Expt. No. TCS NQT - numerical ability

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(Quantitative aptitude)

1. $\boxed{\text{HCF \& LCM}}$ (2-3 qms)

HCF (Highest Common Factors)

$6 = (6 \times 1)$
$= (2 \times 3)$
$= (3 \times 2)$

factors of 6 (these no.s that can completely divide 6) & easily

HCF (out of all factors that is the greatest factor)

Eg = 6 = 1, 2, 3, 6 → HCF

also know as → GCD (Greatest common divisor)

- Eg - 42 54 36 → HCF ??

$$\begin{array}{r|l} 2 & 42, 54, 36 \\ 3 & 21, 27, 18 \\ & 7, 9, 6 \end{array}$$

} HCF (all 3 no.s should have to be divided by the same no.)

HCF = 2 × 3 = 6

LCM (Least common multiple)

Eg - 2 → 4 6 8 10 12 14 16 18 ---
3 → 6 9 12 15 18 21 ---

} LCM (2, 3)

6 is least

multiples that are common b/w 2 & 3

∴ LCM (2, 3) = 6

$\frac{2 \times 3}{2 \times 3}$ → LCM = 6

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- Eg - 250 100 125 → LCM ?

$$\begin{array}{r|l} 2 & 250, 100, 125 \\ 5 & 10, 4, 5 \\ 2 & 2, 4, 1 \end{array}$$

LCM = 500

$10 \times 4 \times 2 = 250$

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(Ans 3 ~ 40)

In HCF = 30 not fine to this

(1) 25 | 250, 100, 125
3 | 10, 4, 5
2 | 5, 2, 1
2 | 1, 1, 1

= 25 × 2 × 2 × 2 = 500

• TIPS

HCF (1) 18, 24, 30 → HCF?

divisible 2, 3, 6 → HCF = 6

3, 4, 5 → not fine div

LCM (1) 16, 36, 72, 144 LCM = 144

(2) 24, 36 (12)

LCM = 72

(3) 24, 36, 48

1st way 12 | 36, 48 / 4 ∴ LCM = 144

2nd way 48 × 2 × 3 (24 × 3 × 2)

144 × 3 = 144

∴ LCM = 144

Apply this for the nos that are easy to mul (either higher) We take time for multiplying

• (1) (1/30 − 1/45) → often in this case how to easily find the LCM & solve the problem?

= (45 − 30)/(30 × 45)

= 15/(30 × 45)

2 | 30 × 45 = 1/30

→ (known to me)

(3, 4, 5)

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(2) (9/30 − 2/45)

= (180 − 60)/(30 × 45) = 120/(30 × 45) = 4/45

(known to me)

(1) What is LCM of 36/225, 48/150, 72/65?

36/225, 48/150, 72/65

$$\boxed{\text{LCM of fraction} = \frac{\text{LCM Numerators}}{\text{HCF Denominators}}}$$

= 36/225, 48/150, 72/65

= 144/5 (Ans)

(2) What is LCM & HCF of 36/75, 48/150, 72/135?

36/75, 48/150, 72/135

LCM = 144/15 (Ans)

$$\boxed{\text{HCF of fraction} = \frac{\text{HCF N}}{\text{LCM D}}}$$

= 12/1350 = 2/225 (Ans)

23 | 48, 72
2, 3

5 | 225, 150, 65
5, 30, 13

15 | 75, 150, 135
5 | 5, 10, 9
1, 2, 9

12 | 36, 48, 72
3, 4, 6

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③ What greatest no divides 17, 42, & 93 & leaves remainders 4, 3, & 15, respectively.

Let, the greatest no is = x

$\frac{17}{x} \rightarrow$ rem = 4

$17 - 4 = \frac{13}{x}$ [power]

$\frac{42}{x} \rightarrow$ rem = 3

$42 - 3 = \frac{39}{x}$ [power]

$\frac{93}{x} \rightarrow$ rem = 15

$93 - 15 = \frac{78}{x}$ [power]

HCF → 13, 39, 78

13, 3, 6

∴ HCF = 13

∴ the greatest no = x = 13 (Ans)

Cross check = $\frac{17}{13}$ = ~~dividend~~ quotent = 1, rem = 4

$\frac{42}{13}$ = quotent = 3, rem = 3

$\frac{93}{13}$ = quotent = 6, rem = 15

④ What least no. when divided by 36, 24 & 16 leaves 11 as remainder in each case?

LCM → 4 | 36, 24, 16 → 144 + 11 (needed rem) = 155 (Ans)

3 | 9, 6, 4

3 | 3, 2, 4

2 | 1, 2, 4

1, 1, 2

LCM = 144

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$\frac{153}{36}$ = quotent = 4, rem = 11	$\frac{153}{24}$ = quotent = 6, rem = 11	$\frac{153}{16}$ = quotent = 9, rem = 11

Whenever there is this type of Qn, i.e what is the least no. that is divided by some given no.s & leaves the same remainders = ① Find the LCM of given no.s ② Add the rem to the LCM ③ The result will be the ans of the Qn.

