Solutions for SM1001906

Chapter – 1
(Simple Equations)

Concept Review Questions

Solutions for questions 1 to 30:

1. Let the number be x

$3x - \frac{x}{3} = 24$

x = 9 Ans: (9)

2. Let the number be x.

$4 + \frac{1}{2} \times \frac{1}{3} \times \frac{1}{6} \times x = \frac{1}{12} x$

$\Rightarrow 4 + \frac{x}{36} = \frac{x}{12}$

$\Rightarrow$ x = 72 Choice (C)

3. Let the two numbers be x and y.
x + y = 18 ---------- (1)
x – y = 4 ---------- (2)
On Solving (1) and (2)
x = 11 and y = 7 Choice (A)

4. 3x + 6y = 12 $\Rightarrow$ x + 2y = 4
4x + 8y = 16 $\Rightarrow$ x + 2y = 4
As both equations are identical, they have infinite solutions.
Choice (D)

5. 3x + 9y = 21 $\Rightarrow$ 6x + 18y = 42
6x + 18y = 45
No value of x and y can satisfy both equations.
Choice (A)

6. Two equations $a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$ will have a unique solution
If $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$. As the given equations satisfy this condition, they have a unique solution. Choice (B)

7. 8x + y – 10 = 0 ---------- (1)
4x + 2y – 13 = 0 ---------- (2)
Solving (1) $\times$ 2 and (2)
16x + 2y – 20 = 0
4x + 2y – 13 = 0
– – +

12x = 7

x = $\frac{7}{12}$ and y = $\frac{16}{3}$ Choice (D)

8. 3x + 9y + 12z = 18
$\Rightarrow$ x + 3y + 4z = 6 ---------- (1)
and 2x + 3y + 4z = 8 ---------- (2)
Solving (1) & (2)
2x – x = 8 – 6 $\Rightarrow$ x = 2 Choice (A)

9. Let the costs of a puff and a samosa be ₹p and ₹s respectively
5p + 2s = 48 . . . . . (1)
p = 2s . . . . . (2)
(1), (2) $\Rightarrow$ 5 (2s) + 2s = 48 $\Rightarrow$ s = 4
p = 8
The cost of a puff is ₹8. Ans: (8)

10. Let the costs of each pen and each eraser be ₹p and ₹e respectively
4p + 5e = 32 --- (1)
5p + 4e = 31 --- (2)
Adding (1) and (2),
9 (p + 3) = 63 $\Rightarrow$ p + e = 7 --- (3)
subtracting (1) from (2),
p – e = –1 -- (4)
Adding (3) and (4),
2p = 6 $\Rightarrow$ p = 3. Choice (B)

11. Let the costs of each pen and each eraser be ₹p and ₹e respectively
3p + 3e = 17
3p + 4e = 18
Adding both equations,
7 (p + e) = 35
p + e = 5
The cost of 1 pen and 1 eraser is ₹5 Ans: (5)

12. 10m + 9a = 104 ---------- (1)
27m + 25a = 285 ---------- (2)
Solving (1) $\times$ 3 and (2)
30m + 27a = 312
27m + 25a = 285

$\Rightarrow$ 3m + 2a = ₹27 Choice (C)

13. Let the costs of each chocolate, each milk shake and each cake be ₹ch ₹m and ₹c respectively.
2ch + 3m + 4c = 190
4ch + 8c = 320
The coefficients of ch and c are proportional, we can determine m, but not ch or c.
2ch + 4c = 160
$\therefore$ 3m = 190 – (2ch + 4c) = 30
$\therefore$ m = 10. Choice (A)

14. Two digit number = TU
New number = TU4 = 100T + 10U + 4 Choice (B)

15. Let the two digit number be xy
Given 2x + 11y = 10x + y
$\Rightarrow$ 8x = 10y $\Rightarrow$ x = $\frac{5}{4}$ y $\Rightarrow$ x : y = 5 : 4
As 54 is the only number where the above condition is satisfied, with the given ratio, the number must be 54 uniquely. Ans: (54)

16. The difference between any two digit number and the number formed by reversing its digits is equal to 9 times the difference of its digits
$\therefore$ the required difference = 9 (3) = 27 Choice (B)

17. Let the number be abc with a > b
Difference of abc and cba = abc – cba
= 100a + 10b + c – (100c + 10b + a) = 99 (a – c)
$\therefore$ 99 (a – c) = 198
a – c = 2 Ans: (2)

18. The difference between a three digit number and the number formed by reversing its digits is always divisible by is 99 but is not always divisible by any greater number. Therefore, 99 is the greatest such number. Ans: (99)

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

x = y – 5 ---------- (1)
and 4x = y + 1 ---------- (2)
Solving (1) and (2)
x = 2, y = 7

$\therefore$ the fraction is $\frac{2}{7}$ Choice (C)

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

$y = x + 2$

$\Rightarrow x - y + 2 = 0$ ---------- (1)

also, $\frac{x}{y+1} = \frac{3}{4}$

$\Rightarrow 4x - 3y - 3 = 0$ ---------- (2)

Solving equations (1) & (2)

$x = 9$ and $y = 11$

$\therefore$ the fraction is 9/11. Choice (D)

21. Let the three consecutive numbers be 2x, 2(x + 1), 2(x + 2)

then $\frac{1}{3} \times 3\,(x + 1) = \frac{1}{4} \times 2(x + 2)$

$\Rightarrow x = 2$

$\therefore$ the three numbers are 4, 6, 8 Choice (A)

22. Let the number of 50 np coins with Nalini be x.

Number of ₹1 coins with her will be (30 – x)

Amount $= x \times 50 + (30 - x)\,100 = 2000$

$\Rightarrow x + 60 - 2x = 40 \Rightarrow x = 20$

$\therefore$ number of ₹1 coins with her is (30 – 20) = 10

Ans: (10)

23. Let Sekhar have x number of ₹500 notes with him, then the number of ₹100 notes with him is (22 – x).

$\Rightarrow x \times 500 + (22 - x)100 = 7000$

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

24. Let the amount with Amar be ₹a

Total amount with the others = ₹ (150 – a)

$a = \frac{1}{4}(150 - a)$

$\Rightarrow a = 30$ Choice (C)

25. Let the amounts P, Q and R be ₹p, ₹q and ₹r respectively.

$p + q + r = 1250$

$p = \frac{3}{7}(q + r) = \frac{3}{7}(1250 - p)$

$\Rightarrow 7p = 3750 - 3p \quad \Rightarrow p = 375$ Choice (D)

26. Let Sreedhar's age be s years

$s + 20 = 6(s - 20)$

$\Rightarrow 5s = 140 \Rightarrow s = 28$ Choice (C)

27. Let the present ages of Ramesh and Suresh be r years and S years respectively

$r = 3s$

$r + 2 = 2\,(s + 2)$

$\Rightarrow r = 2s + 2 = 3s$

$s = 2r = 6$

$\therefore$ Ramesh's present age is 6 years. Choice (D)

28. Let the present ages of Ashok and Bala be a years and b years respectively

$a - 4 = 4\,(b - 4)$

$\Rightarrow a = 4b - 12$ . . . . . (1)

$a + 3 = 3\,(b + 3)$

$\Rightarrow a = 3b + 6$ . . . . . (2)

(1), (2) $\Rightarrow 4b - 12 = 3b + 6$

$\Rightarrow b = 18$ and $a = 60$

Ashok's present age is 60 years. Choice (C)

29. m = 20 years

After x years, Mrudhula's age is 20 + x.

The twins will be of ages x each.

Total = 20 + x + x + x = 50

$\Rightarrow x = 10$ Ans: (10)

30. Let the man's age 27 years ago be x.

His wife's present age is 2x.

His present age is x + 27

Their total present age is 3x + 27 = 90

$\therefore x = 21$

Wife's age is 42 years and man's age is 48 years.

Choice (A)

Exercise – 1(a)

Solutions for questions 1 to 30:

1. $7(x + 2) + 3(y - 2) = 8$ ------- (1)

$3(x - 2) + 7(y + 2) = 8$ ------- (2)

From (1)

$7x + 3y = 8 - (14 - 6)$

$7x + 3y = 0$ ------- (3)

From (2)

$3x + 7y = 0$ ------- (4)

From (3), (4)

$x = 0, y = 0$ Choice (C)

2. $2x + 3y - 6z = 18$ ------- (1)

$2y - \frac{4}{3}x + 4z = 12$ ------- (2)

$(1) \times \left(\frac{2}{3}\right) + (2)$ gives

$4y = (18)\left(\frac{2}{3}\right) + 12$

$\Rightarrow 4y = 12 + 12$

$\Rightarrow 4y = 24 \Rightarrow y = 6$ Ans: (6)

3. $x + 2y + 3z = 14$ ------- (1)

$2x + 3y + z = 11$ ------- (2)

$3x + y + 2z = 11$ ------- (3)

(1) + (2) + (3) gives

$6(x + y + z) = 36 \Rightarrow x + y + z = 6$ Choice (A)

4. $3x + y - 3z = 11$

$\Rightarrow 3(x - z) + y = 11$ ------- (1)

$2(x - z) + 5y = 29$ ------- (2)

Let $x - z = a$

$\Rightarrow 3a + y = 11$ ------- (3)

$2a + 5y = 29$ ------- (4)

$(3) \times 5 - (4)$

$\Rightarrow 13a = 26$

$\Rightarrow a = 2$

$y = 5$

$a = x - z$

$\Rightarrow y + x - z = 5 + 2 = 7$ Choice (A)

5. In order that the equations may be consistent the co-efficients of the corresponding terms shall be proportional.

$\Rightarrow \frac{32}{96} = \frac{5}{15} = \frac{4}{2p}$

$\therefore p = 6$ Choice (B)

6. As the system has a solution, the coefficients are not proportional.

$\frac{3}{k} \neq \frac{k+3}{6}$

$\Rightarrow k(k + 3) \neq 18$

If $k\,(k + 3) = 3(6)$ or $(-6)\,(-3)$

i.e., if $k = 3$ or -6, the system does not have a unique solution.

$\therefore$ Any value other than $k = 3$ and $k = -6$ will result in a unique solution. Choice (D)

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

$\Rightarrow 6y = 8x - 2$

$\Rightarrow 3y = 4x - 1$ ------- (1)

$10x = 10y - 20$

$\Rightarrow x - y = -2$ ------- (2)

(1) + 3 × (2) gives,
4x – 3x – 1 – 6 = 0
⇒ x = 7
Substituting in (1),
y = 27/3 = 9

Answer = $\frac{y}{x} = \frac{9}{7}$ Choice (D)

8. Let the speeds of John and Peter be x and y respectively (in kilometres per hour)
⇒ x = y + 10 - (1)
x + 15 = 2y - (2)
y = 25
x = 35
∴ John's speed is 35 km/hr Ans: (35)

9. Let the number of girls in class A and class B be x and y respectively
x = y + 7
⇒ x – y = 7 - (1)
x + 4 = 2y
x – 2y = – 4 - (2)
Solving (1) and (2), we get
y = 11, x = 18
∴ Number of boys in A = 35 – 18 = 17
Number of boys in B = 35 – 11 = 24 Choice (D)

10. Let the number of marbles with Nitya and Satya be n and s respectively.
n + 1 = s – 1
⇒ n – s + 2 = 0 ---------- (1)
s + 1 = 2(n – 1)
⇒ 2n – s – 3 = 0 ---------- (2)
Solving (1) & (2)
i.e. 2n – 2s + 4 = 0
2n – s – 3 = 0

⇒ s = 7, n = 5 Choice (B)

11. Let the initial amount with Gopi, Murthy and Hari in rupees be x, y and z respectively.

Gopi gives $\frac{x}{2}$ to Murthy

They now have $\frac{x}{2}$, $\frac{x}{2}$ + y and z

Murthy gives half of his amount to Hari
They now have

$\frac{x}{2}; \frac{x}{4} + \frac{y}{2}; \frac{x}{4} + \frac{y}{2} + z$

Hari gives half his amount to Gopi.

Gopi now has $\left(\frac{x}{2} + \frac{x}{8} + \frac{y}{4} + \frac{x}{4} + \frac{z}{2}\right)$ and this is equal to x.

$\Rightarrow x = \frac{x}{2} + \frac{x}{8} + \frac{y}{4} + \frac{z}{2}$

$\Rightarrow \frac{3x}{8} = \frac{y}{4} + \frac{z}{2}$

⇒ 3x = 2y + 4z = 2 x 45 = 90, as (y + 2z) is given equal to 45.
⇒ x = 30 Ans: (30)

12. Let the number of 100 gm weights be x and number of 500 gm weights be y.
100x + 500y = 8000, as per data.
x + 5y = 80 → (1)
the 2nd relation is x + y = 20 → (2)
Subtracting, 4y = 60, y = 15, x = 5
Answer = 500 gm Choice (D)

13. If cost of a pencil is ₹5 then the only feasible values for cost of a pen and cost of a ruler are 6 and 4 respectively.
∴ Cost of 10 rulers = 40
∴ Number of pencils he purchased with ₹40 is
= $\frac{40}{5} = 8$ Ans: (8)

14. Let the initial amount = A
Cost of 1 apple = (A/10)
Cost of 1 orange = (A/15)
Cost of 1 watermelon = (A/2)
As all three types of fruits are bought, the minimum shall be one.
As oranges are to be maximum, others are one each.
Amount spent = 6A (as per data).
Hence, the number of oranges
= [6A – {(A/10) + (A/2)}] / (A/15)
= [6A – (6A/10)] / (A/15) = (54A/10) / (A/15) = 81
Choice (B)

15. Let the present ages of the man and the son be m years and s years respectively.
m – 10 = 2 (s – 10) + 35
m = 2s + 25
(i) let us say after x years the father will be twice his son's age.
m + x = 2 (s + x)
2s + 25 + x = 2s + 2x
25 = x Choice (C)

(ii) Let us say after x years the father will be thrice his son's age
2s + 25 + x = 3 (s + x)
25 = s + 2x
We have only 1 equation but 2 unknowns. So x cannot be found. Choice (D)

16. Data is tabulated below

	Bhangar	Karthin
Runs	x + 10	y
Ballsy +	5	x

x + y + 10 = 50
x + y = 40→ (1)
y + 5 = x – 15
x – y = 20→ (2)
$\Rightarrow x = \left(\frac{40+20}{2}\right) = 30$
Runs scored by Bhangar = 30 + 10 = 40 Ans: (40)

17. Karthik's run rate = $\frac{y}{x} = \frac{10}{30} = 0.33$ Choice (D)

18. A + B + C + D = 90000 ---------- (1)
A + C + D = 4B ---------- (2)
also, B + D = 4/5 (A + C) ---------- (3)
From (1) & (2)
4B + B = 9000
⇒ B = ₹1800
From (2) and (3)
B + D = 4/5 (4B – D)
5B + 5D = 16B – 4D
⇒ 11B = 9D
$\Rightarrow D = \frac{11}{9} \times 1800 = ₹2200$ Choice (C)

19. Let the times for which P, Q, R worked on the project be p, q, r respectively (all in hours)

$p = \frac{2}{3}q$, $q = \frac{2}{5}r$ $\therefore p = \frac{2}{3}\left(\frac{2}{5}r\right) = \frac{4}{15}r$

p : q : r = 4 : 6 : 15
R worked for $\frac{3}{5}$ of the total number of hours that all the three worked. Choice (B)

20. Let the costs of an apple, a banana and an orange be ₹a, ₹b and ₹c respectively.
4a + 6b + 8c = p
5a + 8b + 11c = q
8a + 16b + 20c = r
Going back from the options, only Choice (D) satisfy the given equation. Choice (D)

21. Let the correct number be 10x + y
$\therefore 10y + x - (10x + y) = 10x + y - 4$
$8y - 19x = -4$
$\Rightarrow 19x - 8y = 4$ ------- (1)
$3(x + y) = 10x + y - 10$
$7x - 2y = 10$ ------- (2)
Solving (1) and (2), we get
x = 4, y = 9
Number = 49, Product of the digits = 36 Choice (C)

Solutions for questions 22 and 23:

Let the number of toys sold by the shopkeeper be 'ab'. Let the selling price of each toy be ₹ 'cd'. Let his initial stock be s.
Actual stock left = s – 'ab'.
Stock as shown on record = s – 'ba'
s – ba = s – ab + 81
Given that,
10a + b – (10b + a) = 81
a – b = 9
$\therefore$ a = 9 and b = 0

22. ab = 90 Choice (C)

23. Mistaken sale price = $\frac{882}{\text{'ba'}}=\frac{882}{09}=98$ = ₹98

Actual sale price = ₹89 Choice (A)

24. Let the children be C_{10}, C_9, ……, C_1 in decreasing order of their ages.
Let each child have ₹x at the beginning. The following table gives the amounts with each of them at the end of each transaction.
$1 \rightarrow (x - 9), (x + 1) (x + 1)$ …… $(x + 1)$
$2 \rightarrow (x - 9), (x - 7) (x + 2), (x + 2)$ ……. $(x + 2)$
$3 \rightarrow (x - 9), (x - 7), (x - 5), (x + 3), (x + 3),$……(x+3)
$4 \rightarrow (x - 9), (x - 8), (x - 5), (x - 3), (x + 4), (x + 4)$ …….. $(x + 4)$

At the end, the total sum with children who have given some money
= (x – 9) + (x – 7) + (x – 5) + (x – 3) = 4x – 24
The total sum with those children who have not given any money = 6 – (x + 4) = 6x + 24
$\therefore 6x + 24 = 2(4x - 24)$
$\Rightarrow$ 2x = 72 x = 36 Choice (A)

25. Let the hundreds, tens and units digits be x, y, z respectively.
(100x + 10y + z) is the 3-digit number = 11(10x + z)
= (100x + z) + (10x + 10z)
$\therefore$ y = x + z
Given y – x = 1 $\therefore$ z = 1
Note: If (x – y) is taken as 1, z = – 1, which is inadmissible.
Ans: (1)

26. In addition to the data in Q-25, y – z = 1
$\therefore$ y = 1 + z = 1 + 1 = 2
x = y – z = 1
$\therefore$ Number is 121. Ans: (121)

Note: If (z – y) is taken as 1, then x = –1, which is inadmissible.

Solutions for questions 27 and 28:

Let the actual weight of food grains be w.
Case I:
If it is kept in the pan of weight 0.5 kg
Total weight (including that of food grains) = w + 0.5
On the other side of the balance let an indicated weight "xy" be kept, w + 0.5 = 10x + y + 0.75 $\rightarrow$ (1)

Case II:
If food grains are kept in the other pan of the balance
w + 0.75 = 10y + x + 9.5 + 0.5 $\rightarrow$ (2)
(2) – (1) gives
0.25 = 9(y – x) + 9.25
9(x – y) = 9
x – y = 1 $\rightarrow$ (3)

27. w = 10x + y + 0.25
So, the actual weight w = 10x + y + 0.25
So, in the actual weight after the decimal part 0.25 must appear, and in the integral part, the ten's digit should be more than between the unit's digit. Both these conditions are satisfied for (A), not for choices (B) and (C).
Choice (D)

28. In the indicated weight, ten's digit is 1 more than the units digit and this is satisfied by Choice (A) only. Choice (A)

29. Present time = P(say)
P + t min = 12 p.m. …….(1)
P – 44 min = 9 a.m. + 7t min …….(2)
$\therefore$ P = 12 p.m. – t min
= 9 a.m + (7t + 44) min
$\Rightarrow$ 3 hr – 44min = 8t min
$\Rightarrow$ 180 min – 44 min = 8t min
$\Rightarrow$ 17 = t $\Rightarrow$ P = 11 : 43 a.m. Ans: (11, 43)

30. If the marks for each correct, each wrong and each unanswered question were 4, –1, 0 respectively he would have got 25 marks. But he actually got 5, 0, 1 marks respectively. i.e., for each question, he actually got 1 mark more. There were 35 questions. His actual score = 25 + 35 = 60. Ans: (60)

Exercise – 1(b)

Solutions for questions 1 to 35:

1. (a) $x+\frac{x}{2}+\frac{x}{3}=\frac{x}{4}+5$

$\Rightarrow x+\frac{x}{2}+\frac{x}{3}-\frac{x}{4}=5$

$\Rightarrow \frac{x(12+6+4-3)}{12}=5$

$\Rightarrow x=\frac{12\times 5}{19}=\frac{60}{19}$ Choice (A)

(b) 99x + 101y = 400 ------- (1)
99y + 101x = 400 ------- (2)
(1) + (2) gives
200(x + y) = 800
$\Rightarrow$ x + y = 4 ------- (3)
(1) – (2) gives
2(y – x) = 0
$\Rightarrow$ y = x ------- (4)
From (3) and (4)
2x = 4, x = 2 and y = 2 Choice (D)

(c) $\frac{6}{(2x-y)}+\frac{7}{(3y-x)}=7$ ------- (1)

$\frac{4}{(2x-y)}+\frac{14}{(3y-x)}=6$ ------- (2)

From (2)

$\frac{2}{(2x-y)}+\frac{7}{(3y-x)}=3$ ------- (3)

(1) – (2) gives

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

$\Rightarrow$ 2x– y = 1 ------- (4)
Similarly
(3) x 3 – (1) gives

$\frac{14}{3y-x}=2$

$\Rightarrow$ 3y – x = 7 ------- (5)
(4) + 2 $\times$ (5) gives
5y = 15 $\Rightarrow$ y = 3 and x = 2 Choice (A)

2. Let the two parts be x grams and y grams
$x + y = 1000$
$x + y = \frac{5}{4}(x - y)$
$x - y = 800$
$\Rightarrow x = 900$
$y = 100$ Choice (C)

3. Given that P, Q and R are successive even natural numbers in ascending order. As we need Q, we express P and R in terms of Q.
$P = Q - 2$ and $R = Q + 2$
$\therefore 5(Q + 2) = 7(Q - 2) + 8 \Rightarrow Q = 8$ Ans: (8)

4. $\frac{A+B}{3} = A - B$
$3A - 3B = A + B$
$2A - 4B = 0$
$A - 2B = 0$ ------- (1)
$B + 40 = 2A + 10$
$2A - B = 30$ ------- (2)
$\Rightarrow 4A - 2B = 60$
$3A = 60$
$\Rightarrow A = 20$ and $B = 10$ Choice (C)

5. Let the number of baskets made by Meena and Reena in one hour be m, r respectively.
$3m = 2r + 1$ ---------- (1)
$5m = 4r - 1$ ---------- (2)
Solving (1) and (2)
$m = 3$ and $r = 4$ Choice (C)

6. Let the number be x.
$\frac{9}{2}x - \frac{2}{9}x = 4235 \Rightarrow x = 990$ Ans: (990)

7. Let the number of coins with Ashok and Balu be a and b respectively.
Given that, $a - 20 = 3(b + 20) \Rightarrow a = 3b + 80$
and $a - 30 = 2(b + 30) \Rightarrow a = 2b + 90$
$\therefore 2b + 90 = 3b + 80 \Rightarrow b = 10$ Choice (B)

8. Let the number of ₹20 notes with Alok be x. Number of ₹5 notes with him = 30 – x. Given that,
$20x + 5(30 - x) = 300$
$\Rightarrow x = 10$ Choice (B)

9. Number of sequence copies made = 7500 – 1500 = 6000.
Cost of making these copies (in ₹) = 7080 – 1500 = 5580.
$y = \frac{5580}{6000} = 0.93$ Ans: (0.93)

10. Let the cost of each pen, each eraser and each sharpener be ₹p, ₹e and ₹s respectively.
$4p + 5c + 6s = 47$ ….. (1)
$6p + 7c + 9s = 69$ …… (2)
By $3 \times (1) - 2 \times (2)$, we get $e = 3 \times 47 - 2 \times 69 = 3$
Choice (A)

11. Let the cost of each pen, each eraser and each sharpener be ₹p, ₹e, ₹s respectively.
$5p + 8e + 118 = 54$ ---------- (1)
$3p + 5e + 7s = 34$ ---------- (2)
By multiplying (1) by 2 and subtracting thrice (2), we get
$p + e + s = 6$ Ans: (6)

12. Cost of 1 pen = x
Cost of 1 pencil = y
Cost of 1 eraser = z
$2x + 5y + 7z = 37$ - (1)
$7x + 2y + z = 49$ - (2)
Multiplying equation (2) by 7 and subtracting equation (1) gives the required value.
$\Rightarrow 49x + 14y + 7z = 343$
$2x + 5y + 7z = 37$
$47x + 9y = 306$
Choice (D)

13. Let the cost of each pen, each eraser and each sharpener be ₹p, ₹e and ₹s respectively.
$2p + e + 3s = 23$ …….(1)
$6p + 3e + s = 45$……..(2)
$14p + 7e + 21s = 161$…(3)
But (1), (3) are equivalent.
$\therefore$ We effectively have only 2 equations (1) and (2) or (2) and (3).
In order to find the cost of each pen, the ratio of the coefficients of erasers and sharpeners must be the same. As this is not the case, Choice (D) follows.
Choice (D)

14. Let the cost of each brown pen be b paise, cost of each white pen = (b + 70) paise. Suppose Anand bought B brown pens. He must have bought (30 – B) white pens.
Total cost = $bB + (30 - B)(b + 70)$
$30b - 70B + 2100 = 3200$
$B = \frac{3b - 110}{7}$. Among the given choices, B has a feasible value only when b = 60. Choice (D)

Solutions for questions 15 to 17:

Let the number of pens, erasers and sharpeners that Rakesh purchased be p, e and s respectively.
$p + e + s = 38$
$p < e < s$
$\therefore$ (p, e, s) can be only (11, 12, 15) or (11, 13, 14).

15. In either of the above combinations p = 11
Choice (A)

16. (p, e, s) = (11, 13, 14) results in the minimum expenditure.
Minimum expenditure = ₹ 117. Choice (C)

17. Expenditure = 2p + 3e + 4s.
This will be minimum, if e and s have their minimum values, in which case p has its maximum value
$\therefore$ minimum expenditure occurs when e = s = 11 and p = 16
Minimum expenditure = ₹ 109. Choice (B)

18. Let the shares of A, B and C be A, B and C respectively.
then, $A + B + C = 5600$ ---------- (1)
$B + C = 3A$ ---------- (2)
$A + C = 9/5\ B$ ---------- (3)
Solving (1) & (2)
$4A = 5600 \Rightarrow A = ₹1400$
Solving (1) & (3)
$\frac{14B}{5} = 5600$
$\Rightarrow B = ₹2000$
Share of C
$= 5600 - 1400 - 2000 = ₹2200$ Choice (C)

19. In each city, Aswin spends ₹2 more than half of what he has when he entered the city i.e., he is left with ₹2 less than half of at the beginning. Therefore, when he entered each city he has double of 2 more than what he had when he left the city.
When he entered the third city he has $2(150 + 2)$ or 304
When he entered the second city he has $2(304 + 2)$ or 612
When he entered the first city he has $2(612 + 2)$ or 1228
Ans: (1228)

20. Let the fraction be $\frac{N}{D}$.

Given that

$\frac{N+1}{D+1}=\frac{2}{3} \Rightarrow 2D - 3N = 1 \quad \rightarrow$ (1) and

$\frac{N-2}{D-2}=\frac{3}{5} \Rightarrow 5N - 3D = 4 \quad \rightarrow$ (2)

Applying, $3 \times (1) + 2$ (2), we get

$(-9N) + (10N) = N = (3 \times 1) + (2 \times 4) = 11$

Put N = 11

Substituting in (1), $2D = 1 + 33 = 34 \Rightarrow D = 17$

Required fraction = $\frac{N+4}{D+4}=\frac{11+4}{17+4}=\frac{15}{21}=\frac{5}{7}$

Choice (C)

21. As the system has infinite solutions, the coefficients are proportional

i.e., $\frac{3}{k}=\frac{\frac{k}{3}+2}{2k}$

$k\left(\frac{k}{3}-4\right)=0$

k = 0 or 12. If k = 0, the second equation becomes inconsistent

$\therefore$ k = 12 Ans: (12)

22. Let the number be 'ab'.

$4(a + b) = 10a + b - 18 \Rightarrow b + 6 = 2a$

Also, $10a + b - 18 = 10b + a - 9 \Rightarrow a - b = 1$

$\therefore b + 6 = 2(b + 1)$

b = 4 and a = 5

$\therefore$ Product of digits = 20 Choice (B)

23. Let the number be ab. It's reverse is ba.

$\therefore ab + ba = 99$

i.e., $10a + b + 10b + a = 99$

$\Rightarrow a + b = 9$

(a, b) can be (1, 8), (2, 7), (3, 6) ,……..(9, 0)

$\therefore$ ab has 9 possibilities. Ans: (9)

24. Let the hundreds, tens and units digits be x, y, z respectively.

The number is $100x + 10y + z$

$x + y + z = 8$ - (1)

$y = 3(x + z)$ - (2)

From the third condition, we get x = z

$\therefore y = 6x$ and $2x + y = 8$

$\therefore x = 1$

y = 6

Number = 161 Choice (A)

25. Let the number N be 'abc'.

Let the sum of the remaining numbers be R.

$R + cba = R + abc + 11(a + b + c)$

$\Rightarrow 99(c - a) = 11(a + b + c)$

$\Rightarrow 8c - 10a = b$ ……(1)

As $b \geq 0$ and $c \geq \frac{5}{4}a$, $c > a$

$\therefore$ 8 (Difference of a and c)

$= 8(c - a) = 6 + 2a$

$8c - 10a = 6$ …..(2)

From (1) and (2), b = 6 Choice (B)

26. Let the number be 'abcd'

Given that,

$b + c = 2d \rightarrow (1)$

$b + 6a = 2(c + d) \rightarrow (2)$

$d + 5a = 2b \rightarrow (3)$

Let us that the equations (1), (2) and (3) as the linear equations in a, b and c and express the values of a, b and c in terms of b.

By (2) – (1), we get $3c = 6a \Rightarrow a = \frac{c}{2}$

By substituting c = 2a in (1), it becomes

$2d - 2a = b \rightarrow (4)$

Subtracting (4) from $2 \times (3)$, we get

$12a = 3b \Rightarrow a = \frac{b}{4}$

As c = 2a, $c = \frac{b}{2}$

By substituting $a = \frac{b}{4}$ in (4), we get $2d = \frac{3b}{2} \Rightarrow d = \frac{3b}{4}$

$\therefore a : b : c : d = 1 : 4 : 2 : 3$

$\therefore$ 'abcd' can be 1423 or 2846. Ans: (2)

27. Let the number of questions correctly answered by Ajay be x.

Number of questions wrongly answered by him = 200 – x.

His mark = $2x - \frac{1}{2}(200 - x) = \frac{5}{2}x - 100 = 360$

$\Rightarrow x = 184$

Upon interchanging of the marks, his marks would be

$= 184(1/2) - 16(2) = 60$ Choice (B)

28. Only the first two children have been mentioned individually. Let the number of chocolates with the first child, the second child and all the others be a, b, c respectively. If the first child attempted to double the number of chocolates with each of the others, he would fall short by two chocolates.

$\therefore a + 2 = b + c$

Also, $a - 3 = b + 18$

$\therefore c = 23$ Ans: (23)

29. Suppose Alok started with ₹A. He gave ₹x to his friend in each round. The amounts with him at the end of the first, second and third rounds are (in ₹)

2A – x, 4A – 3x and 8A – 7x respectively.

Given that, $8A - 7x = 0 \Rightarrow x = \frac{8}{7}A$

As $x = A + 20$, $\frac{8}{7}A = A + 20 \Rightarrow A = 140$ Choice (D)

30. Let the present ages of Ram and Shyam be r years and s years respectively.

$r - 6 = 4(s - 6) \Rightarrow r = 4s - 18$

And $r + 6 = 3(s + 6) \Rightarrow r = 3s + 12$

$\therefore 4s - 18 = 3s + 12 \Rightarrow s = 30$, r = 102

$\therefore$ their present combined age is 132 years. It has to increase by 18 years to become 150 years. This will happen if the age of each increases by 9 years. Choice (B)

31. The difference of Ashok's age and his son's age is always 24 years. As x years ago, Ashok was 48, his son was 24. Also 5x years ago Ashok was 36, his son was 12

$\therefore$ The difference of these two times is 4x = 12 or x = 3.

$\therefore$ Ashok's present age is 48 + 3

His son's present age is 24 + 3

The sum is 78. Choice (C)

32. Let the two numbers be $\frac{1}{x}$ and $\frac{1}{y}$

$\frac{1}{x}+\frac{1}{y}=4 \quad \rightarrow$ (1)

and $x - y = 2xy \Rightarrow \frac{1}{y}-\frac{1}{x}=2 \rightarrow$ (2)

(1) + (2) gives $\frac{2}{y}=6 \Rightarrow y=\frac{1}{3}$

(1) – (2) gives

$\frac{2}{x}=2 \Rightarrow x = 1$

$\therefore$Product of the reciprocals = (x) (y) = (1) (1/3) = (1/3)

Choice (C)

33. Let the larger number be a.
Smaller number = 250 – a
$a^2 - (250 - a)^2 = 12500$
$(a + 250 - a)(a - (250 - a)) = 12500$
$\Rightarrow 2a - 250 = 50$
$\therefore a = 150$ Choice (C)

34. Let the number of marbles with Dinesh, Eswar, Ganesh and Harish be d, e, g and h respectively.
Given that $d + e + g + h = 20 \rightarrow (1)$

$d = \frac{1}{2}(e + g + h) = \frac{1}{2}(120 - d)$

$d = 40$

similarly, $e = \frac{1}{3}(120 - e) \Rightarrow e = 30$ and

$g = \frac{1}{4}(120 - g) \Rightarrow g = 24$

$h = 120 - (d + e + g) = 120 - (30 + 40 + 24) = 26$

Ans: (26)

35. Before doubling, the amounts with Bhavan, Chetan and Dinesh, each of them must have had $\frac{80}{2}$ = ₹40.

$\therefore$ Amar must have then had ₹80 + ₹120 i.e. ₹200. Similarly we can work out the amounts with each of them before the other doubled the amounts. The results are summarized below.

	Amar	Bhavan	Chetan	Dinesh
Finally	80	80	80	80
Before Amar doubles	200	40	40	40
Before Bhavan doubles	100	180	20	20
Before Chetan doubles	50	90	170	10
Before Dinesh doubles	25	45	85	165

Choice (D)

Solutions for questions 36 to 40:

36. Statement I: $\frac{x}{2} + \frac{3y}{4} = 1$

Statement I is sufficient.
Statement II: 9y + 6x = 12, we can see that this is equivalent to 3y + 2x = 4.
$\Rightarrow$ The value of 2x + 3y; value can be found, so statement II is sufficient. Choice (B)

37. From statement II, if the cost of 12 shirts is doubled, it will be the same as 72 pants $\Rightarrow$ cost of 12 shirts is the same as the cost of 36 pants. So, only statement II is sufficient and the difference is zero. Choice (A)

38. There are two possibilities
I. 21 attempts __ all correct.
II. 25 attempts __ 22 correct.
Hence, the question cannot be answered even after using both the statements. Choice (D)

39. From statement I, we have man's age = wife's age + 2 years
But to know whether man's age = wife's age + son's age, we should know the ages of at least two of them.
$\therefore$ Statement I alone is not sufficient.
From statement II, we have
son's present age = 12 years
wife's present age = 42 years
But to know whether man's age = wife's age + son's age or not, we should know the relationship between the ages of the man and wife or man and the son.
$\therefore$ Statement II alone is not sufficient.
Using both the statements we have
man's age = 42 + 2 = 44 years
$\therefore$ Clearly man's age < wife's age + son's age. Choice (C)

40. As statements I and II individually do not relate to Uno and Zen, they are not sufficient.
Using both, we have Palio = 4/5 (Alto);
Alto = Zen – 2

Also Alto gives $45 \times \frac{4}{3}$ = 60 km

$\therefore$ Zen = 62 km
$\therefore$ Zen gives more mileage. Choice (C)

Chapter – 2
(Ratio – Proportion – Variation)

Concept Review Questions

Solutions for questions 1 to 30:

1. Given $a = \frac{9}{8}b$

$\frac{3b}{4a} = \frac{3b}{4\left(\frac{9}{8}b\right)} = \frac{2}{3}$ Choice (A)

2. Given 2.4p = 0.08q

$q = \frac{2.4}{0.08}$ p = 30p

$\frac{q+p}{q-p} = \frac{31p}{29p} = \frac{31}{29}$ Choice (C)

3. Let a = 2x b = 3x
3a + 4b = 3 (2x) + 4 (3x) = 18x
4a + 5b = 4 (2x) + 5 (3x) = 23x

$\frac{3a+4b}{4a+5b} = \frac{18}{23}$ Choice (B)

4. a : b = 2 : 3 = 4 : 6
a : c = 2 : 3 = 6 : 9
$\therefore$ a : b : c = 4 : 6 : 9 Choice (A)

5. $p : q = 5 : 6 \Rightarrow p = \frac{5}{6}q$

$q : r = \frac{4}{7} \Rightarrow q = \frac{4}{7}r$

$\therefore p = \frac{5}{6}\left(\frac{4}{7}r\right) = \frac{10}{21}r$

$\therefore p : q : r = \frac{10r}{21} : \frac{4}{7}r : r = 10 : 12 : 21$ Choice (A)

6. $\frac{a}{b} \times \frac{b}{c} \times \frac{c}{d} \times \frac{d}{e} = \frac{2}{3} \times \frac{6}{7} \times \frac{14}{25} \times \frac{1}{2} = \frac{4}{25}$ Choice (D)

7. Let P = 5x q = 4x
5x = a + b --- (1)
4x = a – b--- (2)
From (1) and (2),
2a = 9x and 2b = x
$\therefore$ a : b = 2a : 2b = 9 : 1 Choice (B)

8. Number of sweets received by Sita = $\frac{4}{7}(35) = 20$

Ans: (20)

9. Let the numbers be 2x and 5x.

$\frac{2x+4}{5x+4} = \frac{4}{9}$

18x + 36 = 20x + 16
x = 10
2x = 20 and 5x = 50
$\therefore$ The numbers are 20 and 50 Choice (D)

10. A : B : C = 7 : 5 : 4
let A's age = 7k B's age = 5k
c's age = 4k = 32 $\Rightarrow$ k = 8
= 7k + 5k + 4k = 16 x 8 = 128 years Ans: (128)

11. Let the ages of the four members be 9k, 8k, 3k and 2k years respectively.

Average age = $\frac{9k+8k+3k+2k}{4}$ = 22

$\Rightarrow$ k = 4
$\therefore$ The age of the eldest family member
= 9 x 4 = 36 Choice (A)

12. Let the number of marbles with A and B be 10x and 11x respectively
Total number of marbles = 21x
$\therefore$ the total number of marbles must be divisible by 21. Only Choice (D) violates this condition. Choice (D)

13. Let the ratio of the number of boys and girls in the class be a : b. Number of boys and girls will be ak and bk.
Given ak + bk = 70

K = $\frac{70}{a+b}$.

Since k is an integer a + b must be a factor of 70; from the options
The sum of the ratio in options (A), (B), (C) are factors of 70. But the sum of ratio 9 : 2 is not a factor of 70.
$\therefore$ 9 : 2 is not a possible ratio. Choice (D)

14. Let the number of gents in the party be g.

Number of ladies in the party = $\frac{3}{4}$g

Number of ladies in the party if 8 ladies join the party

= $\frac{3}{4}g+8=\frac{5}{4}g \Rightarrow g = 16$ Ans: (16)

15. Let the present ages of the mother and son be m and s years respectively
m : s = 4 : 1
$\Rightarrow$ m = 4k, s = k
after twelve years

$\frac{4k+12}{k+12}=\frac{2}{1}$

$\Rightarrow$ k = 6
$\therefore$ the present ages of the mother and son are 24 and 6 years respectively. Choice (C)

16. Let the number of chocolates A and B be 3k, 4k

$\frac{3k-4}{4k+4}=\frac{5}{9}$

$\therefore$ A had 3k = 24 chocolates initially. Ans: (24)

17. Let the numbers of students in A, B and C be 3x, 7x and 8x respectively.
If 10 students leave C and join B, C and B would have 8x – 10 students and 7x + 10 students respectively.
7x + 10 = 80
x = 10
Total number of students = 18x = 180 Ans: (180)

18. Let the incomes of A and B be ₹4x and ₹3x
Their savings be ₹5y, ₹6y
Their expenditures are (4x – 5y) and ₹3x – 6y
$\Rightarrow$ 4x – 5y = ¾ (4x) $\Rightarrow$ x = 5y
$\therefore$ the expenditure of A = 4x – 5y = 4(5y) – 5y = 15y
$\therefore$ the expenditure of B = 3x – 6y = 3(5y) – 6y = 9y
$\therefore$ the ratio of the expenditure of A and B is
= 15y : 9y = 5 : 3 Choice (B)

19. If $\frac{s_1}{s_2}<\frac{e_1}{e2}$ then $\frac{s_1}{s_2}<\frac{s_1+e_1}{s_2+e2}<\frac{e_1}{e_2}$

In the given problem, $\frac{e_1+s_1}{e_2+s_2}=\frac{3}{4}$ and $\frac{e_1}{e_2}=\frac{4}{5}$

$\therefore \frac{s_1}{s_2}<\frac{3}{4}$.

Only Choice (C), i.e. $\frac{s_1}{s_2}=\frac{13}{20}$ satisfies this condition.

