac{40}{2x+y}+\frac{40}{2x-y}=3\frac{3}{4}=\frac{15}{4}$$

$$\frac{40(4x)}{4x^2-y^2}=\frac{15}{4} \quad \rightarrow \quad (2)$$

Dividing (1) by (2)

$$\frac{4x^2-y^2}{2(x^2-y^2)}=\frac{48}{15}$$

$15(4x^2 - y^2) = 48(2(x^2 - y^2))$

$y^2 = \frac{4}{9}x^2$

$\therefore$ (1) becomes $\frac{40(2x)}{x^2-\frac{4}{9}x^2}=12$

$\therefore x = 12$ Ans: (12)

20. Let the number of steps on the escalator be S
Let the speed of the person be p steps/sec. Let the speed of the escalator be e steps/sec

Speed at which the person walked up = $p + e = \frac{S}{15}$

Speed at which the person walked down = $p - e = \frac{S}{75}$

$S = 15(p + e) = 75(p - e)$

$p = \frac{3}{2}e$

$\therefore S = 15(p + e) = \frac{75}{2}e$

Time taken by the person to walk up/down the escalator (in seconds) when the escalator is switched off = $\frac{S}{p} = \frac{\frac{75}{2}e}{\frac{3}{2}e}$

= 25 seconds Ans: (25)

21. Ram Shyam Ghanshyam
l l – a
l l – b

When Ram covers l Ghanshyam covers

$$\frac{(l-a)(l-b)}{l}=\frac{l^2-(a+b)l+ab}{l}$$

$= l - (a + b) + (ab/l)$

So, Ram beats Ghanshyam by

$$l-\left\{l-(a+b)+\frac{ab}{l}\right\}$$

$= a + b - \frac{ab}{l}$ Choice (A)

22. Let the length of the race be x, Asha's speed be v and Sunita's speed be 5/4 v
Then Sunita covers x and Asha covers x – 400 by the time the race is over

$$\frac{x}{\frac{5}{4}y}=\frac{x-400}{y}$$

$4x = 5x - 2000$; $x = 2000$ m Ans: (2000)

23. A : B = 500 : 450
= 10 : 9
B : C = 1000 : 950
= 20 : 19
A : B : C = 1000 900 855
A beats C by 29
$\Rightarrow$ C takes 29 seconds to travel 145/2 m
i.e. his speed is 2.5 m/s
To travel 855 m C takes
$\frac{855}{2.5}$ = 5.7 minutes
i.e. to travel 900 m B takes 5.7 minutes
So to travel 2.7 km, B takes 5.7×3
= 17.1 minutes. Ans: (17.1)

24. Let the length of the race be d m. When X finishes the race, Y and Z would have covered (d – 12)m and (d – 24)m respectively. When Y finishes the race, Z would have covered (d – 15)m.

Ratio of speeds of Y and Z = $\frac{d-12}{d-24}=\frac{d}{d-15}$.

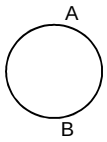
$(d - 12)(d - 15) = d(d - 24)$
$3d = 180$
$d = 60$ Ans: (60)

25. Akash and Anurag will meet after $\frac{900}{20-15}$ = 180 s

Akash and Rishab will meet after $\frac{900}{30+15}$ = 20 s

They will meet after LCM (180, 20) seconds
= 180 s Choice (D)

26. T_0 = starting time = 0
T_1 = first pass at B
$= (6/12) \times 60 = 30$ minutes
T_2 = second pass at B
$= 30 + 30 + (6/9) \times 60 = 100$ minutes
T_3 = third pass at B



$= 100 + \frac{6}{9}\times 60 + \frac{6}{6}\times 60$

= 140 + 60 = 200 minutes
Interval between the first pass and third pass
= 170 minutes Choice (D)

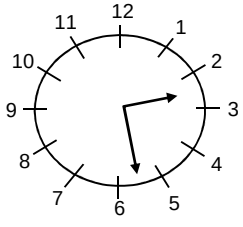
27. Time for the first meeting = $\frac{400}{10+40}$ = 8 s

Speeds after the first meeting
P = 20 m/s Q = 20 m/s
Time between the first and the second meeting
$\frac{400}{20+20}$ = 10s
Speeds after the second meeting
P = 40 m/s Q = 10 m/s
Time between the second and the third meeting
$= \frac{400}{40+10}$ = 8 s
Time from the start to the third meeting
= 8 + 10 + 8 = 26 s Ans: (26)

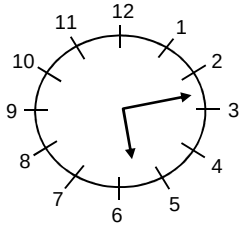
28. The first clock gains $2^1/_2 - (-1^1/_2)$
= 4 minutes every hour relative to the second clock.
To gain 2 hours or 120 minutes it needs 30 hours.
So, Sunday 12 noon + 30 hours i.e. Monday 6:00 p.m. is when, this will happen. Choice (C)

29.

Before leaving



After returning



The respective times are 2 : x minutes and 5 : y minutes.
Angle covered by the minutes hand before leaving is equal to the angle covered by the hours hand after returning.
i.e. $6x = 150 + (y/2) \quad \rightarrow \quad (1)$
Angle covered by the hours hand before leaving is equal to the angle covered by the minutes hand after returning.

i.e. $60 + \frac{x}{2} = 6y \quad \rightarrow \quad (2)$

$(1) - (2) \times 12$
$143y = 1740$
$\Rightarrow y = 1740/143 = 12^{24}/_{143}$
$\therefore$ Her retuning time is $5:12^{24}/_{143}$ p.m. Choice (C)

30. The hour hand covers 30° per hour and $\frac{1^\circ}{2}$ per minute

The minute hand covers 360° (i.e. 0) per hour and 6° per minute
The hands coincide at 12 noon
From 12 noon to 5:15 pm, (i.e. in 5 hours 15 min), the hour hand covers $5(30^\circ) + 15\left(\frac{1^\circ}{2}\right)$ i.e. 157.5°

From 12 pm to 5:15 pm the minute hand covers $5(0) + 15(6^\circ)$ i.e. 90°
Angle between the hands at 5:15 pm = 157.5° – 90°
= 67.5°. Ans: (67.5)

Exercise – 5(b)

1. Let the distance covered at 40 km/hr be x.
$\therefore$ Distance covered at 60 km/hr will be (250 – x) km.

$\frac{x}{40} + \frac{250 - x}{60} = 5 \Rightarrow x = 100$ km Ans: (100)

2. Let the total distance covered by Rajesh be d km. Let us say he travelled for c hours by car. Speed at which he travelled by car = $\frac{2d}{3c}$ kmph

Speed at which he travelled on foot

$= \frac{d}{3 \times 18c} = \frac{d}{54c} = \frac{1}{36}$ (speed at which he travelled by car)

Ans: (36)

3. Let the usual speed be v and usual time be 't'. Since he travels at 5/4 v he takes 4/5 t
i.e. he saves 1/5 t. He started 15 minutes late and he finished 20 minutes early i.e. he saved 35 minutes.
$\therefore$ 1/5 t = 35, t = 175 minutes. Ans: (175)

4. Relative velocity $= \left(\left(36 \times \frac{5}{18}\right) - (2.5)\right)$ m/sec = 7.5 m/s

$\therefore$ Required time = $\frac{\text{Distance of Separation}}{\text{Relative speed}}$

= 225/7.5 = 30 sec Ans: (30)

5. Speed of the train = $\frac{480 - 370}{62 - 51}$ = 10 m/sec

$= 10 \times \frac{18}{5}$ = 36 km/hr Ans: (36)

6. Speed of the train = $72 \times \frac{5}{18}$ = 20 m/sec

Length of the train = $20 \times 10 = 200$ m
Length of the train + length of the platform = $20 \times 44 = 880$ m
$\therefore$ Length of the platform = 880 – 200 = 680 m
Ans: (680)

7. Let the usual speed be x km/hr.
$\frac{480}{x - 8} + \frac{480}{x} = 2$

$\Rightarrow 480\left(\frac{8}{x^2 - 8x}\right) = 2 \Rightarrow x^2 - 8x - 1920 = 0$

$\Rightarrow (x - 48)(x + 40) = 0 \Rightarrow x = 48$
$\therefore$ usual speed = 48 km/hr
(A quicker way to solve such a question would be by substituting the answer choices.) Ans: (48)

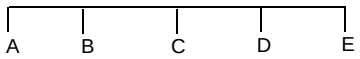
8. Distance covered in the first 12 mins = $30 \times \frac{12}{60}$ = 6 km

Distance covered in the next 12 minutes = $35 \times \frac{12}{60}$ = 7 km

Distance covered in the next 12 minutes = $40 \times \frac{12}{60}$ = 8 km

and so 6 + 7 + 8 + 9 + 10 + 11 = 51 km
i.e. 6 time periods of 12 minutes each = 72 minutes
Choice (B)

9.



Let AB = x km and DE = y km.
CD = 2AB = 2x km and BC = 2DE = 2y km.
BD = BC + CD = 2(x + y) = 180
x + y = 90
AB + DE = 90
AE = AB + BC + CD + DE = 270 km. Choice (A)

10. Let the speed of X be x kmph. Distance travelled by X in 2 hours = 2x km.

Suppose X takes t hours to travel $\frac{1}{5}^{th}$ of the distance AB. Y would take (t – 2) hours to travel $\frac{1}{5}^{th}$ of the distance AB. As Y's speed is thrice that of X's speed,

$\frac{t-2}{t} = \frac{1}{3}$
t = 3
$\frac{1}{5}^{th}$ of the distance AB = 3x km.
AB = 15x km

Time taken by X to cover 15x km = $\frac{15x}{x}$ = 15 hours

Time taken by Y to cover 15x km = $\frac{15x}{3x}$ = 5 hours.

$\therefore$ Difference in the times = 10 hours. Ans: (10)

11. Total time for the journey = $\frac{36}{x} + \frac{36}{3x} + \frac{36}{6x} + x + 3x = \frac{54}{x} + 4x$

$\frac{54}{x} + 4x = 30$
$4x^2 - 30x + 54 = 0$
$2x^2 - 15x + 27 = 0$
$(x - 3)(2x - 9) = 0$

$x = 3$ or $\frac{9}{2}$

As x is an integer, x = 3 Ans: (3)

12. From the given information, normal speeds of A and B are in the ratio 1 : 4.

Normal travel time of B = $\frac{1}{5}(60)$ = 12 min.

Starting time of A = 6:10 a.m.
Normal total travel time of A and B = 50 minutes.
As B doubled its speed on the day, it would reach Q in 6 minutes on that day. Travel time for A on that day is 44 minutes.
∴ Ratio of speeds of A and B on that day = 6 : 44 = 3 : 22
Choice (A)

13. Time taken for taking rest = 11×10 = 110 minutes
= 1 hour 50 minutes
Time for travelling = 12/4 = 3 hours
∴ Total time taken = 4 hours and 50 minutes
Choice (B)

14. Let AB = x km
Speed of Amir = x/10 km/min
Speed of Simran = x/15 km/min
Time taken for them to meet

$= \frac{x}{\frac{x}{10}+\frac{x}{15}} = \frac{10\times 15}{25} = 6$ min

∴ They meet at 8:06 a.m. Choice (B)

15. Let Bali take t_2 hours to reach P.
$36^2 \times 5 = 45^2 \times t_2$
$t_2 = 16/5 = 3^1/_5$ hours Ans: (3.2)

16. From 4:00 p.m. to 5:00 p.m. the train covers 72 km. In 1 hour, the motorcyclist covers a distance of 36 km. So, the separation between the cyclist and the motorcyclist = 72 – 36 = 36 km. This has to be covered by a relative velocity of 36 + 18 = 54 kmph

It will take $\frac{36}{54} = \frac{2}{3}$ hours = 40 min Choice (D)

17. Let the speeds of the two cyclists be u km/hr and v km/hr respectively.
Let the two cyclists cover the distances x and y respectively in the time t.

$x = ut$ $y = ut_1$
$y = vt$ $x = vt_2$
$xy = xy$
$\Rightarrow t = \sqrt{t_1 t_2}$ Choice (C)

18. Distance that A would have travelled by 8:00 a.m. is 54 km.
Distance between A and B at 8:00 a.m. is 90 – 54 i.e., 36 km.
Each hour A and B can travel 102 km together. For them to be 19 km apart for the first time, they have to travel 17 km.

Time taken for them to travel 17 km = $\frac{17}{102}(60)$

= 10 minutes
∴A and B would be 19 km apart for the first time at 8:10 a.m.
Choice (A)

19. Distance that A travelled by 10:00 a.m. is 60 km.
Distance between A and B at 10:00 a.m. = 270 km.
Distance of the halting station of A from its location at 10:00 a.m. = 270 – 120 = 150 km.

A would reach its halting station in $\frac{150}{60}$ i.e., $2\frac{1}{2}$ hours.

By then B would have travelled $2\frac{1}{2}(40)$ i.e., 100 km.

B would need to travel another 120 – 100 i.e., 20 km to reach A's halting station.

Time taken for this travel = $\frac{20}{40}$ i.e., $\frac{1}{2}$hr.

As A would halt for 35 minutes, both would meet at the halting station 3 hours after B starts from Y i.e., at 1:00 p.m.
Choice (C)

20. Distance travelled by the policeman in 6 minutes $= (90)\left(\frac{6}{60}\right) = 9$ km.

Distance travelled by the thief in 6 minutes

$= (60)\left(\frac{6}{60}\right) = 6$ km.

When the policeman took the U turn, he was 15 km behind the thief. He would overtake the thief in

$\frac{15}{90-60}$ hours $= \frac{1}{2}$hr.