Choice (C)

20. Let the present ages of the husband and the wife be 5x years and 4x years respectively.

(i) Ratio of their ages 20 years ago

= $\frac{5x-20}{4x-20}=\frac{5(x-5)+5}{4(x-5)}>\frac{5}{4}$ (some positive quantity)

$\therefore$ the ratio must exceed $\frac{5}{4}$. Only choice (D) satisfies this condition Choice (D)

(ii) Ratio of their ages 20 years hence

= $\frac{5x+20}{4x+20}=\frac{5(x+5)-5}{4(x+5)}<\frac{5}{4}$

$\therefore$ the ratio must be less than $\frac{5}{4}$

Only Choice (B) satisfies this condition. Choice (B)

21. Let the four numbers be x , 2x, 3x, 4x
The sum of squares = 480
$\Rightarrow x^2 + (2x)^2 + (3x)^2 + (4x)^2 = 480 \Rightarrow 30x^2 = 480$
$\Rightarrow x^2 = 16$
$\Rightarrow$ x = 4
$\therefore$ The numbers are 4, 8, 12, 16 Choice (C)

22. Given that $\frac{q+r}{p}=\frac{p+r}{q}=\frac{p+q}{r}=k$

q + r = pk, p + r = qk and p + q = rk
q + r + p + r + p + q = k(p + q + r)
(p + q + r) (2 – k) = 0
$\because$ p + q + r $\neq$ 0,
$\therefore$ 2 – k = 0
$\Rightarrow$ k = 2 Choice (D)

23. $x \propto y^2 \Rightarrow x = k \times y^2$
$4 = k \times 12^2$
$k = 4/12^2$
When y = 18,
$x = ky^2 \Rightarrow x = 4/12^2 \times 18 \times 18 = 9$ Choice (B)

24. Area x $(\text{Diagonal})^2$
A x D^2
$\Rightarrow A = KD^2$

$\Rightarrow \frac{A_1}{D^2_1}=\frac{A_2}{D^2_2} \Rightarrow \frac{32}{8^2}=\frac{72}{D^2_2}$

$\Rightarrow D_2$ = 12 units. Ans: (12)

25. $\frac{S_1}{S_2}=\frac{D_1}{D_2}$

S_1 = 10400, D_1 = 26 and D_2 = 24

$S_2=\frac{S_1D_2}{D_1}=9600$ Ans: (9600)

26. As the distance to be covered is constant, $S_1 T_1 = S_2 T_2$
S_1 = 50, T_1 = 6 and S_2 = 100

$T_2=\frac{S_1T_1}{S_2}=3$ Choice (B)

27. P = k (Q + R) where k is a proportionality constant.
$P_1 = k (Q_1 + R_1)$
$P_2 = K (Q_1 – 1 + R_1 – 1) = k (Q_1 + R_1 – 2) = P_1 – 2k$
As k is unknown, the change in P cannot be found.
Choice (D)

28. From the given information, A varies directly with the product of B and C.

$\therefore \frac{A_1}{A_2} = \frac{B_1C_1}{B_2C_2}$

$A_1 = 6000$, $B_1 = 20$, $C_2 = 30$, $B_2 = 40$ and $C_2 = 60$

$A_2 = \frac{A_1B_2C_2}{B_1C_1} = 24000$ Ans: (24000)

29. $A \alpha B$

$A \alpha 1/C$

$\Rightarrow$ $A \alpha B/C$

$\Rightarrow \frac{A_1C_1}{B_1} = \frac{A_2C_2}{B_2}$

$\Rightarrow \frac{20 \times 30}{65} = \frac{A_2 \times 42}{84}$

$\Rightarrow A_2 = 24$ Choice (A)

30. From the given information, X varies inversely with the product of Y and Z.

$\therefore \frac{X_1}{X_2} = \frac{Y_2}{Y_1}\frac{Z_2}{Z_1}$

$X_1 = 30$, $Y_1 = 8$, $Z_1 = 7$,
$Y_2 = 16$ and $Z_2 = 21$

$X_2 = \frac{X_1Y_1Z_1}{Y_2Z_2} = 5$ Ans: (5)

Exercise – 2(a)

Solutions for questions 1 to 30:

1. $a/b = 3/7$

$$\frac{4a+5b}{2a+2b} = \frac{4\left(\frac{a}{b}\right)+5}{2\left(\frac{a}{b}\right)+2} = \frac{\frac{12}{7}+5}{\frac{6}{7}+2} = \frac{47}{20}$$

Alternate method:
Substituting the values of a and b as 3k and 7k respectively in $\frac{4a+5b}{2a+2b}$,

we get $\frac{12k+35k}{6k+14k} = \frac{47k}{20k} = \frac{47}{20}$ Choice (A)

2. $a : b = 2 : 3 = (2 \times 4) : (3 \times 4) = 8 : 12$
$b : c = 4 : 3 = (4 \times 3) : (3 \times 3) = 12 : 9$

$c : d = 2 : 3 = \left(2 \times \frac{9}{2}\right) : \left(3 \times \frac{9}{2}\right) = 9 : \left(\frac{27}{2}\right)$

$a : b : c : d = 8 : 12 : 9 : \frac{27}{2} = 16 : 24 : 18 : 27$

Choice (B)

3. Let a, b and c be the weights of the Bimal, Basu and Bali respectively.
$a/b = 2/3 = 8/12$; $c/b = 3/4 = 9/12$; $a : b : c = 8 : 12 : 9$
Given the sum of the weights (8 + 12 + 9 = 29 parts) is 203 kg i.e. one part is 7 kg. So Basu's weight i.e. 12 parts is 12 x 7 = 84 kg Ans: (84)

4. Number of boys = 7x
Number of girls = 3x

$\frac{7x}{3x+15} = \frac{2}{3}$

$21x = 6x + 30$
$15x = 30$, $x = 2$
$\therefore$ Number of girls = 6 Choice (D)

5. $3x - 4y + 2z = 0$ ---(I)
$4x - 2y - z = 0$ -----(II)
From (II)
$z = 4x - 2y$
Substituting $z = 4x - 2y$ in I, we get
$3x - 4y + 8x - 4y = 0$
$11x = 8y$
Again, $z = 4x - 2y$
multiply by 4 on both sides we get
$4z = 16x - 8y$; substituting $8y = 11x$
$4z = 16x - 11x = 5x$

$x : z : y = x : \frac{5}{4}x : \frac{11}{8}x = 8 : 10 : 11$ Choice (A)

6. $\frac{p-x}{q+x} = \frac{1}{3}$; $x = \frac{3p-q}{4}$ Choice (B)

7. Two numbers are in the ratio 4 : 7
Let the numbers be 4k and 7k
Let the number added to each be L.
Given that, (4k + L) + (7k + L) = 75
$\Rightarrow$ 11k + 2L = 75 --------- (1)
It is also given that, $\frac{4k+L}{7k+L} = \frac{8}{17}$

$\Rightarrow$ 12k + 9L = 0 ---------- (2)

$\Rightarrow k = \frac{-9L}{12} = \frac{-3}{4}L$

Substituting the value of k in (1) we get L = –12

Alternate method:
Ratio of the resulting numbers = 8 : 17
Sum of the resulting numbers = 75
Hence, the numbers obtained after addition are
(8/25) x 75 = 24 and (17/25) x 75 = 51
i.e., 4k + L = 24 and 7k + L = 51
On subtraction,
7k – 4k = 51 – 24 $\Rightarrow$ 3k = 27, k = 9 and L = –12
Ans: (–12)

8. Let the amounts initially with Mohan and Sohan be 8x and 5x respectively. Let us say Mohan spends y each day.

$\frac{8x - y(9)}{5x + (y/6)(9)} = \frac{10}{11} \Rightarrow x = 3y$

Let us say Mohan and Sohan have amounts which are in the ratio 18 : 35 after t more days.

$\frac{8x - t.y}{5x + t.y/6} = \frac{18}{35}$ i.e. $\frac{8(3y) - t.y}{5(3y) + t.y/6} = \frac{18}{35}$

t = 15
The ratio of the amounts with them would be 18 : 35 after 6 more days. Ans: (6)

9. Let the present age of Kishore be x years,
Vipin's present age is 2(x – 1) years
Given the ratio of the sum of their present ages to the difference of their present ages, is 19 : 5
i.e. $\frac{3x-2}{x-2} = \frac{19}{5}$ $\therefore$ x = 7
sum of present ages = (k + v) = 19 years Ans: (19)

10. Ratio of prices = 5 : 8 : 13
Ratio of number of balls = 5 : 4 : 3
Ratio of amounts spent = $(5 \times 5) : (8 \times 4) : (13 \times 3)$
= 25 : 32 : 39
Total number of parts of the ratio=25 + 32 + 39 = 96
Total amount spent, as per data = ₹768
Value of each part of the amounts' ratio=768/96 = 8
Amount spent on costliest variety
= Value of 39 parts = 39×8
Number of costliest variety balls Paul purchased is
= $(39 \times 8)/13 = 24$ Choice (D)

11.

Brother	1	2	3	4	5	6	7	8	9
Amount with the brother	x	2x + 2	3x + 3	4x + 4	...	...	...	...	9x + 9

$\frac{9x+9}{x}=10$, x = 9;

5^{th} brother gets (5x + 5) = 45 + 5 = 50 Choice (D)

12. Let p. q, r and s represent the apples received by Karan, Kiran, Kumar and Khanna.
Given q : (p + s) = 1 : 2,
$\Rightarrow$ q : (p + s) : (q + p + s) = 1 : 2 : (1 + 2) = 1 : 2 : 3 ------ (1)
r : (p + q + s) = 2 : 5-------- (2)
s = 2 + q ------- (3)
and p : r = 1 : 2 or r : p = 2 : 1 ------- (4)
From (2) $\times$ 3 and (1) $\times$ 5, we have
r : (p + q + s) : (p + s) : q = 6 : 15 : 10 : 5
Combining this with (4) $\times$ 3, we have
r : p : (p + q + s) : (p + s) : q = 6 : 3 : 15 : 10 : 5
$\Rightarrow$ r : p : q : (p + q + s) : (p + s) = 6 : 3 : 5 : 15 : 10
$\Rightarrow$ r : p : q : $(\overline{p+q+s}-\overline{p+q})$: (p + q + s) : (p + s)
= 6 : 3 : 5 : (15 – $\overline{3+5}$) : 15 : 10
$\Rightarrow$ r : p : q : s : (p + q + s) : (p + s) = 6 : 3 : 5 : 7 : 15 : 10
From (3), s – q = 2 and this is satisfied by the number of parts of s and q in the above ratio.
$\Rightarrow$ The number of parts in the above ratio are the actual values.
$\Rightarrow$ p = 3, q = 5, r = 6, s = 7; i.e., p + q + r + s = 21
Choice (A)

13. David received $\frac{9}{17}^{th}$ of the number of toffees distributed by Alok. Amitha received $\frac{1}{16}^{th}$ of the number of toffees distributed by David.

$\frac{1}{16}\left(\frac{9}{17}T\right)=18$

$\Rightarrow$ T = 544 Ans: (544)

14. Quantity of diesel purchased = x lts.
$\therefore$ Cost per liter of diesel = 510/x
Cost per liter of kerosene = $\frac{510\times 3}{x\times 5}$ = 306/x
Since equal volumes are purchased, amount spent on kerosene = $\frac{306}{x}\times x = ₹306$ Choice (B)

15. Amount spent on kerosene = x
Amount spent on petrol = 5x
$\therefore$ Cost involved = 6x ---------- (1)
Ratio of prices per liter of Petrol, diesel and kerosene is 15 : 5 : 3
When equal volumes of all are purchased, the amounts are also in the ratio 15 : 5 : 3.
Amount spent on diesel, in this case = 510
Total amount spent = $(23\times 510)5 = 23\times 102$----- (2)
From (1) and (2), 6x = 2346
x = 391
$\therefore$ Amount spent on petrol = 391×5 = ₹1955
Choice (C)

16. $\frac{a+c}{b+d}=\frac{c+e}{d+f}=\frac{a+e}{b+f}=k$

Using the relationship each ratio

$= k = \frac{\text{sum of numerators}}{\text{sum of denominators}}$

$k = \frac{(a+c)+(c+e)+(a+e)}{(b+d)+(d+f)+(b+f)} = \frac{2(a+c+e)}{2(b+d+f)} = \frac{a+c+e}{b+d+f}$

Now $\frac{a+c}{b+d}=\frac{a+c+e}{b+d+f}=k = \frac{(a+c+e)-(a+c)}{(b+d+f)-(b+d)}=\frac{e}{f}=k$

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

$k = \frac{a+c+e)-(c+e)}{(b+d+f)-(d+f)} = \frac{a}{b}$ and lastly,

$k = \frac{(a+c+e)-(a+e)}{(b+d+f)-(b+f)} = \frac{c}{d}$, hence all the choices (A), (B) and (C) are true. Choice (D)

17. In the two cases, the greatest parts are $\frac{15}{42}N$ and $\frac{12}{42}N$

Their difference = $\frac{3N}{42}$ = 6 $\therefore$ N = 84 Ans: (84)

18. Let the two numbers be "a" and "b".
$\sqrt{ab}$ = 9
Squaring on both sides
ab = 81 ——— (1)
$b^2 = 243a$ --- (2)
multiplying both the sides with b, we get
$b^3 = 243\times 81$
$b = (3^5\times 3^4)^{1/3} = 3^3 = 27 \Rightarrow a = 3$
The larger of the two numbers = 27 Choice (A)

19. Let P = ab and Q = cd P_s = a + b and Q_s = c + d
$\frac{10a+b}{a+b}=\frac{10c+d}{c+d}$
(10a+b) (c+d) = (10c+d) (a + b)
10ac + bc + 10ad + bd = 10ac + ad + 10bc + bd
ad = bc ……(1)
Let a = 1, b = 0, c = 2 d = 0
This would correspond to the minimum value of P_s+Q_s, which is 3. Choice (D)

20. $\frac{d_1}{t_1^2}=\frac{d_2}{t_2^2}$; $\frac{48}{16}=\frac{d_2}{49}\Rightarrow d_2 = 147$ Choice (D)

21. Let the sum of money be `x
The sum is sufficient to pay A's wages for 55 days and B's wages for 66 days.
Daily wage of A = $\frac{x}{55}$ and daily wage of B = $\frac{x}{66}$
Number of days that the sum is sufficient to pay the wages of both workers = $\frac{x}{\frac{x}{55}+\frac{x}{66}}=30$ Ans: (30)

22. V α r^2h; $\Rightarrow$ V = $k.r^2h$;$\Rightarrow$ $V_1/(r_1^2h_1)$
= $V_2 / (r_2^2h_2) = k$
Hence, $66/(9\times 7) = 308/(6r^2)$; $\Rightarrow$ r = 7 Choice (C)

23. Let K, M and S be the kinetic energy, mass and speed of a body respectively.
Given:
K $\propto$ S^2 (when M is kept constant)
and K $\propto$ M (when S is kept constant)
$\Rightarrow$ K $\propto$ MS^2 $\Rightarrow$ $K = CMS^2$
where C is the constant of proportionality.
Given that when M = 2 kg, S = 10 m/s, K = 100 joules
$\Rightarrow$ $100 = C \times 2 \times 10^2 \Rightarrow C = 1/2 \Rightarrow K = 1/2\ MS^2$
When M = 20 kg and S = 1 m/s
$K = 1/2 \times 20 \times 1^2 = 10$
$\therefore$ A body of mass 20 kg moving with a speed of 1 m/s has a kinetic energy of 10 joules. Choice (C)

24. Let the fixed income and the royalty that he gets be denoted by F and R respectively.
Total income (T) = F + kB ($\therefore R \alpha B$).
46000 = F + 2000k
66000 = F + 3000k
Solving these, k = 20. F = 6000
Total income on setting 6000 books = F + 6000k
Income per book = $\frac{F+6000k}{6000}=\frac{6000+6000(20)}{6000}$ = 21.
Ans: (21)

25. $A \alpha (B + C) \Rightarrow A = k_1 (B + C)$
$B \alpha x \Rightarrow B = k_2 x$
$C \alpha \frac{1}{x} \Rightarrow C = \frac{k_3}{x}$
$\therefore A = k_1 \left[k_2 x+\frac{k_3}{x}\right]$
As A = 3, when x = 1,
$3 = k_1 [k_2 + k_3]$ ---- (I)
As per data, A = 3, when x = 2
$\therefore 3 = k_1 \left[2k_2+\frac{k_3}{2}\right]$ ----- (II)
(I) – (II) gives
$-k_1 k_2 + \frac{k_1 k_3}{2} = 0 \Rightarrow k_1 \left(\frac{k_3}{2} - k_2\right) = 0$
$\Rightarrow k_1 = 0$
or $k_2 = \frac{k_3}{2}$ } are the possible cases
k_1 cannot be 0 (as A can't be 0).
Hence $k_2 = \frac{k_3}{2}$
From (I)
$3 = \frac{3k_1 k_3}{2}$
$k_1 k_3 = 2. \Rightarrow k_1 k_2 = 3 - 2 = 1.$
Hence $A = k_1 k_2 x + \frac{k_1 k_3}{x} = x + \frac{2}{x}$
When x = 4,
$A = 4 + \frac{2}{4} = \frac{9}{2} = 4.5$ Ans: (4.5)

26. The quantity of the balance of food after the transfer is such that
(900 – 300) = 600 soldiers, consumed at the rate of 3 kg/day/soldier, for 25 days ------- (1)
If the soldiers were not transferred, 900 soldiers would have consumed it at the rate of 2.5kg/day/soldier, the same food. ---------- (2)
The data can be tabulated as:

Soldiers	Consumption rate	Number of days
600	3.0	25
900	2.5	How many?

Number of soldiers and the number of days for which food lasts are inversely proportional. The number of soldiers increased; hence, number of days decreases. Hence multiplication factor is (600/900).
Consumption rate and number of days are also inversely proportional. Hence, multiplication factor is 3.0/2.5
Applying the above rates of variation, the number of days = 25 x (600/900) x (3.0/2.5) = 20 days
The initial stock was to last for 30 days.
$\Rightarrow$ Soldiers were transferred after 30 – 20 = 10 days
Ans: (10)

27. $v = 40 - k \sqrt[3]{n}$, where v is the speed when n wagons are attached.
If n = 27, v = 34
$34 = 40 - k \sqrt[3]{27}$
$34 = 40 - k(3) \Rightarrow k = 2 \quad \therefore v = 40 - 2 \sqrt[3]{n}$
Minimum speed required = 30
$\therefore 30 = 40 - 2 \sqrt[3]{n}$;
$\Rightarrow 5 = \sqrt[3]{n}$
n = 125
So, a maximum of 125 wagons can be attached.
Choice (B)

28. Let the initial weight of the stone (before breaking) be 6 w.
Weights of the broken stones are w, 2w and 3w respectively.
Initial value of the stone (in ₹) = 10, 872
$10,872 \alpha 36 w^2$
$10,872 = 36 w^2 k$
Total value of the pieces of the stone
$= (1^2 + 2^2 + 3^2) w^2 k = 14 w^2 k$
Loss in the value = $22 w^2 k$
$= 22 \times \frac{10872}{36} = 22 \times 302 = 6644$
Choice (C)

29. distance = d weight = w
Given $d \alpha (1/w)$
dw = k (constant)
Let weights of 3 pieces be x, 3x, 2x
$\therefore$ Sum of distances = $\frac{k}{x}+\frac{k}{3x}+\frac{k}{2x}=\frac{11}{6}\frac{k}{x} = 22$
k = 12x
Weight of unbroken stone is
w = 6x = k/2 as d. w = k
d x k/2 = k $\Rightarrow$ d = 2 m Ans: (2)

30. Fixed charge = x, unit rate = y, x and y are in Rupees.
5/4(x + 100y) = x + 200y
5x + 500y = 4x + 800y -------- (1)
x + 50y = 700 ----------(2) (data)
y = 2, x = 600
Choice (A)

Exercise – 2(b)

Solutions for questions 1 to 40:

1. Let a + b – c = 5x
b + c – a = 6x
a + c – b = 7x
(a + b – c) + (b + c – a) = 11x
$\therefore$ 2b = 11x
(a + b – c) + (a + c – b) = 12x
$\therefore$ 2a = 12x
(b + c – a) + (a + c – b) = 13x
$\therefore$2c = 13x
$\therefore$ a : b : c = 2a : 2b : 2c = 12 : 11 : 13
Choice (B)

2. Given, $\frac{20p^2-40pq}{pq+4q^2}=20 \Rightarrow 20p^2 - 60pq - 80q^2 = 0$
$\Rightarrow p^2 - 3pq - 4q^2 = 0$
$\Rightarrow (p - 4q)(p + q) = 0$
$\therefore \frac{p}{q}=4 \text{ or } -1$
$\therefore$Choice (C) is possible. Choice (C)

3. We will find it convenient to change the notation slightly.
Let A : B = 3 : 4 and c : d = 2 : 3
Let A = 3x ∴ B = 4x
Let c = 2y ∴ d = 3y

To find E = $\frac{A^3c^2+B^3d^2}{AB^2d^2+A^2Bcd}$

As each term has 3 upper case letters and 2 lower case, E is homogeneous and we can evaluate it.

$E = \frac{3^3(2^2)+4^3(32)}{3(4^2)(3^2)+3^2(4)(2)(3)} \frac{x^3y^2}{x^3y^2}$

$= \frac{3+4^2}{3(4)+6} = \frac{19}{18}$ Choice (D)

4. Let the scores of Ajay be a and v respectively.
a + 2v = 310 ……(1)
v + 2a = 290 ……(2)
Solving (1) and (2)
a = 90 and v = 110
∴ a : v = 9 : 11 Choice (A)

5. Let the first and second parts be a and b.
Given, $\frac{3a}{2b} = \frac{25}{4} \Rightarrow \frac{a}{b} = \frac{25}{6}$

$a = \frac{25}{31}(93) = 75$ Ans: (75)

6. Let the fraction be x/y
$\frac{x-3}{y+5} = \frac{1}{2} \quad \Rightarrow 2x - y = 11 \rightarrow (1)$

$\frac{x+2}{y} = 1; \quad x - y = -2 \rightarrow (2)$

Subtracting (2) from (1), we get x = 13; y = 15
∴ Fraction = 13/15 Choice (C)

7. Let the number of students in three classes A, B and C be 3x, 7x and 8x respectively.
Given, $\frac{7x+10}{8x-10} = \frac{8}{7} \Rightarrow x = 10$
Total = 18x = 180 Ans: (180)

8. Let the numbers of sweets received by Ram, Shyam and Tarun be r, s and t.
$\frac{r}{s} = \frac{5}{4}$ and $\frac{s}{t} = \frac{2}{3} = \frac{4}{6}$

∴ r : s : t = 5 : 4 : 6 $\Rightarrow t = \frac{6}{15}(60) = 24$ Ans: (24)

9. Let the 3 parts be x, y, z.
∴ x + y + z = 66 --------- (I)
z = x + y Substituting z in (I) 2x + 2y = 66
⇒ x + y = 33 --------- (II)
Given y = 2x – 3 Substituting y in (II),
we get 3x – 3 = 33 x = 36/3 = 12
∴ y = 21 and z = 33
Ratio of x, y and z is = 12 : 21 : 33 = 4 : 7 : 11
Choice (D)

10. Number of weighing stones of 500 gms = 5000/500 = 10
∴ Number of 100 gm weights = (3/5) × 10 = 6
Choice (A)

11. Let the number of boys in the class be x.
Number of girls in the class = 2x.
Number of day scholars who are boys and girls travel to school by bus = $\frac{1}{4}\left(\frac{1}{3}x\right) = \frac{1}{12}x$.

Number of girls who are day scholars and travel to school by bus = $\frac{1}{2}\left(\frac{2}{3}(2y)\right) = \frac{2}{3}x$

Required part = $\frac{\frac{1}{12}x+\frac{2}{3}x}{3x} = \frac{1}{4}$ Choice (C)

12. The data is tabulated below.

White	Black	Green	Total
3	4		
	3	5	
9	12	20	41

The total number of white and green balls is a multiple of 29. Among the choices, only 58 is a multiple of 29.
Choice (C)

13. Let the number of coins with Amar, Bhavan and Chetan be A, B and C respectively.

The data is tabulated below

A	B	C	AB	AC	BC	2(ABC)
			3	5	4	12

∴ A = 6 – 4 = 2, B = 6 – 5 = 1 and C = 6 – 3 = 3
∴ B : C = 1 : 3 Choice (D)

14. Let the price of tea last year be ₹5x per kg. Let the price of coffee last year be ₹7y per kg.
$\frac{6}{5}(5x)+\frac{8}{7}(7y) = 48$

$5x = \frac{20}{21}(7y) \Rightarrow y = \frac{3}{4}x \Rightarrow 6x = \left(\frac{3}{4}x\right) = 48$

⇒ x = 4 ⇒ 5x = 20 Choice (B)

15. Rohan was supposed to get $\frac{2}{9}$th of the total amount.

But the actual ratio of division was $\frac{1}{2}:\frac{1}{3}:\frac{1}{4} = 6:4:3$.

∴ he got $\frac{6}{13}$th of the total amount.

As $\frac{2}{9} \approx 0.2$ and $\frac{6}{13} > 0.4$, Rohan gained. He gained by $\left(\frac{6}{3}-\frac{2}{9}\right)117 = ₹28$ Choice (C)

16. Let the quantities of milk be 3xml, 4x ml, 5x ml and 6x ml and 7x ml.
Let the capacity of each vessel be 100 ml.
Total capacity = 500 ml

$3x + 4x + 5x + 6x + 7x = \frac{60}{100}(500) \Rightarrow x = 12$

∴ 3x = 36, 4x = 48, 5x = 60, 6x = 72, 7x = 84
The last 3 vessels contain at least 50% milk.
Ans: (3)

17. Let the monthly income of Ashok be ₹3x. Let the expenditure of Ashok be ₹4y.
Monthly income of Bala = ₹4x
Expenditure of Bala = ₹5y
Savings of Ashok and Bala are ₹(3x – 4y) and ₹(4x – 5y) respectively.

Ratio = $\frac{3x-4y}{4x-5y} = \frac{3}{4} - \frac{\frac{1}{4}y}{4x-5y}$ which is less than $\frac{3}{4}$. Only Choice (B) violates this condition. Choice (B)

18. Data can be tabulated as follows:

		Manoj		Shiva
1.	Income Ratio	3	:	4
2.	Savings Ratio	2	:	3
3.	Spending (Expenditure)	-		-

Manoj's expenditure is 2/3rds of his income. Let Manoj's monthly income be ₹36. (an arbitrary number is chosen in such a way that no fractions are encountered in the calculation)
Hence, Manoj's expenditure is 36 x (2/3) = 24 ---- (1)
Hence, Manoj's savings is 36 – 24 = 12
Ratio of savings of Manoj and Shiva = 2 : 3
Hence, Shiva's savings = 3 x (12/2) = 18 ------- (2)
Income Ratio = 3 : 4
As Manoj's income = ₹36, Shiva's shall be
4 x (36/3) = ₹48---------- (3)
Shiva's expenditure = Income – Savings
= 48 – 18 = 30 --------- (4)
From (1) and (4); Ratio of expenditures of Manoj and Shiva is 24 : 30 = 4 : 5 Choice (B)

19. Let the numbers satisfying the condition be denoted by xyz.
$z = x + y$, $z - y = y - x$ $z = 2y - x = x + y$
$y = 2x$
$z = 3x$
$\therefore x : y : z = 1 : 2 : 3$
$\therefore$ (x, y, z) can be (1, 2, 3), (2, 4, 6) or (3, 6, 9)
Choice (C)

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

21.

	Larger plot	Smaller plot	Combined
Area M	8x	29y – 8x	29y
Area B	9x	33y – 9x	33y

$\frac{29y-8x}{33y-9x}=\frac{13}{15} \Rightarrow x = 2y.$

Ratio of the area under maize cultivation in the larger plot and that under barley cultivation in the smaller plot
$= \frac{8x}{33y-9x} = \frac{16y}{33y-18y} = \frac{16}{15}$ Choice (B)

22.

	Number of questions	Time per question	Total time
Mathematics	a	2x	8y
English	b	x	7y

Given 15y = 60
$y = 4 \therefore$ 8y = 32 min 7y = 28 min

$\frac{(a)(2x)}{(b)(x)}=\frac{8}{7}$ [a/b = 16/28 = 4/7]

$\therefore$ Ratio of the number of English questions to the number of Maths = b/a = 7/4 Choice (B)

23. Total number of questions is 22.
Number of English questions = $(7 \times 22)/11 = 14$
Time taken for English questions
$= (60 \times 7)/15 = 28$ minutes
Number of questions that can be answered in 18 minutes
$= 18/(28/14) = 9$ Choice (D)

24. When two ratios like $\frac{m}{n}$ and $\frac{p}{q}$ are equal, each of them is equal to $\frac{m-p}{n-q}$, provided $n \neq q$.
$\therefore k = \frac{(a^2+c^2)-(b^2+c^2)}{(a+c)-(b+c)}=a+b$ Choice (C)

25. As $\frac{p+q}{r}=\frac{q+r}{p}=\frac{p+r}{q}$
Each of them equals = $\frac{p+q+q+r+p+r}{r+p+q}$ =2
If $p + q + r \neq 0$, then k = 2
If $p + q = -r$, then $\frac{p+q}{r}=-1$
$\therefore k = -1$
Sum of all the possible values of k is 1. Choice (A)

26. $\frac{2x^2-4x+3}{4x-3}=\frac{2x^2-3x+5}{3x-5}$
By componendo and dividendo
$\frac{(2x^2-4x+3)+(4x-3)}{4x-3}=\frac{(2x^2-3x+5)+(3x-5)}{3x-5}$
$\Rightarrow \frac{2x^2}{4x-3}=\frac{2x^2}{3x-5} \Rightarrow x = 0$ or $4x - 3 = 3x - 5$
$\Rightarrow x = -2$ or 0 Choice (D)

27. $(10a + b)(10c + d) = (10b + a)(10d + c)$
$100ac + 10bc + 10ad + bd$
$= 100bd + 10ad + 10bc + ac$
$ac = bd$
$\frac{a}{b}=\frac{d}{c}$ or $\frac{a}{d}=\frac{b}{c}$ Choice (A)

28. Let the lengths of the larger and the smaller parts be x units and y units respectively.
$\frac{x+y}{y}=6\frac{y}{x}$ $\frac{x}{y}+1-6\frac{y}{x}=0$
$\left(\frac{x}{y}\right)^2+\frac{x}{y}-6=0$ $\left(\frac{x}{y}+3\right)\left(\frac{x}{y}-2\right)=0$
As $\frac{x}{y}+3>0, \frac{x}{y}=2$ Choice (A)

29. Let the numbers be a and b
$a : 9 = 9 : b \Rightarrow ab$ …….(1)
$a : b = b : 6561 \Rightarrow b^2 = 6561a$ …….(2)
Solving (1) and (2)
a = 1 and b = 81 Ans: (81)

30. Let Ahmed's age = x, Ahmed's brother's age = a
Let Mohammed's age = y, Mohammed's brother's age = b
x/y = a/b; $\frac{x+y}{x-y}=\frac{a+b}{a-b}$ (using compoendo and dividendo)
$\frac{x+y}{a+b}=\frac{x-y}{a-b}=\frac{1}{2}$ as per data $\therefore \frac{a+b}{x+y}$ = 2
Choice (A)

31. $x = k(y^2 + 4)$
$39 = k(13) \Rightarrow k = 3$
$\Rightarrow 60 = 3(y^2 + 4)$
$y^2 = 20 - 4 = 16$, $y = \pm 4$ (but, from the condition $y > 0$
$\Rightarrow y = 4$) Ans: (4)

32. Let the three-digit numbers satisfying the given conditions be denoted by abc

$$b = \frac{a+c}{2} \quad \ldots\ldots(1)$$

$$\frac{ab}{a+b} = \frac{bc}{b+c}$$

$$\frac{10a+b}{a+b} = \frac{10b+c}{b+c}$$

$(10a + b)(b + c) = (10b + c)(a + b)$
$10ab + b^2 + 10ac + bc = 10ab + ac + 10b^2 + bc$
$ac = b^2$

From (1), $ac = \left(\frac{a+c}{2}\right)^2$

$(a - c)^2 = 0$
$\therefore a = c$
From (1), $b = c$
$\therefore a = b = c$
$\therefore$ Nine numbers satisfy these conditions. Choice (C)

33. Let the required distance be x m.
$D = kt^2$ where k is a constant.

$$k = \frac{D}{t^2} = \frac{500}{10^2} = 5$$

x = Distance the body falls in 9 seconds, Distance the body falls in 8 seconds $= 5(9^2) - 5(8^2) = 85$ m Ans: (85)

34. Let $Q = A + B\sqrt{y} + C(\sqrt[3]{y})$
Where A, B and C are constants.
$60 = A + B + C \Rightarrow B + C = 60 - A$

$$230 = A + 8B + 4C \Rightarrow 2B + C = \frac{230 - A}{4}$$

$$729 = A + 27B + 9C \Rightarrow 3B + C = \frac{729 - A}{9}$$

$2B + C - (B + C) = 3B + C - (2B + C)$

$$\therefore \frac{230-A}{4} - (60 - A) = \frac{660-A}{9} - \frac{230-A}{4}$$

Among the choices given, only Choice (C) satisfies the equation above. Ans: (30)

35. Let cost of supply = s
Price per unit = p
$s = k_1 + k_2 p + k_3 p^2$
Given, $s = 9$, when $p = 1$
$\Rightarrow 9 = k_1 + k_2 + k_3$ ----(I)
$s = 24$, when $p = 2$
$\Rightarrow 24 = k_1 + 2k_2 + 4k_3$ ---(II)
$s = 47$ when $p = 3$
$\Rightarrow 47 = k_1 + 3k_2 + 9k_3$ ----(III)
(II) – (I) gives $15 = k_2 + 3k_3$ ----(IV)
(III) – (II) gives
$23 = k_2 + 5k_3$ ---(V)
(IV) – (V) gives
$8 = 2k_3$
$k_3 = 4$
$\Rightarrow k_2 = 15 - 12 = 3$
$\Rightarrow k_1 = 9 - 4 - 3 = 2$.
Hence, when $p = 4$
$s = k_1 + 4k_2 + 16k_3 = 2 + 12 + 64 = 78$ Choice (D)

36. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$;

$$\frac{xy}{100} = \frac{(3x)(2y)}{T_2}, \; T_2 = 600 \text{ K}$$

$\therefore T_2 - T_1 = 500$ K Ans: (500)

37. $P \propto \frac{Q}{V}$, other factors being constant where Q and V are mass and volume of the gas.
Let the volumes of three chambers be V_1, V_2, V_3 respectively.

V_1	V_2	V_3

Let pressures in 3 chambers be P_1, P_2 and P_3
$P_1V_1 = P_2V_2 = P_3V_3$ ----(1)
[Since PV = KQ and as Q is same for all chambers, KQ is constant]
$V_1 : V_2 : V_3 = 1 : 2 : 3$
So, $P_1 = 2P_2 = 3P_3$
$\therefore, P_1 P_2 : P_3 = \frac{6}{1} : \frac{6}{2} : \frac{6}{3}$
$P_1 : P_2 : P_3 = 6 : 3 : 2$ Choice (C)

38. $H = K\sqrt{T - 20}$ where K is a constant.

$$K = \frac{H}{\sqrt{T-20}} = \frac{16}{\sqrt{36-20}} = 4$$

$20 = 4\sqrt{T-20}$ $T = 45$ Choice (B)

39. Let the number of members be x.
$T = F + V$
$(110)(50) = F + 50K$ ….(1)
$(80)(80) = F + 80K$ ….(2)
In (1) and (2) K is a constant.
Solving (1) and (2)
F = 4000 and K = 30
$130x = 4000 + 30x$
$x = 40$ Ans: (40)

40.

	Constant part	Variable rate	Units	Total
x (Patna)	y	100		$x+100y = 500$
5/3x (Bangalore)	y	300		$\frac{5x + 900y}{3} = 1100$

Solving the above two equation, we get $y = 2$; $x = 300$

$\left(\frac{5}{3}\right)x = 5/3 \times 300 = ₹500$

Required difference $= 500 - 300 = 200$ Choice (A)

Solutions for questions 41 to 45:

41. Let 1 Rupee coins, be x; 50 paise coins be y and 25 paise coins be z.
From statement I, $x + y + z = 20$.
From statement II, $x = 6$ and $y : z = 6 : 1$.
Combining statements I and II, we get $x = 6$, $y = 12$, $z = 2$.
Choice (C)

42. Let the number of technical staff be 3x and non-technical staff be 10x.
From statement I,

Total number of graduates $= \frac{80}{100}(3x) + \frac{40}{100}(10x)$

$= 2.4x + 4x = 6.4x$

Percentage of graduates $= \frac{6.4x}{10x} \times 100 = 64\%$

So statement I alone is sufficient.
From statement II,

The required ratio $= \frac{32x}{65x} \times 100\%$

So statement II alone is also sufficient. Choice (B)

43. Let x be the number of boys and y be the number of girls

From statement I, $\frac{x}{y} = \frac{5}{4} \Rightarrow 4x = 5y$

From statement II, $\frac{x-4}{y} = 1 \Rightarrow x = y + 4$

Combining both the statements, we get the value of y which is the number of girls. Choice (C)

44. From statement I, we don't know what percentage of boys and what percentage of girls are intelligent, so we can't answer the question.

From statement II,
20% of boys and 20% of girls are adults so (100 – 20)% = 80% of students are not intelligent, whatever be the ratio of boys and girls. Choice (A)

45. From statement I, we have x = $\frac{1}{8}$ kg (assuming total as 1 kg)

Also B = $\frac{3}{16}$ kg i.e., $\left(\frac{3}{2} \times \frac{1}{8} \text{ kg}\right)$

As we do not know about others, we cannot find who received least from this statement alone.
From statement II, we have

A = $\frac{3}{8}$ kg; Y = $\frac{1}{8}$ kg

Again statement II alone is not sufficient, as we do not know about others.
Using both, we know about four persons out of five. We can find how much Z received and hence, also the one who received the largest part. Choice (C)

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

Concept Review Questions

Solutions for questions 1 to 50:

1. $\frac{40}{100} \times 50 = \frac{x}{100} \times 80 \Rightarrow x = \frac{2000}{80} = 25$

Choice (B)

2. $\frac{200}{80} \times 100 = 250\%$ Ans 250

3. Let the number be x.
32% of x = 256

$\Rightarrow \frac{32}{100} x = 256$

$\Rightarrow x = 800$ Choice (B)

4. 60% of x = 60 + 60% of 60

$= 60 + \frac{60}{100}(60) = 60 + 36 = 96.$ Choice (C)

5. $101^3/_5\% = \frac{508}{5}\% = 508/500 = 127/125$ Choice (D)

6. Let the number be x.

$\left(\frac{60}{100}\right)\left(\frac{70}{100}\right)(x) = 1680$

$\Rightarrow \frac{42}{100} x = 1680 \Rightarrow x = 4000.$ Ans (4000)

7. 40% of y = 75 + 20% of 1500

$\frac{40}{100} y = 75 + \frac{20}{100}(1500)$

$0.4\ y = 375 \Rightarrow y = 937.5.$ Choice (C)

8. A% of $\frac{A}{B} + \frac{A}{B}$% of

$A = \frac{A}{100}\left(\frac{A}{B}\right) + \frac{\frac{A}{B}}{100}(A)$

$= \frac{A^2}{100B} + \frac{A^2}{100B} = \frac{A^2}{50B}$

C% of $\frac{A}{B} = \frac{C}{100}\left(\frac{A}{B}\right) = \frac{AC}{100B}$

$\frac{A^2}{50B} = \frac{AC}{100B}$

$C = \frac{\frac{A^2}{50B}}{\frac{A}{100B}} = 2A$ Ans: (2)

9. a% of b = $\frac{a}{100}(b) = \frac{ab}{100}$

b% of a = $\frac{b}{100}(a) = \frac{ab}{100}$

$33^1/_3\%$ of (a + b) = $\frac{33^1/_3}{100}(a+b)$

$= \frac{1}{3}(a + b)$

$\frac{ab}{100} + \frac{ab}{100} = \frac{1}{3}(a + b)$

$\frac{2ab}{100} = \frac{1}{3}(a + b)$

$\frac{6}{100} = \frac{a+b}{ab}$

$\frac{6}{100} = \frac{1}{a} + \frac{1}{b}$

$6\% = \left(\frac{1}{a} + \frac{1}{b}\right)\%.$ Choice (A)

10. Let the value of the property be ₹x
The value of the part that Ganesh owns (in ₹)

$= \frac{83\frac{1}{3}}{100} \times x = \frac{5}{6} x$

Three fourths of this part is worth ₹ $\frac{3}{4}\left(\frac{5}{6}x\right)$

i.e., ₹ $\frac{5}{8} x$

$\frac{5}{8} x = 5,\ x = 8$ Ans: (8)

11. Let the total marks be x
80% of x = 720

$x = \frac{720 \times 100}{80} = 900$ marks

90% of x = $\frac{90 \times 900}{100} = 810$ marks

Alternate method:
If 80% of x = 720
90% of x = 90/80 x 720 = 810 Choice (C)

12. Let the maximum mark in the test be M.

Pass mark = $\frac{35}{100}$ M

The student failed by 15 marks.
∴ Pass mark R = 230 + 15 = 245

$\frac{35}{100} M = 245 \Rightarrow M = 700$ Choice (A)

13. Reduction in the tax (in ₹) = $\frac{25-17\frac{1}{2}}{100}$ (9200)

= 690 Ans: (690)

14. Let the number of votes polled be x.

Number of votes secured by Ashok = $\frac{70}{100}$ x = 0.7x

He won by a majority of 0.4x votes.

0.4x = 168 $\Rightarrow$ x = 420 Choice (B)

15. Let the original price be ₹ x

Increase = ₹ 0·3x

x + 0·3x = 260 x = 200 Ans: (200)

16. Profit = ₹300.

Profit percentage = $\frac{300}{600}(100)\% = 50\%$ Choice (A)

17. Ratio of profits of P and Q = Ratio of the investments of P and Q = 1: 2

Q's profit = $\frac{2}{3}(9600) = ₹6400$ Ans: (6400)

18. Let the original price be ₹x.

$x - \frac{30}{100}x = 63 \Rightarrow x = 90$ Choice (C)

19. Let the marks of Mohan and Sohan be m and s respectively.

$m = s\left(1+\frac{25}{100}\right) = \frac{5}{4}s$.

m = minimum mark required to pass i.e. pass mark = 35.

$\frac{5}{4}s = 35$

s = 28. Ans: (28)

20. Let Ravi's salary after the increment be 4x

∴ Before the increment it was 3x and the total family income was 15x. After Ravi's increment, the family income is 16x.

Required percentage =

$\frac{\text{Ravi's new salary}}{\text{Total family income}}(100\%) = \frac{4x}{16x}(100\%) = 25\%$.

Choice (D)

21. As the salaries of the two persons are equal and since the percentage increase in the salary for one person equals the percentage decrease in the salary for the other, the increase in the salary and the decrease in the salary must be equal.

∴ the total salary of the 2 persons does not change.

Choice (C)

22. If any quantity becomes n times.

We say it increased by (n – 1) 100%.

As the population quadrupled, it increases by

(4 – 1) 100% = 300%. Choice (C)

23. Let Bala's marks be 100.

Arun's mark = $100 + \frac{20}{100}(100) = 120$

Required % = $\frac{20}{120}(100) = 16\frac{2}{3}\%$. Choice (B)

24. Let the original price be ₹x

Decrease in the price = ₹0·2x

Price after the decrease = ₹0·8x

% increase = $\frac{0\cdot 2x}{0\cdot 8x}(100) = 25\%$

Alternate method:

Any quantity which decreases by x% must be increased by $\frac{100x}{100-x}\%$ to become its original value

As x = 20, $\frac{100x}{100-x} = 25$ Choice (A)

25. Let the original price be ₹x

Increase in the price = ₹0·2x

Price after the increase = ₹1·2x

% decrease = $\frac{0\cdot 2x}{1\cdot 2x}(100) = 16\frac{2}{3}\%$

Alternate method:

Any quantity which increases by x% must be decreased by $\frac{100x}{100+x}\%$ to become its original value

As x = 20, $\frac{100x}{100-x} = 16\frac{2}{3}\%$ Choice (C)

26. Ratio = $\frac{5}{6} : \frac{2}{3}$

Let the first number be 5x,

Second number is 4x

% less = $\frac{5x-4x}{5x} \times 100$

= 20% Choice (A)

27. Let the price of fan B initially be ₹x

Price of fan A initially = ₹2x

Increase in the price of A = $\frac{10}{100}(2x) = ₹0\cdot 2x$

Decrease in the price of B = $\frac{20}{100}(x) = ₹0\cdot 2x$

As the increase equals the decrease, the sum of the prices does not change.

∴ required percentage change = 0% Ans: (0)

28. Suppose there is a group of quantities. If all are increased / decreased by the same percentage, their sum will increase/decrease by the same percentage. Otherwise we can say that the change in the sum is greater than the least percentage and less than the greatest percentage.

The salaries of some of the employees are increased by a different percentage compared to that of the others.

∴ We cannot determine on the percentage change in the total salary. We can say it has to be between 10% and 20%.

Choice (D)

29. Let the initial price of the article be ₹100

Decrease in the price = ₹20

Price after the decrease = ₹80

Increase in the price = ₹16

Price after the increase = ₹96

∴ the price effectively decreases by 4% Choice (C)

30. Let the initial price of the article be ₹100

Increase in the price = ₹10

Price after the increase = ₹110

Decrease in the price = ₹11

Price after the decrease = ₹9

∴ the price effectively decreases by 1%

Note: It can be seen that in problems 1 and 2 the final results are the same although the order of operations vary

∴ in problems on successive percentages the operations can be performed in any order as the result does not depend on the order of the operations. Choice (C)

31. Let the number be x.

Decrease in it = $\frac{20}{100}$ x = 0.2x

Its new value = 0.8x

Increase in the new value = $\frac{20}{100}$ (0.8x) = 0.16x

Final value of the number = 0.96x which is < x

∴ The number decreased.

It decreased by $\frac{x-0.96x}{x}$ (100)% i.e., 4%

Choice (C)

32. Let the first, second and the third numbers be f, s and 100 respectively.

$f = 100\left(1-\frac{40}{100}\right) = 60$

$s = 100\left(1-\frac{50}{100}\right) = 50$

Required percentage = 60 (100)% = 120%. Choice (D)

33. The salary Raja's as a percentage of his family's total income increased by 10 percentage points.

Choice (C)

34. Profit = ₹36 = 6% of CP

$\Rightarrow \frac{6}{100} \times CP = 36 \Rightarrow CP = ₹600$ Ans: (600)

35. Suppose 2 articles have the same cost price and one is sold at x% profit and the other is sold at y% loss. The overall profit/loss percentage is given by $\frac{1}{2}$ (difference of x and y)%

As x = 20 and y = 10, overall
Profit/loss percentage = 5% profit Choice (D)

36. Let the selling price be ₹x
Cost price = ₹0·9x
Profit = ₹0·1x

Profit percentage = $\frac{0\cdot1x}{0\cdot9x}(100) = 11\frac{1}{9}\%$ Choice (C)

37. Selling price = $50\left(\frac{100+20}{100}\right)\left(\frac{100+33\frac{1}{3}}{100}\right)$

$= 50\left(\frac{6}{5}\right)\left(\frac{4}{3}\right) = ₹80$ Ans: (80)

38. Let the cost price of the item be ₹x
Profit = ₹0·2x
x + 0·2x = 60 ⇒ x = 50
To gain 30% profit must be ₹0·3x
∴ selling price must be ₹1·3x = ₹65 Choice (B)

39. Let the cost price of each in be ₹x
Profit made on selling 5 m = cost price of 2 m = ₹2x
Cost price of 5 m = ₹5x

Profit percentage = $\frac{2}{5}(100)\% = 40\%$ Choice (C)

40. Required percentage = $\frac{60-50}{50}(100)\% = 20\%$

Choice (C)

41. Profits of the company, dealer and shopkeeper are ₹10, ₹15 and ₹25 respectively.
∴ The shopkeeper got the highest profit Choice (C)

42. Total cost price (80) (12·50) = ₹1000
Total profit = (80) (4·50) = ₹360
Total selling price = ₹1360
Total selling price of 20 articles = ₹360
Selling price of each of the remaining articles

$= \frac{1360-360}{60} = ₹16\frac{2}{3}$ Choice (B)

43. Let the M.P. be ₹100

First discount (in ₹) = $\frac{30}{100}$ (100) = 30

Price after this discount = ₹70

Second discount (in ₹) = $\frac{10}{100}$ (70) = 7.

Price after this discount = ₹63
Total discount = ₹37
Equivalent single discount percentage = 37%

Ans: (37)

44. Let his C.P. = ₹100

His M.P (in ₹) = $100\left(1+\frac{25}{100}\right) = 125$

His discount (in ₹) = $\frac{30}{100}$ (125) = 37.50

His S.P. = ₹87.50
His loss = ₹12.50

His loss percentage = $\frac{12.5}{100}$ (100) %

= 12.5% Choice (D)

45. Let his C.P. = ₹100

M.P (in ₹) = $100\left(1+\frac{40}{100}\right) = 140$

profit in (₹) = $\frac{12}{100}$ (100) = 12

S.P. = ₹112
discount = ₹28.
discount (∵ Discount = M.P – S.P)

$= \frac{28}{140}$ (100) % = 20% Ans: (20)

46. Let the marked price be ₹x.
Selling price = ₹400

$\frac{100-11\frac{1}{9}}{100}$ x = 400 ⇒ x = 450 Ans: (450)

47. Ratio of profits of Ajay and Vijay = 9 : 12 = 3 : 4

Ajay's share = $\frac{3}{7}(3500) = ₹1500$ Choice (A)

48. Ratio of profits of Ramesh and Suresh
= (9000) (10) : (6000) (12) = 5 : 4

Suresh's share = $\frac{4}{9}(4500) = ₹2000$ Choice (D)

49. Annual income of Ashok = $\frac{6}{100}(12000) = ₹720$

Ans: (720)

50. Market value = ₹105

Number of shares purchased = $\frac{12600}{105} = 120$

Annual income of Ajay = (5) (120) = ₹600 Choice (A)

Exercise – 3(a)

Solutions for questions 1 to 35:

1. Let the price in 2003 be 100.
Price in 2004 = 110
With respect to the price in 2004, its price is less by $\frac{110-100}{110}\times 100 = 9\frac{1}{11}\%$. Choice (B)

2. Let the total marks be x and the pass marks be p
0·38x = p + 18 ——— (1)
0·27x = p – 37 ——— (2)
∴(1) and (2) give 0·11x = 55
$\Rightarrow x = \frac{55}{0.11} = 500$ and p = 0.38x – 18 = 172
Required percentage = $\frac{172}{500}\times 100 = 34{\cdot}4\%$.
Ans (34.4)

3. Let the initial cost of house hold items be x
Present cost = $\frac{100+20}{100}$ x = 1.2x.
Let the initial salary of family be y.
Present salary of family = $\frac{100+10}{100}$ y = 1·1y
Initially 0·2y = x
$\Rightarrow$ 1·2x = 0·24y
Percentage of present salary being spent on household items = $\frac{0\cdot 24y}{1\cdot 1y}\times 100 = \frac{240}{11} = 21\frac{9}{11}\%$.
Choice (D)

4. Let the manufacturing cost in 2001 be ₹100
Transportation cost in 2001 = ₹30
Total cost in 2001 = ₹130
Manufacturing cost in 2002 = $100 + \frac{20}{100}(100) = ₹120$
Transportation cost in 2002 = $\frac{33\frac{1}{3}}{100}(120) = ₹40$
Total cost in 2002 = ₹160
Required percent = $\frac{160-130}{160}(100) = 18.75\%$
Ans: (18.75)

5. Let the male population and the female population in 2001 be x and y respectively.
Male population in 2002 = $x - \frac{25}{100}x = \frac{3x}{4}$
Female population in 2002 = $y + \frac{20}{100}y = \frac{6y}{5}$
$\frac{\frac{6y}{5}}{\frac{3x}{4}} = \frac{44\frac{4}{9}}{100-44\frac{4}{9}} = \frac{4}{5} \Rightarrow x = 2y$
Males form $66\frac{2}{3}\%$ of the population in 2001.
Choice (B)

6. Let the length and the breadth be ℓ and b respectively. $\ell \geq b$.
If ℓ = b, percentage increase in the perimeter is 15%.
Also if ℓ > b, percentage increase is more than 15%.
∴ Percentage increase can be 16%. Choice (D)

7. Total food grain production in 2001= $\frac{100}{25}\times 1000 = 4000$
Production of rice in 2002 = $\left(\frac{100-4}{100}\right)\times 1000 = 960$t
Rice production as a percentage of food grain production, in 2002 = 25 + 5 = 30%.
∴Total food grain production in 2004
= $\frac{100}{30}\times 960 = 3200$. Ans: (3200)

8. From the given information, the percentage of employees who took retirement through the scheme
= $\frac{9120}{45600}$x100 = 20%.
Now by taking 100 as the base, we can calculate the answer easily.
Out of 100 employees, 40 applied for VRS.
But PSU allowed only 85% of 40 i.e. 34 employees to take VRS.
∴34% – 20% = 14%
i.e., 14% of the total employees did not take retirement, although their applications are not rejected.
Choice (B)

9. Number of students in the school = 2,000
Number of students in higher secondary = 40% of 2,000 = 800.
Number of girls in higher secondary = 28% of 800 = 224
Number of girls who passed = 112.
Overall percentage of students who passed in higher secondary = 40% of 800 = 320.
Number of boys who passed = 320 – 112 = 208.
Choice (A)

10. Let the number of votes Q gets be x
Number of votes P gets = 2.2x
Number of votes R gets = 2.2x – 3,50,000
$x - 2.2x - 3{,}50{,}000 = \frac{5}{100}(x+2.2x+2.2x-3{,}50{,}000)$
x = 2,50,000
Number of votes polled = 5.4x – 3,50,000 = 10,00,000
Choice (B)

11. Let the incomes of A, B, C in the month considered be a, b, c respectively.
Amount spent by A, B, C are $\frac{75}{100}a$, $\frac{80}{100}b$, $\frac{62.5}{100}c$ respectively
$\frac{75}{100}a : \frac{80}{100}b : \frac{62.5}{100}c = 42 : 64 : 55$
Let $\frac{75}{100}a = 42k$, $\frac{80}{100}b = 64k$, $\frac{62.5}{100}c = 55k$
a = 56k, b = 80k, c = 88k
Total Income = a + b + c = 644000
224k = 644000
Income of A = a = 56k = $\frac{1}{4}(224k) = \frac{1}{4}(644000)$
= 161000 Ans: (161000)

12. Total number of matches currently played = 60
Number of matches lost = $\frac{75}{100}\times 60 = 45$.
The Indian cricket team loses the next 12 matches
$\Rightarrow$ Total number of matches lost = 45 + 12 = 57.
For a success rate of 50% the minimum matches to be played = $57\times\frac{100}{100-50} = 114$.
(Since the 57 matches should be equal to 50% of total matches played. Hence 100% - total matches).
Choice (D)

13. Let the salary in 2003 be x.
The tax paid by him in 2003 is 0·2x

Salary in 2004 = $x\left(1+\frac{93\cdot75}{100}\right)$ = 1·9375x

This salary > 10000
Given tax difference = 500
(1·9375x – 10000) 0·2 + 1000 – 0·2x = 500
(1·9375) (0·2)x – 1000 – 0·2x = 500.
0·1875x = 1500
x = 8000.
Salary in 2004 = 1·9375x = ₹15500. Choice (A)

14. Let the number of sharpeners that Anil bought be x
Total expenditure = 2.5s (25) + s(x)
In the conditional case, total expenditure = 2.5s(x) + s(25)

This is $9\frac{1}{11}\%$ less than the actual total expenditure

$$2.5x + s(25) = [2.5s(25) + xs]\left(1-\frac{9\frac{1}{11}}{100}\right)$$

s = 20 Ans: (20)

15. Ratio of market shares of Margo, Palmolive, Dove and the new soap in 2001 = 0.9(40) : 0.9(30) : 0.9(30) : 10
= 36 : 27 : 27 : 10

Market share of Margo in 2002 = $\frac{36}{100}(90)=32.4\%$

Choice (B)

16. Let the original price of that jewel be ₹ P.

$$P\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)=P-100$$

$$\Rightarrow \left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)=\frac{P-100}{P}$$

$$\Rightarrow (P-100)\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)=2304$$

$$\Rightarrow (P-100)\left(\frac{P-100}{P}\right)=2304$$

$\Rightarrow P^2 – 2504P + 10000 = 0$
(P – 2500) (P – 4) = 0
P must be greater than 2304 since each up down cycle reduces the price effectively.
∴ P = 2500

Note:– $(P-100)\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)$

$$(P-100)\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)-100\left(1+\frac{x}{100}\right)\left(1-\frac{x}{100}\right)$$

= P – 100 – (some number which is less than 100) = Some number which is more than P – 200
∴ 2304 > P – 200
2504 > P
Only Choice (D) satisfies this condition. Choice (D)

17. Number of goats with Sunil at the end of 2002

$$=(4)(12)\left(1+\frac{x}{100}\right)\left(1-\frac{y}{100}\right)$$

Number of goats with Sunil at the end of 2003

$$=(4)(12)\left(1+\frac{x}{100}\right)\left(1-\frac{y}{100}\right)$$

If x = y, this equals $(4)(12)\left(1-\frac{y^2}{100}\right)^2$ which is less than (4) (12). But he had more than (4) (12).
∴ x > y.

If x = $\frac{100y}{100-y}$, $(4)(12)\left(1+\frac{x}{100}\right)^2\left(1-\frac{y}{100}\right)^2$

$$=(4)(12)\left[\left(\frac{100}{100-y}\right)\left(\frac{100-y}{100}\right)\right]^2=(4)(2)$$

∴ x > $\frac{100y}{100-y}$ must hold true. Choice (A)

18. 0·82CP + 990 = 1·15CP
990 = 0·33CP
CP = ₹3000
To make a profit of 10% he should sell at
$3000 \times 1\cdot1$ = ₹3300. Ans: (3300)

19. Cost price of the first shirt = $\frac{880}{1\cdot1}$ = ₹800

Cost price of the second shirt = $\frac{880}{0\cdot8}$ = ₹1100

∴Overall cost price ₹1900
Overall selling price = 880×2 = ₹1760

Loss = $\frac{140}{1900}\times 100$ = 7·36%. Choice (D)

20. Let the initial cost be ₹100.
It went up by 40% i.e., new cost price = ₹140
Initial Selling Price = ₹120.
(as the profit is 20%)
Present Selling Price = 140(1·2) = ₹168
Percentage increase in selling price

$$=\frac{168-120}{120}\times 100$$

$$=\frac{48}{1\cdot2}=40\%$$ Ans: (40)

21. Let the Marked price = ₹x

Discounted price = $\frac{100-40}{100}\times x$ = 0·6x.

The dealer reduces the price further by 20%

$\Rightarrow$ Selling price = $\frac{100-20}{100}\times 0\cdot6x$

= 0·48x

Given 0·48x = 9600 $\Rightarrow$ x = 20000.

Choice (C)

22. Let the total cost price of the shopkeeper be c
Total profit made by the shopkeeper

$$=\frac{18}{100}\left(\frac{2}{9}c\right)+\frac{27.5}{100}\left(\frac{3}{5}c\right)+\frac{30}{100}\left(\frac{8}{45}c\right)=25\frac{5}{6}c\left(\frac{1}{100}\right)$$

Overall profit % = $\frac{\text{Total profit}}{\text{Total cost price}}.100\%=25\frac{5}{6}\%$

Choice (B)

23. Let the initial selling price of each mango be ₹x.
∴New selling price = ₹1.25x.
Overall selling price now = 1.25x (80) = ₹100x.
∴ As there was 25% overall profit on selling,

Overall cost price = $\frac{(100x)(100)}{125}$ = ₹80x.

If the remaining 80 apples are sold at ₹x, then the selling price = ₹80x.
∴Overall C.P = Overall S.P, hence no profit or no loss.

Alternate method:

Let the cost price of 1 mango = ₹1
Cost Price of 100 mangoes = ₹100 …. (1)
Profit percentage expected = 25%
∴Proposed sale price per mango = ₹1.25 …… (2)
20 mangoes are rotten; 80 mangoes are available for sale.
If these mangoes are sold at the original sale price of ₹1.25 per mango, the money received from the sale of 80 mangoes = 80 (1.25) = ₹100 …… (3)
As (1) and (3) are equal, there is neither profit nor loss.
Choice (A)

Note: Information that sale price is increased by 25% is redundant because, no mangoes are sold at this price.

24. Let the initial cost price be ₹x.
Initial SP = x + 25
Now, the cost price is reduced by ₹25
New CP = (x – 25)
Selling price is reduced by 25%.

∴New SP = $(x + 25) \times \frac{3}{4}$.

Profit = 25%

$\therefore (x - 25) \times \frac{5}{4} = (x + 25) \times \frac{3}{4}$

5x – 125 = 3x + 75
2x = 200 ⇒ x = 100. Ans: (100)

25. Let the correct weight be 100 kg
Let its cost be ₹100.
S.P = ₹120
Weight usually weighed = 80 kg
Present weight is 20% more = 96 kg
Selling Price = ₹120
Cost of 96kg = ₹96

Profit percentage = $\frac{120-96}{96} \times 100 = \frac{24}{96} \times 100 = 25\%$.

Choice (B)

26. Let the selling price of one television be x.

Total money made = $\frac{1}{2}(50x) = 25x$

(since one TV is given free with each one bought by customer.)
Given total cost = 10,000 × 50 = 500000
Loss = 15(x) = 15x
Selling price + loss = cost price ⇒ 25x + 15x = 500000
40x = 500000
x = 12500
Selling price of each television = ₹12500. Choice (C)

27. Let the cost price for Balu be C
Price at which Balu sold the article

$= C\left(\frac{5}{4}\right)\left(\frac{5}{6}\right) = \frac{25\,C}{24}$

Profit made by Balu = $\frac{C}{24}$.

Profit percentage = $\frac{100}{24}\% = 4\frac{1}{6}\% = \frac{25}{6}\%$

Ans: (25)

28. Total cost of printing (in rupees) = 8[24 – 2(2)] [14 – 2(2)] (2000) = (1600) (2000) = 3.2 million.
Charge for 2000 pages to a profit of 8% must be ₹3.2 million (1.08). Then charge per page must be

$\frac{3.2 \text{ million } (1.08)}{2000}$ = ₹1728 Choice (A)

29.

	Venus	Serena
Months	3	3
Investment	50,000	50,000
Months	9	9
Investment	40,000	50,000

Venus's profit percentage

$= \frac{(3)(5)+(9)(4)}{[(3)(5)+(3)(5)+(9)(4)+(9)(5)]} \times 100$

$= \frac{15+36}{30+36+45} \times 100 = \frac{51}{111} \times 100 = \frac{5100}{111}\%$

$= \frac{1700}{37}\% = 45\frac{35}{37}\%$ Choice (D)

30. Investment Ratio of Mehta, Mehra, and Mihir = 1 : 2 : 3
Ratio of time periods of Mehta, Mehra and Mihir
= 12 : 8 : 4 = 3 : 2 : 1
Profit would be distributed in the ratio of
(Amount Invested × Time)
Here the ratio = 3 : 4 : 3
Mehta gets $\frac{3 \times 600000}{10}$ = 180000. Ans: (180000)

31. Let Goyal's salary be C and the total profit be P.

C = 0·2 (p – C) ∴C = $\frac{p}{6}$.

Hence $\frac{5p}{6}$ is shared in the ratio of their capitals
i.e. 20,000 : 30,000 or 2 : 3 and Goyal's share will be

$\frac{2}{5} \times \frac{5p}{6} = \frac{p}{3}$

$\frac{p}{6} + \frac{p}{3}$ = 4800 ⇒ p = ₹9600. Choice (C)

32. Let the profit be p. Hence half the profit i.e., $\frac{p}{2}$ will be shared equally i.e., $\frac{p}{4}, \frac{p}{4}$ and remaining $\frac{p}{2}$ will be shared in the ratio 24 : 36 or 2 : 3

∴Gayathri will get $\frac{3}{5} \times \frac{p}{2} = \frac{3p}{10}$

Total earnings of Gayathri = $\frac{3p}{10} + \frac{p}{4} = \frac{11p}{20}$ —— (1)

Had the entire profit been shared in the ratio of their capitals,

Gayathri would have got $\frac{3}{5}$ p = $\frac{12}{20}$p ——— (2)

∴Given $\frac{12p}{20} - \frac{11p}{20}$ = 2500 [from (1) and (2)]

∴p = ₹50000. Choice (D)

33. Number of shares bought = $\frac{1395}{93}$ = 15

He sells ₹1000 worth stock i.e., 10 units of stock at 95
i.e., gain of 2 × 10 = ₹20.
Remaining 5 shares are sold at 80, i.e., loss of 5 × 13 = ₹65. Net Loss of ₹45, in the sale and purchase transaction.
Choice (D)

34. Dividend = ₹3600

Total number of shares = $\frac{3600}{6}$ = 600

(since it is a 6% stock)
Premium of 5% $\Rightarrow$ cost of stock = 100 + 5 = 105
Total amount invested by Ismail = 105×600
= ₹63000. Ans: (63000)

35. Let the total investment be $110 \times 90 \times x$.
1st case

Number of 4% stock at 90 = $\frac{110\times 90}{2\times 90}x = \frac{110x}{2}$ = 55x

Number of 8% stock at 110 = $\frac{110\times 90}{2\times 110}x = \frac{90}{2}x$ = 45x

Total returns = $(55x \times 4) + (45x \times 8) = 580x$
2nd case

Number of 8% stock at 110 = $\frac{110\times 90}{110}\times x = 90x$

Total returns = $90x \times 8 = 720x$
Given $720x - 580x = 3500 \Rightarrow x = 25$
His investment = 110 x 90 x 25 = 247500.
Choice (B)

Exercise – 3(b)

Solutions for questions 1 to 45:

1. Let B's salary be x.

A's salary = $\frac{100-20}{100} \times x = 0{\cdot}8x$

C's salary = 10000 and it is also 25% more than B's salary
$\Rightarrow \frac{100+25}{100} \times x = 10000$.
x = ₹8000.
A's salary = 0·8x = ₹6400 Choice (D)

2. Let the numbers of students in school B = x
Number of students in school A = 1·3x
Given 1. 3 x – x = 0·3x = 120
$\Rightarrow$ x = 400
Total number of students in both the schools
= (1 + 1·3)x = (2·3) x400 = 920. Ans: (920)

3. Let the initial price be ₹100

Final price = $\left(100+\frac{2}{100}(100)\right)+\frac{4}{100}\left(100+\frac{2}{100}(100)\right)$

= ₹106.08
$\therefore$ Percentage increase = 6.08% Choice (B)

4. Let the pass mark be x. Rahul's mark = $x+\frac{25}{100}x=150$

x = 120

Required percent = $\frac{165-120}{120}(100)=37.5\%$

Ans: (37.5)

5. Number of girls = $\frac{30}{100}(1000)=300$

Number of boys = 1000 – 300 = 700
Number of UGs = 1000 – 600 = 400
Let the number of female UGs be f. Number of male UGs = 400 – f $\Rightarrow$ 400 – f – f = 120
$\Rightarrow$ f = 140

Required percent = $\frac{140}{700}(100)=20\%$ Choice (A)

6. It can be seen that it depreciates by (18 – 1.5(n – 1)) in the n^{th} year.
$\therefore$ In the seventh year it depreciates by 9%.
$\therefore$ required amount = 9% (4,00,000) = 36,000
Ans: (36000)

7. Present salary of Mrs. Rai = 20000
This is a gain of 25% from last month's earnings.
$\Rightarrow$ Last month's salary of Mrs. Rai.
= $\frac{100}{125} \times 20.000 = 16000$
Mr. Rai's salary has come down to ₹20000. This represents a 33·33% drop.

Mr. Rai's salary last month = $\frac{100}{66\cdot 66} \times 20000$

= 30000
Total income of Mr. Rai and Mrs. Rai last month
= 30000 + 16000 = 46000. Choice (C)

8. Let the monthly income of Ram be ₹100 initially.
Initial expenditure of Ram = ₹70.
Initial Saving of Ram = ₹30
Final monthly income of Ram = ₹126
Final expenditure of Ram = ₹84
Final savings of Ram = ₹42
Percentage increase his savings = 40% Choice (A)

9. Let its original area be x sq cm.

Area after the first cut = $x - \frac{40}{100}x=0.6x$

Area after the second cut = $0.6x-\frac{50}{100}x(0.6x)=0.3x$

Given, 0.6x – 0.3x = 30 $\Rightarrow$ x = 100 Ans: (100)

10. Let the breadth be 100 units initially. Let the length be 100 units initially.
New breadth

$= \left(100-\frac{20}{100}(100)\right)+\frac{30}{100}\left(100-\frac{20}{100}(100)\right)$

$= \frac{130}{100}(80)$ = 104 units

New length = $\frac{\text{Area}}{\text{New Breadth}}$

$= \frac{10000}{104}=96\frac{2}{13}$ units

$\therefore$ Required percent = $\frac{100-96\frac{2}{13}(100)100\%}{100}=3\frac{11}{13}\%$
Choice (D)

11. Let the cost price of the laptop be 100x.
Selling Price (15% profit) = 115x
If the selling price was 10% lower i.e., 103·5x,
Profit was ₹1050 $\Rightarrow$ 3.5x = 1050 $\Rightarrow$ x = 300
Cost price of the laptop = 100x = 30,000.
Choice (C)

12. Let the minimum number of matches be x. Let us say, of these x matches y matches were won. Number of matches won after the coach took over = $\frac{80}{100}(60)=48$.

Given, $\frac{48+y}{60+x}(100)=60 \Rightarrow 48 + y = 0.6(60 + x)$

$\Rightarrow$ x would be minimum when y = 0.
In this case, x = 20 Ans: (20)

13. Let Mr. Singh's initial income per hour be ₹100
Present income per hour = ₹120
Let the number of hours per month be 100, initially
Present number of hours = 80
Earlier monthly income = $100 \times 100 = 10000$
Present monthly income = $120 \times 80 = 9600$
Percentage decrease in his income

$= \frac{400}{10000} \times 100 = 4\%$.

Alternate method:

Mr. Singh's income (I) is the product of his hourly rate (R) and the number of hours he works (n).
i.e., I = rn

R increases by 20% to $\frac{6R}{5}$ and

n decreases by 20% to $\frac{4n}{5}$.

$\therefore$ The income changes to = $\frac{6R}{5} x \frac{4n}{5}$

$= \frac{24}{25} I$, i.e., it decreases by 4%. Choice (C)

14. Let the income in Dec 2014 be I and in Feb 2015 be J.
Amount spent on utility bills

– in Dec 2014 = $\frac{2}{15}\left(\frac{75}{100}\right) I = \frac{I}{10}$

– in Feb 2015 = $\frac{7}{48}\left(\frac{72}{100}\right) J = \frac{21J}{200}$

The second amount is $16\frac{2}{3}\%$ more than the first

$\therefore \frac{I}{10}\left(\frac{7}{6}\right) = \frac{21J}{200} \; I = \frac{9J}{10}$

$\therefore$ I is 10% less than J. Ans: (10)

15. Let the total distance be 100 km. Let the total fuel be 10 litres. As 10% of the fuel was used to cover 20% of his total journey driving conditions, a litre is required for driving every 20 km (under given driving conditions).
$\therefore$ Total fuel required for conditions which were different = Fuel required for the 60% of the journey

$= \frac{\frac{60}{100}(100)}{20} = 3 \text{ litres}$.

$\therefore$ 7 litres is required for driving the balance 40 km.

Required percent = $\frac{20 - \frac{40}{7}}{20} \times 100\% = 71\frac{3}{7}\%$

Choice (A)

16. Let the total salary of the family be ₹100.
In the year 2001 the family saved 100 – 30 = 70
In the year 2002, the total salary of the family
= 30 + 42 + 9 + 24 = 105
To save 70, they have to spend 105 – 70 = 35

Required percentage of spending = $\frac{35}{105} \times 100$

= 33·33%.

Choice (C)

17. Let the initial total income in 2001 be 100.
The total income of the family in 2001
= 30 + 42 + 9 + 24 = 105
After 20% increase, total income of the family

$= \frac{105 \times 120}{100} = 126$

$\therefore$ Increase = 21 = Increase in salary of A.

Required percentage increase = $\frac{21}{30} \times 100 = 70\%$.

Choice (C)

18. Let the number of questions attempted by Ram be x. Let the pass mark be p.

Ram's mark = $2\left(\frac{70x}{100}\right) - \frac{30}{100} x = 1.1x$

Shyam's mark = $2\left(\frac{60}{100}\right)(100 - x) - \frac{40}{100}(100 - x)$

$\Rightarrow$ 1.1x = p + 40 ……(1)
$\Rightarrow$ 0.8(100 – x) = p + 25 ….(2)
Solving (1) and (2), x = 50 and p = 15 Choice (A)

19. Percentage secured by Ram

$= \frac{(1.1)(50)}{80(2)}(100)\% = \frac{1.1(50)}{80(2)}(100)\% = 34.375\%$

Choice (D)

20. The price of a computer four years ago was ₹50000. Now, it is ₹32805
i.e., it has decreased by a factor of

$\frac{32805}{50000} = 0 \cdot 65610$

If each year the price decreases by a factor of r, in 4 years it decreases by a factor of r^4.
i.e., $r^4 = 0{\cdot}65610$
$\therefore r = 0{\cdot}9$
i.e., Each year the price decreases from p to 0·9p or decreases by 10%. Choice (C)

21. Let the whole sale price index on 1st April be points. As per data,

$p - p\left(1 + \frac{x}{100}\right)\left(1 - \frac{x}{100}\right) = 160$

$p - p\left(1 - \frac{x^2}{10000}\right) = 160 \; p\left(\frac{x^2}{10000}\right) = 160$ …… (1)

The second equation:

$p\left(1 - \frac{x^2}{10,000}\right) - p\left(1 - \frac{x^2}{10,000}\right)\left(1 - \frac{x^2}{10,000}\right) = 134{\cdot}4$

$p\left(1 - \frac{x^2}{10000}\right) \cdot \frac{x^2}{10000} = 134{\cdot}4$ …… (2)

from (1), $160\left(1 - \frac{x^2}{10000}\right) = 134{\cdot}4$

$1 - \frac{x^2}{10000} = 0{\cdot}84 \quad x = 40\%$
$\therefore$ from (1), p = 1000. Choice (C)

22. Let the total cost be ₹100. Costs of P, Q and R are ₹10, ₹20 and ₹20 respectively
Let costs of others is 100 – (10 + 20 + 20) = ₹50
Increase in each of the costs of P, Q and R is 2
Increase in the total cost is ₹15
Increase in the cost of the others = 15 – 3 (2) = ₹9

Percentage increase in the cost of the others = $\frac{9}{50} \times 100$

= 18%. Ans: (18)

23. Let the initial values of the length and the breadth be l and b respectively.
Intial perimeter = 2(l + b)
New perimeter = 2(1.1l + 1.2b)

% increase in perimeter = $\frac{2(1.1l+1.2b)-2(l+b)}{2(l+b)} \times 100\% =$

$\frac{10l+20b}{l+b} = 10 + \frac{10b}{l+b}$

$l \geq b$

$\therefore l + b \geq 2b$

$\frac{1}{2} \geq \frac{b}{l+b}$

$10 + \frac{10b}{l+b} \leq 15$

% increase in perimeter ≤ 15%. Choice (B)

24. Let the cost price of P's article P be ₹x

Selling price of P's article P = ₹ $\left(X + \frac{20}{100}X\right) =$ ₹1.2X

This is also the cost price of Q's article

Selling price of Q's article Q = ₹2x $\left(1 + \frac{25}{100}\right) =$ ₹1.5X

1.5x -1.2x = 90 ⇒ x = 300 Choice (C)

25. Let the cost of 100 radios be ₹100.
Cost of 65 radios = ₹65
Selling price of 65 radios = ₹100

Profit percentage = $\frac{100-65}{65} \times 100$

$= \frac{35}{65} \times 100 = 53\frac{11}{13}\%$. Choice (A)

26. Let his cost price be ₹x per watch

Given, $\frac{10}{100}x = 60 \Rightarrow x = 600$

⇒ Profit = $\frac{10}{100}[(600)(600)]$ = ₹36000 Ans: (36000)

27. Suppose Rakesh purchased 2x chocolates.
He bought x chocolates at 15 paise each and x chocolates at 20 paise each.
Total cost price = 15x + 20x = 35x paise
Selling price of each chocolate = 20 paise
Total selling price = (20)(2x) = 40 x paise
Profit = 5x paise
5x = 1000 ⇒ x = 200 ⇒ 2x = 400 Choice (D)

28. Number of articles sold = 20% of 50 = 10
Cost of 5 articles = ₹1200
Cost of 1 article = ₹240
Cost of 10 articles = ₹2400
Selling price of 10 articles = 2400 + 1200 = ₹3600
Selling price of 1article = ₹360
Number of articles remaining = 40.
Total value of the remaining articles at selling price
= 40 × 360 = 14400. Ans: (14400)

29. Let the cost prices for Ajay and Dinesh be ₹a and ₹d respectively.
Cost price of Balu = ₹1.560.
∴ Ajay's article's value increases by ₹0.56a.
Cost price of David = ₹0.8d.
Selling price of David = ₹0.56d
0.56a + 0.56d = 28000
a + d = 50000 Choice (A)

30. Let the cost price of the article = 100x
Marked price = 135x
For profit to be 20%, selling Price = 120x

Percentage of discount = $\frac{135x-120x}{135x} \times 100$

$= \frac{100}{9} = 11\frac{1}{9}\%$. Choice (A)

31. Let the marked price be ₹ x.
Let the cost price be ₹100
Profit = ₹20
Selling Price = ₹120
Discount = ₹0.2x
Given, x – 0.2x = 120 ⇒ x = 150
∴ The marked price is 50% above the cost price.
Ans: (50)

32. Let the cost of a car be 100x.
After a discount of 100000, the profit = 15%
⇒ Selling price of the car = 115x, and
Marked price of the car = 115x + 100000
Given that the M.P of the car is 25% more than the C.P of the car ⇒ 125x = 115x + 100000
⇒ 10x = 100000, x = 10000
Marked price of the car = 115x + 100000 = 1250000.
Choice (D)

33. For Samuel
Let's assume the marked price of each VCD is ₹100
For Simon
Cost price of each VCD = 0·75 × 100 = 75
Cost price of 100 VCDs = 7500
Now, undiscounted price of 25VCDs = price marked by Samuel for 25 VCDs = 2500
So, profit on 100 VCDs = 2500

Percentage of profit = $\frac{2500}{7500} \times 100 = 33{\cdot}33\%$.

Choice (D)

34. Let the cost of 10000 hard disks be ₹10000
After a discount of 10%, cost = ₹9000
20% of the hard disks are damaged.
⇒ Number of hard disks to be sold = 8000
Selling price = 20% more than the price at which he bought
Total sales = ₹(8000 × 1·2 × 0·9) = ₹8640

Loss percentage = $\frac{9000-8640}{9000} \times 100 = \frac{360}{9000} \times 100 = 4\%$.

Alternate method:

Ratio of CP of undamaged disks and damaged disks = 80% : 20% = 4 : 1
Undamaged disks are sold at a price which is 20% more than the CP;
⇒ profit percentage on these = (+)20%
Damaged disks are to be taken as unsaleable;
⇒ loss percentage on these = (–)100%
Overall percentage of profit/loss
= [4 × (+20) + 1(-100)]/(4 + 1) = (–20/5) = –4
∴ 4% loss Choice (D)

Note:
1. Information about number of disks is redundant.
2. The statement about the discount (10%) received at the time of purchase, is also redundant.

35. Let his profit / loss percentage be 3x%.
His discount percentage = 2x%

His selling price = $200\left(1+\frac{3x}{100}\right) = 300\left(1-\frac{2x}{100}\right)$

If he made a profit, $200\left(1+\frac{3x}{100}\right) = 300\left(1-\frac{2x}{100}\right)$

$x = \frac{25}{3}$

Profit percentage = 25

If he made a loss $200\left(1-\frac{3x}{100}\right) = 300\left(1-\frac{2x}{100}\right)$

200 – 6x = 300 – 6x which is not possible.
∴ He made 25% profit. Choice (B)

36. Let the cost price to Feroze be ₹100
Feroze marks up the price to ₹130
He sells it at 20% discount; at ₹104
Sohail marks up the price to 20% more than ₹100, equal to ₹120
The least sale price = 104
To sell it at ₹104, percentage discount to be offered

$= \frac{16}{120} \times 100 = \frac{40}{3} = 13\frac{1}{3}$ %. Choice (D)

37. Let the cost price of Girish be ₹100.
Marked price of Girish = ₹160
Let the maximum number of discounts be n.
$160(0.9)^n \geq 100$ ……(1)
Maximum value of n satisfying (1) is 4. Ans: (4)

38. If there is a lower limit on the discount, there is a corresponding upper limit on the profit. If there is an upper limit on the discount, there is a corresponding lower limit on the profit. Neither statement (A) nor (B) is of this type. Consider Choice (C).
If cost price (c) = 300, marked price (M) = 400. Profit percentage = discount percentage, Profit (p) : Discount (D) = 3: 4.
As P+ D = 100, P = (3/7) (100) and D = (4/7) (100),
i.e., profit percentage (p)

$= \frac{(3/7)(100)}{(300)}(100\%) = 14\frac{2}{7}$

= discount percentage (d).

If $P \geq D$, (in particular if p = d), $P = 42\frac{6}{7}$,

while $D = 57\frac{1}{7}$, i.e., D can be greater than P.

∴ Choice (C) is false. Consider Choice (D). If $p \leq d$ (in particular if p = d),

$p = d = 14\frac{2}{7}\%$,

$P = 42\frac{6}{7}$ and $D = 57\frac{1}{7}$,

i.e., $D \geq P$. If p < d, D is definitely greater than P. This is true. Choice (D)

39. Let the labelled weight of dal be 100 gm
Let the labelled price of dal of 100 gm be ₹100
Amount of dal in the packet = 80 gm
Price paid by the customer = ₹90 (because of 10% discount)
Quantity to be received for ₹90 = 90 gm.
Dal to be added = 90 – 80 = 10 gm

Percentage of dal to be added = $\frac{10}{80} \times 100 = 12{\cdot}5\%$.