∴The policeman would catch the thief 36 minutes after they cross each other. Ans: (36)

21. Assume the speeds of A and B are a kmph and b kmph respectively. Let XY = d km.
When the cars meet for the first time, B will have travelled 30 km. A will have travelled (d – 30) km.
When the cars meet for the second time, B will have travelled (d + 10) km or (d –10) km. A will have travelled (2d – 10) km or (2d + 10) km

$\frac{a}{b} = \frac{d-30}{30} = \frac{2d-10}{d+10}$

$(d – 30)(d + 10) = (2d – 10)30$
$d^2 – 20d – 300 = 60d – 300$
$d(d – 80) = 0$
As d cannot be 0, d = 80
(or)

$\frac{a}{b} = \frac{d-30}{30} = \frac{2d+10}{d-10}$

$d^2 – 40d + 30 = 60d + 30$
$d(d–100) = 0$
As d cannot be 0, d = 100

Alternate method:
Suppose two bodies A and B start from two points / places P and Q respectively towards others starting point simultaneously which are initially d km apart. If they travel back to their starting points using the same route after reaching their destinations and meet a km from Q for the first time and b km from P for the second time.
d = (3a – b) (or) (3a + b)
As a = 30 and b = 10, d = 80 or 100 Choice (B)

22. Let us say both meet after t hours at point P.
MP = 5t km
NP = 4t km

Time taken by Anand to reach N from P = $\frac{4t}{5}$ hours.

Time taken by Bhaskar to reach M from P = $\frac{5t}{4}$ hours

$\therefore \frac{4t}{5} = \frac{5t}{4} - 9$

t = 20
MN = 5t + 4t = 9t = 180 km.

Alternate method:

Distance from the meeting point to M = $\frac{5MN}{9}$

Distance from the meeting point to N = $\frac{4MN}{9}$

$\frac{1}{5}\left(\frac{4MN}{9}\right) = \frac{1}{4}\left(\frac{5MN}{9}\right) - 9$

MN = 180 Ans: (180)

23. Let the initial speeds of A and B be x kmph and y kmph respectively.
When they meet, A and B would have travelled x km and y km respectively.
$\therefore x + y = 12 \Rightarrow y = 12 - x$.

Additional time taken by A to reach Y = $\frac{y}{x+6}$

Additional time taken by B to reach X = $\frac{x}{y-6}$

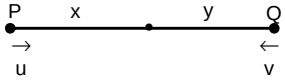
$\frac{y}{x+6} = \frac{x}{y-6}$

$\frac{12-x}{x+6} = \frac{x}{12-x-6}$

$(6 - x)(12 - x) = x(x + 6)$

$x = 3$ Choice (B)

24. Let Bryan and Adam travel at speeds of v and u respectively and let them have covered respective distances of y and x by the time they meet. Then



Adam ('s time) = $\frac{x}{u} + \frac{y}{v}$

Bryan ('s time) = $\frac{y}{v} + \frac{x}{u}$

Hence same time. Choice (C)

25. Time taken by P to cross the tunnel = $\frac{900}{72 \times \frac{5}{18}} = 45$ seconds

Time taken by Q to cross the tunnel = $\frac{1200}{90 \times \frac{5}{18}}$

= 48 seconds
$\therefore$ P exits the tunnel first. When P exits, Q will have travelled a distance of $90 \times \frac{5}{18} \times 45$ = 1125 m.

$\therefore$ 75 m of Q would still be inside the tunnel. Choice (A)

26. The rear ends of the trains will cross each other when the trains completely cross each other.

This will happen after $\frac{1500}{(72+90)\frac{5}{18}}$ seconds.

$= \frac{100}{3}$ seconds

Distance travelled by the slower train in this time

$= \frac{100}{3}(72)\left(\frac{5}{18}\right) = 666^2/_3$ m

Distance between the point where the rear ends of the trains cross each other and the point of entry of the slower train

$= 666\frac{2}{3} - 300 = 366^2/_3$ m Choice (B)

27. Let the speeds of the train and the cyclist be t kmph and c kmph respectively.

$\frac{270}{(t-36)\frac{5}{18}} = 27$

$t = 72$

$\frac{270}{(t-c)\frac{5}{18}} = 18$

$\frac{270}{(72-c)\frac{5}{18}} = 18$

$c = 18$

In an hour, the train can travel 36 km more than the motorcyclist. So when the train overtakes the cyclist, the cyclist and the motor cyclist will be separated by 36 km.
The motor cyclist would overtake the cyclist in another $\frac{36}{(36-18)}$ hours = 120 minutes Choice (A)

28. Speed of first train = $\frac{180 + 120}{20} = 15$ m/s.

Length of second train = $10 \times 15 = 150$ m
Time taken to cross each other when moving in opposite directions = $\frac{\text{sum of lengths of two trains}}{\text{relative speed}}$

$= \frac{180+150}{15+15} = 11$sec. Ans: (11)

29. Speed of the train = $36 \times \frac{5}{18}$ = 10 m/sec

$\therefore$ Sum of the lengths of the train and the bridge
$= 48 \times 10 = 480$ m

Speed of the man = 9 km/hr = $9 \times \frac{5}{18}$ = 5/2 m/s

Relative velocity of the train = 10 – 5/2 = 15/2 m/s

$\therefore$ Length of the train = $20 \times \frac{15}{2}$ = 150 m

$\therefore$ Length of the bridge = 480 – 150 = 330 m
Ans: (330)

30. Let the speed of the stream be 'u'

$\frac{32}{6+u} = \frac{16}{6-u}$

$2(6 - u) = 6 + u$

$6 = 3u$

$u = 2$ kmph Ans: (2)

31. Let the speed of man in still water be x kmph and speed of stream be y kmph.

3 hours 45 min = $\frac{15}{4}$ hours

2 hours 12 min = $\frac{11}{5}$ hours

speed downstream = $x + y = \frac{30}{\frac{15}{4}} = 8$kmph

speed up stream = $x - y \frac{11}{\frac{11}{5}} = 5$kmph

$x + y = 8$ and $x - y = 5$. Solving the two equations we get $x = 6{\cdot}5$ and $y = 1{\cdot}5$. Choice (C)

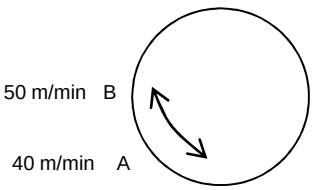
32. Time taken for A to complete one round = $\frac{1800}{40}$ = 45 min

Time taken for B to complete one round = $\frac{1800}{50}$ = 36 min

If B had not reversed his direction, time taken for A and B to meet for the first time would have been

$\frac{1800}{50-40}$ = 180 min

But now after 36 mins



They will take a further $\frac{360}{50+40}$ = 4 min.

So, they will meet after 40 min. Ans: (40)

33. Ratio of the speeds of Rohan and Sohan = 3 : 2

When Rohan meets Sohan for the first time, he covers $\frac{3}{5}$th of the track length.

When he meets Sohan for the second time, he covers $\frac{2}{5}$th of the track length. In this manner Rohan completes 4 rounds. When Rohan covers the next $\frac{1}{2}$of the 5th round, Sohan will have covered $\frac{2}{3}\left(\frac{1}{2}\right)$, i.e., $\frac{1}{3}$rd of a round.

∴ Shortest distance between Rohan and Sohan along the track = $1-\left(\frac{1}{2}+\frac{1}{3}\right) = \frac{1}{6}$th of a round, i.e. 150 m.

Choice (C)

34. Ravi and Vikram complete one round of 900 m in 9 s and 15 s respectively
∴ speeds are 900/9, 900/15
= 100 m/s, 60 m/s i.e. relative speed of 40 m/s
Hence Ravi will meet Vikram after every $22^1/_2$ seconds.
But since the race lasts for 90 seconds only (i.e. Ravi finishes 10 rounds)
Ravi meets Vikram exactly 4 times and the time taken will be 90 seconds. Ans: (90)

35. B takes 5s to cover 50 m
So B's speed = 10 m/s
So, B takes 1000/10 = 100s to cover 1000 m.
A takes 95s to complete the race.

A's speed = $\frac{1000}{95}=\frac{200}{19}$ m/s = $10^{10}/_{19}$ m/s Choice (B)

36. Let the radii of the hours hand and the minutes hand be R m and r m respectively.
Hours hand completes a revolution every 12 hours while minutes hand completes a revolution every hour.
Total area covered by the hours hand in 4 days = Area covered in 8 revolutions = $8\pi R^2$.
Total area covered by the minutes hand in one day = $24\pi r^2$

Given that $8\pi R^2 = \frac{3}{16}\left(24\pi r^2\right)$

$R^2=\frac{9}{16}r^2 \Rightarrow \frac{r}{R}=\frac{4}{3}$. Choice (B)

37. Let it be at p minutes after 1 p.m. Angle made by the hours hand = $30+\frac{p}{2}$

Angle made by minutes hand = 6P
Since they are coincident

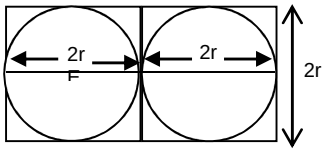
$6P = 30+\frac{p}{2}$

$11\frac{p}{2} = 30$

P = 60/11
So, they are coincident 60/11 minutes after 1:00.

Choice (C)

38.



Let the radius of each circle be r units. The rectangle has a length of 4r units and a breadth of 2r units. In order for both to reach their starting points simultaneously, P must complete running the circumference of the two circles and Q must complete running the rectangle perimeter once simultaneously.
The circumference of each circle = $2\pi r$ units
Perimeter of the rectangle = 12r units.

Required percentage = $\frac{2(2\pi r)-12r}{2(2\pi r)}\times 100 = 4\frac{6}{11}\%$

Choice (C)

39. Let the distance it travelled without any problem be x km and its speed over that part of the journey be S kmph

$\frac{x}{S}+\frac{900-x}{\frac{3}{5}S}=\frac{900}{S}+2 \rightarrow$ (1)

$\frac{x+150}{S}+\frac{900-(x+150)}{\frac{3}{5}S}=\frac{900}{S}+1 \rightarrow$ (2)

Subtracting (2) from (1),

$-\frac{150}{S}+\frac{150}{\frac{3}{5}S}=1$

S = 100
Substituting S in (1) or (2), x = 600. Choice (C)

40. Length of the track = $2\left(\frac{22}{7}\right)(7)=44$ m

For each meeting, Mahesh and Naresh together complete one round. In the first round, Mahesh covered $\frac{4}{5}$ of the length of the track and Naresh covered $\frac{1}{5}$ of the length of the track. In the second round, Naresh covered $\frac{4}{5}$ of the length of the track and Mahesh covered $\frac{1}{5}$ of the length of the track.

Hence for every two meetings, each of them covered the length of the track. For 22 meetings, each of them cover 11 rounds.
∴Required distance = $11\times 44 = 484$ m Ans: (484)

41. In the time A runs 500 m, B runs 460 m.
In the time B runs 1000 m, C runs 960 m.
In the time B runs 460 m, C runs $\frac{460}{1000}(960)$ = 441·6 m.
∴ A would beat C by 58·4 m in a 500 m race.
As A beats C by 14·6 seconds in a 500 m race, the speed of

$C=\frac{58\cdot 4}{14\cdot 6}=4\text{m/sec}$

Speed of B = $\frac{460}{441\cdot 6}(4)\text{m/sec}$

Time taken by B to run 2·4 km = $\frac{2400}{\frac{460}{441\cdot 6}(4)}=9.6$ minutes.

Ans: (9.6)

42. Let the time at the start of the test be p minutes after 5.

Angle made by hours hand = $150+\frac{p}{2}$

Angle made by minutes hand = 6p
Let the time at the end of the test be q minutes after 6 Angle made by hours hand = $180+\frac{q}{2}$

Angle made by minutes hand = 6q
Since the hours hand and minutes hands have interchanged their positions,

$150 + \frac{p}{2} = 6q \quad \rightarrow \quad (1)$

$6p = 180 + \frac{q}{2} \quad \rightarrow \quad (2)$

Solving $p = \frac{420}{13}, q = \frac{360}{13}$

Duration of the test = 60 – p + q = $55^5/_{13}$ minutes

Choice (B)

43. Let Ajay's speed over stretch Z be z kmph.
Speed of travel of Ajay over stretch X = 20 kmph.
Speed of travel of Ajay over stretch Y = 40 kmph.

Total time of travel of Ajay = $\left(\frac{4}{20} + \frac{4}{40} + \frac{4}{z}\right) 60$

This is ≥ 22 minutes.

$60\left(\frac{4}{20} + \frac{4}{40} + \frac{4}{z}\right) = 22$

z = 60 Ans: (60)

44. As Ajay travelled stretch X taking the maximum possible time, he travelled at the minimum speed i.e. 20 kmph.

Time of travel to cover X = $\frac{4}{\frac{20}{60}}$ = 12 minutes

Time of travel to cover Z = $\left[\frac{100 - 66\frac{2}{3}\%}{100}\right]$ of 12

= 4 minutes

Time taken to run the race = $22\left(\frac{100 - 4\frac{6}{11}}{100}\right)$ minutes

= 21 minutes
Time of travel to cover Y = 21 – (12 + 4) = 5 minutes.

Speed of travel to cover stretch Y = $\frac{4}{\frac{5}{60}}$ = 48 kmph.

Choice (D)

45. Let Ajay's speed over X be x kmph.
Let Ajay's time over X and (Y and Z) combined (in hours). be p and q respectively.

$\frac{4}{p} = \frac{5}{12}\frac{8}{q}$

$q = \frac{5}{6}p$

$\frac{12}{p + \frac{5}{6}p} = \frac{450}{11}$

p = 0.16

$\frac{4}{x} = 0.16$

x = 25 Ans: (25)

46. From statement I, distance travelled is 200 km, and time taken is 6 hours.

Hence average speed is $\frac{200}{6}$ = 33.33 km/hr.

Statement I alone is sufficient.
From statement II, his onward journey speed is 30 km/hr and his return journey speed is 40 km/hr. Hence average speed is $\frac{2 \times 30 \times 40}{30 + 40}$ km/hr.
Statement II alone is also sufficient.