Ans: (12.5)

40. Ratio of the profit shares of Gopal, Hari and Karthik
= (8000) (I12) : (12000) (x) : (16000) (x)
= 96 : 12x : 16x
16x > 96 > 12x
∴ x > 6 and x < 8
As x is an integer, x = 7
∴ Required ratio = 24 : 21 : 28 Choice (B)

41. Let the investments of P and Q be ₹p and ₹q respectively.
Salary of Q = ₹10000

$\frac{p}{p+q}(50000) = \frac{p}{p+q}(40000) + 8000$

p : q = 4 : 1

Profit share of p = $\frac{4}{5}$ (40000) = ₹32000 Ans: (32000)

42. Let the investments of A, B, C and D be ₹3x, ₹4x, ₹5x and ₹6x respectively. Let the salary of B be ₹S.

Given $\frac{4x+S}{5x+S} = \frac{9}{10}$

$\Rightarrow$ S = 5x
Total amount of profit = 18x + 2S
= 28x = 84000 $\Rightarrow$ x = 3000
∴B's salary is 5x i.e., 15000 Ans: (15000)

43. Let the number of registered voters be T

Number of voters who voted = $\frac{90}{100}$T

Number of votes that were valid = $\frac{90}{100}\left(\frac{90}{100}T\right) = \frac{81}{100}T$

Number of votes that P got = $\frac{65}{100}\left(\frac{81}{100}T\right)$

Number of votes that P won by = $\frac{65-35}{100}\left(\frac{81}{100}T\right)$ i.e.

$0.3\left(\frac{81}{100}T\right) = 0.3\left(\frac{81}{100}T\right) = 9720 \Rightarrow T = 40000$

Ans: (40000)

44. The data is tabulated below. All the amounts are in thousands of rupees.

Month	Satish	Sanjay	Sunil
1st	20	20	20
2nd	21	22	20
3rd	22	22	23
4th	23	24	23
5th	24	24	23
6th	25	26	26
7th	26	26	26
8th	27	28	26
9th	28	28	29
10th	29	30	29
11th	30	30	29
12th	31	32	32

∴ the ratio of their profit shares is

$\left(\frac{20+31}{2}\right)12 : 2\left(\frac{22+30}{2}\right)(5) + 20 + 32 : 20 + 20 + 32 + 3(26)$

= 51(6) : 52(6) : 72 + 9(26) = 153 : 156 : 153
We see that Sanjay gets the greatest share.
Choice (B)

45. Number of stocks at 5% premium for ₹19950

$\frac{19950}{105} = 190$

Dividend per year = 190 × 4 = ₹760 (4% stock)
Value of stock purchased at 5% discount for ₹19950 = 19950/95 = 210
Dividend income from it = 6 × 210 = ₹1260
Total dividend = 1260 + 760 = 2020.

Effective yield percentage = $\frac{2020}{19950 \times 2} \times 100 = 5{\cdot}06\%$.

Choice (C)

Solutions for questions 46 to 55:

46. Each statement is not sufficient.
Combining statements I and II,

S.P = 20 + $\frac{25}{100} \times 20 = 25$.

M.P ≤ 30. ∴ Discount ≤ 5.

Hence, the discount percentage ≤ $\frac{5}{30} \times 100 = 16\frac{2}{3}\%$

∴ Discount percentage may or may not be less than 16%
Choice (D)

47. From statement I, profit = S.P – C.P so
C.P = 10 [S.P – C.P] ⇒ C.P = 10(165 – C.P)
so we can find the cost price of the cycle

From statement II, profit = $\frac{10}{100} \times 160 = ₹16$

So the cost price of the cycle = 160 – 16 = ₹144
∴ Statement II alone is sufficient. Choice (B)

48. Cost price of the article is not known so we can't find the profit percentage, so statement I alone is not sufficient
From statement II,
18 Selling Price = 21 Cost Price

Profit percentage = $\frac{21-18}{18} \times 100$.

Statement II alone is sufficient. Choice (A)

49. Combining statements I and II, the percentage of income saved is $\frac{25}{100} \times \frac{65}{100} \times 100$. Choice (C)

50. Combining statements I and II,
$(7 \times 12) = 12 \times (x) \Rightarrow x = 7$
(as they share equal profits)
∴ B joined after 12 – 7 = 5 months. Choice (C)

51. Combining statements I and II, we can say that they did not invest equal capitals because inspite of B getting 25% remuneration, they got equal profits. Choice (C)

52. From statement I,
Let the population be x, and the female literacy rate be a%.
Males = 0.6x so females = 0.4x

$\frac{0.6x \times 25}{100} + \frac{0.4x \times a}{100} = \frac{25}{100}x$, solving, we can get the value of a.

This can also be obtained by Alligation the rule of from statement II,

Female literacy = $\frac{x}{4x} \times 100\% = 25\%$

So statement II alone is also sufficient. Choice (B)

53. Either of the statements alone is not sufficient as earning and the rate of commission is given in different statements.
Combining statements I and II,
let the sales values be ₹x

$1500 = \frac{7.5}{100} \times (x) + [x - 9000] \times \frac{2.5}{100}$.

Solving we can get the value of x. Choice (C)

54. Let the selling price of item Y be ₹a
then the selling price of item X be ₹0.9a
From statement I,
Let the number of units of item Y sold be k
Then the number of units of item X sold be 1.2k
Revenue from item Y = ak
Revenue from X = $0.9a \times 1.2k = 1.08ak$
Required ratio = ak : 1.08 = 25 : 27
From statement II,

Ratio of the revenues is $\frac{6000}{8000} = \frac{3}{4}$

Hence either statement alone is sufficient.
Choice (B)

55. Reduced price = 120 – d

From statement I, $d = 120 \times \frac{25}{100} = 30$

Required percentage = $\frac{30}{120-30} \times 100\%$

So statement I alone is sufficient.
From statement II,
$d = (1/3)(120 - d) \Rightarrow 4d = 120 \Rightarrow d = 30$

Required percentage = $\frac{30}{120-30} \times 100\%$

So statement II alone is also sufficient. Choice (B)

Chapter – 4
(Simple Interest and Compound Interest)

Concept Review Questions

Solutions for questions 1 to 25:

1. Interest earned on a sum of ₹P invested for T years at R% p.a. under simple interest = ₹ $\frac{PTR}{100}$.

Interest earned = $\frac{(5000)(2)(10)}{100}$

= ₹1000 Choice (A)

2. The interest on a sum remains the same each year under simple interest.
∴ Total interest = 3(1000) = ₹3000 Ans: (3000)

3. Let the sum be ₹x then,

$\frac{x \times 6 \times 5}{100} = 306 \Rightarrow x = ₹1,020$ Choice (D)

4. Let the sum be ₹x

S.I. = 25410 = $\frac{x \times 11 \times 6}{2 \times 100}$

⇒ x = ₹77,000 Choice (C)

5. Let the time period in years be x then,

$4000 = \frac{15000 \times 5 \times x}{100}$

$\Rightarrow x = \frac{16}{3}$ years

Number of months = $\frac{16}{3} \times 12 = 64$ Ans: (64)

6. Let the sum be ₹x.

then, $\frac{x \times 37 \times 6}{100} - \frac{x \times 33 \times 6}{100} = 54$

$\Rightarrow \frac{x \times 4 \times 6}{100} = 54 \Rightarrow x = ₹225$ Choice (A)

7. Let the rate of interest be R% p.a.
Interest for 2 years = ₹ 600

$600 = \frac{(3000)(2)(R)}{100}$ R = 10.

The rate of interest is 10%.
For two years it is 20%. Choice (A)

8. Simple Interest = $\frac{24000\times18\times5}{100}$ = ₹21,600

Amount = Principal + Simple Interest
= 24000 + 21600 = ₹45,600 Ans: (45600)

9. Let the sum be ₹100.
Sixteen times of sum = ₹1,600
Interest = ₹1,500

$1500 = \frac{100\times30\times x}{100}$

$\Rightarrow$ x = 50 i.e. 50 years. Choice (D)

10. If a sum takes T years to become N times at simple interest at R% p.a., RT = 100 (N – 1)

Rate of interest = $\frac{100\ (1.84-1)}{7}$ = 12% p.a.

Choice (C)

11. Let the sum be ₹x.
Then Amount = ₹10x.
Interest = ₹9x.
Let the time period be r years and rate of interest be r%.

$\Rightarrow 9x = \frac{x\times r\times r}{100} \Rightarrow r = 30\%$ Choice (C)

12. Let the total amount invested be ₹ 2x
Amount invested in each scheme = ₹ x

Total S.I (in ₹) = $\frac{(x)(1)(15)}{100}+\frac{(x)(1)(20)}{100} = 0.35\ x$

0.35x = 1400
x = 4000
2x = 8000 Ans: (8000)

13. Let its present value be ₹P.

$P\left(1+\frac{6\ (10)}{100}\right) = 2400$

P = 1500 Choice (D)

14. Let the rate of interest be R% p.a.
Amount at the end of 2 years = ₹630

$3630 = 3000\left[\left(1+\frac{R}{100}\right)^2\right]$

$(1.1)^2 = \left(1+\frac{R}{100}\right)^2$

$1.1 = 1+\frac{R}{100}\ \ 10 = R$ Choice (A)

15. Interest earned on a sum of ₹ P invested for T years at R% p.a. under compound interest

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

Interest earned = $5000\left[\left(1+\frac{10}{100}\right)^2-1\right]$ = ₹1050

Ans: (1050)

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

$P\left(1+\frac{R}{100}\right)^2 = 6000$ -- (1)

$P\left(1+\frac{R}{100}\right)^3 = 7200$ -- (2)

Dividing (2) by (1),

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

R = 20 Choice (B)

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

$P\left[\left(1+\frac{R}{100}\right)^3-\left(1+\frac{R}{100}\right)^2\right] = 2420$

$P\left[\left(1+\frac{R}{100}\right)^4-\left(1+\frac{R}{100}\right)^3\right] = 2662$

$P\left(1+\frac{R}{100}\right)^2\frac{R}{100} = 2420$ --(1)

$P\left(1+\frac{R}{100}\right)^3\frac{R}{100} = 2662$ --(2)

Dividing (2) by (1),

$1+\frac{R}{100} = 1.1 \Rightarrow R = 10$

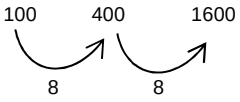
Alternate method:

(100) The interest on a sum for the kth year under compound interest, interest being compounded annually is $\frac{1+R}{100}$ (Interest for the (k – 1) th year)

$2420\left(1+\frac{R}{100}\right) = 2662$

$\therefore$ R = 10 Ans: (10)

18. Let the sum be ₹100
Amount after eight years = ₹400
Amount after sixteen years = ₹1,600
i.e., it takes 8 + 8 = 16 years for the sum to become sixteen times of itself.



8 + 8 = 16 years Choice (D)

19. Let the sum be ₹x.
Then, the amount after three years = ₹2.197 × x

$\Rightarrow 2.197\times x = x\left(\frac{100+r}{100}\right)^3$

$\Rightarrow (1.3)^3 = \left(\frac{100+r}{100}\right)^3$

$\Rightarrow 1.3 = \frac{100+r}{100}$

$\Rightarrow$ 130 = 100 + r
$\Rightarrow$ r = 30% Ans: (30)

20. If a sum takes T years to become N times under compound interest, interest being compounded annually at R% p.a.

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

$\Rightarrow R = (N^{1/T}-1)100$

$\therefore$ Rate of interest = $\left[\left(1+\frac{33.1}{100}\right)^{\frac{1}{3}}-1\right]100 = 10\%$ p.a.

Choice (C)

21. Rate of interest = $\frac{20}{2}\%$ = 10% per half year.

Interest = $200\left[\left(1+\frac{10}{100}\right)^2-1\right]$ = ₹42 Ans: (42)

22. In all the cases, the rate of interest per year is the same. If this is the case, then the interest will increase with the number of times compounding is done per year.
∴ Choice (A) will result in the maximum interest.
Choice (A)

23. The effective rate of interest per annum is that rate of interest, which will fetch the same rate of interest if the interest was calculated annually. Hence it will be the same for each year. Choice (A)

24. Rate of interest = 10% per quarter. A sum of ₹P under compound interest when invested at R% p.a. would become ₹$P\left(1+\frac{R}{100}\right)^N$
A sum of ₹100 would become
$100\left[\left(1+\frac{10}{100}\right)\right]=146.41$
∴ This is the effective rate of interest is 46.41% p.a.
Choice (D)

25. Let the sum be ₹P.
Let the rate of interest be R% p.a.
$I_1 = P\left[\left(1+\frac{R}{100}\right)^{x+1}-1\right]-\left[\left(1+\frac{R}{100}\right)^{x}-1\right]$
$= P\left(1+\frac{R}{100}\right)^{x}\left(1+\frac{R-1}{100}\right)$
$= \frac{PR}{100}\left(1+\frac{R}{100}\right)^{x}$
Similarly $I_2 = \frac{PR}{100}\left(1+\frac{R}{100}\right)^{y}$
As $I_1 > I_2$, x > y Choice (A)

Exercise – 4(a)

Solutions for questions 1 to 25:

1. Given $P+\frac{Pnr}{100} = 18600$
$P\left(1+\frac{nr}{100}\right) = 18600$ n = 5, r = 11
$\Rightarrow P = \frac{18600}{1+\frac{5\times 11}{100}} = 12000$

Alternate method:

A = P (1 + nr%), ⇒ 18600 = P(1 + 55%) = 1.55 × P
⇒ 18600 × 100 = 155P, ⇒ P = 12000 Ans: (12000)

2. For Simple Interest $P\left(1+\frac{nr}{100}\right) = 10080$
n = 2, r = 10
P = 10080/1.2 = 8400
n = 2, r = 10, P = 8400
$A = 8400\left(1+\frac{10}{100}\right)^2 = 10164$
∴ CI = 10164 – 8400 = ₹1764

Alternate method:

A = P(1 + nr%) ⇒ 10080 ⇒ P(1 + 20%);
Under CI, $A = P(1 + R\%)^n = \frac{10080}{1.2}(1.1)^2 = 10,164$
Hence, CI = 10,164 – P = 10,164 – 8400 = 1764.
Choice (B)

3. Under Compound interest policy, amount
$= P\left(1+\frac{r}{100}\right)^n$
Given, $P\left(1+\frac{r}{100}\right)^5 = 199065.6$ ——— (1)
$P\left(1+\frac{r}{100}\right)^3 = 138240$ ——— (2)
⇒ (1) ÷ (2) gives $1.44 = \left(1+\frac{r}{100}\right)^2$
$P = 138240/(1.2)^3 = ₹80000$ Choice (B)

4. Amount that ₹10000 becomes under compound interest
$=1000(1+\frac{10}{100})(1+\frac{20}{100})(1+\frac{30}{100}) = 17160$
amount that ₹10000 becomes under simple interest
$= (10000)\left[1+3\left(\frac{20}{100}\right)\right] = 16000$
interest realized is ₹1160 less Choice (D)

5. The compound interest for the $(n + 1)^{th}$ year is the same as the amount for one year on a principal equal to the n^{th} year interest.
∴1996.5 = 1885[(1 + (r/100)];
⇒ r = 10% ⇒ r = 10% p.a. Choice (C)

6. When compounded annually, the interest accrued for the n^{th} year is r% more than the interest accrued for the $(n – 1)^{th}$ year, where r is the annual rate of interest.
$\therefore I_5 = \left(1+\frac{r}{100}\right) I_4$
$\Rightarrow 1464.1=\left(1+\frac{r}{100}\right)(1331) \Rightarrow 1+\frac{r}{100} = 1.1 \Rightarrow r = 10\%$
Interest accrued for the first two years when ₹12000 is invested in the same scheme
$= 1200\left[\left(1+\frac{10}{100}\right)-1\right] = 12000[(1.1)^2 - 1]$
$= 12000 \times 0.21 = 2520$ Choice (C)

7. In 3 years ₹10000 amounts to $10000\left(1+\frac{3\times 20}{100}\right)$ under simple interest and is ₹16000
In the next 2 years, under compound interest ₹16000 amounts to $16000\left(1+\frac{20}{100}\right)^2 = ₹23040$ Choice (D)

8. Let the amount that ₹8000 becomes after 4 years be x. Then
$(x + 14440)(1.1)^2 = 30,250$
Or x + 14440 = 30250/1.21
x + 14440 = 25000; 10560 = x
Now, let the rate of simple interest for the first 4 years be r% Then 8000(1 + 4r/100) = 10,560; 320r = 2560, r = 8
Ans: (8)

9. Let P_1 be the sum invested in scheme A; and P_2 be the sum invested in scheme B.
$P_1 + P_2 = 34000$ ——— (1)
$P_1 (1 + 20/100)^2 = 9 \times P_2(1 + 60/100)^2$
$P_1 \times (1.2)^2 = 9 \times P_2 \times (1.6)^2$
$P_1 = P_2 \times \left(\frac{3\times 1.6}{1.2}\right)^2$; $P_1 = P_2 \times 16$
$\frac{P_1}{P_2} = \frac{16}{1}$ ——— (2)
From (1) and (2), P_2 = ₹2000 Ans: (2000)

10. Let the first, second and third sums be ₹f, ₹s and ₹t respectively.

$f\left(1+\frac{5}{100}\right)=s\left(1+\frac{5}{100}\right)^2=t\left(1+\frac{5}{10}\right)^3=A$ (say)

$f:s:t=\frac{A}{\frac{21}{20}}:\frac{A}{\frac{441}{400}}:\frac{A}{\frac{9261}{8000}}=\frac{20}{21}:\frac{400}{441}:\frac{8000}{9261}$

= 8820 : 8400 : 8000 = 441 : 420 : 400 Choice (D)

11. Suhaas borrows at 28% compound interest and pays back in 1 year (let him borrow P_1)

$P_1\left(1+\frac{28}{100}\right)^1=38400$

P_1 (1.28) = 38400 P_1 = 30000
Let Bhanu borrow P_2
Given $P_1 + P_2$ = 54000; P_2 = 24000

$24000\left(1+\frac{4\times r}{100}\right)=38400$

4r/100 = 1.6 – 1= 0.6 ⇒ r = 15% Choice (C)

12. Puneet borrows ₹32000 at 10% simple interest

Simple interest for 3 years = $\frac{32000\times10\times3}{100}$ = ₹9600

Compound interest for 3 years
= 32000 $(1.2)^3$ – 32000 = ₹23296
Puneet would have gained (23296 – 9600) = ₹13696

Simple interest for 2 years = $\frac{32000\times10\times2}{100}$ = ₹6400

Compound interest for 2 years
= 32000$(1.2)^2$ – 32000 = ₹14080
Puneet would have gained (14080 – 6400) = ₹7680
Puneet would have gained an extra amount of
13696 – 7680 = ₹6016

Alternate method:

Profit in the case of 3 years = $P(1.2)^3 - P(1 + 3\times0.1)$
= 1.728P – 1.3P = 0.428P
Profit in the case of 2 years = $P(1.2)^2 - P(1 + 2\times0.1)$
= 1.44P – 1.2P = 0.24P
Difference in the two profits = 0.428P – 0.24P
= 0.188P = 0.188 × 32000 = 6016. Choice (C)

13. If compounding is done annually r = 20%, n = 2,
Let P = 100, A = 100$(1.2)^2$ = 144
If compounding is done half-yearly
r = 10%, n = 4, A = 146.41 Difference = 2.41
If P = 100 then, difference = 2.41
If difference is 1084.5, P = $\frac{1084.5}{2.41}\times100$ = ₹45000

Ans: (45000)

14. Sum = P, C.I = r%, n = 10 years

Given, $Pe^{\left(\frac{nr}{100}\right)}=a.P$

$e^{10\times\frac{r}{100}}=a$

Given $e = a^2$ hence $e^{r/10} = e^2 \Rightarrow r = 20$

Choice (B)

15. Let the rate be R % p.a.

$2.4c\left(1+\frac{R}{100}\right)^{18}=19.2c$

$\Rightarrow \left(1+\frac{R}{100}\right)^{18}=8$

$\Rightarrow 1+\frac{R}{100}=2^{\frac{1}{6}}$

The value that 4 crores would amount to in 24 years at the same rate = $4c\left(1+\frac{R}{100}\right)^{24}=4c\left(2^{\frac{1}{6}}\right)^{24}$ = 64c

Ans: (64)

16. CI – SI = 30 = $P\left(\frac{r}{100}\right)^2$. Also, Pr/100 = 600

∴ 600 × r/100 = 30
r = 5%
⇒ P × 5/100 = 600
P = ₹12000 Choice (B)

17. The difference between the compound and simple interest for 3 years is given by

$P\left[\left(\frac{r}{100}\right)^3+3\left(\frac{r}{100}\right)^2\right]$

$\therefore P\left[\left(\frac{20}{100}\right)^3+3\left(\frac{20}{100}\right)^2\right]=3200$

P × 16/125 = 3200
P = ₹25000

Alternate method:

Under CI, amount for 3 years = $(1.2)^3$ P = 1.728P
Under SI, amount for 3 years = (1 + 3 × .2)P = 1.6P
Difference in amounts = Difference in interests.
Hence, 1.728P – 1.6P = 3200; ⇒ 0.128P = 3200.
⇒ P = (3200/0.128) = 25000. Choice (D)

18. He borrows ₹2500000
At the end of the first year it becomes
2500000 × $(1 + 12/100)^1$ = ₹2800000
He repays ₹500000 ——— (1)
₹2300000 is the principal for the 2nd year.
This becomes 230000 $(1 + 12/100)^1$= ₹2576000
Which is repaid by the person, at the end of 2nd year.
In the first year, (on his earnings side), he earns 20% on ₹2500000 = ₹500000.
Out of this, (1) is repaid. Investment remains as ₹250000.
This earns 20% during the second year. So, it becomes ₹3000000. Out of this ₹2576000 is repaid. So, he makes, 3000000 – 2576000
= ₹424000 Choice (A)

19. Loan amount = ₹24000
Simple Interest = 12% per annum

After 1 year, interest = $\frac{24000\times12}{100}$ = 2880

Interest for the second year = $\frac{19200\times12}{100}$ = 2304

(Since 20% of the principal has been repaid)

Interest for the third year = $\frac{14400\times12}{100}$ = 1728

Interest for the fourth year = $\frac{9600\times12}{100}$ = 1152

Total interest = 2880 + 2304 + 1728 + 1152 = 8064

Alternate method:

Repayment at the end of every year = 20% of the principal
= 20% of 24000 = ₹4800
Hence, interest accrued every year decreases by 12% of ₹4800.
decrease in interest per year = 12% of 4800 = ₹576
Interest for the first year = 12% of 24000 = ₹2880
Hence, interest accrued in 4 years
= 2880 + (2880 – 576) + (2880 – 2 × 576) + (2880 – 3 × 576)
= 4 × 2880 – 576 (1 + 2 + 3)
= 11,520 – 3456 = 8064 Ans: (8064)

20. Let the annual instalment be ₹x.
Let $(FV)_i$ denote the value of the i^{th} instalment at the end of the fifth year.
Sum of future values of all the instalments = ₹1450

$(FV)_1 = x + \frac{(x)(8)(4)}{100}$

$(FV)_2 = x + \frac{(x)(8)(3)}{100}$

$(FV)_3 = x + \frac{(x)(8)(2)}{100}$

$(FV)_4 = x + \frac{(x)(8)(1)}{100}$

$(FV)_5 = x$

$\therefore, 5x + \frac{x}{100}(8)(4 + 3 + 2 + 1) = 1450$

$\Rightarrow 5x + 0.8x = 1450$

$\Rightarrow x = \frac{1450}{5.8} = 250$

Alternate method:

Each instalment must be less than ₹($\frac{1}{5}$ th of 1450) = ₹(290). From among the choices given, only Choice (C) satisfies the condition. Choice (C)

21. Present worth (in ₹) of ₹20000 due after 3 years at CI of 10% p.a.

$= \frac{20,000}{\left(1+\frac{10}{100}\right)^3} \simeq 20,000 \times (0.9)^3 = 14580$ Choice (C)

22. Principal = ₹100000
At the end of first year it amounts to
$100000(1 + 8/100)^1 = 108000$
Out of this he repays ₹10000
So, amount due at the end of 1st year
= 108000 – 10000 = ₹98000.
At the end of the second year this amounts to
$98000\ [1 + 8/100]^1 = 105840$.
Out of this he repays ₹10000
∴At the beginning of the third year amount due from him = 105840 – 10000 = ₹95840 Choice (D)

23. Let the sum be ₹P.

CI (2nd year) = $P\left(1+\frac{5}{100}\right)^2 - P\left(1+\frac{5}{100}\right)$ ($\because A_2 - A_1$)

CI (3rd year) = $P\left(1+\frac{5}{100}\right)^3 - P\left(1+\frac{5}{100}\right)^2$

Difference = $P(1.05)^3 - 2(1.05)^2 - (P(1.05) = 42$

$P\left(\frac{21}{20}\right)^3 - 2\left(\frac{21}{20}\right)^2 - P\left(\frac{21}{20}\right) = 42 \Rightarrow P = 16000$

Ans: (16000)

24. Cost of the car = ₹525000
Cash payment = ₹125000
∴Principal of loan to be discharged in instalments = ₹400000

Each instalment $X = \frac{Pr}{100\left[1-\left(\frac{100}{100+r}\right)^n\right]}$

$= \frac{400000 \times 12}{100\left[1-\left(\frac{100}{112}\right)^3\right]}$

$= \frac{4000 \times 12}{(1-0.71)} = \frac{4000 \times 12}{0.29}$

$\cong \frac{4000 \times 12}{0.29} \simeq \frac{4000 \times 12}{0.3} = 160000$. As the actual denominator is slightly less than 0.3 the actual answer should be slightly more than ₹160000.
Actual answer is ₹165000 as per the options.
Choice (B)

25. The value of the first instalment (at the time the sum was borrowed) = $\frac{1200}{1.2} = 1000$.

The value of the second instalment (at the time the sum was borrowed) = $\frac{1152}{(1.2)^2} = 800$.

The value of the third instalment (at the time the sum was borrowed) = $\frac{2592}{(1.2)^3} = 1500$.

Sum borrowed = Total value (at the time the sum was borrowed) = ₹3300 Ans: (3300)

Exercise – 4(b)

Solutions for questions 1 to 40:

1. Let the principal be P.
Let 'I' be the interest for one year
P + 3I = 2832 ——— (1)
P + 5I = 3120 ——— (2)
Subtracting (1) from (2), I = 144 and P = ₹2400
Choice (A)

2. Let the sum be ₹P

Extra interest = $P\left(\frac{10}{100}\right)(2) = 4000$

P = 20000 Ans: (20000)

3. Let the rate of interest be R% p.a.

Extra interest = $(10000)\left(\frac{R}{100}\right)(2) = 4000$

R = 20 Choice (C)

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

$(P)\left(\frac{R}{100}\right)(10) = 2P - P = P$

R = 10
Let us say it will take T years for it to become 5 times itself.

$(P)\left(\frac{R}{100}\right)(T) = 4P\ T = 40$ Choice (B)

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

$(P)\left(\frac{R}{100}\right)(4) = P$

$(P)\left(\frac{R}{100}\right)(5) = 12500$

$P = \frac{12500}{\frac{25}{100} \times 5} = 10000$

Required interest = $P\left(\frac{R}{100}\right)(3) = ₹7500$ Choice (B)

Solutions for questions 6 and 7:

Let the sum that Rohan lent to P be ₹x
Sum he lent to Q = ₹(100000 – x).

$2\left[\frac{10}{100}x+\frac{20}{100}(100000-x)\right] = 32000$

x = 40000
Let the effective rate at which Rohan lent the entire sum be R% p.a.

$(100000)\left(\frac{R}{100}\right)(2) = 32000$

R = 16

6. ₹40000 Ans: (40000)

7. 16% Choice (C)

8. Let us say he lends ₹P
Let us say the least number of years it takes the sum to fetch an interest at least equal to itself be N. The rate of interest for the ith year = 2i % p.a.

$P\left[\left(\frac{2}{100}\right)+\left(\frac{4}{100}\right)+\left(\frac{6}{100}\right)+....\left(\frac{2N}{100}\right)\right] \geq P$

N(N + 1) ≥ 100
If N = 9, N (N + 1) < 100
If N = 10, N (N + 1) > 100
N = 10 Choice (B)

9. Let P_1 = ₹x
P_2 = ₹4x.
P_3 = ₹5x
P_4 = ₹2x

Simple interests on P_1, P_2, P_3 and P_4 are (x) $\left(\frac{10}{100}\right)(1)$

$(4x)\left(\frac{20}{100}\right)(5),(5x)(\frac{2}{100})(4)$ and $(2x)\ (\frac{6}{100})(10)$i.e

₹01x, ₹4x, ₹0.4x and ₹1.2x respectively
4x – 0.1x = 7800 x = 2000
The total simple interest = 5.7x = ₹11400 Ans: (11400)

10. Let the sum that Ajay borrowed from Balu be ₹X. The sum he borrowed from Chetan = ₹2x
Let the sum he added b ₹y

He earned $(3x + y)\ \frac{18}{100}-x\left(\frac{10}{100}\right)-2x\left(\frac{20}{100}\right)$

0.04x + 0.18y = 4400
3x = 60000 ⇒ x = 20000 ⇒ y = 20000 Choice (D)

11. Let the present value be ₹x

$x = \frac{17280}{1+3\left(\frac{20}{100}\right)} = 10800$ Ans: (10800)

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

$P\ (1+\frac{R}{100})^3 = 266200 \rightarrow (1)$

$P\ (1+\frac{R}{100})^4 = 292820 \rightarrow (2)$

Dividing (2) by (1), $(1+\frac{R}{100}) = 1.1$

⇒ R = 10 Choice (B)

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

$P\ [(1+\frac{R}{100})^2-(1+\frac{R}{100})] = 14400 \rightarrow (1)$

$P[(1+\frac{R}{100})^3-(1+\frac{R}{100})^2] = 17280 \rightarrow (2)$

Dividing (2) by (1), $\frac{P(1+\frac{R}{100})^2\left[\frac{R}{100}\right]}{P(1+\frac{R}{100})\left[\frac{R}{100}\right]} = 1.2 \Rightarrow R = 20$

Choice (C)

14. Let the rate of interest be r%
then, r% of interest of n^{th} year
= Difference of interest for n^{th} and $(n + 1)^{th}$ year.
⇒ r% of 1256 = (1413 – 1256)

$\Rightarrow \frac{r}{100} \times 1256 = 157 \Rightarrow r = 12.5\%$ Choice (D)

15. Let the present value be ₹x.

$x = \frac{87880}{(1+\frac{30}{100})^3} = 40000$ Ans: (40000)

16. Let the time period be n years $1875\left(1+\frac{8}{100}\right)^n = 2187$

$\left(\frac{108}{100}\right)^n = \frac{2187}{1875}\ \left(\frac{27}{25}\right)^n = \frac{729}{625} = \left(\frac{27}{25}\right)^2 \Rightarrow n = 2$

Choice (B)

17. Interest for the third year

$= P\left(1+\frac{r}{100}\right)^2\left(\frac{r}{100}\right) = 12000\left(\frac{21}{20}\right)^2\left(\frac{5}{100}\right) = ₹661.5$

Alternate method:

Interest for the first year = 5/100 x 12000 = ₹600
Interest for the second year = 600 + 5/100 x 600 = 630
Interest for the third year = 630 + 5/100 x 630
= ₹661.5 Choice (B)

18. Let the sum be ₹P and the total interest for the second and third years be ₹X.

Interest for the first year = $P\ \left(\frac{20}{100}\right) = 0.2\ P$

Interest for the second year = (Amount at the end of two years) - (Amount at the end of one year)
= P [$(1.2)^2$ – 1.2] = 1.2 P (0.2)
Interest for the third year = P[$(1.2)^3$ – $(1.2)^2$] = 1.2 P (0.24)
0.2 P = 4000 ⇒ P = 20000
X = 0.528 P ⇒ ₹10560 Ans: (10560)

19. Let the sum be P and the rate be r%

$P\left(1+\frac{r}{100}\right)^2 = 1200$ ——— (1)

$P\left(1+\frac{2r}{100}\right)^2 = 1323$ ——— (2)

Dividing (2) by (1), $\frac{\left(1+\frac{2r}{100}\right)^2}{\left(1+\frac{r}{100}\right)^2} = \frac{1323}{1200}$

$\left(\frac{100+2r}{100+r}\right)^2 = \frac{441}{400} \Rightarrow r = 5\frac{5}{19}\%$ Choice (C)

20. Sum = P; C.I = r%; In 3 years, amount = 27P

$P\left(1+\frac{r}{100}\right)^3 = 27P \Rightarrow \left(1+\frac{r}{100}\right)^3 = 27$

$\Rightarrow 1+\frac{r}{100}=3$ r = 200.

Compounding half yearly, the amount will be

$P\left(1+\frac{100}{100}\right)^6$ = P x 2^6 = 64P

Additional Amount received = 64P – 27P = 37P

Choice (B)

21. Excess interest = 10000

$\left[\left(1+\frac{20}{100}\right)^3-1\right]-\left[\left(1+\frac{10}{100}\right)\left(1+\frac{20}{100}\right)\left(1+\frac{30}{100}\right)-1\right]$

= ₹120. Ans: (120)

22. Let the sum be ₹P

$P(1+\frac{20}{2(100)})^2 - P(1+\frac{20}{100}) = 400$

P = 40000 Choice (B)

23. As the rate of interest is increasing by 20 percentage points annually, the rate of interest per half year increases by 10 percentage points.

Half year	Principal	Interest for the half year	Interest of the end of half year	Amount
1	40000	2000	2000	42000
2	42000	6300	8300	48300
3	48300	12075	20375	60375

∴ The required interest will be ₹20375. Choice (C)

24. Let the sum be ₹P.

$Pe^{(5)}\left(\frac{20}{100}\right) = 60000$

P = 22075 ≈ 22000 (to the nearest thousand) Ans: (22000)

25. Given $Pe^{(nr/100)} - P\left(1+\frac{r}{100}\right)^n = 952000$

Given r = 100 e = 2.71 n = 3

$\Rightarrow P = \frac{952000}{(2.71)^3-2^3} = 80{,}000$ Choice (C)

26. ₹20000 deposited at the beginning of the first year becomes, in 2 years, an amount equal to
20000 x $(1.05)^2$ = ₹22050
(i.e., at the beginning of the third year)
₹20000 deposited at the beginning of the second year becomes in 1 year (20000) × (1.05) = ₹21000
∴Amount at the beginning of the third year
= 22050 + 21000 = ₹43050
Now ₹10000 is withdrawn
∴There is ₹33050 in the account on which 5% interest for one more year is earned.
Final amount = 33050 x 1.05 = ₹34702.5 Choice (D)

27. Value of ₹72000 at the end of the first year = ₹86400. Since ₹x was repaid at the end of the first year, in order to clear the loan at the end of the second year, the amount to be repaid must be

$(86400 - x) + \frac{20}{100}(86400 - x)$

1.2 (86400 – x) = 57600
x = 38400 Ans: (38400)

28. Let the values of each instalment that he should have paid and that he actually paid be ₹x and ₹y respectively.

$x = \frac{320320\left(\frac{20}{100}\right)}{1-\left(\frac{100}{120}\right)^2} = 209664$

$y = \frac{320320\left(\frac{20}{100}\right)}{1-\left(\frac{100}{120}\right)^3} = 152064$

x – y = 57600 Choice (D)

29. Let the sum Ashok borrowed from the bank lending at 10% p.a. be ₹x
Sum he borrowed from the other bank = ₹(84000 – x)

$\frac{10}{100}x+\frac{20}{100}(84000-x) = 13200$

x = 36000
difference = 84000 – 2x = 12000 Ans: (12000)

30. If a sum is doubled in the same time at simple interest as well as compound interest, the rate of interest under simple interest is more than rate under compound interest.
Choice (A)

31. Let the sum that Anil gave Bala be P.

Bala ℓent $\frac{75}{100}$P i.e. $\frac{3}{4}$P at 10% p.a CI for 3 years

$\frac{3}{4}P\left(1+\frac{10}{100}\right)^3 = 3993 \Rightarrow P = 4000$ Ans: (4000)

32. $PR^2/10000 = 112.5$; $\frac{P\,x15^2}{10000} = 112.5$

P = ₹5000 Choice (B)

33. Difference between the simple interest and the compound interest, interest being compounded annually, on a sum of ₹P at R% p.a for 2 years

$= P\left(\frac{R}{100}\right)^2$. As P = 8000,

and $P\left(\frac{R}{100}\right)^2$ = 320, it follows that R = 20 Ans: (20)

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

$0.4P = (P)\left(\frac{R}{100}\right)(2)$

20 = R

$(1+\frac{x}{100})P = P(1+\frac{20}{100})^2 \Rightarrow x = 44$ Choice (D)

35. In case of simple interest SI, P = I, given data.

$\Rightarrow P = \frac{5Pr}{100}$ or r = 20%

Now, if the sum is lent at CI at 20% p.a, let it double in n years

$2P = P\left(1+\frac{20}{100}\right)^n \; 2 = \left(\frac{6}{5}\right)^n$

n lies between 3 and 4. After four complete years, the sum becomes for the first time, more than twice itself.
⇒ n = 4; Ans: (4)

36. Let the sum be ₹100.
Hence the interest is ₹100

$\therefore 100 = \frac{100 \times 25 \times R}{3 \times 100}$

$\Rightarrow$ R = 12% p.a
$\therefore$ New rate of interest is 24% p.a.
Let after n years, the sum becomes twice of itself.

$\therefore 200 = 100\left(1+\frac{24}{100}\right)^n \Rightarrow 2 = (1.24)^n$

Instead of 1.24, if 1.25 is taken up for n = 2,
R.H.S = 1.5625
For n = 3, R.H.S = (1.5625) (1.25) i.e., 1.95
Even for 1.25, it doubles in fourth year, hence for 1.24 also, it doubles in fourth year.
$\therefore$ In 4th year, it doubles. Choice (A)

37. Let the sum be ₹2P.
₹P lent at simple interest fetches ₹0.2 P as interest each year. ₹P lent at compound interest fetches ₹0.24 P as interest in the second year and ₹0.3456 P as interest in the fourth year
0.24 P - 0.2P = 400
P = 10000
Required difference = 0.3456P – 0.2P = ₹1456
Choice (C)

38. The smaller and the larger parts are Ra.1000 and ₹3000
₹1000, in 2 years, under simple interest amounts to (1000) $[1 + \frac{10(2)}{100}] = ₹1200$
₹3000 in 2 years, under simple interest amounts to (3000) $[1 + \frac{30(2)}{100}] = ₹4800$
₹4000, in 2 years under simple interest amounts to (4000) $(1 + \frac{20}{100}(2) = ₹5600$
The interest realized is ₹400 less. Choice (C)

39. The amount that ₹1000 becomes under compound interest $= (1000)\left(1+\frac{10}{100}\right)^2 = ₹1210$
The amount that ₹3000 becomes under compound interest $= (3000)\left(1 + \left(1+\frac{30}{100}\right)^2 = ₹5070$
The amount that ₹4000 becomes under compound interest $= (4000)\left(1 + \left(1+\frac{20}{100}\right)^2 = ₹5760$
The interest realized is ₹520 less Choice (D)

40. Let the value of the machine two years ago ₹x
then, $x\left(\frac{90}{100}\right)^2 = 24300$
$\Rightarrow$ x = ₹30,000 Ans: (30000)

Solutions for questions 41 to 45:

41. Statements I and II, give the same information.
$\therefore$ The question cannot be answered as the principal is not given. Choice (D)

42. From statement I, $\frac{p(8)R}{100} = 36{,}000$
So, statement II alone is not sufficient.
From statement II, $\frac{p(8)R}{100} = p$.
$\therefore$ R = 12.5%.
Statement II alone is sufficient. Choice (A)

43. Statement I is not sufficient
From statement II,
Let the sums be a, b and c, then

$\frac{a(100+2\times5)}{100} = \frac{b(100+3\times5)}{100} = \frac{c(100+4\times5)}{100} = k$

$\frac{11a}{10} = \frac{23b}{20} = \frac{6c}{5} = k$

a : b : c = 276 : 264 : 253 Choice (A)

44. From statement I,

$125 = 100\left(1+\frac{R}{100}\right)^3$ so we can find the rate of interest (R).

From statement II,

$1.5x = x\left(1+\frac{R}{100}\right)^3 \Rightarrow 1.5 = \left(1+\frac{R}{100}\right)^3$

So we can find the rate of interest.

So each statement alone is sufficient. Choice (B)

45. Either of the statements alone is not sufficient as the rate of interest and the simple interest earned in 5 years is given in different statements.
Combining statements I and II,
$\frac{p(5)(6)}{100} = 600$ so we can get the value of p.
Compound Interest = $\{p\,[1 + {}^6/_{100}]^5 - p\}$ Choice (C)

Chapter – 5
(Time and Distance)

Concept Review Questions

Solutions for questions 1 to 50:

1. (a) 36 km/hr $\times$ 5/18 = 10 m/s Choice (A)
(b) 12.6 $\times$ 5/18 = 3.5 m/s Choice (A)
(c) 216/35 $\times$ 5/18 = 2 m/s Choice (C)

2. s = 2.5 m/s $\times$ 18/5 = 9 km/hr
t = 4 hours
d = 9 $\times$ 4 = 36 km. Ans: (36)

3. 6 m/s $\times$ 18/5 = 108/5 km/hr
d = s $\times$ t $\Rightarrow$ 108/ 5 $\times$ 15/4 = 81 km Choice (A)

4. Time $\propto \frac{1}{\text{speed}}$

$\therefore$ Ratio of the times = $\frac{1}{3} : \frac{1}{4} : \frac{1}{6} = 4 : 3 : 2$

Choice (A)

5. Total distance = (Average speed) x (time)
$= \frac{2\times35\times45}{80} \times 16 = 630$ km. Ans: (630)

6. As speed and time are inversely proportional, if speed decreases to 5/6th, time taken will be increasing to 6/5th of original time.