Choice (B)

47. From statement I, Pulkit takes an hour and a half more than Angadh. But we do not know the time taken to cover the distance by Angadh.
From statement II, the ratio of speeds of Angadh and Pulkit is $= \sqrt{\frac{4\frac{4}{5}}{3\frac{1}{3}}} = \sqrt{\frac{24}{5} \times \frac{3}{10}} = \frac{6}{5}$

Hence statement II alone is sufficient. Choice (A)

48. From statement I, we do not know the speeds of ship and riskshaw and hence we can't answer the question.
From statement II, by knowing only ratio of speeds we can't find the speed of train.
So statement II alone is not sufficient.
Using both the statements, let the speeds of ship, train and riskhaw be 4x, 15x and x respectively.

Given, $\frac{12}{4x} + \frac{45}{15x} + \frac{6}{x} = 2$

So the speed of the train can be found. Choice (C)

49. From statement I, when Aarti and Bhallu met, the distance covered is 20 x 2 = 40 km. We do not know about their speeds. So we can't answer the question Statement I alone is not sufficient.
From statement II, the ratio of speeds of Aarti and Bhallu is 3 : 5.
Let their speeds be 3x and 5x respectively.
Now the length PR is equal to 2PQ × 3x/8x
We do not know the distance between P and Q.
So statement II alone is not sufficient.

Using both statements, PR = 2 x 20 x $\frac{3x}{8x}$ = 15.

Choice (C)

50. Let V_a be the velocity of the slower man.
∴the faster man will walk at V_a + 2 m/s.
Let the train travel at V_t m/s and let its length be ℓ.

From statement I, we have $\frac{\ell}{V_t - V_a} = 9 \ldots (1)$

$\frac{\ell}{V_t - V_a - 2} = 10 \ldots\ldots (2)$

So = $\frac{V_t - V_a}{V_t - V_a - 2} = \frac{10}{9}$

Let $V_t - V_A = x$

$\frac{x}{x - 2} = \frac{10}{9}$

So x = 20 i.e. $V_t - V_a = 20$.

Now $\frac{\ell}{20} = 9$

∴ℓ = 180 m.
Statement I alone is sufficient.
From statement II faster man travels at 4 m/s. But without the times the train takes to overtake the men we cannot solve for the length of the train. Statement II alone is not sufficient.

Choice (A)

51. Let the length of train be L meters. From statement I the train covers L meters in 6 seconds.
So speed of train = L/6.
But we do not know L. Hence statement I alone is insufficient. From statement II, the train crosses 750 + L in 25 seconds.

Speed of train = $\frac{750 + L}{25}$

Again we do not know L, therefore statement II is also insufficient.

Using both the statements, we have $\frac{750 + L}{25} = \frac{L}{6}$

i.e. 25L = 4500 + 6L.

$\therefore L = \frac{4500}{19}$

So speed of train is $\frac{4500}{19 \times 6}$ m/s Choice (C)

52. Let the distance between A and B be d km.

From statement I, $\frac{d}{x} - \frac{d}{x+10} = 2$

We do not know the value of d or x so we can't find the time taken to travel from A to B at x kmph Statement I alone is not sufficient.

From statement II, ratio of speeds is x : $\frac{3x}{4}$ i.e. 4 : 3. So ratio of time taken to cover the distance at x kmph and $\frac{3x}{4}$ kmph is 3 : 4

$\therefore$ time taken to cover the distance at x kmph

$= \frac{3}{4-3} \times 2 = 6$ hours. Statement II alone is sufficient.

Choice (A)

53. Either of the statements alone is not sufficient to answer the question as we have information about Alok and Asif in different statements.

Using both statements, $\frac{\text{Biswas}}{\text{Alok}} \times \frac{\text{Asif}}{\text{Biswas}} = \frac{400}{370} \times \frac{760}{800}$

$\frac{\text{Asif}}{\text{Alok}} = \frac{380}{370}$. In a 380 m race, Asif beats Alok by 10 m. So in a 800 m race, Asif beats Alok by $\frac{10}{380} \times 800$ m.

Choice (C)

54. The angle between the hands of a clock at 3 O'clock is 90°. From here on, the angle decreases to 0° and then in creases upto 180° and again decreases upto 120° (i.e., the angle at 4 O'clock.)

From statement I, the angle is 130°. But this angle occurs twice.

$\therefore$ Statement I alone is not sufficient.

From statement II, the angle is 100°, which occurs only once. Hence we can find the time.

$\therefore$ Statement II alone is sufficient. Choice (A)

55. From statement I, let the speed of the boat in still water and the speed of the water current be x kmph and y kmph respectively.

$\frac{d}{x+y} = \frac{1}{2}\left(\frac{d}{x-y}\right)$

$\Rightarrow$ x = 3y i.e speed of the boat in still water is 3 times the speed of the water current.

Statement I alone is sufficient.

Statement II gives the speed of the boat upstream as 10 m/s. But this alone is not sufficient. Choice (A)

Chapter – 6
(Time and Work)

Concept Review Questions

1. Part of the job which can be completed by 30 men in a day $= \frac{1}{30}$.

Part of the job completed by 1 man in a day

$= \frac{1}{(30)(30)} = \frac{1}{900}$. Choice (C)

2. Time taken to complete the job = 36 hours.

Number of days required to complete the job working 9 hours a day $= \frac{36}{9} = 4$. Ans: (4)

3. (i) Job to be completed = (2) (8) (8) = 128 man hours.

Required number of men = $\frac{128}{(4)(4)} = 8$. Choice (A)

(ii) Required number of men = 2(8) = 16. Ans: (16)

4. Part of the book he can read in 1 minute = $\frac{1}{k}$

$\therefore$ Park of the book he can read in 8 minutes = $\frac{8}{k}$.

Choice (B)

5. Let time taken by P to do the work be x days. Q and R together can do the work in 2x days.

$\frac{1}{x} + \frac{1}{2x} = \frac{1}{21}$

$\frac{2+1}{2x} = \frac{1}{21}$

$\Rightarrow 2x = 21 \times 3 = 63$ days. Choice (B)

6. Ratio of the time taken by A and B to complete the job

$= \frac{1}{\text{Ratio of the efficiencies of A and B}} = 2 : 3$

Let the time taken by A and B to complete the job be 2x days and 3x days respectively.

$\frac{(2x)(3x)}{2x+3x} = 30$

x = 25

Time taken by the faster person to complete the job = Time taken by A = 50 days. Ans: (50)

7. Ratio of the parts of the jobs done by P, Q and R is an hour is the ratio of the reciprocals of their individual times to complete it.

i.e. $\frac{1}{2} : \frac{1}{3} : \frac{1}{6} = 3 : 2 : 1$ Choice (C)

8. Ratio of the efficiencies of X and Y = 140 : 100 = 7 : 5

Choice (D)

9. Part of the job completed by P and Q working together in a day = $\frac{1}{x+8} + \frac{1}{x+18} = \frac{1}{x} \Rightarrow \frac{x+18+x+8}{(x+8)(x+18)} = \frac{1}{x}$

$2x^2 + 26x = x^2 + 26x + 144$

As x > 0, x = 12

Alternate method:

If P takes (x + a) days to complete a job and Q takes (x + b) days to complete the job and both working together takes x days to complete the job, it follows that $x = \sqrt{ab}$.

In the given problem, a = 8 and b = 18.

$\therefore$ x = 12 Ans: (12)

10. Fraction of the job done by P = $\frac{4}{4+5+6} = \frac{4}{15}$.

Choice (C)

11. Total consumption of the family members per day = (6) (1.25) = 7.5 kg.

Number of days the ration will be sufficient = $\frac{75}{7.5} = 10$.

Ans: (10)

12. X and Y, Y and Z, Z and X can complete the job in ascending number of days.

$\therefore$ When X and Y are together they are faster than Y and Z who are together faster than X and Z.

$\therefore$ Z is slower than X and X is slower than Y.

$\therefore$ Z is the slowest of the three. Choice (C)

13. Total job = (9) (20) = 180 man days.

= (180) (3) = 540 women days.
Time taken by 15 women to complete the job
$= \frac{540}{15} = 36$ days Ans: (36)

14. P and Q, Q and R and P and R can complete $\frac{1}{12}^{th}$, $\frac{1}{20}^{th}$ and $\frac{1}{15}^{th}$ of the job respectively working together in a day.
∴ 2 P's, 2 Q's and 2 R's can together complete $\frac{1}{12}+\frac{1}{20}+\frac{1}{15}=\frac{1}{5}^{th}$ of the job in a day.
∴ P, Q and R can complete $\frac{1}{2(5)}=\frac{1}{10}^{th}$ of the job in a day.
∴They will take 10 days. Choice (B)

15. Part of the job completed by X and Y working together in a day = $\frac{1}{30}+\frac{1}{60}=\frac{1}{20}^{th}$.
In 10 days, they can complete $\frac{1}{2}$ of the job working together.
∴ Z completes the remaining $\frac{1}{2}$ of the job.
∴ Z gets a share of $\frac{1}{2}$ (6000) = ₹3000. Ans: (3000)

16. Part of the job completed in the 1st two days irrespective of the person who starts the job = $\left(\frac{1}{30}+\frac{1}{60}\right)^{th}=\frac{1}{20}^{th}$
∴ The entire job which is 20 times will be completed in (2)(20) = 40 days irrespective of the person who starts the job. Choice (C)

17. Part of the job completed in the 1st two days irrespective of the person who starts the job = $\left(\frac{1}{2}+\frac{1}{4}\right)^{th}=\frac{3}{4}^{th}$
If A starts the job, then the remaining part of the job i.e., $\frac{1}{4}^{th}$ can be completed in 1/2 a day.
But if B starts the job, then he will take 1 full day to complete the remaining 1/4th part of the job.
∴ The job can be completed in the least possible time if A starts the job first Choice (A)

18. As they work on rotation, the part of the job completed in every period of 3 consecutive days will be constant and is $\frac{1}{20}+\frac{1}{30}+\frac{1}{40}=\frac{13}{120}$.
As the number of such periods $\left(\frac{120}{13}\right)$ is not an integer, the job will be completed in the least possible time if the most efficient person starts the job. As P is the most efficient, he must start the job. Choice (A)

19. The inlet pipe can fill $\frac{1}{8}^{th}$ of the tank in an hour. The outlet pipe can empty $\frac{1}{12}^{th}$ of the tank in an hour. Both pipes working together can fill $\left(\frac{1}{8}-\frac{1}{12}\right)^{th} = \frac{1}{24}^{th}$ of the tank in an hour.
∴ The tank will be filled in 24 hours. Ans: (24)

20. Time taken by both taps working together to fill the tank $= \frac{(4)(6)}{4+6} = 2.4$ hours.
Every hour A can fill $\frac{1}{4}^{th}$ of the tank. Fraction of the tank filled by A in 2.4 hours = $\frac{2.4}{4}=\frac{3}{5}$. Choice (D)

Exercise – 6(a)

1. Part of the job P and Q can complete in a day = $\frac{1}{12}^{th}$.
Part of the job P can complete in a day = $\frac{1}{20}^{th}$.
Part of the job Q can complete in a day
$= \left(\frac{1}{12}-\frac{1}{20}\right)^{th}=\frac{1}{30}^{th}$.
∴ Q can complete the job in 30 days. Choice (D)

2. In the first 6 days, A completed 6/24 = 1/4th of the work.
The remaining 3/4th of the work would be done by A and B in 3/4 [1/1/24 + 1/48] i.e., 12 days. Ans: (12)

3. Portion of work completed by Rajesh in 10 days
= 10/12 = 5/6
Portion of work completed by Rakesh = 1 – 5/6 = 1/6
Time taken by Rakesh to complete 1/6th of the work
= 1/6 × 24 = 4 days.
∴ Rakesh joined Rajesh after (10 – 4) = 6 days.
Ans: (6)

4. Portion of work completed in the first 5 days
= 5[1/20 + 1/30 + 1/60] = 5[1/10] = 1/2
Portion of work completed in the next 5 days
= 5[1/30 + 1/60] = 5[1/20] = 1/4
∴ Portion of work completed by C alone = 1 – [1/2 + 1/4] = 1/4
Time taken to complete 1/4th of the work = 1/4 × 60
= 15 days.
∴ C worked for 5 + 5 + 15 = 25 days
Hence, portion of work completed by him = $\frac{25}{60} = \frac{5}{12}$
Choice (B)

5. Amount of work done by A, B and C in 4 days
$= 4[1/12 + 1/16 + 1/20] = \frac{47}{60}$
Amount of work completed by C in the last 2 days
$= \frac{2}{20} = \frac{1}{10}$
Amount of work completed by B and C
= 1 – [47/60 + 1/10] = 7/60
Amount of work completed by B and C in 1 day
$= \frac{1}{16}+\frac{1}{20} = \frac{9}{80}$
∴Time taken by B and C to complete 7/60 of the work
$= \frac{7}{60}\times\frac{80}{9}$
$= 1\frac{1}{27}$ days
∴ Total time taken = $4 + 1\frac{1}{27} + 2$
$= 7\frac{1}{27}$ days Choice (A)

6. Let a, b be the respective number of days required by A and B to complete the work
$\frac{a}{5} + \frac{4b}{5} = 20$

$\frac{4a}{5} + \frac{b}{5} = 30$

Solving we get a = $\frac{100}{3}$, b = $\frac{50}{3}$.

If A and B work together they need $\frac{1}{\frac{3}{100}+\frac{3}{50}}$ (or) $\frac{100}{9}$ days. Choice (A)

7. Time taken by B to complete the job = 2 days.
Time taken by C to complete the job = 4 days.
Time taken by D to complete the job = 8 days.
As two of the four when working together take less than 40% of the time taken by the other pair, they must have a combined efficiency which is more than $\frac{5}{2}$ times that of the other pair.
∴ The part of the job completed by them in a day must be more than $\frac{5}{2}$ times of that completed by the other pair. Only A and B satisfy this condition. Choice (C)

8. Ratio of the work done by A, B and C
= (1 × 15) : (3 × 20) : (2 × 25)
= 15 : 60 : 50 = 3 : 12 : 10

Total wage of A = $\frac{3}{3+12+10} \times 5000$ = ₹600

∴ Daily wages of A = $\frac{600}{15}$ = ₹40

Similarly daily wages of B = $\frac{1}{20} \times \frac{12}{25} \times 5000$ = ₹120 and

daily wage of C = $\frac{1}{25} \times \frac{10}{25} \times 5000$ = ₹80

∴ Total wage for A, B and C for the given periods for a work which is twice as big as this work
= 2[10 × 40 + 15 × 120 + 12 × 80] = ₹6320.
∴ Total wages = ₹3160 Ans: (3160)

9. The ratio of the shares of A, B, C for the first work
= $\frac{1}{20} : \frac{1}{15} : \frac{1}{30}$ = 3 : 4 : 2
The ratio of the shares of A, B, C for second work
= $\frac{1}{15} : \frac{1}{25} : \frac{1}{10}$ = 10 : 6 : 15

A's total share (in ₹) = $\frac{3}{9}(4000) + \frac{10}{31}(10{,}000)$

B's total share (in ₹) = $\frac{4}{9}(4000) + \frac{6}{31}(10{,}000)$

C's total share (in ₹) = $\frac{2}{9}(4000) + \frac{15}{31}(10{,}000)$

We can divide all the shares by 4000. We have to compare
$\frac{3}{9} + \frac{25}{31}, \frac{4}{9} + \frac{15}{31}, \frac{2}{9} + \frac{37.5}{31}$.
i.e. 93 + 225, 124 + 135, 62 + 337.5
∴ B has the least share. Choice (B)

10. Let the time in which Mahesh, Suresh and Naresh can complete the work be m days, s days and n days respectively
Ratio of the wages of Mahesh, Suresh and Naresh = ratio of the work done by Mahesh, Suresh and Naresh

∴ 6300 : 7350 : 8400 = $4\left(\frac{1}{m}\right) : 4\left(\frac{1}{s}\right) : 4\left(\frac{1}{n}\right)$

⇒ $\frac{1}{m} : \frac{1}{s} : \frac{1}{n}$ = 6 : 7 : 8

Also, $\frac{4}{m} + \frac{4}{s} + \frac{4}{n} = 1$ i.e. $\frac{1}{m} + \frac{1}{s} + \frac{1}{n} = \frac{1}{4}$

∴ $\frac{1}{n} = \frac{8}{6+7+8}\left(\frac{1}{4}\right) = \frac{1}{10.5}$

n = 10.5. Ans: (10.5)

11. In each jump the boy goes forward by (2 –1) = 1 m.
In 98 jumps he covers 98 m.
In 99th jump he would have covered the distance of 100 m.
Choice (A)

12.

Men	Days	Work
25	20	10
x	10	8

Now, x = $\frac{25 \times 20}{10} \times \frac{8}{10}$ = 40

∴ 40 men would be required to complete the work in the given time. Ans: (40)

13. Number of men hours put in the first 5 days
= 64 × 5 × 8 = 2560 hours.
For the remaining 60% of the work, men hours required
= 2560 × $\frac{60}{40}$ = 3840
Let number of hours everyday = x
∴ x = $\frac{3840}{64 \times 4}$ = 15 hours Ans: (15)

14. Portion of work completed by A in 2 days = 2/8 = 1/4
Portion of work completed by B and E in 3 days
= 3[1/12 + 1/24] = 3/8
Portion of work remaining = 1 –[1/4 + 3/8] = 3/8
C does 1/2 × 3/8 i.e., 3/16th of the work and D 3/16th of the work.
Time taken by C to complete his portion of the work
= 3/16 × 16 = 3 days
Time taken by D to complete his portion of the work
= 3/16 × 20 = 15/4 = $3^3/_4$days
∴ Total time taken = 2 + 3 + 3 + $3^3/_4$ = $11^3/_4$ days
Choice (B)

15. Let the time in which Bala alone would complete the work be b days.
Let the amount that the two would have been paid together had they completed the work on time be A.
The two together lost $\frac{3}{8}$A. This is thrice the amount of wages corresponding to the uncompleted part of the work.
∴ Amount of wages corresponding to the uncompleted part of the work = $\frac{1}{8}$A.
∴ $\frac{7}{8}$th of the work was completed in 14 days.
∴ Time that Anil and Bala would take to complete the work
= $\left(14 \times \frac{8}{7}\right)$ viz 16 days
Anil can complete the work in 80 days.
∴ $\frac{1}{80} + \frac{1}{b} = \frac{1}{16} \Rightarrow$ b = 20. Choice (B)

16. Part of work completed in the first 2 days
= $\frac{1}{16} + \frac{1}{12} = \frac{3+4}{48} = \frac{7}{48}$
Work done in (2 × 6) days = $\frac{7}{48} \times 6$
So, in 12 days $\frac{7}{8}$ of work is completed.
Work remaining after 12 days = $1 - \frac{7}{8} = \frac{1}{8}$

On the 13th day Q works and he can do $\frac{1}{16}$ of total work on that day.

Work remaining after 13 days = $\frac{1}{8}-\frac{1}{16}=\frac{1}{16}$

On the 14th day P works and he can complete the work in $\frac{1/6}{1/12}=\frac{3}{4}$ days

Total time taken = $13\frac{3}{4}$ days . Choice (C)

17. Let the time taken by A to fill the tank be x hours.
Then, the time taken by B to fill the tank will be 2x hours.

Now, $\frac{1}{x}+\frac{1}{2x}=\frac{1}{8}$

$\Rightarrow \frac{3}{2x}=\frac{1}{8} \Rightarrow x = 12$

∴ A alone can fill the tank in 12 hours. Ans: (12)

18. Portion of the tank filled in 10 minutes

$= 10(1/40 + 1/60) = 10 \times \frac{1}{24} = \frac{5}{12}$

Portion of the tank which is yet to be filled = $1 - \frac{5}{12}=\frac{7}{12}$

Time taken by P_2 to fill 7/12th of the tank

$= \frac{7}{12} \times 60 = 35$ min Ans: (35)

19. Portion of the tank filled by P in 2 hours = $2 \times 1/8 = 1/4$
Portion of the tank filled by P and Q in 1 hour

$=\frac{1}{8}+\frac{1}{10}=\frac{9}{40}$

Portion of the tank yet to be filled = 1 – [1/4 + 9/40] = 21/40
Time taken to fill the remaining portion of the tank

$= \frac{21/40}{1/8+1/10+1/12}$

$= \frac{21}{40} \times \frac{120}{37} = 1\frac{26}{37}$

∴ Total time taken to fill the tank = $2 + 1 + 1^{26}/_{37}$
$= 4^{26}/_{37}$ hours = 4 hours 42 minutes 9 sec.
∴ The tank was filled at 12:42 p.m. Choice (C)

20. Let, the time be t hours

$\frac{t}{6}+\frac{t-1}{8}+\frac{t-2}{10}+\frac{t-3}{12}=1 \Rightarrow t = 63/19 = 3^{6}/_{19}$

∴ The time at which the tank was full was around 10 hours 18 minutes and 57 seconds.
(Since 6/19 hours = $6/19 \times 60$ minutes = 18.95 minutes.
0.95 minutes = $0.95 \times 60 = 57$ seconds) ≈ 10:19 a.m.
Choice (A)

21. $3 \times$ (portion of the tank filled by P in 1 hour) = Portion of the tank filled by Q and R in 1 hour.
Adding the portion of the tank filled by P in 1 hour to both sides, we get;
$4 \times$ (portion of the tank filled by P in 1 hour) = portion of the tank filled by P, Q and R in 1 hour = 1/10
⇒ Portion of the tank filled by P in 1 hour = 1/40
∴ P alone can fill the tank in 40 hours.
Similarly, we can find that Q takes 30 hours to fill the tank.
∴ Time taken by R to fill the tank

$= \frac{1}{1/10-[1/40+1/30]}=\frac{1}{1/24}$ = 24 hours Ans: (24)

22. Portion of the tank filled in 5 minutes
$= 5[1/20 + 1/30 + 1/40] = 13/24$
Portion of the tank filled by B and C in the next 6 minutes = $6[1/30 + 1/40] = 7/20$
Portion of the tank which is yet to be filled
$= 1 – [13/24 + 7/20] = 13/120$
Time taken by C to fill the tank taking into consideration the leak as well = $\frac{13/120}{(1/40-1/60)}=\frac{13}{120} \times 120 = 13$ minutes
∴ Total time taken = 5 + 6 + 13
= 24 minutes Ans: (24)

23. Portion of the tank filled in the first three hours

$=\frac{1}{7}+\frac{1}{14}+\frac{1}{21}=\frac{11}{42}$

∴ Portion of the tank filled by the three taps in 9 hours

$= 3 \times \frac{11}{42} = \frac{33}{42}$

∴ Portion of tank still empty = $1-\frac{33}{42}=\frac{9}{42}$
In the next hour A can fill 1/7th of the tank.
Portion of tank yet to be filled up = $\frac{9}{42}-\frac{1}{7}=\frac{1}{14}$,

which can be filled by tap B in one hour.
∴ Total time taken = 9 + 1 + 1 = 11 hours. Choice (B)

24. The part of the tank filled if 3 type–A, 2 type–B, 4 type–C and 5 type–D pipes are used in an hour =

$\frac{3}{20}+\frac{2}{25}-\frac{4}{40}-\frac{5}{50}=\frac{15+8-10-10}{100}=\frac{3}{100}$

It will be filled in $33\frac{1}{3}$ hours. Ans : A

25. Let's say k type D pipes are used

$\frac{1}{20}+\frac{1}{25}-\frac{1}{40}-\frac{k}{50}=\frac{1}{40}$

$\frac{k}{50}=\frac{1}{20}-\frac{1}{20}+\frac{1}{25}=\frac{1}{25} \Rightarrow$ k =2. Ans: (2)

26. Time taken to fill the tank = $\frac{1}{1/8+1/24}=\frac{1}{1/6}$ = 6 hours

∴ Time taken to fill 2/3rd of the tank = $2/3 \times 6 = 4$ hours
Time taken to fill the remaining 1/3rd of the tank
= 1/3 [1/18 + 1/24 – 1/12]

$=\frac{1}{3} \times 12 = 4$hours

∴ Total time taken = 4 + 4 = 8 hours Ans: (8)

27. The two taps should fill the tank in $\frac{30 \times 20}{5}$ = 12 minutes but they take (12 + 6) = 18 minutes.
i.e., they fill 18/12 = 1½ tanks or 1/2 tank extra.
This has been leaked by the emptying pipe in 12 hours.
So, it empties a full tank in 2×12
= 24 hours. Ans: (24)

28. Portion of tank filled by pipe A in 1 hour = $1-\frac{1}{4}+\frac{1}{12}=\frac{5}{6}$

∴ Time taken by A to fill the tank = 6/5 hours
∴ Volume of the tank = $6/5 \times 50 = 60$ ltrs. Choice (B)

29. Let the time taken for the tank to become full be x hours.
Time taken by X, Y and Z to fill the tank are 6x hours, (7x – 40) hours and (x + 10 hours).
Part of the tank filled by X, Y and Z

$=\frac{1}{x}=\frac{1}{6x}+\frac{1}{7x-40}+\frac{1}{x+10}$

$=\frac{5}{6x}=\frac{1}{7x-40}+\frac{1}{x+10}=\frac{8x-30}{7x^2-30x-400}$

$5(7x^2 + 30x – 400) = 6x(8x – 30)$
$13x^2 – 330x + 2000 = 0$

$x = 10$ or $\frac{200}{13}$

As x is an integer, $x = 10$

$\therefore 6x = 60$, $7x - 40 = 30$ and $x + 10 = 20$

$\therefore$ Z is the most efficient. Choice (C)

30. Let the rate of filling of P_1 be x lit/min.

Let the rate of filling of P_k where $1 \le k \le N$ be R_K

$R_1 = x$

$R_2 = 3R_1 = 3x$

$R_3 = 3(R_1 + R_2) = 12x$

$R_4 = 3(R_1 + R_2 + R_3) = 48x$

$R_5 = 3(R_1 + R_2 + R_3 + R_4) = 192x$

We see that $R_y = 4R_{y-1}$ where $y \ge 3$

As $N > 10$, $N - 3 > 7$.

$\therefore R_N = 4(R_N - 1) = 4(4R_{N-2}) = 4(4(4R_{N-3})) = 64\, R_{N-3}$.

Time taken by P_N to fill the tank = $\frac{1}{64}$ (time taken by P_{N-3} to fill the tank) = $\frac{1}{64}$ (128 min) = 2 min. Ans: (2)

Exercise – 6(b)

1. We have $\frac{m_1 d_1 h_1}{w_1} = \frac{m_2 d_2 h_2}{w_2}$ (variation rule)

$\frac{x \times k \times h}{p} = \frac{m_2 \times h \times k}{m}$

$\Rightarrow m_2 = mx/p$. Choice (C)

2.

Men	hrs./day	days
30	7	18
21	8	n

$n = 18 \times \frac{30}{21} \times \frac{7}{8} = 22.5$ Choice (C)

3. Part of the tank filled each hour = $\frac{1}{3} - \frac{1}{4} = \frac{1}{12}$th

The tank will be filled in 12 hours. Ans: (12)

4. Let B be closed after x minutes. Part of the tank filled by (A + B) in n minutes + Part of the tank filled by A in (8 – n) minutes = 1

$\therefore n\left(\frac{1}{10} + \frac{1}{20}\right) + (8 - n) \times \frac{1}{10} = 1$

$8\left(\frac{1}{10}\right) + n\left(\frac{1}{20}\right) = 1$

$n = 4$ Ans: (4)

5. $2(A + B + C) = \frac{1}{12} + \frac{1}{15} + \frac{1}{20} = \frac{1}{5}$

$A + B + C = \frac{1}{10}$

Part of the total work completed by A, B and C in the first 4 days = $\frac{4}{10} = \frac{2}{5}$th. A and B can finish the remaining $\frac{3}{5}$th of the total work in $\frac{\frac{3}{5}}{\frac{1}{12}} = \frac{36}{5}$ days. Choice (C)

6. Let the total work be 1 unit. Work done by A and B in the first 2 days = $\frac{1}{15} + \frac{1}{20} = \frac{7}{60}$ units

Work done in 8 such time periods of 2 days i.e., period of 16 days = $8 \times \frac{7}{60} = \frac{56}{60}$ units.