$\therefore \frac{6t}{5} - t = 10 \Rightarrow t = 50$ minutes. Choice (A)

7. As the speed is increased to 1.25 times the original, time taken will be decreased by 4/5 times of actual.

$\therefore t - \frac{4t}{5} = 6 \Rightarrow t = 30$ minutes. Ans: (30)

8. Time taken by them to meet = $\frac{270}{\text{Relative speed}}$

$= \frac{270}{50+40} = 3$ hours

$\therefore$ The meeting time is 12 : 00 p.m Choice (B)

9. Distance that X would have traveled by 10 : 00 a.m.= 30 k.m. Distance between the cars at 10 : 00 a.m. = 150 k.m.

Meeting time = $\left(\frac{150}{30+20}\right)$ hours after 10 : 00 a.m. i.e. 1 : 00 p.m. Choice (C)

10. Let the speeds of P and Q is 3x kmph and 4x kmph respectively. Distance that P would have traveled by 10 : 00 a.m. = 9x km. They would meet after another $\frac{9x}{4x-3x}$ = 9 hours i.e. at 7 : 00 p.m. Choice (A)

11. Average speed = $\frac{\text{Total distance}}{\text{Total time}}$

XY = (4) (90) or 360 km. Ans: (360)

12. Average speed = $\frac{(2.5)(40)+(2.5)(60)}{5} = \frac{40+60}{2}$

= 50 kmph. Choice (B)

Note: Whenever a person covers a journey in 2 parts such that he covers each part for the same time, his average speed for the journey will be the average of the speeds at which he travelled each part.

13. Average speed = $\frac{(3)(40)+(5)(60)}{8}$ = 52.5 kmph.

Choice (A)

14. Let x km be the distance between Hyderabad and Tirupathi.

Average speed = $\frac{x+x}{\frac{x}{60}+\frac{x}{90}}$

$= \frac{2(60)(90)}{60+90}$ = 72 kmph Ans: (72)

15. His average speed = $\frac{4}{5}$ th of the usual average speed.

Choice (A)

16. Average speed of Alok = $\frac{5}{4}$ (usual average speed of Alok)

$\therefore$ His time taken $\propto \frac{1}{\text{Average speed}}$

$\therefore$ His time taken would be $\frac{4}{5}$ th of the usual time.

Choice (B)

17. d_1 = x km.
S_1 = 60km/hr
T_1= d/s = x/60
D_2 = 3x, S_2 = 90km/hr
T_2 = x/30 = x/60
Total time = x/30 + x/60 = x/20
Total distance = 3 x + 1x = 4x
$\therefore$ Average speed = 4x/ x/20 = 80 km/hr Choice (D)

18. Let the time for which the car has to travel to reach Y at the scheduled time be t hours.
XY = 60 (t + 2) = 80 (t – 2) $\Rightarrow$ t = 14

Required average speed = $\frac{60(14+2)}{14} = \frac{480}{7}$ kmph.

Choice (D)

19. Let the speeds of Ram and Shyam be 5x kmph and 4x kmph respectively. Suppose Ram overtakes Shyam after t hours.

$t = \frac{12}{5x-4x} = \frac{12}{x}$

$\therefore$ Ram will overtake Shyam after traveling 5x t = 60 km.

Ans: (60)

20. Let PQ = d km.

Speed of A = $\frac{d}{20}$ km/min

Speed of B = $\frac{d}{30}$ km/min

Time they would take to meet each other = $\frac{d}{\frac{d}{20}+\frac{d}{30}}$

= 12min

Ans: (12)

21. The train has to travel a distance of 800 m to cross the electric pole. Hence, the time it takes to cross the pole

$= \frac{800}{40\times\frac{5}{8}}$ = 72 seconds. Choice (D)

22. Speed of the train = $\frac{\text{length of the train}}{\text{time taken to cross the pole}} = \frac{500}{25}$

= 20 m/sec = 72 kmph Choice (B)

23. The distance to be travelled by the train to cross a platform of length 750 m is 750 + 650 i.e., 1400 m. At 72 km/hr. or 20 m/s. the train takes $\frac{1400}{20}$ i.e. 70 seconds to cross the platform. Choice (C)

24. Time taken = $\frac{400+300}{(36)\left(\frac{5}{8}\right)}$ = 70 seconds Ans: (70)

25. L_t = 300 m; L_b = 120 m
t = 3m = 180 seconds.
s = 1500/180 = 25/3 m^{-1}
s = 25/3 $\times$ 18/5 m^{-1} = 30 km/hr Ans: (30)

26. Given speed of the train is 72 kmph

$F = 72 \times \frac{5}{18}$ = 20 m/s.

The time taken to cross the person is 12 sec.
$\therefore$ The length of train = speed time
L = (12) (20) = 240 m. Choice (B)

27. l_1 = 250m
s_1 = 90km/hr = 25ms^{-1}
l_2 = 200m, S_2 = 36km/hr = 10ms^{-1}
But S_p = 25 – 10 = 15 m^{s-1}
D = $l_1 + l_2$ = 450m
T = 450/15 = 30 seconds Choice (C)

28. Relative to the boy the speed of the train is 99 + 9 i.e., 108 km/hr.

Hence, the time it takes to cross him = $\frac{750}{108\times\frac{5}{8}}$ = 25.

Ans: (25)

29. Required distance = Sum of the lengths of the trains = 1000 m. Choice (B)

30. Ratio of the speeds of A and B = $\frac{1000}{1000-250} = \frac{4}{3}$

Choice (B)

31. When Eswar finishes the race, Girish would have run 200 – (10 + 10) = 180 m.

∴ Ratio of Eswar's and Girish's speeds = $\frac{200}{180} = \frac{10}{9}$

Choice (C)

32. Ratio of the speeds of X and Y = $\frac{1000}{1000 - 200} = \frac{5}{4}$

∴ Y's speed = $\frac{4}{5}(10)$ = 8 m/sec. Choice (D)

33. Ganesh beats Harish by 10m or 2 seconds.
∴ Harish must have taken 2 seconds to run the final 10 m.

∴ Harish's speed = $\frac{10}{2}$ = 5 m/sec Choice (A)

34. $\frac{\text{Ganesh's speed}}{\text{Harish's speed}} = \frac{100}{90}$

Ganesh's speed = $\frac{10}{9}(5) = 5\frac{5}{9}$ m/s Choice (C)

35. Akbar gives Birbal a start of 2 s and Birbal covers 10 m in these 2 s.
∴ Birbal's speed is5 m/sec.
∴ He takes 18 seconds, more to cover the 90 m.
∴ Akbar covered 100 m in 18 seconds.

His speed = $\frac{100}{18}$ m/sec= $5\frac{5}{9}$ m/sec Choice (B)

36. Let the time taken by R to run the race is t seconds.
Time taken by Q to run the race = (t + 30) seconds.
Time taken by P to run the race = (t + 50) seconds.
∴ P beats R by 50 seconds. Ans: (50)

37. Let the speeds of A, B and C be a m/sec, b m/sec and c m/sec respectively.

$\frac{a}{b} = \frac{100}{100 - 10} = \frac{10}{9}$

$\frac{b}{c} = \frac{100}{100 - 20} = \frac{5}{4}$

$\frac{a}{c} = \left(\frac{a}{b}\right)\left(\frac{b}{c}\right) = \frac{25}{18}$

∴ A beats C by $\frac{25 - 18}{25}(100)$ = 28 m. Choice (B)

38. Speed of Anand's boat downstream = 8 kmph.

Time taken = $\frac{40}{8}$ = 5 hours Ans: (5)

39. Let AB = d km.
Let the speed of his boat in still water be x kmph. Let the speed of the river be y kmph.

x + y = $\frac{d}{6}$ --(1)

x – y = $\frac{d}{8}$ --(2)

Solving (1) and (2), x = $\frac{7d}{24}$ and y = $\frac{d}{24}$

∴ x : y = 7 : 1 Choice (A)

40. Time = LCM $\left(\frac{600}{10}, \frac{600}{15}, \frac{600}{20}\right)$ = LCM (60, 40, 30) = 120 seconds Choice (A)

41. (i) Time = $\frac{600}{\text{Relative speed}} = \frac{600}{10}$ = 60 seconds.

Choice (A)

(ii) Time = $\frac{600}{\text{Relative speed}} = \frac{600}{20}$ = 30 seconds

Choice (B)

42. Time = LCM $\left(\frac{600}{15}, \frac{600}{10}\right)$ = LCM (40, 60) = 120 seconds.

Ans: (120)

43. Number of rounds completed by Ram in one hour
= $\frac{(2)(3600)}{60}$ = 120
Number of rounds completed by Shyam in one hour
= $\frac{(4)(3600)}{60}$ = 240
∴ Shyam would have completed 120 more rounds than Ram. Choice (C)

44. The relative speed does not change when the two exchange their speeds. ∴ Both will reach the starting point simultaneously. Choice (C)

45. Angle covered by the hour hand from 12 : 00 p.m. to 2 : 30 p.m. = (Angle covered by from 12 : 00 p.m. to 2 : 00 pm) + (Angle covered by it from 2 : 00 p.m. to 2 : 30 p.m.) = 2 (30°) + 30 (1/2) ° = 75°.
Angle covered by the minute hand from 12 : 00 p.m. to 2 : 30 p.m. = (Angle covered by it from 12 : 00 p.m. to 2 : 00 p.m.) + (Angle covered by it from 2 : 00 p.m. to 2 : 30 p.m.) = 2 (0°) + 30 (6°) = 180°
∴ The angle between the hands would be 105° at 2 : 30 p.m.
Ans: (105)

46. The hands of a clock will be at an angle of θ where θ is any angle satisfying 0° < θ° < 180° for a total of 44 times in a day. Ans: (44)

47. The hands of a clock will be at an angle of 0° for 22 times in a day and at an angle of 180° for 22 times in a day .
Choice (C)

48. Every 12 hours the hands of a clock coincide 11 times.
∴ The hands of a clock coincide once every $\frac{12}{11}$ hours or $65\frac{5}{11}$ minutes. Choice (C)

49. The hands of a clock coincide every $\frac{12}{11}$ hours i.e. $65\frac{5}{11}$ min. We know that hands of a clock coincide at 12 : 00. So, they also coincide at 12 : 00 + 1 : $05\frac{5}{11}$ = 1 : $05\frac{5}{11}$. Choice (A)

50. Since the hands of a clock take more time to coincide than the normal $65\frac{5}{11}$ minutes the clock is losing time.

Choice (A)

Exercise – 5(a)

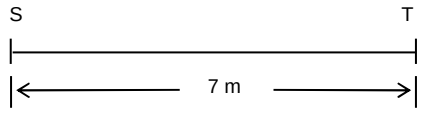
Solutions for questions 1 to 35:

1. Let the usual time taken by the man to reach his office be t.
The speed is 3/4ths the normal speed.
Hence, time is 4/3rd. (4/3t) – t = 1/3 t = 20
t = 60 minutes
Had the person walked at 4/3 of his usual speed, time taken by him = 3t/4 = 3/4 (60) = 45 minutes
Ans: (45)

2. Let the usual time taken by the boy be t.

Distance between his home and school
= 5(t – 4/60)
= 4(t + 2/60) → (1)
Solving (1) we have t = 28/60 hr.
Time taken by the boy to go to school if he walks at
6 km/hr = 5(28/60 – 4/60)/6 = 1/3 hr = 20 min.
Choice (B)

3.



When M meets 'N' for the 2nd time, sum of the total distances travelled by M and N = 7 + (7 + 7) = 21 m.
(M covered from S to T, 7 m;
N covered from T to S, 7 m;
and they together covered ST 7 m.)
The time of travel from the start to the time of second meeting is the same for both. Hence, distance = time x (sum of the speeds).

Time taken = $\frac{21}{(3+4)}$ = 3 sec.

Total distance travelled by 'M' alone = 3×3 = 9 m.
Choice (C)

4. Let the person cover x m in the 1st second. In the 2nd second, he covers x/4 m. Hence in 2 seconds, he covers x + x/4 = 5x/4 m
In the 3rd second, he covers 1/4(5x/4) m
Hence in 3 seconds, he covers 5x/4 + 5x/16
= 25x/16 = $(5/4)^2$x m
Thus after 5 seconds, the person would have covered
$(5/4)^{5-1}$x = 625x/256 m
625x/256 = 15.625
x = 15.625/625 x 256 = 6.4 m Ans: (6.4)

5. Distance travelled by the stone in the last two seconds before it reaches the ground be x.
$5t^2 = 180$
$t^2 = 36 \Rightarrow t = +6$
$x = 5(6)^2 - 5(6-2)^2 = 5(6)^2 - 5(4)^2$
$= 5(6^2 - 4^2) = 5(20) = 100$ m Choice (C)

6. Let the length of the train be 'l' m, and the speed of the train be 'v' m/sec

$\therefore \frac{430+\ell}{30} = \frac{550+\ell}{36} = v \Rightarrow \ell = 170$

and $v = \frac{430+170}{30} = 20$ mps

$v = 20 \times \frac{18}{5} = 72$ kmph

Alternate method:

Difference of the lengths of bridges = 550 – 430
= 120 m
Difference of the time taken to cross the bridge
= 36 – 30 = 6 seconds
Speed of the train = 120/6 = 20 mps
= (20 x 18)/5 = 72 kmph Choice (B)

7. Let the length of the train travelling at 60 kmph be L.

$\Rightarrow \frac{L}{(60+12)\left(\frac{5}{18}\right)} = 20 \Rightarrow L = 400$ m

Time taken by the train to cross another cyclist travelling in the same direction as the train, at 20 kmph

$= \frac{400}{(60-20)\left(\frac{5}{18}\right)} = 36$ sec

Alternate method:

The distance covered in both the cases is equal to the length of the train.
Hence, ratio of relative speeds = inverse ratio of the times taken.
$\Rightarrow$ (60 + 12) /(60 – 20) = (x)/12, where x is the required time.
From the above, x = 36 sec. Ans: (36)

8. Time taken by Train U to exit the tunnel

$= \frac{\text{Length of the tunnel + length of the train U}}{\text{Speed of B}}$

$= \frac{200+150}{25}$

Train U exits the tunnel after 350/25 = 14 sec.
In 14 sec, front end of train T's engine travels
= 14 x 15 = 210 mts
That means the front end of engine is 10 mts out of the tunnel.
$\therefore$ The length of the train T still in the tunnel
= 100 – 10 = 90 m Choice (C)

9. Let the point at which the ends cross each other be x mts from the point of entry of the slower train.
$\therefore$ The time elapsed before the ends meet for the two trains will be equal to $\frac{100+x}{15} = \frac{200-x+150}{25}$

$\Rightarrow 500 + 5x = 1050 - 3x$
$8x = 550$
$x = 68.75$ mts

Alternate method:

Distance between the rear ends of the two trains, at the instant of entry = 100 + 200 + 250 = 450 metres.
Time taken for the two ends to meet
= (distance)/(relative speed)
= 450/(15 + 25) = 11.25 seconds.
Distance covered by the slower train
= 11.25 x 15 = 168.75 metres.
The required distance = 168.75 – (length of slower train)
= 168.75 – 100 = 68.75 metres. Choice (D)

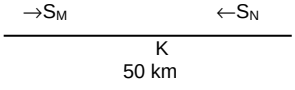
10. Distance covered by P, t hours after starting from X = at.
When Q overtakes P, he would have covered
(a + b) (t – p) = at – ap + bt – bp; and this equals at

$\Rightarrow t = \frac{p(a+b)}{b}$ ------- (1)

Let R start q hours after Q started.
Distance covered by R when he overtakes P would be
(a + 2b) (t – p – q) = at → (2)
Substituting the values of t from (1) and simplifying we get

$q = \frac{pa}{a+2b}$ Choice (D)

11.



In the above diagram, we have S_M and S_N as the speed of M and N and K is the meeting pointing of M and N.
As distance = (Relative speed) (time),
$(S_M + S_N)5 = 50$.
$S_P + S_Q = 10$ -------- (1)
After M and N meet, they move towards their destinations which they reach at the same time; i.e., the times of travel are equal.

Hence $\frac{5S_M}{S_N+1}=\frac{5S_N}{S_M-1}$

$S_M^2 - S_M = S_N^2 + S_N$ --------- (2)

Substituting (1) in (2) and solving we have

$S_M = 5.5$ kmph

Alternate method:

If 't' is the time taken to meet, and t_1, t_2 are the durations taken after the meeting to reach the respective destinations then, $t = \sqrt{t_1\, t_2}$. But it is given $t_1 = t_2$.

Hence $t = \sqrt{t_1^{\,2}}$ or $t = t_1 = t_2$ -------- (1)

But it is given t = 5

$\therefore t = t_1 = t_2 = 5$ hours.

M travelled for 5 hours at x kmph and for another 5 hours at (x – 1) kmph.

$\therefore 5x + 5(x - 1) = 50 \Rightarrow x = 5.5$ kmph Ans: (5.5)

12. Distance ran by the thief in 10 minutes = 1km

Distance moved by the jeep in 10 minutes = 1·5km

Distance between the jeep and the thief when the jeep found a gap in the median = 2.5 km

Additional time in which the jeep would overtake the thief

$= \frac{2\cdot 5}{9-6}=\frac{5}{6}$hours = 50 minutes

$\therefore$ Total time = 60 minutes. Choice (D)

13. Let the speeds of Anand and Bala be x kmph and y kmph respectively

Distance traveled by them when they met are 6x km and 6y km respectively.

$\frac{6y}{x}-\frac{6y}{y}=5$

$\frac{y}{x}-\frac{x}{y}=\frac{5}{6}=\frac{3}{2}-\frac{2}{3}$

Comparing both sides, $\frac{y}{x}=\frac{3}{2}$

Total time = $\frac{6y}{x}+\frac{6x}{y}=6\left(\frac{3}{2}+\frac{2}{3}\right)=13$hours .

Choice (C)

14. Let XY be d km

Let the points of their first and second meetings be denoted by A and B respectively.

XA : AY = 30 : d – 30

Ratio of the distances covered by man starting from X and man starting from X when they meet for the second time

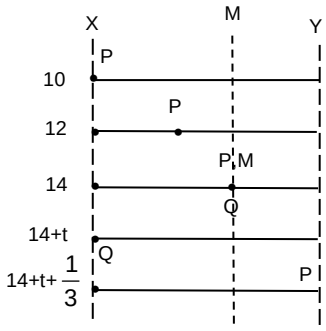
= XY + YB : YX + XB

= d + 20 : d + d – 20

$\frac{d+20}{2d-20}=\frac{30}{d-30}$

d = 70. Ans: (70)

15.



Let the speeds of P and Q be p kmph and q knph respectively.

Time taken by P and Q to reach their meeting point are 4 hours and 2 hours respectively. Let M be the meeting point.

XM = 4P and YM = 2q

Let the time taken by Q to cover MX be t hours

$\therefore$P takes $t + \frac{1}{3}$ hours to cover MY.

We have $\frac{4}{t}=\frac{t+\frac{1}{3}}{2}$

$\Rightarrow 8 = t\left(t+\frac{1}{3}\right) \Rightarrow (3t - 8)(t + 3) = 0$

$t = \frac{8}{3}\left(\because t > 0\right)$. $\therefore$Q reached his destination

at $\left(2\text{p.m}+\frac{8}{3}\text{hours i.e. at}\right)$ 4 : 40 p.m Choice (B)

Solutions for question 16:

Let us say Anil turned back after t hr. He would have covered 50t km then. Chetan would have covered 10t km. $\therefore$ The two would be 40t km apart. They would meet in $\frac{40t}{10+50}$more hr .i.e., $\frac{2t}{3}$ hr. In this time, Chetan would have covered $\frac{20t}{3}$ km while Anil would have covered $\frac{100t}{3}$ km. Also Bala would have covered $\frac{2t}{3}$ km.

When Anil picks up Chetan he would be 40t km behind Bala. Also the ratio of the speeds of Anil and Bala is 5 : 1. Anil (with Chetan) would catch up with Bala, when he covers 5x and Bala covers x

$\therefore 5x - x = 40t$.

The bike and Bala would have covered distances of 50t km and 10t km respectively

XY = $10t + \frac{20}{3}t + 50t = \frac{200t}{3}$km = 40km

$\Rightarrow t = \frac{3}{5}$

16. (i) Time after which Anil turned back = $\frac{3}{5}$ hours

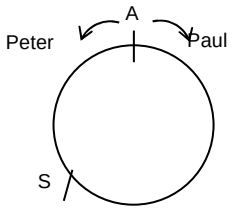
= 36 minutes Choice (C)

(ii) Bala's average speed = $\frac{40}{t+\frac{2}{3}t+t}=25$km/hr

Choice (D)

Note: The distance covered by Chetan until he was picked up by Anil is the same as that covered by Bala from the point he was dropped.

17. Since Peter and Paul start at A and have the ratio of their speeds as 1 : 2, first time when they meet say at S, the distances covered by them respectively were in the ratio 1 : 2 i.e., Peter would have covered 200 m and Paul would have covered 400 m



At the point S, the ratio of speeds will now become 2 : 1
So, Peter will cover 400 m and reach A and Paul will cover 200 m and reach A. So, the 2nd meeting point will be at A, the 3rd meeting point will be at S and the 4th meeting point will be at A and so on.
So, by the time they meet for the 8th time i.e., at A, Peter would have covered 4 rounds.
Now, both are at A.
When Peter covers 1/4th round, (i.e., 150 m),
Paul will cover 1/2 round, (i.e., 300 m)
Distance between them is either or 150 + 300
= 450 m or 600 – (150 + 300) = 150 m. Ans: (150)

18. Let the speeds of the faster and the slower runners be x kmph and y kmph respectively. Time to meet for the first time is:

$\frac{3}{x-y}$ hrs, and this is given as 1 hour.

Hence [3/(x – y)] = 1 ---------- (1)
Time taken, by the faster and the slower runners respectively, for one lap are $\frac{3}{x}$ and $\frac{3}{y}$ hrs. As the difference of the above times is given as 2 minutes,

$\frac{3}{x}=\frac{3}{y}-\frac{1}{30}$ ---------- (2)

From (1), we get y = x – 3 which, when substituted in (2) and solved for y, we get y = 15 kmph.

Alternate method:

The faster runner overtakes the slower runner once in every hour. This implies that the number of rounds (or laps) of the track made by the faster in 1 hour is more than the rounds made by of the slower by 1. Let the slower complete n rounds in 1 how; then the faster completes (n + 1) rounds in 1 hour.
Time taken by the faster to complete 1 round is less than that of the slower by 2 minutes, i.e., (1/30)th hour.

$\Rightarrow \frac{1}{n}-\frac{1}{n+1}=\frac{1}{30};$

$\Rightarrow \frac{1}{n(n+1)}=\frac{1}{30};$

$\Rightarrow n^2 + n – 30 = 0; (n + 6) (n – 5) = 0$
Ignoring the negative value, n = 5.
Track length is 3 km; hence for 5 rounds, the distance covered is 15 km; and the speed is 15 kmph.
Choice (C)

19. Since Pramod runs at half the speed of Prakash, they meet once for every round Pramod makes or for every 2 round Prakash makes.
∴ If they meet 11 times, Pramod makes 11 round and Prakash makes 22 round i.e., Prakash covers 11 times the circumference more than Pramod, i.e., 11(22/7) (7) (2)m
= 484 m Ans: (484)

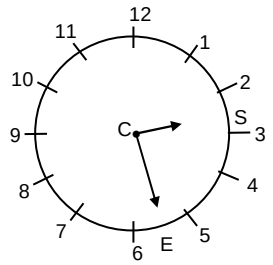
20. Let the speeds of P and Q be p km / hr and q km/hr respectively.
Same direction: Initial position of P was behind that of Q. When P catches up with Q for the second time, the difference of the distance covered by them would be (XY + track length) i.e. 8 km.

$\frac{8}{p-q}=\frac{40}{60}$ . . . . . (1) (when the two meet, p would have covered a greater distance ∴ p > q)

Opposite direction $\frac{6-2}{p+q}=\frac{12}{60}$ . . . . . (2)

Solving (1) and (2) p = 16 and q = 4 Choice (A)

21.



The angle of rotation of minute hand
= 6 degrees / minute.
The angle of rotation of hour hand
= (1/2) degree/minute.
If the duration of the test is 't' minutes, then the sum of the angles of rotation of the two hands is 6t + t/2
= 13t/2 degrees ---------- (1)
The test started between 2 and 3 o' clock, when the hour hand was pointing at S (in the diagram) and the minute hand was pointing at E (in the diagram).
The test ended between 5 and 6 o' clock, and the position of the two hands got interchanged.
This implies that the duration of the test is less than 3 hours; (because 3 hours would have been completed if the minute hand came to the point E.)
During the test period, the minute hand completes 2 rounds of the dial, and falls short of the angle SCE for the 3rd round; but the hour hand rotates through the angle SCE.
Hence, sum of the angles of rotation of both the hands = angle of rotation for 3 rounds of the dial
= 360 x 3 = 1080 degrees. ---------- (2)
From (1) and (2),

$\frac{13t}{2}=1080; t=\frac{2\text{ x }1080}{13}$ minutes

$=\frac{2\text{ x }1080}{13\text{ x }60}\text{hours}=2\frac{10}{13}\text{hours}.$

Alternate method:
Let the time at start be p minutes past 2 and the time at the end be q minutes past 5.
∴ At the start, angle made by minutes hand = 6p;
hours hand = 60 + p/2.
At the end of the test, the angles are:
minute hand = 6q
hour hand = 150 + q/2
Since the positions interchange
6p = 150 + q/2 → (1)
60 + p/2 = 6q → (2)

$6(p-q)=90-\left(\frac{p-q}{2}\right)$

$\frac{13}{2}(p-q)=90$

$(p-q)=\frac{180}{13}\rightarrow(1)$

We know that the duration from 2 : p to 5 : q is
3 hours + (q – p) minutes = 180 + (q – p) minutes
Substituting from (1)
= 180 – 180/13 = 180 x 12/13 minutes
= (180 x 12)/(13 x 60) hours

= 36/13 hours = $2\frac{10}{13}$ hours Choice (B)

22. Starting from 12 noon, angle moved by the hour hand
= (4 x 30) + (30 x ½) = 135
Angle covered by minute hand
= (4 x 360) + (30 x 6)
= [(4 x 0) + 180] = effectively 180.
Angle between the hands of the clock at 4:30 p.m.
= 180 – 135 = 45° Choice (D)

23. The first clock will show the correct time when it gains 24 hours. It gains 4 minutes every hour.

To gain 24 hours, $24 \times \frac{1}{(4/60)} = 360$ hours, are required.

The second clock will show the correct time when it loses 24 hours. It loses 6 minutes per 1 hour
To lose 24 hours, it requires,

$24 \times \frac{1}{(6/60)} = 240$ hours.

If both of them have to be correct, then LCM of (360 and 240 i.e. 720) hours or 30 days exactly are required.
So, at 8:00 a.m. on 31st January both the clocks will show the correct time. Choice (D)

24. The hands of the correct clock coincide every $65\frac{5}{11}$ minutes.

$\therefore$ The first clock loses $80 - (65^5/_{11})$
$= 160/11$ min per 80 min

The second clock gains $65\frac{5}{11} - 65$
$= (5/11)$ min per 65 min
In 24hours, the first clock loses
$[24 \times 60 \times 160/11] \times 1/80$
The second clock gains in 24 hours
$[24 \times 60 \times 5/11] \times 1/65$

Time difference $= \frac{24 \times 60 \times 2}{11} + \frac{24 \times 60}{11 \times 13}$

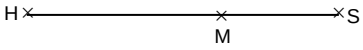
$= \frac{24 \times 60}{11}\left[2 + \frac{1}{13}\right] = \frac{24 \times 60 \times 27}{11 \times 13} = 271.89$ minutes
$\cong 272$ minutes Choice (A)

25. City P must be to the west of city Q. Let the local time difference between the cities be t hrs.

Method 1
The speed of A each way is the same
$\therefore$ The travel time each way must be same
Travel time from P to Q = (4 – t) hrs
Travel time from Q to P = (2 + t) hrs
4 – t = 2 + t
t = 1 and 4 – t = 2 + t = 3
PQ = 800(3) = 2400

Method 2
Total distance traveled=2PQ = 800(4 – t) +800 (2 + t)
= 800(6) PQ = 2400 Ans: (2400)

26.



Let H be the home, S be the school and M be the point where Anwar and his wife meet.
As Anwar travels always at the same speed of 30 kmph, ratio of HS to HM shall be same as the ratio of times of travel.
$\Rightarrow$ (HS/HM) = [(6PM – 4PM)/2]/[(5.45 PM – 4.0 PM)/2]
$\Rightarrow$ (HS/HM) = (2 hrs/2)/(1 hr 45 min/2) = 1/(7/8) = 8/7
$\Rightarrow$ (HM + MS)/HM = [1 + MS/HM] = 1 + (1/7)
$\Rightarrow$ (MS/HM) = 1/7
As HM and MS are covered by Anwar and the wife during the same time interval, (MS/HM) shall be equal to the ratio of their speeds.
$\Rightarrow$ (1/7) = (speed of the wife)/speed of Anwar
= (speed of wife)/30
$\Rightarrow$ speed of the wife = (30/7) kmph. Choice (A)

27. Let the time taken by L to run 500 m be t_L.
Time taken by M to run 500 m = $t_L + 40$
If M and N run a 500 m race, time taken by N = $t_L + 40 + 40$
$= t_L + 80$

Since L beats N by 125 m, and as they run for the same time; ratio of speeds of L and N will be

$= \frac{500}{500 - 125}$ -------- (1)

L and N, individually cover the distances of 500 m in t_L seconds and $(t_L + 80)$ seconds respectively.

Hence, ratio of their speeds = $\frac{t_L + 80}{t_L}$ ---------- (2)

From (1) and (2)

$\frac{t_L + 80}{t_L} = \frac{500}{375}$

Solving, we have $t_L = 240$ sec.
Time taken by M to run the race = 240 + 40
= 280 sec Choice (C)

28. During the time Rahim covers 600 metres, Saleem covers 300 m, as Rahim's speed is double that of Saleem. During the time Rahim covers the balance 400 metres, Saleem covers 400 m, as their speeds are equal. Saleem had a head start of 200 m and he covers (300 + 400) = 700 m. Hence, when Rahim is at finishing point, Saleem is at 200 + 700 = 900 m metres. Saleem takes 20 seconds to cover the balance 100 m. Saleem's speed = 5 m/s. Choice (B)

29. First condition gives $4(b - s) = b + s \rightarrow$ (I)
where, b = speed of the boat in still water (kmph) and s = speed of stream (in kmph)
Second condition gives $10/b = 2 \Rightarrow b = 5 \rightarrow$ (II)
From (I), (II)
$4(5 - s) = 5 + s \Rightarrow s = 3$
$\therefore$ Speed of the stream = 3 kmph Ans: (3)

30. Let the speed of the stream be y, then the speed of the boat in still water will be y + 8
Upstream speed = y + 8 – y = 8 kmph.
Hence, upstream time = (96/2)/8 = 6 hours
Time for downstream = 9 – 6 = 3 hours. Choice (A)

31. Let the number of steps on either escalator be S
Let the speed of the person be x steps / sec and that of either escalator be y steps / sec

$S = 90 (x - y) = 18 (x + y) \quad \Rightarrow x = \frac{3}{2} y$

$\therefore S = 45y$

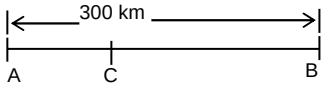
Time taken to go up / down (in seconds) using either escalator, if it is switched off = $\frac{S}{x} = \frac{45y(2)}{3y} = 30$

Ans: (30)

32. In 11 minutes, 4½ tonnes of water is admitted by the leak.
In 1 minute, the leak admits = 9/2 x 1/11
= 9/22 tonnes of water.
In 1 minute, the pumps can throw out 1/5 tonnes
The net inflow of water per minute = (9/22) – (1/5)
= 23/110 tonnes
Time taken to accumulate 184 tonnes of water
184/(23/110) = 880 minutes
Average rate of sailing so that the boat may just reach the shore as she begins to sink = 154/880
= 10.5 kmph Choice (A)

33. If the car was stationary, the gunfire would have been heard at an interval of 24 seconds. But because it is moving towards the source of the sound, sound of the second gunfire was heard after an interval of 22 seconds only. The distance sound would have travelled in 2 seconds is the distance travelled by the car in 22 seconds.
$\therefore$ 330 x 2 = V x 22 where V is the speed of the car
$\therefore$ V = 30 m/sec Ans: (30)

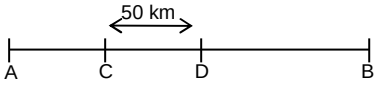
34.



Let the car develop an engine problem at point C. So, it covers CB at 3/4th of its original speed. New time taken = 4/3rd of the original time taken to cover CB.

Given $\left(\frac{4}{3}-1\right)t=\frac{1}{3}(t)=80,$

where, t is the original time taken to cover CB.
t = 240 minutes.---------- (1)
When the problem develops 50 km further on, (i.e., at point D)



Let t, be the time taken to travel the distance DB, if the car had moved with normal speed.

$\frac{1}{3}t_1=(80-20)=60$

$\Rightarrow$ t_1 = 180 minutes. (As the car reached 20 minutes sooner) --------- (2)
From (1) and (2)
Time taken to cover 50 km = (240 –180)
= 60 min = 1 hr
Speed of the train = 50 kmph.

AC = $300-\left(\frac{240}{60}\right)(50)$ = 300 – 200 = 100 km

Choice (A)

35. Let the length of a round be R km. Let the speed at which Hari walked be s km/hr

$3s + 5\left(\frac{R}{S}\right)=9R$

$4s+10\left(\frac{R}{S}\right)=14R$

Solving these, s = $\frac{5}{3}\left(\text{and } R=\frac{5}{6}\right)$ Choice (A)

Exercise – 5(b)

Solutions for questions 1 to 50:

1. Distance = speed x time = (36 x 5/18) x 20
= 200 m Choice (D)

2. Let the times taken for traveling to the town by train and by car be x hours and y hours respectively
Given, x + y = 16 and 2y = 16 – 4 = 12
$\therefore$ y = 6
$\therefore$ x = 10
$\Rightarrow$ 2x = 20
$\therefore$ He would lose 4 hours. Ans: (4)

3. Let the original time taken be 't'. Since, his speed increases to 3 times his original speed, new speed = (3) (original speed) $\Rightarrow$ New time

= $\frac{\text{original time}}{3}$

Given, $t-\frac{t}{3}=40;\ \Rightarrow \frac{2t}{3}=40\ \Rightarrow$ t = 60 sec.

Choice (D)

4. Let his usual time be x minutes. Let the distance be d km

Usual speed = $\frac{d}{x}\ \frac{\text{km}}{\text{minute}}$

If Ashok traveled at $\frac{4}{5}$th of his usual speed, his usual speed, his time = $\frac{d}{\frac{4}{5}\frac{d}{x}}=\frac{5}{4}x$ minutes

$\frac{5}{4}x-x=15$

x = 60

If Ashok traveled at $\frac{6}{5}$th of his usual speed, his time

= $\frac{d}{\frac{6}{5}\frac{d}{x}}=\frac{5}{6}x$

He would be early by $\frac{1}{6}x=10$ minutes.

The ratio of speeds of Ashok in three instances i.e., usual speed, 4/5th speed and 6/5th speeds, is s : 4s/5 : 6s/5 i.e., 5 : 4 : 6.

As speed $\alpha\frac{1}{\text{time}}$, time taken ratio is $\frac{1}{5}:\frac{1}{4}:\frac{1}{6}$ i.e., 12 : 15 : 10.
Given, 3 parts is representing 15 minutes, hence 2 parts will represent 10 minutes. Choice (B)

5. By formula

$\frac{vu}{v-u}(p+q)=$ distance

$\Rightarrow \left(\frac{v\,x\,8}{v-8}\right)\frac{24}{60}=16$

$\Rightarrow \frac{8v}{v-8}x\frac{2}{5}=16$

$\Rightarrow$ v = 5v – 40 $\Rightarrow$ 40 = 4v $\Rightarrow$ v = 10 kmph

Alternate method:

$\frac{d}{s_1}-\frac{d}{s_2}=$ difference of times of travel

$\frac{16}{8}-\frac{16}{s_2}=\frac{15+9}{60}=\frac{24}{60}=\frac{2}{5}$

Solving, s = 10 kmph Choice (A)

6. Let the total distance covered be 100d km

$\frac{50d}{15}+\frac{30d}{18}+\frac{20d}{45}=9.8\ \Rightarrow d=1.8$
and 100d = 180 Ans: (180)

7. Time after which they meet = $\frac{84}{36+27}=\frac{4}{3}$hours

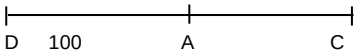
$\therefore$The first person will cover 36 x 4/3 = 48 km in this time.
So, they will meet 48 km from P. Choice (D)

8. Let the speeds of the faster car and the slower car be x kmph and y kmph respectively.

Given, $\frac{80}{x+y}=1\Rightarrow$ x + y =80 ——— (1) and

$\frac{80}{x-y}=4\ \Rightarrow$ x – y = 20 ——— (2)
Solving (1) and (2), x = 50 Ans: (50)

9.



The cat runs away from an initial point A for 1 minute at a speed of 24 kmph.
∴ AC = 24 x 60 x 5/18 = 400 m
Now, the dog is separated from the cat by a distance of 100 + 400 (DA + AC) = 500 m and this lead has to be covered at a speed of (33 – 24)
= 9 kmph i.e., relative speed.

$\therefore$ Time = $\frac{500}{9 \times \frac{5}{18}}$ = 200 sec

But, if the time is required from the start of the cat's run, 1 minute has to be added. i.e. 200 + 60 = 260 seconds.
Choice (C)

10.

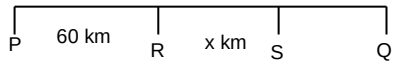
When 'B' starts from city P towards city Q, the distance which 'A' would already have covered = 54×3 = 162 km.
At 9 a.m., train B is separated from train 'A' by a distance of 162 km.
Train B overtakes train A after a time of

$\frac{162}{(72-54)} = \frac{162}{18}$ hrs = 9 hrs.

In 9 hrs, the distance travelled by B = 72×9
= 648 km.
Distance from city Q, when they meet
= (1440 – 648) = 792 km Choice (B)

11. By 10:00 a.m, A would have traveled 120 km. At 10:00 a.m, distance between A and B = 145 km. In another hour A and B would have traveled 60 km and 40 km repeating both cars would have together traveled 100 km
∴ At 11:00 a.m, distance between A and B = 45 km. In the next half an hour, A would travel 30 km while B would be stationary. By 11:30a.m, A would have traveled 210 km. Now it would stop for 20 minutes. At 11:30a.m, B would resume its journey and would be 15 km from S. It would reach S in another 22·5 minutes.
∴ Time of meeting = 11:52. 30 a.m. Choice (C)

12.



Suppose the trains met at S. Let RS = x km

$\frac{PS}{90} = \frac{RS}{60} = \frac{SQ}{120} + 1$

$\frac{60+x}{90} = \frac{x}{60}$

120 = x

$\therefore \frac{RS}{60} = 2 = \frac{SQ}{120} + 1$

SQ = 120 km
PQ = PR + RS + SQ = 300 km. Ans: (300)

13. Let the speeds of the cars leaving P and Q be p kmph and q kmph respectively.
px = qy ——— (1)
pz = qx ——— (2)
Dividing (1) by (2),

$\frac{x}{z} = \frac{y}{x}$

$x = \sqrt{yz}$. Choice (C)

14. Let the time taken by Gopi to reach K after meeting Ram, be t_G. Then, we have $\frac{2}{3} = \sqrt{\frac{t_G}{t_G^2 - 7}}$

Squaring both sides and solving for t_G we get t_G = 4 hours. Distance between K and L = Distance covered from the meeting point to L by Ram + the Distance covered from the meeting point to K by Gopi = $2(4^2 - 7) + 3(4)$ = 30 km
Choice (C)

15. Anand and Ajay would meet for the first time during their onward journeys. They would meet for the second time during their return journeys. Time taken by Anand to travel from M to N = $\frac{8}{3}$ seconds.

Distance travelled by Ajay in this time = $\frac{8}{3}(5) = \frac{40}{3}$ m.

$\therefore$ He would be $\frac{40}{3} - 8 = \frac{16}{3}$ m from N when Anand reached N.

$\therefore$ Distance between them would then be $8 - \frac{16}{3} = \frac{8}{3}$ m.

Anand would cross Ajay in another

$\frac{\frac{8}{3}}{\text{Relative speed}} = \frac{1}{3}$ seconds.