A can do $\frac{1}{15}$ units in one day. So A will take 1 more day to complete this work.

So total time taken = 16 + 1 = 17 days Ans: (17)

7. $a + b = \frac{1}{12}$

$b + c = \frac{1}{16}$

$5a + 7b + 13c = 1$

$(5a + 5b) + 2b + 2c + 11c = 1 \Rightarrow c = \frac{1}{24}$ C can do the work in 24 days. Choice (C)

8. Let the total work be 1 unit. Parts of it completed by one man and one woman in $\frac{3}{2}$days = $\frac{1}{2}$units and $\frac{3}{8}$units respectively.

Remaining = $1 - \left(\frac{1}{2} + \frac{3}{8}\right) = \frac{1}{8}$ units

$\therefore$ work completed by each boy in $\frac{3}{2}$days = $\frac{1}{8}$

Only one boy will be required. Choice (C)

9.

Workers	Area	Days	Hrs/day
20	120	30	6
30	x	15	12

$\frac{20 \times 30 \times 6}{120} = \frac{30 \times 15 \times 12}{x} \Rightarrow x = 180$

$\therefore$ 60 more acres can be reaped. Ans: (60)

10. Total work = $30 \times 20 = 600$ man days

$\Rightarrow 600 = 20n + 15(35 - n)$

$n = 15$ days Ans: (15)

11. Number of workers working on the i^{th} day = 25 + i – 1

Task = 25 + 26 +27 + …..... + 25 + x – 1 = 330

Adding 1 + 2 + … 24 on both sides,

$\frac{(25 + x - 1)(25 + x)}{2} = 330 + \frac{(24)(25)}{2} = \frac{(35)(36)}{2}$

Comparing both sides, $25 + x - 1 = 35 \Rightarrow x = 11$

Choice (C)

12. $A + B = \frac{1}{9}$, $\frac{A}{2} + 2B = \frac{1}{6}$,

$\therefore B = \frac{2}{27}$. So B can do the job in $\frac{27}{2}$ days. Choice (C)

13. Number of horses taken by Hari = $18 \times 6 = 108$ and Raghu = $12 \times 3 = 36$.

Together they will do $\frac{1}{108} + \frac{1}{36} = \frac{1}{27}$th of the total work in 1 hour.

Together they will take 27 hours to do it.

Number of days = $27 \times \frac{2}{5} = 10.8$ Ans: (10.8)

14. In 4 days P completed 4/24 = $1/6^{th}$ of the work.

R completed $1/3^{rd}$ of the work.

$\therefore$ Portion of work completed by P and Q in 4 days

= 1 – (1/6 + 1/3) = 1/2

$\therefore$P and Q would take 2×4 i.e., 8 days to complete the work.

$\therefore$Time taken by Q to complete the work = $\frac{1}{1/8 - 1/24}$

= 12 days Ans: (12)

15. Let the number of men be x.

$15x = 18(x - 4) \Rightarrow 3x = 18 \times 4$
$\therefore x = 6 \times 4 = 24$ Choice (A)

16. Time taken by A to complete the work = 30/1.2 = 25 days
$\therefore$ Time taken by both A and B to complete the work
$= \frac{1}{1/25 + 1/30} = \frac{150}{11} = 13^{7}/_{11}$ days Choice (B)

17. Ratio of the time taken by Sanjay, Vijay and Ajay
= 16 : 24 : 32 = 2 : 3 : 4
Let time taken by Sanjay be 2x, that by Vijay be 3x and Ajay be 4x.
Now, $\frac{1}{2x} + \frac{1}{3x} + \frac{1}{4x} = \frac{1}{24} \Rightarrow \frac{6+4+3}{12x} = \frac{1}{24}$
$\Rightarrow x = 26$
$\therefore$ Time taken by Ajay = $4 \times 26 = 104$ hours.
Ans: (104)

18. Let, time taken by Pankaj be x days.
$\therefore$ Time taken by Vinod will be 2x days.
Now, $2x - x = 30 \Rightarrow x = 30$
$\therefore$ Required time = $\frac{1}{1/30 + 1/60} = 20$ days Ans: (20)

19. Portion of work completed on the first day = 1/16
Portion of work completed on the second day = 2/16
Similarly, the portion of work completed on the third day is 3/16 and that on the fourth day is 4/16 and so on.
In the first five days, the portion of work completed
= 1/16 (1 + 2 = 3 + 4 + 5) = 15/16.
Portion of work to be completed next day = $1 - \frac{15}{16} = 1/16$
Six men would take $1/6^{th}$ of a day to complete $1/16^{th}$ of the work.
$\therefore$ Total time taken = $5^{1}/_{6}$ days Choice (C)

20. 3 men + 5 women = 12 days
$\Rightarrow$ 36 men + 60 women = 1 day
Also, 5men + 12 women = 6 days
$\Rightarrow$ 30 men + 72 women = 1 day
$\therefore$ 36 men + 60 women = 30 men + 72 women
$\Rightarrow$ 6 men = 12 women $\Rightarrow$ 1 man = 2 women
Now 3 men + 5 women $\equiv$ 6 men + 5 women i.e., 11 women
Also, 4 men + 4 women $\equiv$ 8 women + 4 women
i.e., 12 women.
Now, 11 women can complete the work in 12 days and hence 12 women can complete the same work in 11 days.
Ans: (11)

21. (9m + 24w) 8 = (8m + 32b) 9
$\Rightarrow$ 72m + 192w = 72m + 288b
$\Rightarrow$ 192w = 288b $\Rightarrow$ 2w = 3b
30 women can do the work in 12 days. So to complete the work in 18 days number of women required = $\frac{30 \times 12}{18} = 20$
20 women = 30 boys
So 30 boys can do the work in 18 days. Ans: (18)

22. Portion of work completed in the first 2 days = 2/40 = 1/20
Portion of work completed in the next 2 days = 2/60 = 1/30
$\therefore$ Portion of work completed in the first 4 days = $\frac{1}{20} + \frac{1}{30} = \frac{1}{12}$
$\therefore$ Time taken by A and B to complete the work
$= 4 \times \frac{1}{1/12} = 48$ days Choice (C)

23. In 20 days (20 is the LCM of 5 and 4) A eats 12 apples and B 30 apples.
$\therefore$ They eat 42 apples in 20 days.
Hence, they would be eating 21 apples in 10 days
Ans: (10)

24. Ratio of the portion of work done by X to that done by Y and Z is 1/8 : (1/12 + 1/20) = 1/8 : 2/15 = 15 : 16
$\therefore$ Ratio of time taken by X to that by Y and Z = 16 : 15
$\therefore$ If X takes 64 hours, then Y and Z together would take 60 hours ($15/16 \times 64 = 60$) Choice (C)

25. Let, the number of days be x
$10x = 8(x + 3) \Rightarrow x = 12$
Now, number of days taken by 24 men to complete the same work = $\frac{10 \times 12}{24} = 5$ Ans: (5)

26. Let us say, A produced x pieces.
$\therefore$ B produced 2x pieces, D produced 3x/4 pieces and C produced $1/3 \times 3x/4$ i.e., x/4 pieces.
Now, $x + 2x + 3x/4 + x/4 = 256 \Rightarrow x = 64$.
$\therefore$ B produced $2 \times 64 = 128$ pieces Choice (A)

27. As Shyam is twice as efficient as Tarun, Shyam receives ₹48000.
$\therefore$ Ram receives 90000 – (48000 + 24000) = ₹18000 for working one day.
At his usual capacity Ram receives $\frac{90000}{4}$ i.e., ₹22500 for working one day.
$\therefore$ Required percentage = $\frac{18000}{22500} \times 100 = 80\%$
Choice (C)

28. The ratio of money shared is $\frac{1}{16} : \frac{1}{18} : \frac{1}{20} = 45 : 40 : 36$
Share of B = $\frac{40}{121} \times 1089 = ₹360$ Ans: (360)

29. Amount of work done by D in 4 days
$= 1 - 4(1/10 + 1/15 + 1/20) = 2/15$
$\therefore$ Amount of work done by D in 1 day = $\frac{1}{4} \times \frac{2}{15} = \frac{1}{30}$
$\therefore$ The ratio in which the earnings would be shared between A, B, C and D is $\frac{1}{10} : \frac{1}{15} : \frac{1}{20} : \frac{1}{30}$ i.e., 6 : 4 : 3 : 2
$\therefore$ D's share = $\frac{2}{(6+4+3+2)} \times 3750 = ₹500$
Ans: (500)

30. 5 goats = 1 cow
$\Rightarrow$ 40 goats = 8 cows and 30 goats = 6 cows
20 cows + 40 goats = 28 cows and
50 cows + 30 goats = 56 cows
Now,

Cows	Days	Sum
28	10	460
56	12	x

$\therefore \frac{56 \times 12}{x} = \frac{28 \times 10}{460}$
$\Rightarrow x = \frac{56 \times 12 \times 460}{28 \times 10} = 1104$
$\therefore$ Cost of keeping 50 cows and 30 goats for 12 days = ₹1104. Choice (D)

31. Part of tank emptied in one minute when all the pipes are opened = $\frac{1}{6} + \frac{1}{18} - \frac{1}{27} = \frac{9-3-2}{54} = \frac{2}{27}$
So $\frac{2}{3}$ of tank will be emptied in $\frac{27}{2} \times \frac{2}{3}$ minutes.
= 9 minutes. Ans: (9)

32. Parts of the tank which P and Q can fill in a minute are $\frac{1}{20}$ and $\frac{1}{25}$ respectively.

Part of it filled by them in the first 4 minutes. 4 $\left(\frac{1}{20}+\frac{1}{25}\right)=\frac{9}{25}$.

Remaining part = $\frac{16}{25}$. This would have been filled by Q.

∴ Required time = $\frac{\frac{16}{25}}{\frac{1}{25}}$ = 16 minutes. Ans: (16)

33. Parts of the tank which X and Y can fill in a minute are $\frac{1}{12}$ and $\frac{1}{18}$ respectively.

Part of it which Z can empty in a minute = $\frac{1}{24}$

Part of it filled at the end of 1 minute = $\frac{1}{12}+\frac{1}{18}-\frac{1}{24}=\frac{7}{72}$.

Remaining part = $\frac{65}{72}$. This would have been filled by X and Y.

∴ Required time = $\frac{\frac{65}{72}}{\frac{1}{12}+\frac{1}{18}}=\frac{\frac{65}{72}}{\frac{5}{36}}=\frac{65}{72}\times\frac{36}{5}$

= $6^1/_2$ minutes. Choice (C)

34. Let leak empty the full tank in x hours.

$\frac{1}{8}-\frac{1}{x}=\frac{1}{10}$

$\Rightarrow \frac{1}{8}-\frac{1}{10}=\frac{1}{x} \Rightarrow \frac{1}{40}=\frac{1}{x} \Rightarrow x = 40$

The leak can empty $\frac{3}{5}$of the tank in

$\frac{3}{5}\times 40 = 24$ hours . Ans: (24)

35. Let Pipe B be closed x hours after 6 a.m. Pipe A worked from 6 am to 8 pm i.e., 14 hours.

$\frac{14}{12}-\frac{x}{18}=1$

$\frac{x}{18}=\frac{1}{6}\Rightarrow x = 3$

So, pipe B was closed 3 hours after 6 a.m. i.e. at 9 a.m.
Choice (C)

36. Part of the tank filled by A, B and C in 1 hour

= A + B + C = $\frac{1}{6}$

In the first 2 hours, $\frac{1}{3}$rd of the tank is filled

Remaining part = $\frac{2}{3}$rd

This was filled in 8 hours
A and B can together fill the tank in 12 hours.

∴ Part of the tank filled by C in 1 hr = $\frac{1}{6}-\frac{1}{12}=\frac{1}{12}$ th

C can fill the tank in 12 hours. Ans: (12)

37. Part of the tank filled in 3 minutes

= $\frac{1}{20}+\frac{1}{30}-\frac{1}{15}=\frac{1}{60}$

Part of the tank filled in 55×3 minutes = $\frac{55}{60}$

Part filled in (165 + 1) minutes = $\frac{58}{60}$

Part of the tank filled in (166 + 1) minutes = $\frac{58}{60}+\frac{1}{30}=1$

∴ It will take 167 minutes Choice (C)

38. The ratio of the time taken by A, B and C to complete the job working independently is

$\frac{1}{1.8\times1.6\times1}:\frac{1}{1.6\times1}:1=\frac{1}{2.88}:\frac{1}{1.6}:1$

$=\frac{100}{288}:\frac{10}{16}:1=\frac{25}{72}:\frac{5}{8}:1 = 25 : 45 : 72$

∴ A takes 25x days, B 45x days and C 72x days to complete the work.
Now, 45x – 25x = 40 ⇒ x = 2
∴Times taken by A, B and C to complete the work are 50 days, 90 days and 144 days respectively.
Portion of work completed by A in 25 days = 25/50 = 1/2
Portion of work completed by B in 30 days = 30/90 = 1/3
∴ Amount of work remaining = 1 – (1/2 + 1/3) = 1/6
∴ Time taken by C to complete the remaining work
= 1/6 × 144 = 24 days Choice (B)

39. Portion of work done by A, B and C in 1 day
= 1/2 [Portion of work done by A and B in 1 day + Portion of work done by B and C in 1 day + Portion of work done by C and A in 1 day] = 1/2 [1/10 + 1/12 + 1/15]

= $\frac{1}{2}\times\frac{1}{4}=\frac{1}{8}$

∴Portion of work completed by A, B and C in 4 days
= 4 × 1/8 = 1/2
Also, portion of work completed by A and C in 3 days
= 3 × 1/15 = 1/5
Now, portion of work to be completed by A and B
= 1 – (1/2 + 1/5) = 3/10
In 1 day they will do 1/10 work
So, to do 3/10, they will take 3 days.
Total 4 + 3 + 3 = 10 days. Ans: (10)

40. Let the capacity of P to fill be p litres/ hr.

Capacity of Q to fill = $\frac{3p}{2}$ litres/ hr.

Capacity of R to fill = 2p litres/ hr.
Capacity of S to fill = 3p litres/hr
Ratio of the sum of the four capacities and S's capacity

= $\frac{15p}{2}$: 3p = 5 : 2

∴ Required ratio = 2 : 5 Choice (A)

41. Statement I is definitely not sufficient, since it gives no information other than the starting time.
Using statement II, from 9:30 AM to 11:00 AM i.e., in $1^1/_2$ hour, $\left(\frac{3}{4}-\frac{3}{8}\right)$ of the tank is filled, so the time taken to completely fill the tank would be 4 hours. Hence statement II alone is sufficient. Choice (A)

42. Using statement I let the number of pots made by a man, woman and child per day be m, w and c respectively.
m +1w+1c = 10 pots/day.
1w +1c = 15pots/3day = 5 pots/day
Therefore from the above two equations we can find the time taken by a man to make 100 pots. Therefore statement I alone is sufficient.
Using statement II, let the number of days taken by a boy to make 100 pots be x.
Given 10m(x+1)=25b(x)and m=2b. We can calculate 'x'. Therefore statement II alone is also sufficient.
Choice (B)

43. Using statement I, 10 soldier ants take 6 hours to build anthill, so 5 soldier ants will take 12 hours. As each queen ant is

working at half the rate of a soldier ant. 5 queen ants will take 24 hours to build the anthill. Therefore I alone is sufficient. Using statement II, from the initial data, we know the time taken by a soldier ant to build anthill. From the given statement the relation between the time taken by a soldier ant and that taken by a queen ant can be found. From these the time taken to build the anthill by five queen ants can be determined. Hence II alone is also sufficient. Choice (B)

44. Using statement I, we know the time that each individual takes to construct the wall, but we don't know for how long each individual worked in constructing the wall, therefore we can not answer. Hence statement I alone is not sufficient.
Using statement II, we do not know how long each individual takes to construct the wall. Hence statement II alone is also insufficient.
Using I and II, let x be the number of days for which all the four persons worked together

$$\frac{3}{10} + 2\left(\frac{1}{10}+\frac{1}{15}+\frac{1}{20}\right) + x\left(\frac{1}{10}+\frac{1}{15}+\frac{1}{20}+\frac{1}{30}\right) = 1.$$

From the above equation we can find 'x', which is the number of days for which Tarun worked. Hence by combining I and II we can answer the question. Choice (C)

45. Consider statement I. Let the time taken by A and B working together be x days. The most efficient of A and B can definitely complete the work in less than 2x days. The less efficient can take 5x days or more or less C takes 5x days. From this, we can conclude that either A or B is the most efficient and A or B or C is the least efficient.
Consider statement II. To complete the job, A takes as much time as B and C take working together So he does more work than either of them in the same time. Therefore, of the three, A is the most efficient.
Statement II is enough to answer the question, but not statement I. Choice (A)

46. Statement I alone is not sufficient as it has no data about the times taken by them to complete the work. From statement II, Asha works on days -1, 3, 5,……35, i.e., on 18 days to complete the work. On one day she can do 1/18 of the work; Vidya works on days 1,4,7,10,13,16,19, 22 and 25 i.e., on 9 days. On one day, she can do 1/9 of the work.
In a two day period, the part of the work completed by them working on alternate days = $\frac{1}{9}+\frac{1}{18}=\frac{3}{18}=\frac{1}{6}$
∴ six such periods are required.
Irrespective of who starts the work, the work will be completed in 12 days.
∴ Statement II alone is sufficient. Choice (A)

47. From statement I, we have the ratio of efficiencies of Varun and Sameer as 1:3. Therefore, we can find the share of Sameer in ₹5000.Statement I alone is sufficient.
From statement II, we can get Sameer's share. The two persons' individual and combined efficiencies and times taken are tabulated below.

	V	S	VS
Eff.	5	3	8
No.of Days	40		25

∴ Sameer's salary is (3/8)(5000) = 1875.
We can answer the question using statement II alone
Choice (B)

48. Statement I tells that the six taps are turned on one after the other at intervals of half an hour. But the flow rates of the taps are not mentioned. This is not enough.
Statement II alone is not sufficient, as we do not know the number of taps. Combining both the statements we have, according to statement II, each tap can fill a 20 litre tank in 1 hour i.e. in half an hour it can fill 10 litres. Using this data and the data in statement I, we can say that the 330 litre tank will be filled in 4 hours. Choice (C)

49. Let the number of days in which Rishab's cow, Shrayan's cow and Vashist's cow can individually eat the grass on the farm be R,S and V respectively.
Using statement I, $\frac{1}{R}+\frac{1}{S}+\frac{1}{V}=\frac{1}{20}$. As we do not have any information about S and V, R cannot be found.
∴ I alone is insufficient.
Using statement II, as nothing is mentioned about R, the question can not be answered.
∴ II alone is also insufficient
Using I and II we have
$\frac{1}{R}+\frac{1}{S}=\frac{1}{30}$; $\frac{1}{R}+\frac{1}{S}+\frac{1}{V}=\frac{1}{20}$ and S = 2V.
$\frac{1}{R}+\frac{1}{2V}=\frac{1}{30}$ and $\frac{1}{R}+\frac{1}{2V}+\frac{1}{V}=\frac{1}{20}$
R can be found uniquely from these two equations.
∴ I and II together are sufficient to answer the question.
Choice (C)

50. Let the time taken by A, B, C and D to fill the tank be a hours, b hours, c hours and d hours respectively.
$\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}=\frac{1}{2\frac{2}{7}}=\frac{7}{16}$ ….(1)
$\frac{1}{a}>\frac{1}{b}>\frac{1}{c}>\frac{1}{d}$
Using I, the tank will be filled in the maximum time if B, C and D fill it
∴ $\frac{1}{b}+\frac{1}{c}+\frac{1}{d}=\frac{1}{3\frac{9}{13}}=\frac{13}{48}$ …..(2)
As 1/d is unknown, the question cannot be answered.
I is not sufficient.
Using II, the tank will be filled in the minimum time if A,B and C fill it $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{1}{2\frac{2}{3}}=\frac{3}{8}$ ……(3)
As 1/a is unknown, the question cannot be answered
∴ II is not sufficient.
Combining both the statements, adding (2) and (3)
$\frac{1}{a}+2\left(\frac{1}{b}+\frac{1}{c}\right)+\frac{1}{d}=\frac{31}{48}$ …..(4)
Subtracting (1) from (4), $\frac{1}{b}+\frac{1}{c}=\frac{10}{48}$
∴ Time taken by B and C to fill the tank is 48/10 hours
Choice (C)

Chapter – 7
(Averages– Mixtures – Alligations)

Concept Review Questions

1. As the age of each member would be 5 years more after 5 years, the average age of the family would also be 5 years more i.e. 20 years. Choice (B)

2. As the age of the new student equals the old average age of the class, the new average age of the class will be 20 years. Ans: (20)

3. As nothing is known about the ratio of the number of boys to the number of girls in the class, the average weight of the students in the class cannot be found. Choice (D)

4. As nothing is known about the ratio of the number of male employees to the number of female employees in the office, the average height of the employees cannot be found. Choice (D)

5. As more than half of the strength of the class are boys, the average age of the class will be more than half of the sum of the average ages of boys and girls. Choice (D)

6. There are 30 girls in the class
Sum of the marks of the girls = (30) (90) = 2700
Sum of the marks of the boys = (15) (60) = 900
Average marks of all the students in the class
$= \frac{2700 + 900}{45} = 80$ Choice (B)

7. As the average salary of male employees as well as female employees is the same, irrespective of the number of male and female employees, the average salary of all the employees will be equal to the average salary of the male or female employees.
Here, the required average salary will be ₹15000 per month.
Choice (B)

8. Total score of Mahesh in 6 subjects = (6) (75) = 450
Score of Mahesh in the sixth subject = 450 – (60) (5)
= 150 Ans: (150)

9. Let the numbers of boys and the girls in the class be 3x and 5x respectively.
Average weight of the students in the class
$= \frac{20(3x) + 16(5x)}{3x + 5x} = 17.5$ kg Choice (C)

10. If some members are in arithmetic progression, their average is middle term (if the number of terms is odd) and the average of middle two terms (if the number of terms is even). Here, the average will be 57. Ans: (57)

11. Total number of sweets with 6 children = (6) (6) = 36
Total number of sweets with 7 children = (7) (7) = 49
The number of sweets with the seventh child
= 49 – 36 = 13 Ans: (13)

12. Total cost of potatoes = (3) (6) = ₹18
Total cost of tomatoes = (5) (8) = ₹40
Average price per kilogram of the vegetables in the bag
$= \frac{18 + 40}{8} = ₹7.25$ Ans: (7.25)

13. Average number of sweets received by each child
$= \frac{57}{10} = 5.7$
Let the number of girls be x. By alligation rule,
$\frac{x}{10 - x} = \frac{6 - 5.7}{5.7 - 5} = \frac{3}{7} = \frac{3}{10 - 3}$
Comparing both sides, x = 3 Ans: (3)

14. Average monthly income of the man
$= \frac{(4000) + (5600) + (6420)}{3} = 5340$ Choice (C)

15. Required average $= \frac{5(100) + 8(200)}{300} = 7$ Ans: (7)

16. Average monthly income of the man for that year
$= \frac{9(12000) + 3(16000)}{12} = ₹13000$ Ans: (13000)

17. Average monthly income in that month = ₹9000 – 900 = ₹8100 Ans: (8100)

18. Initial quantity of milk in the vessel = 60% (20) = 12 litres
Final quantity of milk in the vessel = 12 + 5 = 17 litres.
Quantity of new mixture = 20 + 5 = 25 litres.
Required percentage = $\frac{17}{25}$ (100) = 68% Choice (D)

19. Quantity of water in the vessel does not change. The vessel contains 60% water, quantity of pure milk to be added must be 20% of the vessel's contents so that the ratio of milk to water becomes 1 : 1.
Quantity of pure milk to be added = 0.2 (25) = 5 litres.
Choice (B)

20. Quantity of milk in the vessel does not change.
Quantity of milk in the vessel = (0.9) (70) = 63 litres.
After adding water, milk forms 87.5% of the vessel's contents.
$\frac{87.5}{100}$ (Final quantity of mixture) = 63 litres.
Final quantity of the mixture = (63) $\left(\frac{100}{87.5}\right)$ = 72 litres.
Quantity of water to be added = 72 – 70 = 2 litres.
Choice (B)

21. As the milkman wants to get 50% profit by selling it at cost price, the milk man has to add water which is equal to 50% of pure milk i.e., 50% (20 litres) = 10 litres. Choice (B)

22. Ratio of milk and water in the vessel after the first replacement = 9 : 1.
When 1 litre of the mixture is now taken out, remaining mixture will have $\frac{9}{10}$ th of 9 litres as milk i.e. 8.1 litres. Final mixture will have milk and water in the ratio 8.1 : (10 – 8.1) = 81 : 19

Alternate method:
P = 10, Q = 1
Ratio of quantity of milk in the final mixture to the final mixture
$= \left(\frac{P - Q}{P}\right)^2 = 81 : 100$
Ratio of milk and water in the final mixture = 81 : 19
Choice (B)

23. Final quantity of milk = $\frac{81}{100}$ (10) = 8.1 litres
Choice (B)

24. Total cost price of the mixture = (6) (10) + (9) (15) = ₹195
Selling price of the mixture (in ₹ per kg) = Cost price of the mixture (in ₹ per kg) = $\frac{195}{6 + 9} = ₹13$ Ans: (13)

25. Let the quantities of the two solutions be 3x litres and 7x litres
Quantity of the final mixture = 10x litres.
Quantity of sulphuric acid in the final mixture
= 0.2 (3x) + 0.3(7x) = 2.7x litres.
Concentration of sulphuric acid in the final mixture
$= \frac{2.7x}{10x}$ (100) = 27% Ans: (27)

Exercise – 7(a)

1. The older man increased the total age of the group by 24 years.
Since the average age increased by 2 years, therefore the number of members in the group = 24/2 = 12
Choice (D)

2. Total marks obtained by 64 students = $64 \times 88 = 5632$
Total marks obtained by 10 students = $10 \times 142 = 1420$
∴Total marks obtained by the remaining students
= 5632 – 1420 = 4212
∴Required average = 4212/54 = 78 Ans: (78)

3. Since the teacher increases the average by 1 year, he contributes in 31 years more than the average to the group. Hence, the age of the teacher is 31 + 16 = 47 years.
Ans: (47)

4. Let the average of the batsman before the 53rd innings be x. $52x = 53 (x + 1) - 126 \Rightarrow x = 73$. Choice (B)

5. Let the average be ₹x.

$\frac{15\times 80+1(x+75)}{16} = x$

$\Rightarrow 1275 + x = 16x \Rightarrow x = 85$

$\therefore$Total bill = 16 x 85 = ₹1360. Choice (C)

6. Given that the average of n numbers is 32.

Since 3/4th of the numbers are increased by 4, the overall average of the n numbers increases by $\left(4\times\frac{3}{4}\right)=3$

So the average becomes (32 + 3) = 35

Since 1/4th of the n numbers are decreased by 6, the overall average of the n numbers decreases by $\left(6\times\frac{1}{4}\right)=1.5$

So the new average is (35 – 1.5) = 33.5 Ans: (33.5)

7. Let the number of wickets taken before last match be x

$\frac{1200}{x}=\frac{1200+144}{x+4}-1$

$\Rightarrow \frac{1200}{x}+1=\frac{1200+144}{x+4}$

$\Rightarrow (1200 + x) (x + 4) = 1344x$

$\Rightarrow x^2 – 140x + 4800 = 0$

$\Rightarrow (x – 60) (x – 80) = 0$

$\therefore$ x = 60 or 80 Choice (C)

8. The total age of the family should have increased by 25 years (5×5). Since it did not happen, it implies that the member who has come in is 25 years younger than the member who left the group.