$\therefore$ Ajay would have travelled a distance of $\frac{40}{3} + \frac{1}{3}(5) = 15$ m when he crossed Anand for the second time. Choice (C)

16. Let the speeds of Anand and Ashok before the meeting be x kmph and y kmph respectively

$1 = \frac{10}{x+y} \Rightarrow x + y = 10$ ——— (1)

Distances travelled by Anand and Ashok before meeting are x km and y km respectively. As they reached their destinations simultaneously,

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

2 = x – y ——— (2)
Solving (1) and (2), x = 6. Ans: (6)

17. Let his forward and return speeds be x kmph and y kmph respectively.

Average speed = $\frac{2xy}{x+y}$

Given, $\frac{2xy}{x+y} = \frac{x+y}{2}$

$\Rightarrow (x + y)^2 - 4xy = 0$
$\Rightarrow (x - y)^2 = 0$
$\Rightarrow x = y$

$\therefore \frac{2xy}{x+y} = x$

$\therefore$ Forward speed = Average speed = $\frac{1200}{12} = 100$ kmph

Choice (A)

18. From the given data, which is about the speeds of travel and the average speed, in terms of a variable x, the average speed can be determined. As no information about the total time is available, distance cannot be calculated. The same can be seen from the calculations shown below.
Let the total distance AB be d.

$$\text{Total time} = \frac{\left(\frac{d}{3}\right)}{x} + \frac{\frac{1}{4}\left(\frac{2d}{3}\right)}{2x} + \frac{d - \left(\frac{d}{3} + \frac{1}{4}\left(\frac{2d}{3}\right)\right)}{3x}$$

$$= \frac{d}{x}\left(\frac{1}{3} + \frac{1}{12} + \frac{1}{6}\right) = \frac{d}{x}\left(\frac{7}{12}\right)$$

$$\text{Average speed for the entire journey} = \frac{d}{\frac{d}{x}\left(\frac{7}{12}\right)}$$

= 12x/7 = x + 2, 5x/7 = 2, x = 14/5 kmph
Total distance the person covers cannot be determined as total travel time is unknown. Choice (D)

19. AB = BC

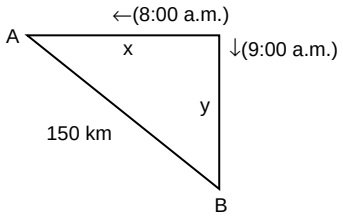
(i) Average speed = $\frac{(2)(4)(6)}{4+6}$ = 4·8 kmph
Choice (C)

(ii) Using similar method as shown in (i), average speed of Rahul from C to A = 4·8 kmph i.e., same as that from A to C.
∴ Average speed of Rahul for his journey
= 4·8kmph. Choice (C)

(iii) Time taken for his journey = $\frac{\text{total distance}}{\text{Average speed}}$

= $\frac{(0\cdot48)(4)}{4\cdot8} = 0\cdot4$ hours. Choice (C)

20.



The distances covered by C and D are x and y respectively. Since C starts early compared to D, he covers more distance by noon compared to D. Hence x > y. If speed of each car is s.
x = 4s and y = 3s
$x^2 + y^2 = (150)^2$ (by Pythagoras theorem)
Taking x = 4s, y = 3s and solving for s we have,
s = 30 kmph. Ans: (30)

21. Let the time he would take to reach Q be x minutes
Speed of his car in the xth minute
= 51 + x – 1 = (50 + x) km/hr

$$PQ = \frac{1}{60}(51 + 52 + ...(50 + x))$$

$$\Rightarrow \frac{1}{60}(50 + 1 + 50 + 2 + ...50 = x) = \frac{3775}{60}$$

$\Rightarrow$ 50x + 1 + 2 +…….x = 3775

$$\Rightarrow x\left(50 + \frac{x+1}{2}\right) = 3775$$

$\Rightarrow$ x (101 + x) = 7550 i.e., (50) (101 + 50)
Comparing both sides, x = 50. Choice (D)

22. Let the distance it traveled without any problem be d km. Distance it traveled at the reduced speed = (600 – d)km.
Let its usual speed by S kmph

Given, $\frac{d}{s} + \frac{600-d}{\frac{4}{5}s} = \frac{600}{s} + 1$ ——— (1)

$$\Rightarrow \frac{d+150}{S} + \frac{450-d}{\frac{4}{5}s} = \frac{600}{s} + \frac{1}{2} \text{ ——— (2)}$$

Subtracting (1) from (2),

$$\Rightarrow \frac{150}{s} - \frac{(150)s}{4s} = \frac{-1}{2}$$

$\Rightarrow$ S = 75
Substituting S in (1) or (2),
d = 300. Choice (D)

23. Let the speed of his son be x kmph.
As Ashwin returned home 20 minutes early, he saved a travel of 10 minutes to school from the meeting point and the return journey of 10 minutes. Distance he saved travelling each way = Distance travelled by his son by walk. His son would have walked for 50 minutes.

$$(x)\left(\frac{50}{60}\right) = (55)\left(\frac{10}{60}\right)$$

x = 11 kmph Ans: (11)

24. Since R has given S a start of 2 hours and arrives at the destination 12 minutes after S, he takes 1 hr 48 min (9/5 hrs) less than S to reach the meeting point compared to S. If the speed of R is x, we have, $\frac{36}{x-18} - \frac{36}{x} = \frac{9}{5}$
Solving this equation, we have x = 30 kmph
Choice (C)

25. Let the length of the race be dm
When Mohan finished the race, Sohan would have run (d – 40)m and Rohan would have run (d – 104)m.
When Sohan finished the race, Rohan would have run (d – 80)m.
∴ Ratio of speeds of Sohan and Rohan

$$= \frac{d-40}{d} \times \frac{d}{d-104} = \frac{d}{d-80}$$

$\Rightarrow$ (d – 40) (d – 80) = d (d – 104)
$\Rightarrow$ d = 200. Ans: (200)

26. (i) Distances run by Bhavan and Charan when Amar finishes the race are (d – x)m and (d – y)m respectively.
∴ Ratio of speeds of Bhavan and Charan = d – x:d – y
∴ When Bhavan finishes the race, Charan would have run $\frac{d-y}{d-x}(d)$ m

∴ Bhavan would beat Charan by $\left(d - \frac{d-y}{d-x}(d)\right)$ m

= $\frac{(y-x)d}{d-x}$m Choice (B)

(ii) When Amar finishes the race, Bhavan would have run (d – x)m. When Bhavan finishes the race, Charan would have run (d – y) m. Ratio of speeds of Amar and Chetan = (Ratio of speeds of Amar and Bhavan) (Ratio of speeds of Bhavan and Chetan)

$$= \frac{d}{d-x} \quad \frac{d}{d-y} = \frac{(d)\ (d)}{d^2 - (x+y)d + xy}$$

$$= \frac{d}{d - \left(x + y - \frac{xy}{d}\right)}$$

∴ When Amar finishes the race, Chetan would have run $d - \left(x + y - \frac{xy}{d}\right)$m Choice (D)

27. As Ajay gives Bala a start of atleast 20m, Bala has to run a maximum distance of 80m. As he is beaten by Bala by atmost 20m, Ajay would have run a minimum of 80m when Bala finishes the race. As the speeds of both are distinct, Bala must have run less than Ajay when Ajay finished the race.
∴ Ajay is faster than Bala. Choice (D)

28. B covers 25 m in 5 s
∴ Speed of B = 5 m/s
Hence time taken by B = 500/5 = 100 s
Time taken by A = (100 – 5) = 95 s

Speed of A = 500/95 = 100/19 = $5\frac{5}{19}\text{m/sec}$

Choice (B)

29. When Raja finishes the race, Rakesh would have run
200 – (20 + 20) = 160m

∴ Ratio of the speeds of Raja and Rakesh = $\frac{200}{160}=\frac{5}{4}$

As Raja beats Rakesh by 20m and also beats him by 4 seconds, Rakesh must have taken 4 seconds to run the last 20 m.

∴ speed of Rakesh = $\frac{20}{4}=5\text{m/sec}$

∴ speed of Raja = $\frac{5}{4}(5)=6\cdot25\text{m/sec}$. Ans: (6.25)

30. Let the time taken by Ram to run the race be t seconds. Time taken by Shyam to run the race = (t + 60) seconds. Time taken by Tarun to run the race
= (t + 90) seconds. Ratio of speeds of Ram and Tarun

$$= \frac{1000}{1000-250}\frac{\frac{1000}{t}}{\frac{1000}{t+90}}$$

$$\frac{4}{3}=\frac{t+90}{t}$$

t = 270. Choice (B)

31. Let Karna's speed = k
Kiran's speed = b
Kumar's speed = r
∴100/k = 80/b ------- (1)
(100/b) + 7.5 = 100/r ---------- (2)
Given that k = 2r
∴(100/b) + 7.5 = 160/b
⇒ 7.5 = 60/b
b = 8 m/s Ans: (8)

32. Distance travelled by Habib/Distance travelled by Akram = 500/440
Let the length of the pace of Habib be x and that of Akram be y.
Ratio of speeds = ratio of distances covered in equal intervals of time = (5x/4y)
∴ 5x/4y = 500/440
x/y = 10/11 Choice (A)

33. Initial speed of Donald = b kmph
Initial speed of Allen= a kmph

Total time taken by Allen= $\frac{d}{2a}+\frac{d}{2x}$ where x is the speed for the 2nd half of the distance.

Total time taken by Donald = $\frac{d}{b}$.

∴(d/2a) + (d/2x) = (d/b);

$$\frac{1}{2a}+\frac{1}{2x}=\frac{1}{b},\ \left(x=\frac{ab}{2a-b}\right)$$

Alternate method:

Distance = d km; speed of Donald = b kmph.
Here, total time taken by Donald
= (d/b) hours -----(1)
Time taken by Allen = Time taken by Donald
(given data) = (d/b) hours ------- (2)
Time taken by Allen for the first half
= (d/2)/a = (d/2a) -------- (3)
Hence the time taken by Allen for the second half
= (d/b) – (d/2a) (from (2) and (3)
= d(2a – b)/2ab --------- (4)
Speed of Allen while covering the second half
= (d/2)/[d(2a – b)/2ab]

$= \frac{d \text{ x } 2ab}{2d\,(2a-b)} = (ab)/(2a-b)$ kmph. Choice (D)

34. The distance is covered in the same time by both of them and since Donald travels at a constant speed of b, Allen's average speed will be equal to Donald's speed = b km/hr.
Choice (D)

35. Let the length and the speed of the train be Lm and S m /sec respectively

Given, $\frac{L+200}{S}=30\Rightarrow L+200=30S$ ——— (1)

Given, $\frac{L+300}{S}=40\Rightarrow L+300=40S$ ——— (2)

Subtracting (1) from (2), 100 = 10s ⇒ 10 = S
From (1) or (2), L = 100m. Ans: (100)

36. Let the length and the speed of the train be Lm and S m/sec respectively.
L = 60s

$$L+3600=240\,(S\pm(54)\left(\frac{5}{18}\right)$$

60S + 3600 = 240 (S ± (15)
60S + 3600 = 240S + 3600
or 60S + 3600 = 240S – 3600
S = 0 or 20
As S = 0 is not possible, S = 20
∴ Speed of the train = 144 kmph. Choice (B)

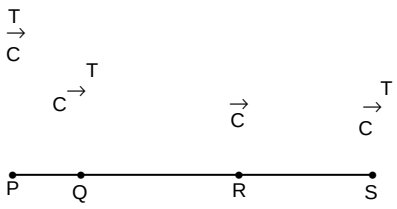
37. Let the length and the speed of the train be Lm and Sm/sec respectively

$$L=120\left(S-(18)\left(\frac{5}{18}\right)\right) \quad \text{- - - - -} \quad (1) \text{ and}$$

$$L=90\left(S-(9)\left(\frac{5}{18}\right)\right) \quad \text{- - - - -} \quad (2)$$

Solving (1) and (2), we have
S = 12·5
∴ L = 900 Choice (D)

38.



Let the speed of the train be V m/s

Then $\frac{360}{V-20}=12$; V = 50 m/s

Similarly let the speed of the cyclist be V_1m/s

$$\frac{360}{50-V_1}=9$$

V_1 = 10 m/s

Let P be the point where the train begins to overtake the car Q be the point where the train completely overtake the car R be the point where the car is, when the train begins to overtake the cyclist
S be the point where the train begins to overtake the cyclist.
In 48 min, when it is just about to overtake the cyclist, it will cover (48) (60 (50) m, i.e. QS = 48(60) (50)m i.e. QR = 48(60) (20)m
And the car will cover (48) (60) (20) m
At this instant the distance between the car and the cyclist RS is 360 + (48) (60) (50 – 20)
= 360 + (48) (60) (30)
This distance has to be covered with a relative speed of (20 – 10) = 10 m/s

$\therefore$ Time required = $\frac{360+(48)(60)(30)}{10}$

= 36 s + 144 min = 2 hr 24 min 36 s
As the time required is the time after the train overtook the cyclist, it is 9 seconds less; i.e., 2 hr.24 min 27 s.

Choice (D)

39. Speed of the boat upstream = $\frac{30}{5}=6$ kmph

Speed of the boat downstream = $\frac{24}{3}=8$ kmph

Speed of the boat in still water = $\left(\frac{8+6}{2}\right)$ kmph = 7 km/hr

Speed of the water current = $\left(\frac{8-6}{2}\right)=1$ kmph

Choice (C)

40. Let the seed of the boat in still water and the speed of the river be x kmph and y kmph respectively. Let the time taken for the downstream journey be t hours. Time taken for the upstream journey = (9 – t) hours.
(x + y) t = 24
(x – y) (9 – t) = 24
In still water,
y = 0
$\therefore\ x=\frac{24}{9-5}=6$
(6 + y) t = 24 ——— (1)
(6 – y) (9 – t) = 24 ——— (2)
Solving (1) and (2), y = 2. Ans: (2)

41. Let the speed of the boat in still water and the speed of the river be x kmph and y kmph respectively.

Given $\frac{x^2-y^2}{x}=6$

Let the round trip journey be covered between two points d km apart. Total time for the journey

$=\frac{d}{x+y}+\frac{d}{x-y}=\frac{2dx}{x^2-y^2}$ hours

Average speed = $\frac{2d}{\frac{2dx}{x^2-y^2}}=\frac{x^2-y^2}{x}$. = 6

Choice (B)

42. If two or more runners have their speeds as a multiple of the speed of a runner N the time taken by these runners to meet for the first time at the starting point for the first time is the time taken by the N to complete one round.
As the speeds of Harish and Suresh and Multiples of the speed of Girish, required time = Time taken by Girish to complete 1 round = 1 minute. Ans: (1)

43. l = 1120 m
a = 10 m/s, b = 8 m/s, c = 7 m/s

(i) Required answer

$=\text{LCM}\left(\frac{l}{a-b},\frac{l}{b-c}\right)=\text{LCM}\left(\frac{1120}{10-8},\frac{1120}{8-7}\right)$

= LCM (560, 1120) = 1120 s

(ii) Required answer

$=\text{LCM}\left(\frac{l}{a},\frac{l}{b},\frac{l}{c}\right)$

$=\text{LCM}\left(\frac{1120}{10},\frac{1120}{8},\frac{1120}{7}\right)$

= LCM (112, 140, 160) = 1120 s Choice (D)

44. Radius = 35 m.
$\Rightarrow$ Circumference = 2 x 22/7 x 35 = 220 m
Time taken for them to meet for the first time at the starting point is LCM [220/20, 220/11]
= LCM [11, 20] = 220sec
To meet for the third time at the staring point from the start, they need 220 x 3 = 660 sec = 11 minutes

Choice (A)

45. Akbar completes 1 revolution in 40/5 = 8 sec
Circumference/Akbar's speed = Circumference/11
$\therefore$ Circumference = 88 m
Time taken to meet for the first time is

LCM of $\left\{\frac{88}{22-11},\frac{88}{11-7}\right\}$ i.e.,LCM of $\left\{\frac{88}{11},\frac{88}{4}\right\}$

i.e., LCM of {8, 22} = 88
So, they meet for the first time 88 seconds after the start.

Ans: (88)

46. As P's speed increases by the same amount as that by which Q's speed decreases, their relative speed remains unchanged.
$\therefore$ Time taken by them to meet for the third time = 3 (Time taken by them to meet for the first time)

$=3\left(\frac{48000}{10+30}\right)=3600\,\text{sec}$. Choice (A)

47. Time taken by them to meet for the first time

$=\frac{1800}{6+12}=100$ seconds

Distances covered by Ram and Shyam in this time are 600 m and 1200 m respectively. After the first meeting, their speeds would be exchanged. This would not affect time interval between consecutive meetings.
$\therefore$ In the next 100 seconds, Ram would have travelled 1200 m and would have reached his starting point and would meet Shyam there. In this manner
Ram completed a round. In this manner he would have completed 3 rounds. When he would have completed another $\frac{1}{4}$rounds, Shyam would have

completed $\frac{12}{6}\left(\frac{1}{4}\right)=\frac{1}{2}$ a round.

$\therefore$ Distance between them = $1800\left(1-\frac{1}{2}-\frac{1}{4}\right)=450\text{m}$.

Ans: (450)

48. Ratio of the speeds of Rohan and Sohan = 1000 :
1000 – 200 = 5 : 4
Let the speeds of Rohan and Sohan be
5x m/ minute and 4x m/ minute respectively.
$\frac{1000}{5x+4x}=111\frac{1}{9}$
x = 1

Required time = $\frac{1000}{5x-4x}=1000\,\text{seconds}$. Ans: (1000)

49.

	Correct time	Clock time
10:00 a.m.	6:00 p.m.	6 : 20
	(8 hrs)	(8 1/3 hrs)
	?	10 : 30
	(x)	(12½ hrs)

Applying the rule of proportions to the durations,

$$\frac{8}{x} = \frac{8\frac{1}{3}}{12\frac{1}{2}} = \frac{25/3}{25/2}$$

$\Rightarrow x = 12$

$\therefore$ The correct time is 10:00 a.m. + 12 hours = 10:00 p.m.

Choice (B)

50. Let the time at which he began the test be 3 : p p.m. Let the time at which he ended the test be 4 : q p.m.

Angle made by the minute hand at 3 : p p.m = 6p°. Angle made by the hour hand with the 12:00p.m position of hands is $\left(90+\frac{p}{2}\right)^\circ$

Angle made by the minute hand at 4 : q p.m = 6q°. Angle made by the hour hand at 4 : q p.m with the 12:00 p.m position of hands is $\left(120+\frac{q}{2}\right)^\circ$.

As the hands interchanged their positions,

$$6p^\circ = \left(120+\frac{q}{2}\right)^\circ \text{ ——— (1)}$$

$$\left(90+\frac{p}{2}\right) = 6q \text{ ——— (2)}$$

subtracting (1), from (2),

$$6(q-p) = -30 + \frac{p-q}{2}$$

$$q-p = \frac{-60}{13}$$

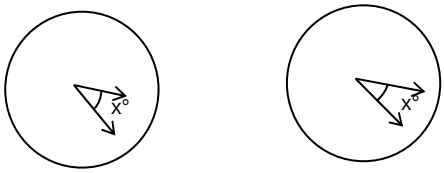
Duration for which he took the test = 4 : q p.m – 3 : p p.m

$$= 1\,\text{hr} + \frac{q-p}{60} = 1 - \frac{1}{13} = \frac{12}{13}\text{hours}.$$

Alternate method:

Starting position between 3-00 and 4-00 — Ending position between 4-00 and 5-00

(I) (II)



Let the angle between the hands of the clock be x° in the position (I) taken from the minutes hand to the hour hand in the anti-clockwise direction.

By the time the hour hand covers angle of x° to come to the position II, the minutes hand will cover (360° – x).

$\Rightarrow$ The time taken by the hour hand to cover x° is equal to the time taken by the minute hand to cover (360° – x°).

The speeds of hour hand and minute hand are 0.5° per minute and 6° per minute respectively.

$$\therefore \frac{x}{0.5} = \frac{360-x}{6} \Rightarrow x = \frac{360^\circ}{13}$$

$\therefore$ The duration of the test is $\frac{360}{13\times 0.5}$ minutes

$= \frac{12}{13}$ hours. Choice (B)

Solutions for questions 51 to 60:

51. From statement I,
speed of the train is

$$\frac{200}{10} = 20 \text{ m/s}$$

From statement II, we do not know the length of the platform, so we can't find the speed of the train.
So statement II alone is not sufficient. Choice (A)

52. Let the length of the race be L m.

In the above figure, A and B denote the starting points of Ram and Shyam respectively. D denotes the finishing points of both. C denotes the position of Ram when Shyam finished.
When Shyam covered BD, Ram would have covered AC.
BD = BC + CD = BC + y
AC = AB + BC = x + BC
If Ram had not been faster than Shyam, AC ≤ BD must have been true.
$\therefore x \le y$ must be true.
From statement I, if x = y, Ram was not faster than Shyam.
If x > y, Ram was faster than Shyam.
I. alone is not sufficient.
II. alone is sufficient. Choice (A)

53. Let the speed of Mohan's boat in still water and the speed of the stream be x kmph and y kmph respectively.
From statement I, 12 = 4(x – y)
$\Rightarrow 3 = x - y$
$\therefore x > 3$
I is sufficient.
From statement II, 12 = 3 (x + y)
4 = x + y
For $x \ge y$
$\therefore x \ge 2$
II is not sufficient Choice (A)

54. A drove for 5 hours and B drove for 4½ hours.
From statement I, $d_A + 50 = d_B$ and $d_A + d_B = 500$
$\Rightarrow d_A = 225$ and $d_B = 275$.
$\therefore$ We can find the average speed of B.

From statement II, $\frac{d_A}{5} + 5 = \frac{d_B}{4.5}$

$$\Rightarrow \frac{2d_B}{9} - \frac{d_A}{5} = 5$$

$$\Rightarrow \frac{10d_B - 9d_A}{45} = 5 \Rightarrow 10d_B - 9d_A = 225$$

We know $d_A + d_B = 500$
So we can find d_A and d_B and then the average speed.
$\therefore$ It can be answered using either statement alone.
Choice (B)

55. From statement I, speed of the river current = 2 m/s
From statement II, speed of the boat relative to the speed of the river is 1 m/s.
Using both the statements,
V – 2 = 1 where V is the speed of the boat in still water.
$\Rightarrow$ V = 3. Choice (C)

56. Statement I alone is not sufficient as time taken for the trip is not known.
From statement II alone, distance travelled in the trip = st where s is the average speed and t is the time taken for the trip.
Given (1.25s)t – st = 100 $\Rightarrow$ 0.25 st = 100
$\therefore$ st can be found
Hence II alone is sufficient. Choice (A)

57. Let the usual time be t hours.

Distance between his home and office = $a\left(t-\frac{a}{60}\right)$

$= b\left(t-\frac{b}{60}\right)$

$(a-b)\,t = \frac{a^2-b^2}{60}$

$t = \frac{a+b}{60}$

I is sufficient.

From II, as we cannot find a + b, it is not sufficient.

Choice (A)

58. Let the length of A be 3z m. Length of B = 2z m. Let the speeds of A and B be a m/sec and b m/sec respectively. Let the lengths of P_1 and P_2 be p m and q m respectively.

$\frac{3z+p}{a} = x$

$\frac{2z+q}{b} = y$

From statement I, a = b

$\therefore \frac{x}{y} = \frac{3z+p}{2z+q}$

Nothing is known about p and q.
$\therefore$ The question cannot be answered. I is not sufficient.

From statement II, p = q

$\therefore \frac{x}{y} = \frac{3z+q}{2z+q}\left(\frac{b}{a}\right)$

Nothing is known about a and b.
$\therefore$ The question cannot be answered.
II is not sufficient.

Using both statements, we get a = b and p = q

$\therefore \frac{x}{y} = \frac{3z+p}{2z+q} = \frac{3}{2} - \frac{2q}{2z+q} \therefore 1 < \frac{x}{y} < \frac{3}{2}$

We cannot answer the question.
Both statements even when taken together are not sufficient. Choice (D)

59. Let the lengths of A and B be p m and q m respectively. Let the speeds of A and B be a m / sec and b m / sec respectively.

$b = \frac{a}{2}$

$\frac{p+500}{a} = 50$ ——— (1)

Length of B = 2 p m

Required time = $\frac{2p+q}{b} = \frac{2p+q}{\frac{a}{2}}$

From statement I, q and a are unknown.
$\therefore$ required time cannot be found.
I is not sufficient.

From statement II, q = 1000

$\frac{2p+q}{\frac{a}{2}} = 4\left(\frac{p+500}{a}\right)$

From (1), this can be found. II is sufficient.

Choice (A)

60. Let the speeds of A, B and C be a m/sec, b m/sec and c m/sec respectively.

$\frac{a}{b} = \frac{1000}{1000-x}$

$\frac{b}{c} = \frac{1000}{1000-y}$

$\frac{a}{c} = \left(\frac{a}{b}\right)\left(\frac{b}{c}\right) = \frac{1000^2}{1000^2 - 1000(x+y) + xy}$

$\frac{a}{c} = \frac{1000}{1000 - \left(x+y-\frac{xy}{1000}\right)}$

A beats C by $\left(x+y-\frac{xy}{1000}\right)$ m

In each statement, x = 200

When $200 + y - \frac{200y}{1000} > 400$

$y > 250$

Using statement I, we cannot say that y > 250. A is not sufficient. As $y \le 200$, II is sufficient. Choice (A)

Chapter – 6
(Time and Work)

Concept Review Questions

Solutions for questions 1 to 35:

1. 10 men can do $\frac{1}{10}$ th of the job in a day.

$\therefore$ 1 man can do $\frac{1}{100}$ th of the job in a day.

Choice (B)

2. 6 men can eat 6 apples in 1 day.
$\therefore$ They can eat 36 apples in 6 days. Ans: (36)

3. Per min grass cut = 1/T
In 30 minutes = 30/T part will be cut. Choice (A)

4. X men $\rightarrow$ 120 days
X + 10 men $\rightarrow$ 100 days
X (120) = (X + 10) 100
$6X = 5X + 50 \Rightarrow X = 50$ Ans: (50)

5.

Men	Work	Days
10	1	15
X	5	10

1 men $\rightarrow$ 1/150 (one day's work)
10 days work = 10/150 = 1/15
i.e. 15 men for one work
men needed = $15 \times 5 = 75$ Ans: (75)

6. Job = (15) (9) = 135 man days = (135) (C) = women days.

Time taken by 15 women to complete the job = $\frac{405}{15}$ or 27 days Choice (C)

7. $\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$ --(1)

$M_1 = M_2 = 1$
$W_1 = W_2$
$D_1 = 4$, $H_1 = 10$ and $H_2 = 8$
Substituting these values in (1), $D_2 = 5$. Ans: (5)

8. $\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$ --(1)

$M_1 = D_1 = H_1 = 3$
$W_1 = W_2$
$M_2 = 9$ and $H_2 = 1$
Substituting these values in (1), $D_2 = 3$ Choice (C)

9. X's rate = $\frac{140}{100}$ (Y's rate) = $\frac{7}{5}$ (Y's rate)

∴ Required ratio = 7 : 5 Choice (A)

10. Let the job be 1 unit.
Let the times taken by X and Y to complete it be 5x hours and 6x hours respectively.
Parts of the job completed by X and Y in a hour are $\frac{1}{5x}$ units and $\frac{1}{6x}$ units respectively.

Required ratio = $\frac{1}{5x} : \frac{1}{6x}$ = 6 : 5 Choice (A)

11. Let the job be 1 unit.
Let the times taken by A, B and C the complete it be 3x hours, 4x hours and 6x hours respectively.
Parts of the job completed by A, B and (in a hour are $\frac{1}{3x}$ units, $\frac{1}{4x}$ units and $\frac{1}{6x}$ units respectively.

Required ratio = $\frac{1}{3x} : \frac{1}{4x} : \frac{1}{6x}$ = 4 : 3 : 2 Choice (B)

12. Part of the job completed by A and B in a day
= $\frac{1}{60} + \frac{1}{15} = \frac{1}{12}$
∴ They will complete the job in 12 days. Ans: (12)

13. Part of the job completed by Y in a day
= $\frac{1}{30} - \frac{1}{60} = \frac{1}{60}$
∴ Y will complete the job in 60 days. Choice (D)

14. Per day
Adam = 1/25
Adam + Chris = 8/75
∴ Chris $= \frac{8}{75} - \frac{1}{25} = \frac{1}{15}$
∴ Chris takes 15 days. Choice (D)

15. Time taken A = A
Time taken B = B
A = 4B
B = 60 days ⇒ A = 15 days
∴ In one day
A does 1/15 of work
B does 1/60 of work
Together in 1 day $= \frac{1}{15} + \frac{1}{60} = \frac{1}{12}$
So, they take 12 days. Choice (B)

16. One day's work
A = 1/x
B = 1/3x
$\frac{1}{x} + \frac{1}{3x} = \frac{1}{6} \Rightarrow x = 8$ days
∴ 3x = 24 days
∴ B takes 24 days. Choice (D)

17. Part of the job completed by P and Q in a day = $\frac{1}{48}$ th.
Part of the job completed by the faster person in a day
= $\frac{5}{8}\left(\frac{1}{48}\right) = \frac{5}{384}$
∴ The faster person will complete the job in $\frac{384}{5}$
= 76.8 days. Ans: (76.8)

18. The part of the job which P can complete in a day = $\frac{1}{60}$.
The part of it which Q can complete in a day
= $\left(1 - \frac{25}{100}\right)\left(\frac{1}{60}\right) = \frac{1}{80}$.
∴ Q can complete it in 80 days. Choice (B)

19. P's rate = $\frac{1}{4}$ (Combined rate of P, Q and R)
∴ P must have done $\frac{1}{4}$ th of the job. Choice (A)

20. Work done by Amar one day = 1/12
Work done by Bharat in 1 day = 1/24
Work done by Charu in 1 day = 1/24
Work done by 3 of them in one day $= \frac{1}{12} + \frac{1}{24} + \frac{1}{24} = \frac{1}{6}$
∴ they take 6 days to finish the work. Choice (B)

21. Work done by Anand, Bhanu and Chandra in 1 day = 1/4
Work done by Anand in 1 day = 1/8
Work done by Chandra in 1 day = 1/16
∴Work done by Bhanu in 1 day $= \frac{1}{4} - \left(\frac{1}{8} + \frac{1}{16}\right) = \frac{1}{16}$
∴Bhanu takes 16 days. Choice (A)

22. Parts of the job, which can be completed, by P and Q, Q and R and R and P in a day are $\frac{1}{12}$ th, $\frac{1}{20}$ th and $\frac{1}{15}$ th respectively.
∴ 2 P's, 2 Q's and 2 R's can 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 $\frac{1}{10}$ th of the job in a day.
∴ They can complete the job in 10 days. Choice (A)

23. P and Q take less time to complete the job compared to Q and R. ∴ R is slower than P. We should new compare R and Q (not P and Q).
P and Q take less time to complete the job compared to P and R. ∴ R is slower than Q.
∴ R is the slowest of the 3 workers. Choice (C)

24. 60 days → Somu ⎫ Time taken
40 days → Ramu ⎭
Total amount = ₹450
Ratio of shares of Somu and Ramu = $\frac{1}{60} : \frac{1}{40} = 2:3$
Somu's share = $\frac{2}{5} \times 450$ = ₹180 Ans: (180)

25. Work done by Gautham in 1 hour = 1/4
Work done by Karan in 1 hour = 1/12
Work done by both (in 2 hours) $= \frac{1}{4} + \frac{1}{12} = \frac{1}{3}$
∴ total work is done in $3 \times 2 = 6$ hours. Ans: (6)

26. One day's work
X = 1/12
Y = 1/18
X + Y = $\frac{1}{12}+\frac{1}{18}=\frac{5}{36}$ (in 1 time period)
Work in 7 time periods = $7 \times 5/36 = 35/36$
Remaining work = 1/36
Time taken by X to finish it = $\frac{1/36}{1/12}=1/3$
$\therefore$ total time = 7×2 + 1/3
$\downarrow$
7 time periods = $14^1/_3$ hours Choice (B)

27. Part of the job completed in the first 2 days
= $\frac{1}{12} + \frac{1}{20} + \frac{1}{30}$
The complete job involves 12 such parts.
$\therefore$ Total time = 2(12) = 24 days. Choice (C)

28. The following points, must be noted. Suppose 2 workers take x days to complete a job working together. If they work on alternate days, part of the job they would complete in the first 2 days would be (1/x). If x is an integer, they will take 2x days to complete the job irrespective of who starts the job. If x is not an integer, the job would be completed faster if the faster of the workers starts the job. Here, the part alone in the first two days is $\frac{1}{6}+\frac{1}{10}=\frac{8}{30}=\frac{1}{30/8}$ and X is the faster worker.
$\therefore$ Choice (A) follows. Choice (A)

29. Total quantity of rations consumed by 6 members in a day = (6) (2.5) = 15 kg. Number of days = $\frac{120}{15}$ = 8
Ans: (8)

30. Part of cistern filled by pipe x in 1 minute = 1/6
Part of cistern filled by pipe y in 1 minute = 1/12
$\therefore$ part of cistern filled by pipes x and y in 1 minute $=\frac{1}{6}+\frac{1}{12}=\frac{1}{4}$
$\therefore$ Time taken by both pipes = 4 minutes. Choice (B)

31. Part of the tank filled in a hour by both taps = $\frac{1}{6} + \frac{1}{9} = \frac{5}{18}$
$\therefore$ The tank will be filled in $\frac{18}{5}$ = 3.6 hours by them.
Ans: (3.6)

32. Part of the tank filled in a hour by both taps
= $\frac{1}{10}+\frac{1}{15}=\frac{5}{6}$
$\therefore$ The tank will be filled in 6 hours by them. In this time X can fill $\frac{6}{10}=\frac{3}{5}$th of the tank. Choice (D)

33. Part of the tank filled in a hour by both pipes
= $\frac{1}{9}-\frac{1}{18}=\frac{1}{18}$
$\therefore$ The tank will be filled in 18 hours by them.
Choice (C)

34. Time taken by tap to fill the tank = 3 hours
Time taken by leak = x hours
Per hour
Tap = 1/3; Leak = 1/x
Part of the tank filled in 1 hour $=\frac{1}{4}=\frac{1}{3}-\frac{1}{X}$
$\therefore \frac{1}{x}=\frac{1}{3}-\frac{1}{4}=\frac{1}{12}$
$\therefore$x = 12 hours. Choice (D)

35. Time taken by pipe A = 30 minutes
Time taken by pipe B = 20 minutes
Time taken by emptying pipe C = 60 minutes
Per minute
A = 1/30, B = 1/20, C = 1/60
All pipes open at one time $=\frac{1}{30}+\frac{1}{20}-\frac{1}{60}=\frac{4}{60}=\frac{1}{15}$
$\therefore$ It takes 15 minutes to fill the tank. Ans: (15)

Exercise – 6(a)

Solutions for questions 1 to 30:

1. Time in which A can complete the job = $\frac{600}{100}=6$ days .
Time in which B can complete the job
= $\frac{900}{60}=15$ days
Time in which C can complete the job $\frac{1200}{40}=30$ days
Part of the job which can be done by A, B and C in a day
= $\frac{1}{6}+\frac{1}{15}+\frac{1}{30}=\frac{4}{15}$
$\therefore$ They would take $\frac{15}{4}$days to complete it.
Cost to Anwar = $\left(\frac{15}{4}\right)(100+60+40)=$ Rs. 750
Choice (C)

2. Total work = 30 (12) (50) man hours = 18000 man hours.
Amount of work done in 15 days putting 10 hours a day = 15 (10) (50) = 7500 man hours.
Work remaining = 18000 – 7500 = 10,500 man hours.
Number of men remaining = 40
Number of hours = 10 per day.
Number of days needed = $\frac{10500}{40(10)}$ = $26^1/_4$ days.
$\therefore$ They require $11^1/_4$ more days to complete the work.
Choice (A)

3. Let p, q, r denote the work done by P, Q and R respectively in one day.
p + q = $\frac{1}{20}$ ---------- (1)
q + r = $\frac{1}{15}$ ---------- (2)
p + r = $\frac{1}{12}$ ---------- (C)
Adding the three equations,
2(p + q + r) = $\frac{1}{20} + \frac{1}{15} + \frac{1}{12} = \frac{12}{60} = \frac{1}{5}$
p + q + r = $\frac{1}{10}$ ---------- (D)
(D) – (2) gives
p = $\frac{1}{10} - \frac{1}{15} = \frac{1}{30}$
$\therefore$ P can do it in 30 days
(D) – (C) gives
q = $\frac{1}{10} - \frac{1}{12} = \frac{1}{60}$
$\therefore$ Q can do it in 60 days
(D) – (1) gives
r = $\frac{1}{10} - \frac{1}{20} = \frac{1}{20}$
$\therefore$ R can do it in 20 days. Choice (A)

4. In one day A and B together complete $\frac{1}{40}^{th}$ of the work and in 8 days $\frac{8}{40}$ of the work.

Work remaining = $\frac{32}{40}$.

After C joins them work gets completed in 24 days.
Let C alone do the work in x days.

A, B and C can do $\left(\frac{1}{40}+\frac{1}{x}\right)$ work in one day.

They do $\frac{32}{40}^{th}$ of the work in 24 days.

Hence, $\frac{24}{40}+\frac{24}{x}=\frac{32}{40}$; 24x + 40(24) = 32x

$8x = 24 \times 40$

$\Rightarrow x = 120$ days

C alone can do the work in 120 days.

Alternate method:

As A and B worked for 32 days on the whole, work done by them = $\frac{32}{40}=\frac{4}{5}$.

$\therefore$ Remaining work i.e. ⅕th of the work is completed by C in 24 days.

$\therefore$ C takes 24 x 5 = 120 days to complete the work.

Ans: (120)

5. Akbar can do the work in 40 days.
The work is completed 10 days earlier.
i.e. 40 – 10 = 30 days
Akbar worked on it throughout; i.e., for 30 days.
Let the number of days Ajay worked be x.
Ajay does (1/60)th of the work in one day.

$\Rightarrow \frac{30}{40}+\frac{x}{60}=\frac{3}{4}+\frac{x}{60}=1$

$\Rightarrow x = 15$ days
Number of days after which Ajay joins Akbar
= 30 – 15 = 15 days. Choice (C)

6. P works for a total of 9 days. Q works for a total of 18 days. R works for a total of 12 days. Let the times taken by Q and R to complete the job be q days and r days respectively.

$\frac{9}{27}+\frac{18}{q}+\frac{12}{r}=1$

$q \le 54$

$\therefore r \ge 36$

Only Choice (B) violates this condition. Choice (B)

7. Let the efficiencies of P, Q and R be 3x gadgets/day, 4x gadgets/day, 5x gadgets/day.
(3x) (6) + (4x) (8) + (5x) (10) = 400 x = 4
Required number of gadgets
= (6x) (6) + (12x) (8) + (5x) (10) = 728 Ans: (728)

8. Portion of wall built per day = $\frac{1}{8}^{th}$ = 12.5%

20% of this (i.e. 2.5% of the wall) falls off.
Therefore 10% of the wall is completed every day.
To determine whether the whole of the 10th day is needed for work, consider work done in 9 days.
In 9 days 90% of the wall is built. On the 10th day, one-tenth has to be built. So, he takes = $\frac{1/10}{1/8}=\frac{4}{5}$ days

So, he takes $9\frac{4}{5}$ days to construct the wall.

Choice (D)

9. Let the number of days taken by Kapil be x.

Work done by Kapil in one day = $\frac{1}{x}$

Work done by Raman in one day = $\frac{2}{x}$

Work done by Sunil in one day = $\frac{2\times3}{x}=\frac{6}{x}$

Work done by 3 of them together in 30 days.

= $\frac{30}{x}+\frac{2\times30}{x}+\frac{6\times30}{x}=\frac{270}{x}$

Work done by Sunil and Raman in 18 days

= $\frac{36}{x}+\frac{108}{x}=\frac{144}{x}$

Total work = $\frac{270}{x}+\frac{144}{x}$ = 1

$\Rightarrow x = 414$

$\therefore$ Time taken by Raman = $\frac{x}{2}$ i.e. 207 days.

Choice (D)

10. Given that the man can complete the job in 150 hours at maximum efficiency. i.e. at maximum efficiency he can do $\frac{1}{150}$th of the work per hour.
(He works each 2 hours with the same efficiency)
$\therefore$ In 8 hours he can do :

$2\left[\frac{1}{150}+\frac{1}{2(150)}+\frac{1}{4(150)}+\frac{1}{8(150)}\right]$

$=\frac{2\times15}{8\times150}=\frac{1}{40}^{th}$ of the work.

Hence, total number of hours = 8(40) = 320.

Ans: (320)

11. Let the first man do the work in x days. Everyday a new man joins. The work done on successive days is tabulated.

Day	Work (increasing power)	Work (constant power)
1	$\frac{1}{x}$	$\frac{1}{x}$
2	$\left(\frac{2}{x}\right)2$	$\frac{2}{x}$
3	$\left(\frac{4}{x}\right)3$	$\frac{3}{x}$
4	$\left(\frac{8}{x}\right)4$	$\frac{4}{x}$
5	$\left(\frac{16}{x}\right)5$	$\frac{5}{x}$

$\therefore$ The work done in 5 days

= $\frac{1}{x}(1 + 4 + 12 + 32 + 80) = \frac{129}{x}$ = 1 i.e. x = 129

If each man's efficiency had remained constant, the work done in n days is $\frac{n(n+1)}{2}\frac{1}{x}$.

When work is completed, $\frac{n(n+1)}{2}\frac{1}{x}$ = 1

$\Rightarrow n(n + 1) = 2x = 2(129) = 258$

$\Rightarrow n^2 \cong 256$ or $n \cong 16$

We find that 15(15 + 1) < 258 < 16(16 + 1)

$\therefore$ Work is completed on the 16th day. Ans: (16)

12. Let the work done by Ram on first day be x,
∴Second day he does 2x work.
Also as A takes 40% less time than Ram, the ratio of time taken by Saleem and Ram is 0.6 : 1 ⇒ 3 : 5.
∴ The ratio of efficiencies of Saleem and Reema = 5 : 3.
∴ On first day Saleem did $\frac{5x}{3}$ and on second day $\frac{10x}{3}$.

Total work = $(x + 2x) + \left(\frac{5x}{3}+\frac{10x}{3}\right) = 8x$.