$\therefore$The age of the daughter-in-law = 48 – 25 = 23 years.

Ans: (23)

9. Total marks of all the students = $40 \times 85 = 3400$

Total marks of the remaining 38 students

$= 38 \times 84 = 3192$

$\therefore$Sum of the highest and the least marks

= 3400 – 3192 = 208

Difference between the two marks = 108

$\therefore$ Highest marks $=\frac{208+108}{2}=\frac{316}{2}=158.$

Choice (B)

10. Choice (A) :

This is true because it is a property of weighted average.

Choice (B) :

Average weight of P, Q and R = $\frac{3\,(\text{Total weight of Q})}{18+24+30}$

$=\frac{3(\text{Total weight of Q})}{72}$ = Average weight of Q

$\therefore$ Choice (B) is true.

Choice (C) :

For P's average weight to decrease, the student's weight must be more than P's average weight, and for R's average weight to decrease, his weight must be less than R's average weight.

$\therefore$ Choice (C) is true. Choice (D)

11. Required average earnings = $\frac{12\,x\,11000-10\times 8500}{2}$

$=\frac{132000-85000}{2}$ = ₹23500 Ans: (23500)

12. Number of the goals scored in the first 5 matches

$= 6 \times 2 – 3 = 9.$

$\therefore$ Total number of goals scored in 11 matches = $9 + 6 \times 4$ = 33.

$\therefore$ Average number of goals scored = 33/11 = 3

Ans: (3)

13. Let the total of the ages of the persons other than the person ab years old be T

T = 55A – ab and 55(1.2A) = T + ba

$\therefore$55(1.2A) = 55A – ab + ba

$\Rightarrow$ 55(0.2A) = ba – ab

$\Rightarrow$ 11A = (10b + a) – (10 a + b)

$\Rightarrow$ 11A = 9(b – a)

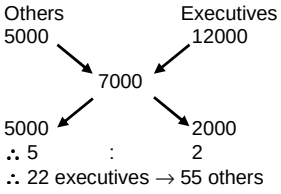
All the ages are two digit numbers. $\therefore$ A is a two digit number. But then b – a will also be a two digit number This is not possible,. Choice (D)

14. Let the number of non-executives be x.

$\frac{22\times 12000+x(5000)}{22+x}$ = 7000 $\Rightarrow$ x = 55

$\therefore$The total number of employees = 22 + 55 = 77

Alternate method:



$\therefore$ 5 : 2

$\therefore$ 22 executives $\rightarrow$ 55 others

Total = 55 + 22 = 77 Choice (B)

15. Average weight $=\frac{(250x43)+(240x46)+(275x46)+(200x55)+(220x52)}{250+240+275+200+220}$

$=\frac{10750+11040+12650+11000+11440}{1185}$ = 48 kg

Alternate method:

Let us assume the average weight to be 50 kg.

Considering only the deviations

$\sum d = – 7 \times 250 – 4 \times 240 – 4 \times 275 + 5 \times 200 + 2 \times 220$

= – 1750 – 2060 + 1000 + 440 = –2370

Actual average = Assumed average + $(\sum d/n)$

n = 250 + 240 + 275 + 200 + 220 = 1185

$\therefore$ Required average = $50-\frac{2370}{1185}$ = 48 Ans: (48)

16. Let the number of students in A, B and C be b, b and c respectively. Total marks obtained by the students of class A and B, B and C and A and C = 2(Total marks obtained by the students of class A, B and C) = 2(60(b + b + c))

= 120(b + b + c)

This also equals

52.5(b + b) + 70(b + c) + 60(b + c)

$\therefore$ 120(2b + c) = 235b + 130c

b = 2c

Total number of students of A, B and C = b + b + c = 50

2(2c) + c = 50

c = 10 Choice (A)

17. We are interested in 3 – digit numbers of the form xyz where x = 2z.

z can take the values 1, 2, 3 and 4. The corresponding values of x are 2,4,6 and 8. y can take all the values from 0 to 9.

The average of all the 3 – digit numbers =

$\frac{(100x_1+10y_1+z_1)+(100x_2+10y_2+z_2)+....+(100x_N+10y_N+Z_N)}{N}$

=

$\frac{100(x_1+x_2+....+x_N)+10(y_1+y_2+....+y_N)+(z_1+z_2+...+z_N)}{N}$ =

$100\,A_H + 10\,A_T + A_U$

As each value in the units, tens and hundreds place occurs an equal number of times,

$A_U = \frac{1+2+3+4}{4} = 2.5$

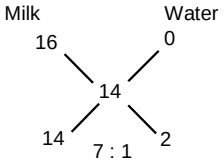
$A_T = \frac{0+1+2+...9}{10} = 4.5$

$A_H = \frac{2+4+6+8}{4} = 5$

Average of all numbers = 5 (100) + (4.5) (10) + (2.5) (1) = 547.5

Choice (A)

18. Cost of each litre of milk = 560/35 = ₹16.

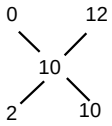


$\therefore$ Quantity of water added = $\frac{1}{7} \times 35 = 5$ litres

Ans: (5)

19. Cost of the mixture = 12/1.2 = ₹10

Applying the rule of alligation,



Ratio of water to milk = 1 : 5

$\therefore$ 1/5th of 25 litres i.e., 5 litres of water has to be added.

Choice (B)

20. The mixture of 20ml has 0.4(20) i.e. 8 ml milk and 12 ml water.

Initial ratio of milk and water = 2 : 3.

$\frac{8+X}{12} = \frac{3}{2} \Rightarrow X = 10$

$\frac{8+X}{12+Y} = \frac{2}{3} \Rightarrow Y = 15$

Difference of X and Y is 5. Ans: (5)

21. Cost of the mixture = 12/1.2 = ₹10 per kg.

Let the cost of the first variety be ₹x kg, that of the second variety would be ₹ (x – 7) per kg.

$\frac{2}{5} = \frac{10-(x-7)}{x-10} \Rightarrow 2x - 20 = 85 - 5x$

$\Rightarrow 7x = 105 \quad \therefore x = 15.$ Choice (B)

22.

Vessel	Quantity of alcohol (in litres)	Quantity of water (in litres)
I	$\frac{2}{3} \times 6 = 4$	$\frac{1}{3} \times 6 = 2$
II	$\frac{4}{7} \times 35 = 20$	$\frac{3}{7} \times 35 = 15$
	24	17

$\therefore$ Required ratio = 24 : 17. Choice (C)

23. Quantity of petrol now = $1/7 \times k + 3/14 \times k = 5k/14$

Quantity of diesel now = $2/7 \times k + 5/14 \times k = 9k/14$

Quantity of kerosene now = $4/7 \times k + 6/14 \times k = 14k/14$.

Ratio of quantities of petrol, diesel and kerosene

= 5k/14 : 9k/14 : 14k/14 = 5 : 9 : 14 Choice (A)

24. Let x litres be taken from the first container.

Total quantity of petrol = $\frac{4}{7}x + \frac{3}{4}x16 = \frac{4}{7}x + 12$

Total quantity of diesel = $\frac{3}{7}x + \frac{1}{4}x16 = \frac{3}{7}x + 4$

Now, $\frac{\frac{4x}{7}+12}{\frac{3x}{7}+4} = \frac{32}{19} \Rightarrow x = 35.$ Ans: (35)

25. Let the quantities of the first, second and third varieties used for mixing be x kg, y kg and z kg respectively.

Total cost of the mixture = ₹ (12x + 18y + 21z)

$12x + 18y + 21z = (x + y + z)\frac{15 \times 100}{120}$

$\Rightarrow 2(12x + 18y + 21 z) = 25(x + y + z)$

$\Rightarrow x = 11y + 17z$

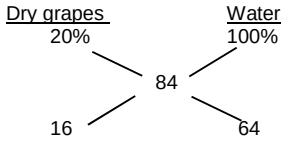
Only choice (C) is a possible ratio among the choices.

Choice (C)

26. When the water in the fresh grapes is evaporated you get dry grapes (or raisins with less water content).

So Fresh grapes can be treated as a mixture of dry grapes and pure water.

Water content in dry grapes is 20% whereas the water content in fresh grapes is 84%.



$\therefore$ Dry grapes : Water = 1 : 4

So from every 5 units (1 + 4) of fresh grapes 1 unit of dry grapes can be obtained.

$\therefore$ From 80 kg of fresh grapes, we can get

$(1/5) \times 80 = 16$ kg of dry grapes or raisins. Ans: (16)

27. Quantity of alcohol solution = $\left(\frac{800-80}{800}\right)^3 \times 800$

= 583.2 litres. Ans: (583.2)

28. One litre of milk when poured into B would result in the ratio of milk and water in B to be 1 : 5.

When 1 litre from B is poured into A, B would have $\frac{1}{6}(5) = \frac{5}{6}$ litres of milk.

A would have water only from 1 litre poured into it whose quantity is $\frac{5}{6}(1) = \frac{5}{6}$ litres.

$\therefore V_M = V_W = \frac{5}{6}$ litres Choice (B)

29. Let the containers have x litres of water and x litres of alcohol initially.

After the first transfer, container A has x – 3 litres water and container B has x litres alcohol and 3 litres water.

After the second transfer, container B will have $\left(3 - 3\left(\frac{3}{3+x}\right)\right)$ litres water and $(x - 3)\left(\frac{x}{3+x}\right)$ litres alcohol.

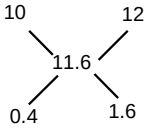
Given, water content is the same in both the containers finally

$x - 3 + \frac{3(3)}{3+x} = 3 - \frac{3(3)}{3+x}$

$x + \frac{18}{3+x} = 6 \Rightarrow x = 3$ Choice (D)

30. Percentage interest earned = $\frac{2900}{25000} \times 100 = 11.6$

Applying the rule of alligation,



Ratio of amounts lent = 1 : 4

Amount lent at 12% = $\frac{4}{5} \times 25{,}000 = ₹20000$

Ans: (20000)

Exercise – 7(b)

1. Required average = $\frac{50(1+2+3+4+5+....+10)}{10}$

$= \frac{10}{2}(50 + 500)\frac{1}{10} = \frac{550}{2} = 275$

Alternate method:

Average of <u>even</u> number of terms in an arithmetic series is equal to average of 1st and last terms.

$\therefore$ Average = $\frac{50+500}{2} = 275$ Choice (D)

2. The total weight of the 3 men is 210 kg

$\therefore$ Their average weight is 70 kg. Ans: (70)

3. The man buys 2 dozens for ₹24 and x dozens for ₹120

$\frac{24}{2} = \frac{120}{x} \Rightarrow x = 10$

The total number of apples with the man is 2 + 10 dozens or 144. Ans: (144)

4. In 5 cu.m of the alloy, volume of the first metal

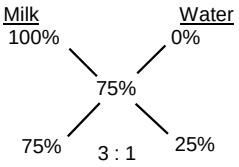
$= \frac{40}{100} \times 5 = 2$ cu.m

and, volume of the second metal = 3 cu.m.

$\therefore$Required weight = $(2 \times 1500) + (3 \times 2500)$

= 10,500 kg. Ans: (10500)

5.



$\therefore$Quantity of water added = $1/2 \times 36 = 12$ litres

Ans: (12)

6. $A = \frac{2B + C}{2} \Rightarrow 2A = 2B + C \rightarrow$ (1)

$B = \frac{\frac{1}{2}(A) + C}{2} \Rightarrow 2B = \frac{A + 2C}{2}$

$\Rightarrow 4B = A + 2C \Rightarrow A = 4B - 2C \rightarrow$ (2)

From (1), $4A = 4B + 2C \rightarrow (3)$

$2C = 4A - 4B = 4B - A$ ($\because$ From (2) and (3))

$5A = 8B$

$\frac{A}{B} = \frac{8}{5}$ Choice (B)

7. Let the amount spent by each girl be ₹a.

Amount spent by each boy = ₹(a + 20)

$\therefore 6(a + 20 + a) = 1380 \Rightarrow a = 105$

Average amount = $\frac{1380 - 3(a + a + 20)}{6}$

$= \frac{1380 - 3(230)}{6} = ₹115$ Ans: (115)

8. Let the average age of the class be A years. Let the ages of the replaced students be 2x and x years. Total age of the students who are not replaced = (48A – 3x) years.

$48A - 3x + 16 + 11 = 48\left(A + \frac{1.5}{12}\right)$

$\Rightarrow x = 7$ Ans: (7)

9. Total salary = 20 (8000) = 1, 60,000

There is a 22.5% increase for 10 employees.

$\frac{22.5}{100}$ (8000) = 1800.

The new salary of these employees is 8000 + 1800 or 9800.

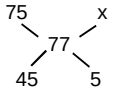
For 10 employees, the total is 10 (9800) = 98,000

From the remaining 10 employees, 2 left. The total salary of the other eight is 8 (8000) or 64,000

$\therefore$ Total income of all the 18 employees = 1,62,000

$\therefore$The new average = $\frac{162000}{18} = ₹9000$ Choice (D)

10.



$\therefore \frac{x - 77}{77 - 75} = \frac{45}{5} = 9 \Rightarrow x = 77 + 18 = 95$ Ans: (95)

11. The average temperature for Monday and Sunday is the temperature on Thursday

$\therefore$ The temperatures on the 7 days are as follows.

Mon	Tue	Wed	Thu	Fri	Sat	Sun
34	35	36	37	38	39	40

$\therefore$The average temperature for Mon, Tue, Wed is 35℃.