Combined efficiency of Saleem and Ram, when there is no change = x + (5x/3) = (8x/3)
Number of days required = Work/efficiency = (8x)/(8x/3) = 3
∴ Saleem and Ram can together do it in 3 days.
Choice (D)

13. From the ratio (2 : 3 : 5),

Vivek does $\frac{2}{10}$ of work in 12 days.

⇒ Vivek does full work in $12 \times \frac{10}{2}$ i.e., 60 days.

From the ratio 1 : 2 : 3, it can be decided that Rameshwar does in 30 days. Bhuvan does in 20 days.

In 8 days they complete $\frac{8}{60}+\frac{8}{30}+\frac{8}{20} = \frac{8+16+24}{60}=\frac{4}{5}$
Choice (C)

14. In 20 days, Praveen makes 2000 hats.
= There are 10% defects
1800 good hats in 20 days, ⇒ 90 good hats/day → (1)
Shiva makes 2000 hats in 10 days
There are 20% defects.
⇒ 1600 non-defective hats; ⇒ 160 good hats/day → (2)
Sunny in 5 days
Sunny makes 2000 hats
There are 40% defects
⇒ 1200 non-defective hats; ⇒ 240 good hats/day → (C)
Total number of non-defective hats / day = 90 + 160 + 240 = 490
Number of days taken to make 10,000 non-defective hats
= $\frac{10000}{490}=20\frac{20}{49}$ = 20.4 days. Choice (D)

15. By 10 : 15 a.m., A would have worked for 15 min and C would have worked for 5 min
Part of the tank filled by 10 : 15 a.m.
$= 15\left(\frac{1}{18}\right) - 5\left(\frac{1}{36}\right) = \frac{25}{36}$

Remaining part to be filled = $\frac{11}{36}$

Time taken to fill the remaining part

$= \frac{\frac{11}{36}}{\frac{1}{18}+\frac{1}{26}-\frac{1}{36}}$ = .4 min

The tank would be full at 10 : 19 : 24 a.m.
Choice (D)

16. Every minute it goes by 3 cm and in the subsequent minute it is pulled back by 1 cm.
So, in a time period of 2 minutes it covers 2 cm.
There can be a total of 19 such time periods as when it reaches the top, it will not be pulled back.
So, in $19 \times 2 = 38$ minutes, it will cover 38 cm.

Remaining 2 cm will be covered in $\frac{2}{3}$ minutes

[∵ it climbs 3 cm in 1 min]

Hence $38\frac{2}{3}$ minutes is the total time taken.
Choice (C)

17. Let the work totally take x days from the start.
Niranjan stopped working after y days and Rajesh stopped working y days before the completion of the work. Vinayak worked throughout.

∴ $\frac{y}{10}+\frac{x-y}{15}+\frac{x}{12}=1 \quad \frac{6y+4(x-y)+5x}{60}=1$

9x + 2y = 60
∴The only possible solution such that x > y, is x = 6, y = 3.
x and y are integers. Also x > y. Ans: (6)

18. In 20 days Krishna does 1 work. In 6 days he does $\frac{6}{20}$th part of work.

∴ He should get $\frac{6}{20}$ x 720 = ₹216.

Similarly, Rama should get $\frac{6}{30} \times 720$ = ₹144

Hence Gopi should get 720 – (216 + 144) = ₹360

Daily earnings of Gopi = ₹$\frac{360}{6}$ = ₹60 Choice (D)

19. Ratio of the wages of P, Q, R and total = 3 : 4 : 5 : 12
∴This is also the ratio of the work completed by P, Q and R.
∴ P completed 1/4 th of the job. Also the job was completed in 5 days. ∴ P, working, alone, can complete the job in 20 days. Choice (A)

20. Alok and Sachin were to complete a piece of work in 20 days. They lost $(1/3)^{rd}$ of the pay. It implies that they could not complete one-sixth of the work after working for 20 days.
Alok alone can do it in 40 days

⇒ Sachin alone can do it in x days.

⇒ $\frac{20}{40}+\frac{20}{x}=\frac{5}{6} \Rightarrow \frac{20}{x}=\frac{5}{6}-\frac{1}{2}=\frac{1}{3}$

x = 60 days. Choice (B)

21. (i) Part of the job completed in the first two days
$= \frac{1}{30}+\frac{1}{60}=\frac{1}{20}$

job = $20\left(\frac{1}{20}\right)$

∴ time taken to complete the job = 20 (2)
= 40 days
Note: The time taken to complete the job would be the same if Ramesh starts the job. Whenever the part of the job completed by two workers working on alternate days in the first two days
= $\frac{1}{n}$ where n is an integer, the time taken to complete the job = 2n days. Choice (C)

(ii) Part of the job completed in the first 2 days = $\frac{11}{60}$

After S cycles of 2 days, part of the job completed = $\frac{11}{12}$.

This is completed in 10 days. Remaining part = $\frac{1}{12}$

On the 11^{th} day, Rakesh would work. He would complete the remaining part in $\frac{5}{6}$th of that day.

∴ total time = $10\frac{5}{6}$ days. Choice (B)

22. Men hired (M) days worked (D) work completed (W)

M	D	W
48	60	$\frac{2}{5}$
48 + x	60	$\frac{3}{5}$

M α W ($\because$ D constant)

$\frac{M_1}{M_2}=\frac{W_1}{W_2}$ $\frac{48}{48+x}=\frac{2}{5}\ \frac{5}{3}=\frac{2x}{3x}\Rightarrow x=24$

Ans: (24)

23. Tank is full. Total time to empty it is 60 minutes.

In 18 minutes the part emptied = $\frac{18}{60}=\frac{3}{10}$ of the tank.

At that point, the pipe, that can fill the tank in 30 minutes, is opened.

When both are working the tank is filled in

$\frac{1}{30}-\frac{1}{60}=\frac{1}{60}$ i.e., 60 minutes.

$\therefore$ The tank is filled in $\frac{3}{10}$ x 60 + 18 = 36 minutes.

Choice (C)

24. In one cycle of 6 minutes the part of the tank that is filled = $\frac{2}{15}+\frac{2}{20}-\frac{2}{30}=\frac{10}{60}=\frac{1}{6}$

In order to decide whether the 6th cycle is needed in full or in part, consider the situation after 5 cycles.

$5\times\frac{1}{6}=\frac{5}{6}$ th of the tank is filled, in the first five cycles.

5×6 = 30 minutes are over.

Part of tank to be filled = $\frac{1}{6}$ th.

After next 2 minutes, the part of the tank that is empty

= $\frac{1}{6}-\frac{2}{15}=\frac{1}{30}$, as pipe P fills (2/15)th part.

Q can fill this part in 20 x $\frac{1}{30}=\frac{2}{3}$ minutes,

$\Rightarrow$ 6th cycle is not required in full.

$\therefore$ The tank is filled in 30 + 2 + $\frac{2}{3}=32\frac{2}{3}$ minutes.

Choice (B)

25. Required time = Time taken to fill the bottom $\frac{3}{4}$th + time taken to fill the top $\frac{1}{4}$th

The leak will not affect the filling of the bottom $\frac{3}{4}$ th

$\therefore$ Time taken to fill the bottom part is $\frac{3}{4}$ (time taken by the taps to fill the tank). Time taken to fill the top part is $\frac{1}{4}$ th (time taken by the taps to fill the tank along with the leak)

Time taken to fill the bottom part

= $\frac{3}{4}\left(\frac{(16)(48)}{16+48}\right)=9$ hours

Part of the tank which can be filled by the taps and the leak each hour = $\frac{1}{12}-\frac{1}{24}=\frac{1}{24}$

$\therefore$ Time taken to fill the top $\frac{1}{4}$th $=\frac{1}{4}(24)=6$ hours

$\therefore$ Required time = 15 hours. Ans: (15)

26. Let the number of hours taken by the three pipes individually to fill the pool be x, y and z.

then $\frac{(x)(y)}{x+y}=\frac{1}{2}(z)$

But y = x + 12 $\Rightarrow$ x = y – 12 and y = z + 8

$\Rightarrow$ z = y – 8 $\frac{(y-12)(y)}{(y-12)+y}=\frac{1}{2}(y-8)$

$(y^2 – 12y)2 = (2y – 12)(y – 8)$

$2y^2 – 24y = 2y^2 – 28y + 96; \Rightarrow 4y = 96$

$y = 24 \Rightarrow x = 12$ and $z = 16$ Choice (C)

27. Let the times taken by A, B and C to fill the tank be a hours, b hours and c hours respectively.

$C=4\frac{1}{2}\left(\frac{ab}{a+b}\right)$

Taking reciprocals both sides, $\frac{1}{2c}=\frac{1}{9}\left(\frac{1}{a}+\frac{1}{b}\right)$

$\frac{9}{2c}=\frac{1}{a}+\frac{1}{b}$ ——— (1)

Similarly $\frac{5}{6a}=\frac{1}{b}+\frac{1}{c}$ ——— (2)

$\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{11}{20}$

Adding $\frac{1}{c}$ to both sides of (1),

$\frac{11}{2c}=\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{11}{20}\ \frac{1}{c}=\frac{1}{10}$

Adding $\frac{1}{a}$ to both sides of (2),

$\frac{11}{6a}=\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{11}{20}$

$\frac{1}{a}=\frac{3}{10}$

$\frac{1}{b}=\frac{11}{20}-\left(\frac{1}{a}+\frac{1}{c}\right)=\frac{3}{20}$

$\therefore\ b=6\frac{2}{3}$. Choice (C)

28. Let the time taken by X and Y to independently fill the tank be x minutes and y minutes respectively.

$\frac{2}{3}x+\frac{1}{3}y=14$ and $\frac{2}{3}y+\frac{x}{3}=16$

Solving these, x = 12 and y = 18

Part of the tank filled when X and Y work together in a minute = $\frac{1}{12}+\frac{1}{18}=\frac{5}{36}$

$\therefore$ Time taken to fill the tank = $\frac{36}{5}$ min = 7.2 min

Ans: (7.2)

29. (6m + 8w)10 = (8m + 22w)5

$\therefore$ (6m + 8w)2 = 8m + 22w

12m + 16w = 8m + 22w

4m = 6w $\Rightarrow$ 2m = 3w

$\therefore$ work = (6m + 8w)10

= $\left(6\times\frac{3}{2}w+8w\right)10$ = 170 w days

New work = 170×3 days

34 women will do it in $\frac{170\times 3}{34}$ = 15 days. Ans: (15)

30. The given relation of capacities is as follows:

Value of n –1	Value of n	Sum of capacities of first (n –1) taps	Capacity of n^{th} tap	Sum of capacities of first n taps
14	15	x	2x	3x
15	16	3x	6x	9x
16	17	9x	18x	27x
17	18	27x	54x	81x

$\Rightarrow$ Capacity of the 18^{th} tap = 54x; and this is given 1/2 (as the 18^{th} tap alone fills in 2 minutes)

$\Rightarrow 54x = \frac{1}{2}$; $\Rightarrow 2x = \frac{1}{2} \times \frac{1}{27} = \frac{1}{54}$; 2x is the capacity of the 15^{th} tap alone. Hence, the 15^{th} tap, by itself will fill in 54 minutes. Choice (C)

Exercise – 6(b)

Solutions for questions 1 to 45:

1. In one day Rajdeep can do $\frac{1}{15}$ th of the work and Pranav can do $\frac{1}{24}$ th of the work.

Work done by Pranav in 10 days = $10\left(\frac{1}{24}\right)=\frac{10}{24}$

Work remaining = $\frac{14}{24}$

Number of days taken by Rajdeep to complete the remaining work = $\frac{14}{24}\times\frac{15}{1}=8\frac{3}{4}$ Choice (B)

2. In one day Raj can build $\frac{1}{18}^{th}$ of the wall.

Kiran can build $\frac{1}{30}^{th}$ of the wall.

To complete $\frac{1}{2}$ the work Raj takes 9 days.

Remaining work = $\frac{1}{2}$.

In one day both can together complete

$\frac{1}{18}+\frac{1}{30}=\frac{48}{18\times30}=\frac{4}{45}$

To complete $\frac{1}{2}$ the work, it takes them $\frac{1}{2}\left(\frac{45}{4}\right)=\frac{45}{8}$ days.

Total number of days = $\frac{45}{8}+9=14\frac{5}{8}$ days. Choice (B)

3. Amount of work done by Raman and Rajan in 18 days = $\frac{1}{2}$.

Amount of work done by Raman and Rajiv in 12 days = $\frac{1}{2}$.

Rajiv alone can complete the work in 36 days.

Amount of work done by Rajiv in 12 days = $\frac{12}{36}$.

Let Rajan alone complete the work in x days.

Amount of work done by Rajan in 12 days = $\frac{12}{x}$.

$\frac{12}{36}+\frac{12}{x}=\frac{1}{2}$ $6x = 12 \times 36$; $x = 72$

Rajan alone can complete the work in 72 days.
Raman and Rajan complete half the work in 18 days.
Amount of work done by them together in one day = $(1/36)^{th}$.
Amount of work done by Raman in one day

= $\frac{1}{36}-\frac{1}{72}=\frac{1}{72}$

$\Rightarrow$ Raman takes 72 days to complete the work alone.
Ans: (72)

4. Rate of work and time taken to do a work are in inverse proportion.
Hence, Kaushik is one and a half times more efficient than Ravi implies, Ravi takes one and a half time more time than Kaushik, to do the same work.
Kaushik takes 20 days.
Hence Ravi takes 20(1 + 1.5) = 50 days to do the same work.
In 10 days, amount of work completed by both together

= $\frac{10}{20}+\frac{10}{50}=\frac{70}{100}=\frac{7}{10}$ th of the work. Choice (D)

5. Initially let there be x men who take y days.
$xy = 56$ ---------- (1)
$(x - 1)(y + 1) = xy$ ---------- (2)
$\therefore x - y = 1$ ---------- (C)
From (1) and (C), as $56 = 8 \times 7$,
$x = 8$ and $y = 7$ Ans (8)

6. Let Peter and Pan take 8 and 12 days respectively to do 1 unit work. Let the job mentioned in the problem be x units of work. So, they take 8x days and 12x days to do x units of work respectively. Both together can complete x units of work in $\frac{(8x)\times(12x)}{20x}$ = 4.8x days
Given that 4.8x = 36
$\Rightarrow x = 7.5$
$\therefore$ To do x units of work, Pan working alone, takes (12) (7.5) = 90 days. Choice (D)

7. The total work completed is

$28\left(\frac{1}{z}\right)+\left(\frac{1}{36}+\frac{1}{45}+\frac{1}{z}\right)4 = 1$ $\Rightarrow z = 40$.

Ans: (40)

8. Let the time taken by R to complete it be r days

$6\left(\frac{1}{24}+\frac{1}{72}+\frac{1}{r}\right)+12\left(\frac{1}{72}+\frac{1}{r}\right)=1 \Rightarrow r = 36$

Required time = (6) (36) = 216 days. Choice (C)

9. Parts of the job done by P and Q, Q and R and P and R in a day are $\frac{1}{24}, \frac{1}{20}$ and $\frac{1}{30}$ respectively

$\therefore P + Q = \frac{1}{24}$ ——— (1)

$Q+R=\frac{1}{20}$ ——— (2)

$P+R=\frac{1}{30}$ ——— (3)

Adding (1) and (2) and subtracting (3) from the sum,

$2Q=\frac{7}{120}$

$Q=\frac{7}{240}$

From (1), $P=\frac{1}{80}$

From (2), $R=\frac{1}{48}$

$\therefore$ P, Q and R take 80 days, $\frac{240}{7}$ days and 48 days to complete the job respectively. Choice (C)

10. Let the times taken by Anushka, Bhanu and Chawla to complete the job be a days, b days and c days respectively.

$a = m\left(\frac{bc}{b+c}\right)$

Taking reciprocals both sides

$\frac{1}{a} = \frac{1}{m}\left(\frac{1}{b}+\frac{1}{c}\right)$ ——— (1)

Similarly, $\frac{1}{b} = \frac{1}{m}\left(\frac{1}{a}+\frac{1}{c}\right)$ ——— (2)

And $\frac{1}{c} = \frac{1}{m}\left(\frac{1}{a}+\frac{1}{b}\right)$ ——— (3)

Adding (1), (2) and (3) and simplifying

$\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)\left(1-\frac{2}{m}\right)=0$

As $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\neq 0,\ 1-\frac{2}{m}=0$

$\therefore$ m = 2. Choice (B)

11. Number of man-days required to fill 20,000 tyres = 80×84

Number of man-days required to fill one tyre = $\frac{80\times84}{20{,}000}$

Number of man-days required to fill 30,000 tyres

$= \frac{80\times84}{20{,}000} \times 30{,}000.$

To complete filling 30,000 tyres in 63 days, number of persons required = $\frac{80\times84\times1.5}{63}$ = 160. Ans: (160)

12. Each jump followed by a slip would have enabled it to cover 0·4m. In 198 jumps, it would have covered (0·4) (198) = 79·2m. In the next jump, it would have come out of the well. Choice (D)

13. Let a, b and c denote the work done by Ananath, Anand and Arjun respectively in one hour.

12a = 15b = 30c

$\therefore$ a : b : c = $\frac{1}{12}:\frac{1}{15}:\frac{1}{30}$ = 5 : 4 : 3

Let a = 5k, b = 4k, c = 3k

$\therefore$They complete the work in 10 hours, working together.

5k + 4k + 3k = $\frac{1}{10} \Rightarrow k = \frac{1}{120}$

$\therefore$ a = $5\times\frac{1}{120} = \frac{1}{24}$ b = $4\times\frac{1}{120} = \frac{1}{30}$

c = $3\times\frac{1}{120} = \frac{1}{40}$

$\therefore$ Ananath, Anand and Arjun will take 24, 30 and 40 days respectively. Choice (D)

14. Let the work done by Pradeep, Abishek and Antony in one day be a, b and c respectively.

Then, a = $\frac{2}{3}$ (b + c) ---------- (1)

a + c = 2b ---------- (2)

c = $\frac{1}{45}$ ---------- (C)

From (1), 3a – 2b = 2c or 3a – 2b = $\frac{2}{45}$

and from (2), 2b – a = $\frac{1}{45}$

Adding, we get $\therefore$ 2a = $\frac{3}{45}$ a = $\frac{1}{30}$ and b = $\frac{1}{36}$

So, Pradeep takes 30 days and Abishek takes 36 days. Choice (A)

15. 2m = 5w and work = $5w \times 15d$ = 75 women days

$4m + 5w = 2\times(2m) + 5w = 2\times(5w) + 5w = 15w$

So, an equivalent of 15 women complete a work of 75 women days in 5 days. Choice (C)

16. Work 1 man can do in 3 days = Work 4 boys can do in 2 days.

3 man days = 8 boy days $\rightarrow$ (1)

Work to be done = (72)(16) boy days

= (72) (16) $\left(\frac{3}{8}\right)$ man days

= 72 x 6 mandays.

As work is to be completed in 48 days,

$x = (72\times6)/48 = 9.$ Ans: (9)

17. All volumes are in cubic metres,

Capacity of the tank = 30

By 10:30 a.m, volume filled = (2) $\left(1\frac{1}{2}\right)+3(1)=6$

Remaining volume to be filled = 24. This will be filled in $\frac{24}{2+3+5}$ more hours i.e., 2.4 hours.

The tank would be full at 12:54 p.m. Choice (D)

18. Let x boys be required to work,

then $x\left(\frac{1}{8}\right)+\frac{1}{2}+\frac{1}{4}=1$

$\frac{x+6}{8}$ = 1, x = 2 Choice (C)

19. Let the rate of work of each man be x units / day.

The number of men who left after 56 days (i.e. 24 + 32) is N. The total work is

x (40) (96) = x (40) (24) + x (40 +20) (32)

+ x (60 – N) (20) $\Rightarrow$ N = 12 Ans: (12)

20. Dravid starts the work and completes 1/4th work in 16 days. Balaji joins and together they complete 1/4th work more. For them to complete 1/4th it takes

$\frac{1/4}{1/64+(1/32)} = \frac{16}{3}$ days.

Then Bhangar joins and Dravid, Balaji and Bhangar complete another 1/4th of the work. For them to complete 1/4th it takes $\frac{1/4}{1/64+1/32+1/16} = \frac{16}{7}$.

Then Jadeja joins and all four of them complete the remaining (1/4)th work.

For them to complete 1/4th, it takes

$\frac{1/4}{1/64+1/32+1/16+1/8} = \frac{16}{15}$ days.

Total number of days

$= 16\left(1+\frac{1}{3}+\frac{1}{7}+\frac{1}{15}\right) = 24\frac{24}{35}$ days. Choice (D)

21. Number of bolts produced by type A in 10 days

= $\frac{10}{30}$ (1500) = 500 Remaining = 1000

Type B produces 1000 bolts in 10 days.

$\Rightarrow$ 3000 bolts are produced in 30 days by type B.

Together they can produce (3000 + 1500)

= 4500 bolts in 30 days. Ans: (4500)

22. In one day, Machine P does $\frac{1}{20}^{th}$ of the work.

Machine Q does $\frac{1}{30}^{th}$ of the work

Machine R does $\frac{1}{60}^{th}$ of the work

Together in 5 days they complete

$\frac{5}{20}+\frac{5}{30}+\frac{5}{60}=\frac{(1+2+3)}{60}(5)=\frac{1}{2}$ portion of the work.

In 3 days Q and R complete $\frac{3}{30}+\frac{3}{60}=\frac{3+6}{60}=\frac{9}{60}$

Remaining = $1-\frac{30}{60}-\frac{9}{60}=\frac{21}{60}$

Portion of work done by P = $\frac{5}{20}+\frac{21}{60}=\frac{36}{60}=\frac{3}{5}$

Choice (D)

23. Let the work done by Rohit on the first day be 1 unit
Job = 1 + 2 (2) + 3 (4) + 4 (8) + 5 (16) + 6 (32) = 312 units.
If the men worked at twice the rate, part of the job completed in the first 4 days = 1 + 2 (3) + 3 (9) + 4 (27) =142 units. On the 5th day, 5 (81)
= 405 units can be done.
∴ the job will be completed on the 5th day Choice (B)

24. Let us say the job is completed in x days.
On the ith day of work, (25 + – 1) = 24 + i persons would work.
∴ (24 + i) m^2 would be the work done on the ith day

$\sum_{i=1}^{x}(24+i)=330$

24 + 1 + 24 + 2 + …….24 + x = 330

$24x+\frac{x(x+1)}{2}=330$

$\frac{x(49+x)}{2}=\frac{(11)(49+11)}{2}$

Comparing both sides, x = 11. Ans: (11)

25. Let the works done by each worker in group A and each worker in a group B in a day be a units and b units respectively.

Given 3a + 6b = $\frac{1}{20}$ ——— (1)

8a + 4b = $\frac{1}{10}$ ——— (2)

Solving (1) and (2) we get $a=\frac{1}{90}$ and $b=\frac{1}{300}$

a + b = $\frac{1}{72}$

∴ One worker from each group take 72 days to complete it.
Choice (C)

26. Case 1 Anil starts

Anil $\frac{1}{6}$ } 2 days

Mukesh $\frac{1}{8}$ }

In a period of 2 days $\frac{7}{24}$ work is done

In 3 such time periods i.e. 6 days $\frac{21}{24}$

i.e. $\frac{7}{8}$ work is done.Remaining work is $\frac{1}{8}$ and it is done by

Anil in $\frac{6}{8}=\frac{3}{4}$.

Hence a total of $6\frac{3}{4}$ days.

By a similar calculation, if Mukesh starts, a total of 7 days are required. Difference = $\frac{1}{4}$ days. Choice (B)

27. Each cycle consists of 5 days, as they take one day off. For every 4 days of work. Hence work done in one cycle of 5 days

= $\frac{1}{24}+\frac{1}{36}+\frac{1}{24}+\frac{1}{36}+0=2\left(\frac{1}{24}+\frac{1}{36}\right)$

= $\frac{2\times5}{72}=\frac{5}{36}$ th

Full cycles required = Integer part of $\frac{36}{5}$ = 7 cycles.

7 cycles = 7 × 5 = 35 days → (1)
Work remaining to be done on the 36th day

= $1-\left(7\times\frac{5}{36}\right)=\frac{1}{36}$ th → (2)

36th day is the first day of 8th cycle.
All even numbered cycles are begun by Bharat.
Hence, Bharat comes to do work on the 36th day.
Bharat's rate of work is 1/36th → (3)
(2) and (3) imply, Bharat completes the work on the 36th day. Choice (B)

28. Suppose the man can complete 1 unit 1hr if he works at his maximum efficiency. The job (1) (151) = 151 units.

In the first 8 hours, he would complete $2\left(1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}\right)=\frac{15}{4}$ th of the part. In order to complete 150 units, he requires 40 cycles of 8 hours i.e., 320 hours. In order to complete the last unit, he requires another hour.
∴ total time = 321 hours. Choice (D)

29. Work done on

1st day → Sonia → $\frac{1}{20}$

2nd day → Sonia and Priyanka → $\frac{1}{20}+\frac{1}{30}$

3rd day → Sonia, Priyanka and Anjali → $\frac{1}{20}+\frac{1}{30}+\frac{1}{30}$

So in a period of 3 days $\frac{3}{20}+\frac{3}{30}=\frac{3\times5}{60}=\frac{1}{4}$

So, 4 such time periods or 12 days are required to complete the work. Choice (A)

30. (i) The man would work at 1 unit / day. Men joining on the 2nd day, 3rd day and 4th day would work at 2 units / day, 3 units / day and 4 units / day respectively.
Job = (1) + (1 + 2) + (1 + 2 + 3) + (1 + 2 + 3 + 4)
= 20 units.

Required time = $\frac{20}{1}=20$ days. Choice (A)

(ii) Work done on the first day = 1 + 2 + 3 + 4 = 10 units
work done on the second day = 2 + 3 + 4 = 9 units
work done on the third day = 3 + 4 = 7 units work done on the fourth day = 4 units.
Job = 10 + 9 + 7 + 4 = 30 units.
Last man who leaves completes (D) (D) = 16 units.

∴ He will receive $\frac{8}{15}$ th of the total wages.

Choice (C)

31. The data provides three different combinations of working, to do the work completely.

(a) Combination 1 : –
All three people working for (x + 6) days.

Hence, $(x + 6)\left(\frac{1}{20}+\frac{1}{30}+\frac{1}{60}\right) = 1; \Rightarrow x + 6 = 10,$

$\Rightarrow x = 4 \rightarrow (1)$

(b) Combination 2 : –
All three people for x days, and two people for (y + 6) days.

Hence $x\left(\frac{x}{10}\right)+(y+6)\left(\frac{1}{30}+\frac{1}{60}\right)$

= 1; Substituting x = 4, the equation becomes (y + 6) $\left(\frac{3}{60}\right) = 1 - \frac{4}{10} = \frac{6}{10}$, $y = 6 \rightarrow (2)$

(c) Combination 3: –
All three for x days, two people for y days and one person for z days (say).

Hence, $x\left(\frac{1}{10}\right) + y\left(\frac{3}{20}\right)+\frac{z}{60} = 1$

Substituting x = 4, y = 12, and simplifying, $z = 18 \rightarrow (C)$
Total number of days required under combination 3, is x + y + z = 4 + 6 + 18 = 28 days.

Alternate method:
Prakash, Pranay and Pramod together complete

$\left(\frac{1}{20}+\frac{1}{30}+\frac{1}{60}\right)^{th}$ of work per day or, $\frac{1}{10}$th of the work per day. Together, the three take (x + 6) days to complete.
x + 6 = 10,
$\Rightarrow x = 4 \rightarrow (1)$
The work remaining after the departure of Prakash can be completed by Pranay and Pramod in (y + 6) days.

$\therefore (y + 6)\left(\frac{1}{30}+\frac{1}{60}\right) = (1 - \frac{x}{10})$

$\Rightarrow (y + 6)\ 3/60 = [1 - (4/10)], \Rightarrow y = 6 \rightarrow (2)$ Ans: (28)

32. Let the required cost be ₹x
10 cows = 20 sheep
$\therefore$ 10 cows + 40 sheep = 60 sheep
20 cows + 10 sheep = 50 sheep
Let the cost of grass for each sheep be ₹y/day.
(60y) (20) = 900

$y = \frac{3}{4}$

x = (50y) (18) = 675. Choice (B)

33. The cost of grass for 20 cows and 30 sheep for 30 days = ₹720.
Given 30 sheep eat double the grass eaten by 20 cows.
$\Rightarrow$ Cost of grass eaten by 30 sheep in 30 days

$= \frac{2}{3} \times 720 = ₹480$

The cost of grass eaten by 1 sheep in one day

$= \frac{480}{30\times30} = \frac{8}{15}$.

The cost of grass eaten by 20 sheep in 15 days

$= \frac{8\times20\times15}{15} = ₹160$ Ans: (160)

34. Money received for one day's work $= \frac{13500}{45} = 300$

Amount of money received by Gagan $= \frac{3}{4} \times 300$

= 225 per one day.
For 10 days, Gagan receives $225 \times 10 = ₹2,250$.
Choice (B)

35. Ratio of work done by Gokul, Govardhan and Ganesh in equal durations of time

$= \frac{1}{10} : \frac{1}{20} : \frac{1}{30}$ respectively i.e., 6 : 3 : 2

$\Rightarrow$ Govardhan gets $\frac{3}{11}$ (6600) = ₹1,800. Choice (A)

36. Number of days required:

by a man $= \frac{720}{60} = 12$

by a woman $= \frac{810}{45} = 18$; and by a child $= \frac{1080}{30} = 36$

If 1 man, 1 woman and 1 child work together,

$\frac{1}{12}+\frac{1}{18}+\frac{1}{36}$ work will be done in 1 day $= \frac{1}{6}$th

$\therefore$ 6 days will be required.
Cost = 6 × (60 + 45 + 30) = ₹810. Ans: (810)

37. Let x be the number of men initially engaged.
Let d be the number of days for which they worked. Hence, x men completed half of the work in d days (1)
Because 2x men joined, total number of working men = x + 2x = 3x.
This new group completes the remaining work 6 days earlier; i.e., 3x men complete half of the work in (d – 6) days --------- (2)
As the product of men and number of days is the same in both cases, being equal to work done,
(x) (d) = 3x (d – 6);
$\Rightarrow$ d = 3 (d – 6), 2d = 18 -------- (C)
But, 2d is the duration required by x men to complete the work.
Choice (A)

38. Let the rate at which each large pump fills the tank be l litres / hr.

Rate at which each small pump fills the tank = $\frac{2}{3}$ l litres/ hr.

Rate at which six small pumps and three large pumps fill the tank = $6\left(\frac{2}{3}l\right) + 3l = 7l$ litres / hr.

$\therefore$ They will take $\frac{1}{7}$th the time taken by a single large pump to fill it. Choice (B)

39. Pipe A can fill the tank in 20 hours. Pipe B in 30 hours.
Total time for both A and B together to fill the tank

$= \frac{20\times(30)}{30+20}$ = 12 hours.

But it took 3 hours more i.e. 15 hours in total.
Let the number of hours in which the leak can empty the tank be x.

$\Rightarrow \frac{1}{x} = \frac{1}{12} - \frac{1}{15} \Rightarrow x = \frac{60}{5-4}$ = 60 hours. Ans: (60)

40. The time from 10:00 a.m. to 6:00 p.m. = 8 hours.
So, one of the pipes worked for 8 hours and the other pipe worked for x hours.

$\frac{8}{12}+\frac{x}{18} = 1$ ---------- (1)

or $\frac{x}{12}+\frac{8}{18} = 1$ ---------- (2)

We get x = 6 from equation (1)
So, pipe Q was closed for 2 hours.
or

From Eqn (2), $x = 12\left[1 - \frac{8}{18}\right] = \frac{20}{3}$

So, pipe P was closed for $\left[8-\frac{20}{3}\right]=\frac{4}{3}$ hrs

Minimum possible time = $1^1/_3$ hours.

Alternate method:

Part of the tank filled, in 1 hour, by the two pipes

= $\frac{1}{12}+\frac{1}{18}=\frac{5}{36}$ th part.

Hence, time required to fill = $\frac{36}{5}$ = 7.2 hour.

Actual time taken to fill = 6:00 p.m. – 10:00 a.m.
= 8 hours.
Extra time taken 8 – 7.2 = 0.8 hours
Extra time was needed because one pipe was closed for some time.
Hence, part filled by 2 pipes in 0.8 hours = Part not filled due to closure of one tap

i.e. Part not filled = $0.8\times\frac{5}{36}=\frac{1}{9}$ th part.

Minimum time of closure is to be found out;
$\Rightarrow$ The faster pipe was closed.
Rate of filling of the faster pipe = $1/12^{th}$ / hour.
Hence duration of closure = (1/9)/(1/12) = (12/9)
= (4/3) hours. Choice (D)

41. Let the rate of filling of the first tap be x litres/hr
Let the rate of filling of the nth tap be denoted by t_n
$t_2 = x$
$t_3 = 2x$
$t_4 = 4x = 2^2x$
$t_5 = 8x = 2^3x$
$\therefore t_n = 2^{n-2}x$

$\frac{t_6}{t_9}=\frac{2^3x}{2^6x}=\frac{1}{8}$

$\therefore$ time taken by the ninth tap = $\frac{1}{8}(80)=10\,\text{minutes}$

Ans: (10)

42. To fill $\frac{3}{4}$th part, the filling pipe takes 3 hours.

To empty $\frac{3}{4}$th part, the emptying pipe takes
2 hours.
$\therefore$ When both are operated simultaneously, they will empty $\frac{3}{4}$th part of the full tank in $\frac{1}{2}-\frac{1}{3}=\frac{1}{6}$
i.e., 6 hours. Choice (D)

43. The taps can fill the tank in $\frac{(12)(36)}{12+36}=9\,\text{hours}$

But it this time only $\frac{5}{6}$th are full. The balance $\frac{1}{6}$th will be filled in $9\left(\frac{1/6}{5/6}\right)$ or 1.8 hours. Ans: (1.8)

44. If the pipe alone is operated, the tank would take $\frac{200}{5}$ = 40 hours to get filled. Because of the leak, it took 80 hours longer, i.e. 120 hours.

i.e., $\frac{120}{40}$ = 3 tanks were filled or 2 tanks extra were filled.
This is because of the leakage.
So, 2 tanks or 400 litres were leaked in 120 hours.

So, rate of leaking = $\frac{400}{120}$ = 3.33 litres/hour.

Choice (C)

45. To fill the tank, x takes 18 hours, y takes 24 hours and z takes 36 hours. If opened simultaneously, together they can fill the tank in a hours, here $\frac{1}{a}=\frac{1}{18}+\frac{1}{24}+\frac{1}{36}$

$\frac{1}{a}=\frac{4+3+2}{72}$ a = 8 hours
Time taken to fill the tank as per the schedule of filling is $(2\times 8) – (9/2) = (23/2)$ hours.
Hence, x worked for 23/2 hours; y worked for [(23/2) – t] hours and z worked for [(23/2) – 2t] hours.
Hence, the equation of work is :

$\left[\frac{23}{2}\times\frac{1}{18}\right]+\left[\frac{23}{2}-t\right]\left(\frac{1}{24}\right)+\left[\frac{23}{2}-2t\right]\left(\frac{1}{36}\right)=1$

$\Rightarrow\frac{23}{2}\left(\frac{1}{18}+\frac{1}{24}+\frac{1}{36}\right)-\left(\frac{t}{24}+\frac{2t}{36}\right)=1$

$\Rightarrow\left(\frac{23}{2}\times\frac{1}{8}\right)-\frac{7t}{72}=1,\Rightarrow\frac{23}{16}-1=\frac{7t}{72}$

$\Rightarrow$ t = 4.5 hours. Choice (D)

Solutions for questions 46 to 55:

46. From statement I,

1 boy = $\frac{3}{4}$ man $\Rightarrow$ 5 boys = $\frac{3}{4}\times 5$ men = $\frac{15}{4}$ men

10 men take 6 hours to do the work. So 5 boys, which is equal to $\frac{15}{4}$ men, can take $\frac{10\times 6}{15/4}$ days to do the work.

$\therefore$ Statement I alone is sufficient.

From statement II,
10 men can complete the work in 6 hours. So, 5 men can complete the work in 12 hours.
The amount of work done by 5 boys in one hour

= $\frac{1}{10}-\frac{1}{12}=\frac{1}{60}$

So 5 boys can do the work in 60 hours.
Statement II alone is also sufficient. Choice (B)

47. Either of the statements alone is not sufficient as information about I and II is given in different statements.
Combining statements I and II, the time taken to fill the tank is $\frac{1}{(1/2)-(1/3)}$ = 6 hrs Choice (C)

48. From statement I, work done by the pipes together, in the first 2 minutes = 1/6.
$\Rightarrow$ Work done in one minute = 1/12
So the time taken to fill the tank when they are opened alternately = 12 minutes.
So statement I alone is sufficient.
From statement II, we do not know the time taken by the other pipe to fill the tank. So we can't answer the question.
Choice (A)

49. From statement I, it is not known what part of the total work is completed, so we can't answer the question.

From statement II, B and C did $^8/_{23}$ of the work.
$\therefore$ A did $1 – {}^8/_{23} = {}^{15}/_{23}$ of the work.
$\therefore$ He gets $^{15}/_{23}$ of 529.
$\therefore$ Statement II alone is sufficient. Choice (A)

50. From statement I, the question cannot be answered as there is no information about volume of water emptied.

From statement II, as there is no information about tank, we cannot answer the question.
Combining both the statements, as the tub holds $12m^3$ of water, we can say that the tank has a capacity of $12m^3$ and was emptied in 30 minutes. Choice (C)

51. Let the times taken by each person of P and each person of Q to complete the job be p days and q days respectively.

Using statement I,

$2\left(\frac{1}{p}\right) + 3\left(\frac{1}{q}\right) = \frac{1}{\frac{12}{5}} = \frac{5}{12}$

$2\left(\frac{1}{p} + \frac{1}{q}\right) + \frac{1}{q} = \frac{5}{12}$

$\frac{1}{p} + \frac{1}{q} = \frac{5}{24} - \frac{1}{2q}$

$\therefore \frac{1}{p} + \frac{1}{q} < \frac{5}{24}$

$\therefore$ Time taken $> \frac{24}{5}$ days.

I is not sufficient.

Using statement II,

$3\left(\frac{1}{p}\right) + 2\left(\frac{1}{q}\right) = \frac{35}{68}$

$3\left(\frac{1}{p} + \frac{1}{q}\right) - \frac{1}{q} = \frac{35}{68} \Rightarrow \frac{1}{p} + \frac{1}{q} = \frac{35}{192} + \frac{1}{3q}$

$\frac{1}{p} + \frac{1}{q} > \frac{35}{192}$

$\therefore$ Time taken $< \frac{192}{35}$ days i.e., less than 6 days.

$\therefore$ II is sufficient Choice (A)

52. Whenever the time taken by two men to complete a job when they work together is an integral number of days, the time taken by them to complete it if they work on alternate days would be twice of that. In the given problem, from statement I, time taken by both to complete the job is an integral number of days.
$\therefore$ Required time = 2 (20)
= 40 days, I is sufficient

Using II, the time taken when they work together

$= \frac{30 \times 60}{30 + 60} = 20$

$\therefore$ Required time = 2 (20) = 40 days.
$\therefore$ II is sufficient. Choice (B)

53. Given, $\frac{1}{t} = \frac{1}{t+a} + \frac{1}{t+b}$

$\Rightarrow \frac{(t+b)+(t+a)}{(t+a)(t+b)} = \frac{1}{t}$

$\Rightarrow t[(t + b) + (t + a)] = (t + a)(t + b)$
$2t^2 + (a + b)t = t^2 + (a + b)t + ab$

$t = \sqrt{ab}$

Using statement I, ab is unknown.
$\therefore$ t cannot be found
I is not sufficient.
II is sufficient. Choice (A)

54. Using statement I, Rohan and Sohan take less time to complete the job when compared to Rohan and Mohan.
$\therefore$ Sohan is more efficient than Mohan. More information is required about the relation between the efficiencies of Sohan / Mohan and Rohan.
I is not sufficient.

Using statement II, Rohan and Sohan take less time to complete the job when compared to Mohan and Sohan.
$\therefore$ Rohan is more efficient than Mohan. More information is required about the relation between the efficiencies of Rohan / Mohan and Sohan.
II is not sufficient
Using both statements, Mohan is the least efficient. Both statements are required to answer the question.
Choice (C)

55. Let the times taken by A, B and C to fill the tank be a minutes, b minutes and c minutes respectively.

$\frac{1}{a} + \frac{1}{b} - \frac{1}{c} = \frac{1}{6}$ ---------- (1)

Using statement I,

$\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{1}{2}$ ---------- (2)

(2) – (1) $\Rightarrow \frac{1}{c} - \left(-\frac{1}{c}\right) = \frac{1}{2} - \frac{1}{6}$.

c can be found.
Required time can then be found.
I is sufficient.

Using statement II,

$\frac{1}{b} + \frac{1}{c} - \frac{1}{a} = \frac{1}{6}$ ---------- (3)

From (1) and (C),

$\frac{1}{a} + \frac{1}{b} - \frac{1}{c} = \frac{1}{b} + \frac{1}{c} - \frac{1}{a}$

$\frac{1}{a} = \frac{1}{c}$

a is unknown
$\therefore$ c cannot be found
$\therefore$ Required time cannot be found.
II is not sufficient. Choice (A)

Chapter – 7
(Averages, Mixtures and Alligations)

Concept Review Questions

Solutions for questions 1 to 35:

1. Total of the numbers = 513

Average = $\frac{513}{9} = 57$ Ans: (57)

2. Average = 22

$\Rightarrow \frac{17 + 36 + x}{3} = 22 \Rightarrow x = 23$ Choice (D)

3. As each number is doubled, the average will also be doubled.
$\therefore$ The new average = 2x Choice (B)

4. A 50% decrease in each number result in each number being halved. As each number is halved, the average will also be halved.