Ans: (35)

12. Let the number of women be x.

Total salary of the employees is (3000) (80) + 10000x

$= 8000 (80 + x) \Rightarrow x = 200$

Alternate method:

By alligation,

$\frac{80}{x} = \frac{10000 - 8000}{8000 - 3000} = \frac{2}{5} \Rightarrow x = 200$ Choice (D)

13. Quarter pint = $1/4 \times 0.568$ litres = 568/4 = 142 ml.

1 cu.cm = 1 ml.

$\therefore$ 142 ml can write $\frac{340}{10} \times 142 = 4828$ words

Choice (A)

14. Sum of P and its reverse = 10 a + b + 10 b + a = 11(a + b)

Sum of Q and its reverse = 10 c + d + 10 d + c = 11(c + d)

$\therefore 11[(c + d) - (a + b)] = 6.6 \times 10$

$\Rightarrow (c + d) - (a + b) = 6$ Ans: (6)

15. $\frac{30N + (5)(12)}{N + 5} = \frac{30N - (5)(36)}{N - 5}$

$(30N + 60)(N - 5) = (30N - 180)(N + 5)$

$30N^2 + 60N - 150N - 300 = 30N^2 - 180N + 150N - 900$

$600 = 60N$

$N = 10$ Choice (D)

16. Let the scores in the first, second and third matches be a, b and c respectively.

$a + b = 650 \rightarrow$ (1)

$b + c = 600 \rightarrow$ (2)

$a + c = 700 \rightarrow$ (3)

$\therefore a + b + c = \frac{650 + 600 + 700}{2} = 975 \rightarrow$ (4)

and $(a + b + c) / 3 = 325$

Alternate method:

Let the matches be I, II and III

We have been given the average of 3 combinations. I, II and II, III and III, I. If we consider these combinations together, each of I, II and III has equal weightage.
∴ The average of the 3 matches is equal to average of the 3 combinations.
∴The required average is (325 + 300 + 350) / 3 = 325.
Ans: (325)

17. The total height of the 50 students is 50(165) or 8250 cm
The total height of the 5 students who leave is 5(169) or 845 cm.
The total height of the 10 students who join is 10(167) or 1670 cm.
∴ Total height of the 50 – 5 + 10 or 55 students is (8250 – 845 + 1670) cm
∴ Average height = $\frac{9075}{55}$ cm = 165 cm.

Alternate method:
We can think of 3 groups of students. A with 45 students, B with 5 students and C with 10 students. The groups and their average heights are tabulated below

	A	A + B	C	B
Number	45	50	10	5
Average Height		165	167	169

The total deviation of C from 165, the average of A + B, is (167 – 165) 10 = 20 cm
The total deviation of B from 165 is (169 – 165) 5 = 20 cm
∴ In the group A + B, whose average is 165 cm, if we replace B with C, the average should not change.
∴ The average of A + C is also 165 cm. Ans: (165)

18. If we take 25 consecutive odd numbers, the average of all the numbers is the 13th one. The average of the last 15, i.e., the 11th to the 25th numbers is the 18th number. As the 18th number is n, the 13th is n – 10. Choice (C)

19. Total production of salt by the company in that year = 5000 + 5100 + 5200 + 5300 + ….. + 6100 = 66600
Average monthly production of salt for that year
= $\frac{66600}{12}$ = 5550 tonnes Ans: (5550)

20. Total spending of Ajay in the first 5 months
= (5) (3000) = ₹15000
Total spending of Ajay in the next 4 months = (4) (3600) = ₹14400
Total spending of Ajay in the last 3 months of that year = (3) (4000) = ₹12000
Total income of Ajay that year = total spending of Ajay that year + total savings of Ajay that year.
= (15000 + 14400 + 12000) + 15000 = ₹56400
Average monthly income of Ajay that year = $\frac{56400}{12}$
= ₹4700 Ans: (4700)

21. Total score of 70 archers = $70 \times 36 = 2520$
Total score of 20 archers who left = $20 \times 40 = 800$
Total score of 30 archers who joined later = $30 \times 30 = 900$
Present average points of the archers
= $\frac{2520 - 800 + 900}{80} = \frac{2620}{80} = 32.75$ Ans: (32.75)

22. Let fixed cost be F and variable cost per unit of the article produced be K.
30,000 = F + 15,000 K (∵ Total cost = $2 \times 15000 = 30000$)
37,500 = F + 25,000 K
Subtracting the first equation from the second, 7500
= 10,000 K ⇒ K = 0.75
Hence variable cost of each unit produced is ₹0.75.
Choice (C)

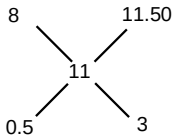
23. Total cost price = (10) (10) + (10) (6) = ₹160
Total selling price = (10 + 10) (10) = ₹200
Total profit = ₹40
Profit percent = $\frac{40}{160}$ (100) = 25% Ans: (25)

24. The quantities of milk, water and mixture at each stage are tabulated below.

	Milk	Water	Total	Decrease
Initial Quantity	10		10	
After water added	10	5	15	
After spilt and sold	$\frac{2}{3}(10)$	$\frac{1}{3}(10)$	10	5
After water added	$\frac{20}{3}$	$\frac{10}{3}+2$	12	

x = (2/3) 10 = 20/3
Percentage of milk in final mixture = $\frac{20/3}{12}$ (100)%
= $\frac{500}{9}$% = 55.55% Choice (B)

25. Cost of the mixture = $\frac{8 + (3 \times 12)}{4}$ = 11



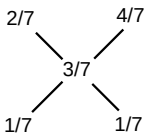
∴ Required ratio is 1 : 6. Choice (B)

26. Cost price of the mixture = $\frac{100}{120}$ (36) = ₹30 / kg.
Let the cost price of the second variety be ₹x / kg.
Using alligation,
$\frac{4}{3} = \frac{x + 7 - 30}{30 - x} \Rightarrow x = 27$ Ans: (27)

27. Cost price of the rice per kg = 15.6/1.2 = ₹13
As there is no information about the quantities, going by back substitution we find that only Choice (D) is possible
($\frac{10 \times 2k + 12 \times 6k + 17 \times 3k}{11k}$ = ₹13 per kg.
∴ considered ratio can be 2 : 6 : 3) Choice (D)

28. Fresh grapes contain 80% water. When the grapes dry, the water content is partially lost and only 50% of the dry grapes is water. In this process, the quantity that does not change is the non-water component. 20 kg of fresh grapes have 4 kg of non-water. These 4 kg is 50% of the resulting dry grapes, i.e., 8 kg of dry grapes can be obtained from 20 kg of fresh grapes. Ans: (8)

29. Quantities of petrol in the two vessels are 2/7th and 4/7th of the volumes of the vessels.



Ratio = $\frac{1}{7} : \frac{1}{7}$ = 1 : 1 Choice (A)

30. Quantity of spirit in 4 litres drawn from vessel A

$= \frac{45}{100}(4) = 1.8$ litres.

Quantity of spirit in 5 litres drawn from vessel B

$= \frac{30}{100}(5) = 1.5$ litres

Quantity of spirit in 6 litres drawn from vessel C

$= \frac{25}{100}(6) = 1.5$ litres

Hence in 15 litres of the resultant solution, 4.8 litres of spirit is present.
Concentration of spirit in the resultant solution

$= \frac{4.8}{15}(100) = 32\%$

Choice (D)

31. Let the quantity of the 27% solution of alcohol added be x litres.

Quantity of alcohol in it $= \frac{27}{100}x$

Quantity of alcohol in 20 litres of 36% alcohol solution

$= \frac{36}{100}(20) = 7.2$ litres

$\frac{27}{100}x + 7.2 = \frac{30}{100}(x + 20)$

$1.2 = \frac{3}{100}x \Rightarrow x = 40$ Ans: (40)

32. Let the ratio in which A and B are mixed be x : y.

Cost price of the mixture $= \frac{10.80}{\left(1+\frac{20}{100}\right)} = ₹9$ per kg

By alligation rule,

$\frac{x}{y} = \frac{9.75 - 9}{9 - 6.75} = \frac{1}{3}$ Choice (B)

33. If a solution of alcohol and water contains y% of alcohol and z% of the solution is taken out and replaced by water, percentage of alcohol remaining is given by $\left(\frac{100 - z}{100}\right) \times y\%$

If this process is repeated n times, the resultant concentration of alcohol is $\left(\frac{100-z}{100}\right)^n \times y\%$

For the given problem, z = 20 and y = 80.
Percentage of alcohol remaining

$= \left(\frac{100 - 20}{100}\right)^2 \times \frac{80}{100} = 51.2\%$ Choice (B)

34. Let the sum invested at 10% p.a. be ₹x.

Simple interest on ₹x for one year $= \frac{10}{100}x$

Simple interest on the sum invested at 18% p.a. for one year

$= \frac{18}{100}(18000 - x)$

$\frac{10}{100}x + \frac{18}{100}(18000 - x) = 2160$

$x = 13{,}500$ Ans: (13500)

35. The initial ratio of the number of boys and girls is not important. Finally, it is 1 : 1. The average age of all the students is 22. Therefore, for girls it is 22 – x and for boys it is 22 + x. As (22 + x) – (22 – x) = 2, x = 1.
∴ The average ages of boys and girls are 23 and 21 years respectively. Choice (B)

36. Total age of x persons initially = 60 x years.
Total age of x persons finally
= 60x – 52 – 68 + y + 72 = 60x + y – 48
∴ 60x + y – 48 = 61x ⇒ y – 48 = x
As 54 < y < 64, 6 < x < 16
As x is a perfect square, x = 9 and y = 57 Choice (C)

37. Let the capacity of the vessel be x litres. After the first replacement, x – 20 litres of milk would be present in the vessel.

∴ $\left(\frac{x - 20}{x}\right)$ of the vessel will have milk. After 20 litres is withdrawn, quantity of milk would have then been $\frac{x - 20}{x}$ (x – 20) litres.

$\frac{(x - 20)^2}{x} = 18$

$x^2 - 58x + 400 = 0$
x = 50 or 8
x must be more than 20.
∴ x = 50 Choice (B)

38. The data is tabulated below.

	I	II
Pepsi	3	2
Coke	2	3

	I	II
Pepsi	3	2
Coke	2	3

Let the quantity taken from I be 5x.
∴ The quantity taken from II is 20 – 5x.
The final quantity of 20 litres contains Pepsi and Coke in the ratio 9 : 11, i.e., 9 litres of Pepsi and 11 litres of Coke.
∴ Amount of Pepsi in final mixture
= 3x + (2/5) (20 – 5x) = 9
⇒ x = 1 ⇒ 5x = 5 Choice (D)

39. Let initially there be x litres of milk.

Now, $\left(\frac{x - 10}{x}\right)^2 = \frac{25}{25 + 24}$

$\Rightarrow \frac{x - 10}{x} = \frac{5}{7}$

⇒ 7x – 70 = 5x ⇒ x = 35. Choice (D)

40. After 20% of the contents of the vessel are removed, remaining contents $= \frac{80}{100}(12.5) = 10$ litres.

Ratio of water and milk in it = 1 : 4.

∴ It contains $\frac{4}{5}(10) = 8$ litres of milk and 2 litres of water. To reverse the ratio, 2 litres of water must be made 32 litres.
∴ 30 litres of water must be added.
To reverse this ratio again 8 litres of milk must be made 4(32) = 128 litres.
∴ 128 – 8 = 120 litres of milk must be added.
Choice (C)

41. From statement (I), the cost price of the mixture (in rupees) = (100/120) (36) = 30. As we know the costs of the varieties A and B, we can find the required ratio. Statement (I) alone is sufficient.
From (II), we don't know the cost of the mixture, so we cannot answer the question. Choice (A)

42. According to statement I, the average age of 92 test takers is 14. We do not know the ages of the remaining test takers. Hence statement I alone is insufficient.
From statement II, the oldest test taker is 24 years old. But we don't know the ages of the remaining test takers. Statement II alone is insufficient.
Combining the two statements, we can find the average, and hence we can answer the question. Choice (C)

43. Let the weights of Amar, Bhanu, Chetan and Dinesh we a kg, b kg, c kg and d kg respectively.

$\frac{a+b+c+d}{4} = 80$. The required average = $\frac{a+b}{2}$

From statement I, a = $\frac{b+c+d}{3}$

More information is required to find $\frac{a+b}{2}$

∴ Statement I is not sufficient.

Using statement II, b = $\frac{a+c+d}{3}$

More information is required to find $\frac{a+b}{2}$

∴ Statement II is not sufficient.

Using both statements,

a = $\frac{b+c+d}{3} \Rightarrow 3a = b + c + d$…….(1)

b = $\frac{a+c+d}{3} \Rightarrow 3b = a + c + d$ ……..(2)

Adding (1) and (2), a + b = c + d

$\frac{a+b+c+d}{4} = \frac{2(a+b)}{4} = 80 \Rightarrow \frac{a+b}{2} = 80$

∴Both statements are required.

Alternative solution:

From statement I, Amar's weight is 80 kg.

From statement II, Bhanu's weight is 80 kg.

∴ By combining the two statements, their average weight is 80 kg. Choice (C)

44. Let the quantities of solutions in can A and can B be 100x litres and 100y litres respectively.

From statement I, we have the required ratio as (40x + 65y) : 60x : 35y. But we don't know the relationship between x and y. ∴ Statement I alone is insufficient.

From statement II, we know the part of water in the resultant solution, but we don't know about the other liquids. ∴ Statement II alone is insufficient.

Combining the two statements, we have

40x + 65y = 1/2 [100x + 100y]

From this, we can get the relationship between x and y. We can then answer the question. Choice (C)

45. Using statement I, let the increase in the average be x years.

20N + 22 + 28 = (N + 2) (20 + x) ⇒ 10 = x (N +2)

and as x is prime, x = 2 or 5.

If x = 2, N = 3. If x = 5, N = 0 which is not possible.

∴ Statement I is sufficient.

Using statement II, let the decrease in the average be x years 20N – 22 – 28 = (N – 2) (20 – x)

10 = x (N – 2)

As x is prime, x = 2 or 5

If x = 2, N = 7. If x =5, N = 4

∴ Statement II is not sufficient. Choice (A)