$\therefore$ The new average = $\frac{b}{2}$ Choice (C)

5. Average = $\frac{21 + 22 + 23 + ... + 30}{10} = 25.5$

or average = $\frac{\text{first} + \text{last}}{2} = \frac{21 + 30}{2} = 25.5$

Ans: (25.5)

6. The two digit numbers divisible by 10 are 10, 20, 30, 40, 50, 60, 70, 80 and 90.
Sum of the two digit numbers divisible by 10
= 10 + 20 + 30 + 40 + 50 + 60 + 70 + 80 + 90 = 450

$\therefore$ required average = $\frac{450}{9} = 50$ Choice (B)

7. There are 25 odd numbers less than 50

Average = $\frac{1+49}{2}$ = 25 Choice (D)

8. The last multiple of 12 less than 100 is (12)
Average of all the multiples of 12

$= \frac{12\,(1+2+3+....+8)}{8}$

$= \frac{12\,\frac{(8)\,(9)}{2}}{8} = 54$ Choice (B)

9. Total of the ages of 15 students = (15) (15) = 225 years
Total of the ages of 16 students = 225 + 15 = 240 years

New average age of the class = $\frac{240}{16}$ = 15 years.

Ans: (15)

10. Total of the ages of 20 students = (20) (20) = 400 years.
Total of the ages of 19 students = 400 – 20 = 380 years.

New average age of the class = $\frac{380}{19}$ = 20 years.

Choice (A)

11. After 5 years, the age of each family member will be 5 years more.
$\therefore$ The average age of the family will also be 5 years more i.e. 30 years. Choice (C)

12. As the present ages of all the friends is at least thirty five years, all of them are born before thirty years.
$\therefore$ Present average = 65
Let their be x friends then sum of their present ages = 64x
Sum of the their ages before thirty years = 65x – 30 $\times$ x
Average age thirty years ago = 35x / x = 35

Choice (A)

13. Average monthly income of Amar, Bhavan and Chetan in that month

$= \frac{4000+4500+6500}{3}$ = ₹5000 Choice (A)

14. Total marks in 6 tests = (6) (65) = 390
Total marks in the first 5 tests = (5) (60) = 300
Mark in the sixth test = 390 – 300 = 90. Ans: (90)

15. Let the age of teacher be t years then, 20 $\times$ 15 + t = 18 $\times$ 21
t = 78 years Choice (C)

16. Let there be n students in the group then,
n $\times$ 16 + 66 = (n + 1) 17 $\Rightarrow$ n = 49 Ans: (49)

17. Let the number of girls be g.
Number of boys = 8 – g

Method 1:
5 (13 – g) + 3g = 55 5 = g

Method 2:
Average number of chocolates received by each child

$= \frac{55}{13}$

$\frac{g}{13-g} = \frac{5-\frac{55}{13}}{\frac{55}{13}-3} = \frac{5}{8}$

$\therefore$ g = 5 Choice (D)

18. Average salary per month

$= \frac{4\,(6000)+4\,(8000)+4(13000)}{12}$

$= \frac{6000+8000+13000}{3}$ = ₹9000 Ans: (9000)

19. Let the numbers of male employees and female employees be m and f respectively.

Average height of the employees = $\frac{180\ m + 170\ f}{m + f}$

$= \frac{180\,\frac{m}{f}+170}{\frac{m}{f}+1}$. As m/f is unknown, the average height cannot be found. Choice (D)

20. There are 60 girls in the class.
Total marks of the boys = (30) (75) = 2250.
Total mark of the girls = (60) (90) = 5400.
Total marks of the class = 7650.

Average marks of the class in the test = $\frac{7650}{90}$ = 85

Ans: (85)

21. There are at least 30 boys in the class. $\therefore$ There are more boys than girls in the class.
If the average weight of the entire class is w, 30 < w < 40 and there are more boys than girls w is closer to 40 than 30 i.e. w > 35.
Only Choice (D) satisfies this condition. Choice (D)

22. Let the number of girls in the class be g.

Number of boys in the class = $\frac{150}{100}g = \frac{3}{2}g$.

Total of the ages of the boys = $10\left(\frac{3}{2}g\right)$. = 15 g years.

Total of the ages of the girls = 8g years.
Total of the ages of the students = 23 g years.
Average age of the class

$= \frac{23\ g}{g+\frac{3}{2}\ g}$ = 9.2 years. Ans: (9.2)

23. As the ratio of heights of boys and girls is 4 : 3, let their actual heights be 4k and 3k respectively.
The average height of the boys and girls =

$\frac{4k\times50+3k\times30}{50+30}$ = 3.625k.

Hence the exact average cannot be found. Choice (D)

24. Let the numbers of boys and girls in the class be b and g respectively. Let the average weights of the boys and the girls be B and G respectively.

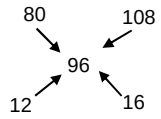
$\frac{Bb+Gg}{b+g} = \frac{B+G}{2}$

2Bb + 2Gg
= Bb + Bg + Gb + Gg
B (b – g) + G (g – b) = 0
(B – G) (b – g) = 0
B = G or b = g or both. Choice (C)

25. Quantity of milk in 20 litres = (0.6) (20) = 12 litres.
Upon addition of 5 litres of pure milk, the new solution of 25 litres would contain 17 litres as milk.

$\therefore$ Percentage of milk = $\frac{17}{25}$ (100) = 68% Ans: (68)

26.



Ratio = 3 : 4 Choice (C)

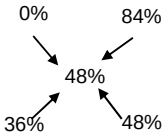
27. As we don't know the percentage of profit at which he sold the rice, we cannot find the average cost price. (Whenever we use alligation rule, all the prices should be in either cost terms or sales terms). Hence required ratio is cannot be determined. Choice (D)

28. Cost price of 5 kg. = (5) (15) = ₹75
Cost price of 10 kg. = (10) (12) = ₹120
Cost price of the mixture
$= \frac{75 + 120}{15}$ = ₹13/kg.

Profit = $\frac{20}{100}$ (13) = ₹ 2.60/kg

Selling price of the mixture = ₹15.60/kg. Ans: (15.60)

29. Pure water has no milk i.e., has 0% milk



= 3 : 4 Choice (D)

30. Quantity of milk in A = $\frac{75}{100}$ (20) =15 litres.

Quantity of milk in B = $\frac{60}{100}$ x litres.

$15 + \frac{60}{100}x = \frac{66}{100}(20 + x)$

$15 + 0.6x = 13.2 + 0.66x \Rightarrow x = 30$ Ans: (30)

31. Let the quantity of water to be added be x litres.
Quantity of water in the vessel = 20% of 30 = 6 litres.

$\frac{6 + x}{30 + x} = \frac{80\%}{100\%} = \frac{4}{5}$

$30 + 5x = 120 + 4x \Rightarrow x = 90$ Choice (C)

32. Let the quantities of the solutions be 2x litres and 3x litres.
Quantity of sulphuric acid in the first solution

$= \frac{10}{100}(2x) = 0.2x$ litres.

Quantity of sulphuric acid in the second solution

$= \frac{20}{100}(3x) = 0.6x$ litres.

Concentration of sulphuric acid in the final mixture

$= \frac{0.2x + 0.6x\ (100)}{2x + 3x} = 16\%$ Choice (A)

33. Let the cost price of the milk be ₹x/litres.
Let the quantity of water to be added to the milk be y litres.
Selling price of the mixture = ₹ x/litre.

Cost price of the mixture = $\frac{x\ (100)}{100 + 60}$ = ₹$\frac{5}{8}$ x/litre.

Cost of water = ₹0/litre

Method 1:

$\therefore 15x + 0 = \frac{5}{8}x\ (15 + y)\ 9 = y$

Method 2:

$\frac{y}{15} = \frac{x - \frac{5}{8}x}{\frac{5}{8}x - 0} = \frac{3}{5}$

y = 9 Choice (A)

34. Ratio of milk and present mixture = $\left(\frac{90 - 9}{90}\right)^2 = \frac{81}{100}$

$\therefore$ Ratio of milk and water = 81 : 19 Choice (C)

35. Quantity of milk in the present mixture = $\frac{81}{100}$ (90)

= 72.9 litres. Ans: (72.9)

Exercise – 7(a)

Solutions for questions 1 to 30:

1. Average of the first 20 multiples of 50

$= \frac{50(1 + 2 + ...20)}{20} = 50\left(\frac{21}{2}\right) = 525$ Choice (C)

2. Let the 11 distinct positive integers be represented by a, b, c, ... k.
a + b + c + d + e + f + g + h + i + j + k = 21 (11)
= 231 ------- (1)
a + b + c + d + e + f = 23 (6) = 138 ------- (2)
f + g + h + i + j + k = 22(6) = 132 -------- (3)
Adding equations (2) and (3) and subtracting equation (1), we get, f = 39. Ans: (39)

3. Temperatures on Sunday, Monday and Tuesday were 28, 30, 32. (all values in degrees celsius).
Temperature on Tuesday was 1 degree less than that on Wednesday.
Hence, temperature on Wednesday was 32 + 1 = 33
Using the same logic, the temperatures on Thursday, Friday and Saturday were : 34, 35, 36 respectively.
Average of first four days = (28 + 30 + 32 + 33)/4
= 123/4 = 30.75 -------- (1)
Average of the last three days
= (34 + 35 + 36)/3 = 35 ---------- (2)
Required difference = 35 – 30.75 = 4.25 Choice (B)

4. Let the present average age of ten advisors as well as their average 3 years ago, be A. Also let the age of the younger man be Y and that of the director replaced by him be D.

$\frac{10A + 30 - D + Y}{10} = A$, as the present average is same as the earlier average.
Hence D – Y = 30 years Choice (D)

5. Four statements are given in the data. They can be represented as the 4 equations given below. BCD represents the total weight of B, C, D.
A + BCD = 240
A + BCD + E = 285
BCD + E + F = 305
$\therefore$ E = 45, and F = 50.
$\therefore$ BCD = 210
Hence A = 30
Weight of A = Total weight of A, BCD, E – Total weight BCD, E = 30 kg. Ans: (30)

6. an = y + k ……..→ (1) bn = x + k ……..→ (2), where k is the sum of the (x – 1) numbers which are other than y and x.
Subtracting equation (2) from equation (1)

$n(a - b) = y - x \Rightarrow \frac{1}{n} = \frac{a - b}{y - x}$ Choice (B)

7. $\frac{36N+(20)(30)}{N+20}=\frac{36N-(5)(40)}{N-5} \Rightarrow N = 10$ Choice (A)

8. Let the number of students in X, Y and Z be x, y and z respectively.

Applying the rule of alligation, $\frac{x}{y}=\frac{81-76}{76-70}=\frac{5}{6}$

and $\frac{y}{z}=\frac{90-86}{86-81}=\frac{4}{5}$ x : y : z = 10 : 12 : 15

Let x = 10a, y = 12a and z = 15a

Average marks of X, Y and Z

$= \frac{70(10a)+81(12a)+90(15a)}{10a+12a+15a} = \frac{3020}{37}=81\frac{25}{37} \approx 82$

Ans: (82)

9. Let the number of students in the three classes be n_A, n_B and n_C and the total scores of students in the three classes be T_A, T_B and T_C

$T_A + T_B = 71(n_A + n_B)$

$T_B + T_C = 76\ (n_B + n_C)$

$T_C + T_A = 79\ (n_C + n_A)$

$2T_A + 2T_B + 2T_C = 150n_A + 147\ n_B + 155n_C$

$\Rightarrow T_A + T_B + T_C = 75\ n_A + 73.5n_B + 77.5n_C$

Hence $p=\frac{T_A+T_B+T_C}{n_A+n_B+n_C}$

$=\frac{73.5(n_A+n_B+n_C)}{n_A+n_B+n_C}+\frac{1.5n_A+4n_C}{n_A+n_B+n_C}$

$\Rightarrow p > 73.5$ -------- (1)

p can also be written as,

$p=\frac{T_A+T_B+T_C}{n_A+n_B+n_C}$

$=\frac{77.5(n_A+n_B+n_c)}{n_A+n_B+n_c}-\frac{2.5n_A+4.n_B}{n_A+n_B+n_C}$

$\Rightarrow p < 77.5$ -------- (2)

Hence 73.5 < p < 77.5 Choice (D)

10. Let the total number of matches that Sachin Tendulkar played be x.

$\frac{2100}{x-1}+1=\frac{2201}{x}$

Among the choices, choices (A) and (C) satisfy the equation above. Choice (D)

11. Average of all the four classes = (32 × 83 × 58 × 76 + 82 × 85 + 48 × 90) × 1/220 = 83.4 (approximately)

Alternate method:

Let us assume average mark of all the four classes is 83. Average deviation of all the four classes combined is: $=\frac{32}{220}\times(83-83)+\frac{58}{220}\times(76-83)+\frac{82}{220}\times(85-83)+$

$\frac{48}{220}\times(90-83)=0.4$ (approximately)

Hence, correct average = 83 + .4 = 83.4 Choice (D)

12. Total of all numbers = 16n

Once 5/8th of the numbers are doubled and 3/8th of the numbers are increased by a factor of 10/3, total of all numbers $=\frac{5n}{8}(2A)+\frac{3n}{8}\left(\frac{10B}{3}\right)+16n$, where A and B are the averages of values of the numbers which are respectively doubled and increased by a factor of 10/3.

New average = $\frac{\frac{5n}{4}A+\frac{5n}{4}B+16n}{n}$.

As A and B are not known, the new average cannot be determined. Hence the percentage increase in the average cannot be determined. Choice (D)

13. Let the average of classes I and II be A kg and B kg.

Let the number of students in the classes I and II be a and b respectively.

$\frac{Aa+Bb}{a+b}=\frac{A+B}{2}$

2Aa + 2Bb = Aa + Bb + Ab + Ba

(a – b) (A – B) = 0

As a ≠ b, A = B ---------- (1)

and 2 A + B = 60 ---------- (2)

solving (1) and (2), we get A = B = 20. Ans: (20)

14. Let a = 10 p + q and b = 10 r + s

Let the sum of all the numbers excluding a and b be x. Let the average of the numbers be A.

x + 10 p + q + 10 q + p = 10 A ---------- (1)

x + 10 r + s + 10s + r = 10 (A + 2.2) ---------- (2)

Subtracting (1) from (2),

11 [(r + s) – (p + q)] = 22

$\Rightarrow$ (r + s) – (p + q) = 2 Choice (B)

15. As each student missed a different number, the sum of the all the numbers added by the students = (N – 1) (sum of the first N natural numbers) = $\frac{(N-1)N(N+1)}{2}$

The number of numbers added by the students in total = (N - 1) (N)

$\therefore$ Average = $\frac{(N-1)N(N+1)}{2(N-1)(N)}$ = 21 $\Rightarrow$ N = 41

Choice (C)

16.

	Alloy A	Alloy B
Copper	4x	5y
Zinc	9x	6y
	---	---
Total wt.	13x	11y
	---	---

As the quantity to be drawn from the Alloys A and B to form another alloy C must be a multiple of 13 and 11, let us choose the quantity drawn as LCM of 13 and 11; which is 143. Hence 13x = 11y = 143 $\Rightarrow$ x = 11 and y = 13.

Amount of copper in Alloy C = 4x + 5y

= 4(11) + 5(13) = 109 kg.

Amount of zinc in alloy C = 9x + 6y

= 9(11) + 6(13) = 99 + 78 = 177 kg.

Hence the ratio of copper and zinc = 109 : 177

Choice (C)

17. Cost price of a mixture of two varieties of wheat

$=\frac{100}{100+40}x\,28 = Rs.20$

Let the cost price of the first and the second varieties of wheat be ₹y per kg and ₹(y + 3) per kg respectively.

Let the quantities be 3x kg and 4x kg respectively.

Cost price of the mixture = $\frac{y(3x)+(y+3)(4x)}{3x+4x}$

$= \frac{7xy+12x}{7x} = y+\frac{12}{7} = 20$

Cost price of the first variety of wheat

$= 20-\frac{12}{7} = ₹\frac{128}{7}$ /kg

Alternate method:

A mixture of two varieties of wheat is sold at ₹28 per kg, at a profit of 40%.

Hence, the cost price of the mixture = (28)/(1.4) = ₹20

Let x and (x + 3) be the prices in rupees of the first and the second varieties respectively.

The quantities are mixed in the ratio 3 : 4 (given)

By alligation equation,

$\frac{q_1}{q_2}=\frac{p_2-p}{p-p_1}; \quad \Rightarrow \frac{3}{4}=\frac{(x+3)-20}{20-x}$

$\Rightarrow \frac{3}{4}=\frac{x-17}{20-x}; \quad \Rightarrow x = 128/7$ Choice (A)

18. Cost price of each litre of diluted milk

$= \frac{100}{100+25}(4) = ₹\frac{16}{5}$

By the principle of allegation,

$$\frac{\text{Amount of water used for mixing}}{\text{Amount of milk used for mixing}}$$

$$= \frac{4-\frac{16}{5}}{\frac{16}{5}-0} = \frac{\frac{4}{5}}{\frac{16}{5}} = \frac{1}{4}$$

Hence 0.25 litres of water will be mixed with each litre of milk.

Choice (A)

19. Initial quantity of milk in the vessel = 0.2 (10) = 2 ml
Initial quantity of water in the vessel = 0.8 (10) = 8 ml
After x ml of milk was added, the ratio of milk and water would become 4 : 1
x = 4 (8) – 2 = 30
After y ml of water was added, ratio of milk and water would again become 1 : 4.
y = 4 (4(8)) – 8 = 120
∴ x + y = 150 Ans: (150)

20. Let the number of Group A employees be m. The number of Group B employees = m – 10
Applying the alligation rule,

$\frac{m-10}{m} = \frac{4800-4000}{4000-3000} = 0.8 \Rightarrow m = 50$ Choice (B)

21. Total cost of the coffee powder bought by Raju = (40) (240) + (160) (360) = 31200

Total selling price = $\frac{4}{5}(100) + \frac{1}{5}(100)(270) = 34200$

Overall profit = 3000

Overall profit % = $\frac{3000}{31200}(100) = 9\frac{8}{13}\%$ Choice (A)

22. Let the required proportion be x : y : z

$\frac{10x+12y+18z}{x+y+z} = 14$

Going by the options, we have only Choice (D) satisfying the above equation.

Alternate method:

Prices of 3 varieties of sugar are ₹10, ₹12 and ₹18 per kg.
Let them be mixed in the ratio x : y : z
Hence, price of the mixture is
(10x + 12y + 18z)/(x + y + z)
But this value is given on ₹14.
Hence, (10x + 12y + 18z)/(x + y + z) = 14
⇒ 10x + 12y + 18z = 14x + 14y + 14z
⇒ 4x + 2y – 4z = 0;
⇒ 2x + y – 2z = 0
This equation has infinite solution sets. Hence, from among the given options, the one which satisfies the equation will be the solution.
Option (D), i.e., 3 : 4 : 5 satisfies the equation.

Choice (D)

23. The data can be tabulated as :

	Alcohol	Water	Concentration
Mixture 1	1 part	2 parts	1/3
Mixture 2	4 parts	1 part	4/5
Combined Mixture	1 part	1 part	1/2

If q_1 and q_2 are the quantities of mixture 1 and mixture 2 that are mixed, then by alligation equation,

$\frac{q_1}{q_2} = \frac{(4/5)-(1/2)}{(1/2)-(1/3)} = \frac{(3/10)}{(1/6)} = \frac{9}{5}$

It is given that, $q_1 + q_2 = 28$;

Hence $q_1 = \frac{9}{14} \times 28 = 18$ litres Ans: (18)

24. In the first, second and third mixtures, $\frac{3}{5}$ th, $\frac{4}{5}$ th and $\frac{7}{10}$ th of the contents respectively is alcohol. Let x ml of each of these be drawn and mixed. The resulting mixture of 3x ml will have $\left(\frac{3}{5}x+\frac{4}{5}x+\frac{7}{10}x\right)$ ml of alcohol i.e. $\frac{21}{10}$x ml of alcohol ∴ It will have 70% alcohol. Choice (B)

25. Let us say we have x kgs of fresh dates and y kg of dry dates formed from them.
Amount of dry pulp = 10x/100 = 72y/100
y =10x/72 = 5x/36
⇒ when x = 36 kg, y = 5 kg Ans: (5)

26. Quantity of milk present in the solution now

$= \left(\frac{700-70}{700}\right)^4 x700$

$= \left(\frac{9}{10}\right)^4 x700$

= 459.2 litres Choice (B)

27. Let the amount of alcohol initially present be x litres. After two successive dilutions,

$\left(\frac{x-6}{x}\right)^2 = \frac{9}{9+16} = \left(\frac{3}{5}\right)^2$

x = 15 litres Ans: (15)

28. Applying the alligation equation, Quantity of milk/quantity of water = $\frac{16-0}{18-16} = 8:1$ Choice (A)

29. The original mixture had 90 litres of milk and 10 litres of water ∴It had $\frac{9}{10}$ th of milk

After the first withdrawal of 10 litres, 9 litres of milk and 1 litre of water is lost.∴ The resulting mixture would have 81 litres of milk. On then adding water the vessel would have $\frac{81}{100}$ th of its contents as milk

We want the milk concentration to be at most $66\frac{2}{3}\%$ (i.e less than or equal to $66\frac{2}{3}\%$), the milk quantity to be at most $66\frac{2}{3}$ litres. After the second replacement the vessel would have $\frac{729}{1000}$ th of its contents as milk. After the third replacement, the vessel would have $\frac{6561}{10000}$ th of its contents as milk i.e. 65.61 litres of milk (which is less than $66\frac{2}{3}$ litres)

The least number of times the procedure has to be carried out is 3. Ans: (3)

30. Let the initial volumes of milk in P and Q be p and q respectively.
After the first transfer, P would have 0.2p and Q would have 0.8p + q. After the second transfer, P would have 0.2p + 0.6(0.8p + q) and Q would have 0.4(0.8p + q)

$$\frac{0.2p+0.6(0.8p+q)}{0.4(0.8p+q)}=\frac{23}{12}\Rightarrow\frac{p}{q}=\frac{5}{2}$$ Choice (D)

Exercise – 7(b)

Solutions for questions 1 to 40:

1. Let A's, B's, C's, and D's weights be a kg, b kg, c kg and d kg respectively.

$a=\frac{b+c+d}{3}$ = 3a = b + c + d ---------- (1)

$b=\frac{a+c+d}{3}$ = 3b = a + c + d ---------- (2)

Adding (1) and (2),
3 (a + b) = a + b + 2 (c + d)
a + b = c + d

$\frac{c+d}{2}$ = 30 ∴ $\frac{a+b}{2}$ = 30. Choice (B)

2. Total weight of 18 students = 18 x 15 = 270 kg.
If a student leaves the class, his weight = the total weight of 18 students – the total weight of the remaining 17 students = 270 – [17 x (15 – 0.8)] = 28.6 kg
Ans: (28.6)

3. Y's age is 32 – 4 = 28
Let the average age of 11 people be A
11A = 32 + 28 + k …… eqn. (1), where k is the sum of the remaining ages.
11(A – 1) = a + b + k……eqn. (2),
where a and b are the ages of the two people replacing x and y. Subtracting equation (2) from equation (1),
11 = 60 – (a + b) ⇒ a + b = 49 and the average age of the people replacing x and y = 49/2 = 24.5 years
Choice (D)

4. Let the number of goals in the first match be a. The number of goals in successive matches are a, a + 2,
a + 4, a + 6, a + 8, a + 10, a + 12, a + 14, and a + 16

The average number of goals = $\frac{9a+72}{9}$ = a + 8 = 16

The average number of goals in the second and eighth matches = $\frac{2a+16}{2}$ = a + 8 = 16 Choice (C)

5. As the tens digits of the 9 numbers are different, the tens digits must be 1, 2, 3, 4, 5, 6, 7, 8 and 9. The units digits of the numbers must be 0, 1, 2, 3, 4, 5, 6, 7 and 8. Their average = $\frac{36}{9}$ = 4 Ans: (4)

6. Total score of 36 students = 36 x 60 = 2160.
If the two highest scores are excluded, total scores of the remaining 34 students = 34 x 58 = 1972.
Highest score of the class = 2160 – 1972 – 90
= 188 – 90 = 98 Choice (A)

7. Total score = 2240
Total score, excluding the top and the least scores = (69) (30) = 2070
Let the top and the least scores be t and l respectively.
t + l = 2240 – 2070 = 170 ---------- (1)
t – l = 70 ---------- (2)
Solving (1) and (2), T = 120 Ans: (120)

8. Let the fifth number be x. Then, from the given data, second number = 7x

first number = $\frac{7x+3}{3}$

fourth number = $\frac{7x+3}{3}-2$

$$\frac{7x+3}{3}+7x+\frac{7x+3}{9}+\left(\frac{7x+3}{3}-2\right)+x=5x16.2=81$$

Solving, we get x = 6 Choice (D)

9. Let the average of the ages of the 11 men be A years. Let the ages of the oldest and the youngest be x years and y years respectively.
If any one person leaves the group the maximum and minimum possible average age of the remaining occur if the person aged y years and the person aged x years, respectively, leave
11 A – y = (10) (11) = 110 ---------- (1)
11 A – x = (10) (12) = 120 ---------- (2)
Adding (1) and (2),
22A – (x + y) = 230

$\frac{x+y}{2}=11$ A = $11\frac{5}{11}$ Choice (D)

10. Let the correct average of the 10 positive integers be A and the number whose digits are interchanged be $(ab)_{10}$
$10A = (ab)_{10}$ + …….
$10(A – 1.8) = (ba)_{10}$ + …….

$18 = (ab)_{10} – (ba)_{10} = 10a + b – (10b + a)$

= 9a – 9b = 9(a – b) Difference of the two digits a and b = 18/9 = 2 Choice (B)

11. The age of the person who is replaced is ab. Let the sum of the ages of the remaining persons be x
ab + x = 60A and ba + x = 60(0.8A)
∴(ab + x) – (ba + x) = 60 (A – 0.8A) (∵ ab – ba = 9)
⇒ 9(a-b) = 12A

$\Rightarrow A=\frac{3}{4}(a-b)$

A has its maximum value when a – b has its maximum value, which is 9 ∴Maximum (A) is 6.75. But all the ages are two digit numbers and A cannot be 6.75, i.e the data is consistent. Choice (D)

12. Let the number of matches totally played be N

$$\frac{1200}{N-1}=\frac{1200+20}{N}\quad\frac{1200}{N-1}=\frac{1220}{N}$$

1200N = 1220 (N – 1) = 1220 N – 1220 Hence N = 61

Alternate method:

In the last match, the score is 20; this can be treated as the average score for the group of matches, whose number is 1. The weighted average of this group and the group of matches played earlier is also 20. i.e., there is no change in average; i.e., the average of the other group is 20. Hence, number of matches of that group = 1200/20 = 60. Hence, total number of matches = 60 + 1 = 61. Ans: (61)

13. Let us say N members met for lunch

$$\frac{2160}{N-6}=\frac{2160}{N}+81$$

Substituting the choices in place of N in the equation above, we see that only Choice (A) satisfies it.
Choice (A)

14. Let the number of chocolates he ate on Monday = a
The number of chocolates he ate on subsequent days are (from Tuesday to Friday) Tuesday are a + 2, a + 10, a, a + 4 respectively.

$$3\left(\frac{a+a+2+a+10}{3}\right)=4\left(\frac{a+a+4}{2}\right)\Rightarrow 4=a$$

Choice (B)

15. Let the numbers be a, b, c, $a_2\ b_2\ c_2$, $a_3b_3c_3$, …..$a_9b_9c_9$

Average of the results = $\frac{1}{9}$ ($a_1b_1c_1 - c_1b_1a_1 + a_2b_2c_2 - c_2b_2a_2 + a_3b_3c_3 - c_3b_3a_3 +$ …….. $a_9b_9c_9 - c_9b_9a_9$)

= $\frac{1}{9}$ [99 ($a_1 - c_1 + a_2 - c_2 + a_3 - c_3 + \ldots a_9 - c_9$]

for i = 1 to 9 $a_i \geq c_i$

As the average of the results is 0, it follows that $a_i = c_i$.

As the units digits of the numbers are distinct, the units digits must be from 1 to 9. The greatest and the least hundreds digits are 9 and 1 respectively.

Their average = 5 Choice (B)

16. Let the present ages of the father, his only son and his wife be f years, s years and m years respectively.

$$\frac{f+s}{2} = \frac{5}{4}\left(\frac{s+m}{2}\right)$$

$\Rightarrow$ 4 (f - m) = s + m

$\Rightarrow$ f – m = 10 and m - s = 30

$\Rightarrow$ s + m = 40 and m – s = 30 $\Rightarrow$ s = 5 Ans: (5)

17. As the average weight of A decreased after the student left, his weight must be more than the average weight of A. As the average weight of B decreased after the student joined, his weight must be less than the average weight of B.

His weight must be between 40 kg and 60 kg

Choice (B)

18. Let a, b, c and d represent the amounts with A, B, C and D respectively.

If a is increased by 100%, the new value is 2a.

When b is increased by 200%, the new value is 3b.

Hence, net increase in total value is (2a – a) + (3b – b) = a + 2b

This increase leads to an increase in the average, equal to (a + 2b)/4.

Given this increase = ₹62.50

Hence, (a + 2b)/4 = 62.50

$\Rightarrow$ a + 2b = 250 ---------- (1)

When the percentage increases are interchanged, then the amounts with A and B will be 3a and 2b respectively.

Average of 3a and 2b is given equal to 275.

Hence, (3a + 2b)/2 = 275;

$\Rightarrow$ 3a + 2b = 550 -------- (2)

Subtracting (1) from (2), 2a = 300; a = 150 Choice (A)

19. From equation (1) of Q.33, (which forms common data),

C + D = 800 – (A + B) = 800 – (150 + 50)

= 600 $\rightarrow$ (5) If C gives ₹50 to D,

C – 50 = 2(D + 50) $\Rightarrow$ C = 2D + 150 $\rightarrow$ (6)

Solving equation (5) and (6)

D = ₹150 and C = ₹450 Choice (D)

20. By using the alligation equation,

$$\frac{\text{Number of clerks}}{\text{Number of managers}} = \frac{10000-8000}{8000-3000} = \frac{2}{5}$$

Number of clerks = 50; $\Rightarrow$ Number of managers = 125

Difference in the number of clerks and managers

= 125 – 50 = 75 Ans: (75)

21. Let the cost of each apple be ₹A and that of each mango be ₹M

5A + 4M = 9 x 48 = 432

7A + 8M = 15 x 60 = 900.

Adding both the equations and multiplying with 2, we get

24A + 24M = ₹2,664 Choice (C)

22. Let the total marks of P and Q, P and R and Q and R be a, b and c respectively. Let the number of students in P, Q and R be p, q and r respectively.

a = 60 (p + q)

b = 64 (q + r)

c = 72 (p + r)

a + b + c = 132 p + 124 q + 136 r

$$x = \frac{a+b+c}{2(p+q+r)} = \frac{66p+62q+68r}{p+q+r}$$

$$\frac{62(p+q+r)}{p+q+r} < x < \frac{68(p+q+r)}{(p+q+r)}$$

62 < x < 68

$\therefore$ Only 62.5 is the only possible value Choice (C)

23. Let the number of students in P be 2x

Let the average marks of P be 5y

Numbers of students in Q, R and S are 3x, 6x and 4x respectively.

Average marks of Q, R and S are 4y, 3y and 2y respectively.

Total marks of P, Q, R and S are 10xy, 12 xy, 18 xy and 8 xy respectively. Greatest weighted average

$$= \text{maximum}\left(\frac{10xy+12xy+18xy}{2x+3x+6x}, \frac{10xy+12xy+8xy}{2x+3x+4x}, \frac{12xy+18xy+8xy}{3x+6x+4x}, \frac{10xy+18xy+8xy}{2x+6x+4x}\right)$$

Max $(3\frac{7}{11}y, 3\frac{1}{3}y, 2\frac{12}{13}y, 3y) = 3\frac{7}{11}y$

$\Rightarrow 3\frac{7}{11}y = 52 \Rightarrow y = \frac{(52)(11)}{40}$

least weighted average = $\frac{38}{13}y = 41.8$ Ans: (41.8)

24. Average value per coin = 775 paise/100 coins 7.75 paise/coin.

By the application of the alligation equation.

The number of 5 paise coins and the number of 10 paise coins = $\frac{10-7.75}{7.75-5} = \frac{2.25}{2.75} = \frac{9}{11}$

Hence the number of 5 paise coins

= (9/20) x (100) = 45 Choice (D)

Note: The problem can also be solved using simultaneous equation.

25. Let the smaller part lent be ₹ x. The larger part lent = ₹ (8000 – x)

The effective rate of interest = $\frac{960}{8000}$ (100)% = 12%

Applying the alligation rule,

$\frac{8000-x}{x} = \frac{20-12}{12-10} = \frac{4}{1}$

x = 1600. $\therefore$ The difference of the parts = 8000 – 2x = 4800

Choice (A)

26. Let the part lent at 10% be ₹x and that lent at 12% be (1800 – x).

$\frac{x}{1800-x} = \frac{12-10.5}{10.5-10} = \frac{3}{1}$

Hence x = 3/4 (1800) = 1350 and y = 1/4 (1800) = 450

Interest earned by the business man from the part lent at 10% = $\frac{1350 \text{ x } 1 \text{ x } 10}{100}$ = ₹135 Choice (A)

27. Let the time in which the part which was covered at the lower speed be x hours. The time in which the other part was covered = (5 – x) hours. Raju's average speed = $\frac{250}{5}$ = 50 kmph

Applying the alligation rule,

$\frac{x}{5-x} = \frac{80-50}{50-30} = \frac{3}{2} \Rightarrow x = 3$

The distance he covered at the higher speed

= 80 (5 – x) = 160 km Ans: (160)

28. When different distances are travelled at different speeds, then the average speed, s, is

$s = \frac{s_1t_1 + s_2t_2}{s_1 + s_2}$ where s_1, s_2 are the speeds and t_1, t_2 are the times of travel with respective speeds.

Hence, $\frac{t_1}{t_2} = \frac{s_2 - s}{s - s_1}$

In the given problem, s_1 = 45 kmph (scooter),
s_2 = 70 kmph (car)
s = (250/5) = 50 kmph (average speed).

Hence, $\frac{t_1}{t_2} = \frac{70 - 50}{50 - 45} = \frac{20}{5} = \frac{4}{1}$

Total time of travel = 5 hours.

Hence, t_1, time of travel by scooter = $\frac{4}{5}$ of 5 = 4 hours.

Distance covered by scooter = 4 x 45 = 180 km.

Choice (B)

29. Once a litre of milk is added, we have the total quantity of the solution = 7litres.

Concentration of water = $\frac{\frac{70}{100}(6)}{7} x100 = 60\%$

Choice (D)

30. Quantity of milk in 350 ml = 10/100 x 350 = 35 ml
Once water is added, milk forms 7% of the solution. Hence the total solution = 100/7 x 35 = 500 ml
Hence the amount of water added = (500 – 350) ml = 150 ml

Choice (D)

31. Let the quantities of milk and water that are mixed be m litres and n litres respectively
Cost of water = ₹0 / litres
Applying allegation,

$\frac{w}{m} = \frac{20 - 18}{18 - 0} = \frac{1}{9}$ Choice (D)

32. Selling price of the mixture = ₹5 / litre

Cost prices of the mixture = $\frac{5(100)}{100 + 25}$ = ₹ 4/ litre

Let the quantity of water mixed be x litres

Applying alligation, $\frac{x}{1} = \frac{5 - 4}{4 - 0} = \frac{1}{4}$

x = 0.25 Ans: (0.25)

33. Let x litres and y litres be the respective quantities to be drawn from A and B to form the mixture

$\frac{4}{9}x + \frac{3}{4}y = \frac{3}{5}(x + y) \Rightarrow \frac{x}{y} = \frac{27}{28}$ Choice (A)

34. Concentration of alcohol in the 1st mixture = 3/(3 + 4) = 3/7
Concentration of alcohol in the 2nd mixture
= (65)/65 + 79) = (65/144)
Concentration of alcohol in the combined mixture
= 4/(4 + 5) = 4/9
If q_1 and q_2 are the quantities of mixture 1 and mixture 2 that are combined, then, by the equation of alligation,

$\frac{q_1}{q_2} = \frac{(65/144) - (4/9)}{(4/9) - (3/7)} = \frac{1/144}{1/63} = \frac{63}{144} = \frac{7}{16}$

Choice (A)

35. The ratio in which A and B are mixed = 2 : 3
Let the quantities of A and B mixed be 2x kg and 3x kg respectively.
Cost of the mixture formed

= $\frac{20(2x) + 30(3x)}{5x}$ = ₹26 per kg

(i) Cost of the mixture formed by interchanging the quantities of A and B = $\frac{20(3x) + 30(2x)}{5x}$ = ₹24 per kg

Choice (C)

(ii) profit percentage = $\frac{39 - 26}{26}$ (100)% = 50%

Choice (C)

36. Let the quantities of A, B and C used for mixing be a kg, b kg and c kg respectively.

Cost price of the mixture = $\frac{15(100)}{100 + 66\frac{2}{3}}$ = ₹9 / kg

Total cost price of the mixture = 6a + 9b + 12 c = 9
(a + b + c) ⇒ a = c
As b = 50 and a + b + c = 100, a = 25 and b = 25.
∴ The quantity of variety A is 25 kg. Ans: (25)

37. Let the cost of P, Q, R be ₹p, q, r. per kg (p = 200, given)

$r + \frac{20}{100}r = 288$. ∴ r = 240

Let x kg of P and 2x kg of Q be mixed to form R. Let the cost of Q be ₹q/kg

$\frac{x(200) + 2x(q)}{3x} = 240 \Rightarrow q = 260$

Let a kg of the first variety and b kg of the second variety be mixed to form Q.

$\therefore \frac{280a + 180b}{a + b} = 260 \Rightarrow a = 4b$ i.e., $\frac{a}{b} = \frac{4}{1}$

Choice (C)

38. Let x kg be the quantity of T1 in the mixture.
Cost of the mixture of T1, T2 and T3

= $\frac{56(x) + 64(2x) + 80(4x)}{7x}$ = ₹ 72 per kg

Let y kg of T1 be added to this mixture. The cost of the final mixture = $\frac{(72)(4) + 56y + 80(4y)}{4 + 5y}$

This also equals $\frac{87.60(100)}{100 + 20} = 73$

$\Rightarrow \frac{288 + 376y}{4 + 5y} = 73 \Rightarrow \frac{4}{11} = y$ Choice (D)

39. Let the capacity of the vessel be x ml.
Amount of milk originally in the vessel = 9x/100 ml
Amount of milk in the vessel after replacement by water = 6x/100 ml.
Amount of milk in the 9 litres withdrawn
= 9(9)/100 = 81/100 ml
Hence 9x/100 – 6x/100 = 81/100;
⇒ 3x/100 = 81/100
⇒ x = 27litres

Alternate method:

In the case of replacement, the relation between the initial and the final concentration is :

$C_1\left(\frac{v - x}{v}\right) = C_2$

C_1, C_2 are the initial and the final concentrations respectively; v is the total volume, x is the volume replaced.

Hence, 9% $\left(\frac{v - 9}{v}\right)$ = 6%; ⇒ v = 27 Choice (A)

40. Let the capacity of the vessel be x litres.

(i) quantity of milk in the vessel finally

= $x\left(\frac{x - 9}{x}\right)^2 = x - 17.1$

$x^2 - 18x + 81 = x^2 - 17.1x$ x = 90 Ans: (90)

(ii) let the number of further replacements be n.

$$\left(\frac{x-9}{x}\right)^{n+2} \le \frac{75x}{100}$$

x = 90

$(0.9)^{n+2} \le 0.75$ ---------- (1)

least value of n satisfying (1) is 1 Ans: (1)

Solutions for questions 41 to 45:

41. From statement I, 18 students are 15 years old.
From statement II, the average age of 4 students is less than 15 years.
Combining statements I and II, there are two students whose age is less then 15 years and the remaining 18 students are 15 years old.
So, we can say that the average age of 20 students is less than 15 years. Choice (C)

42. Statement I alone is sufficient as tin by weight is

$$\left[1-\left[\frac{2}{5}+\frac{3}{16}\right]\right] \times 60 \text{ kg}$$

Statement II alone gives by volume. So, it is not sufficient.
Choice (A)

43. Either of the statement alone is not sufficient as the information about six numbers is not given in one statement.
Using both the statements,
We can say that three numbers are more than 30.
Choice (C)

44. Using both statements I and II, we can say that x is more concentrated. (concentration of x is $\frac{4}{7}$ = 57.14% and then concentration of y is $\frac{6}{13}$ < 50%) Choice (C)

45. Either of the statements alone is not sufficient as the total score of boys and girls is given in statement I and total score of girls is given in statement II.
Using both the statements,
Let the average score of the boys be k
$kx + 86y = 85(x + y) \Rightarrow kx = 85x - y$
$y = x(85 - k)$
As x and y are positive, k must be less than 85.
So the average score of the boys is less than 85 but we can't say whether it is more than 83 or not. Choice (D)