⑤ What least no. when divided by 20, 48, 36 leaves the remainders 13, 41, & 29 respectively?

Method

Least → LCM

4 | 20, 48, 36 → LCM = 720

3 | 5, 12, 9

5, 4, 3

Number	No.	no.
20	48	36
↓ rem	↓ rem	↓ rem
13	41	29

(diff) 7 | 7 | 7

∴ diff. is common here

now, 720 − 7 = 713 (Ans)

Whenever, there is the Qn like this, i.e what the least no. that is divided by some given no.s & leaves diff. remainders = ① Find the LCM of given no.s ② The diff. b/w given no.s & rems are same (if so) then, ③ Subtract that rem from LCM ④ The result will be our ans

(and the diff. b/w the given no.s & rems are same)

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⑤ [whenever the rems is same we add it, & when even the rems are different we subtract it] (the difference)

⑥ What least possible 4-digit number, when divided by 12, 16, 18 & 20 leaves 21 as remainder?

Rem = same (so need to add to result of the lcm)

∴ Lcm (12, 16, 18) = 2 | 12, 16, 18, 20
2 | 6, 8, 9, 10
3 | 3, 4, 9, 5
3, 4, 3, 5

= 144 × 5

= 720 → 3 digit

~~now, 720 + 21~~ now 720 is divisible by 12, 16, 18, 20 (as it is their lcm), i.e the multiples of 720 will be also divisible by 12, 16, 18, 20 (as 720 itself is divisible by them)

∴ no multiples of 720 = 720 × 2 = 1440

this is a 4 digit no. (least 4 digit no. that we can find out)

∴ now → 1440 + 21 = 1461 - Ans

⑦ The ratio of 2 no.s is 5:6 & their lcm is 480, then their HCF is?

It's here are 2 no.s A B

$\boxed{AB = HCF(A,B) * Lcm(A,B)}$

eg – A 15 B 20

HCF = 5 | 15, 20 (3, 4) HCF = 5

Lcm = 5 | 15, 20 (3, 4) Lcm = 60

now, LHS = A * B = 15 * 20 = 300

RHS = 5 * 60 = HCF * Lcm = 300

∴ LHS = RHS (proved)

$\boxed{AB = HCF(A,B) * Lcm(A,B)}$

Ratio of 2 no.s = 5:6 (as it's ratio we can't use them directly)

let, x be the common factor

∴ Two no.s are = 5x 6x [as it's ratio

that means there is some common factor, eg. 6:9 = 2:3 (common factor = 3) 2×3 : 3×3

Lcm = 480 (given)

HCF = ?

5x, 6x (5, 6) ∴ HCF = x

(whenever there will be the ratio, the common factor of the ratio is HCF (always))

∴ now,

5x × 6x = x × 480

⇒ 30x = 480

⇒ x = 16

∴ HCF = x = 16 - Ans

(8) HCF & LCM of 2 nos is 8 & 96. Sum of these nos is 56. Then what is sum of their reciprocals?

A B

$AB = HCF \times LCM$ — (I)

let the nos are A & B

Given, $A+B = 56$ — (II)

HCF = 8

LCM = 96

$\therefore AB = 8 \times 96$ [from (I)] — (III)

now, the qn is, $\frac{1}{A} + \frac{1}{B}$?

$\frac{1}{A} + \frac{1}{B} = \frac{B+A}{AB} = \frac{\cancel{56}^{7}}{8 \times 96}$ (from (II) & (III))

$= \frac{7}{96}$ — Ans

(9) What largest no. will divide 47, 35 & 27 leaving same remainder in each case? what will be the common remainder?

largest = GCD/HCF

47 35 27 [We don't know the common rem]

So, $47 - 35 = 12$
$35 - 27 = 8$
$27 - 47 = -20$
(ignore the '-' sign)

} substract them from e/o

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HCF (12, 8, 20) = 4 | 12, 8, 20
3, 2, 5

$\therefore$ HCF = 4 → that is the largest no. [any other also too] — Ans

$\frac{47}{4}$ → rem = 3 | $\frac{35}{4} = 3$ | $\frac{27}{4} = 3$

$\therefore$ the common rem = 3 — Ans

(10) There are 3 equilateral triangles with sides 114 cm, 76 cm & 152 cm. What maximum size scale can measure them exactly?

114 76 152

(this isn't a regular scale, this is a piece of log)

HCF (114, 76, 152)

2 | 114, 76, 152
19 | 57, 38, 76
3, 2, 4

$\therefore$ HCF = 38 cm

$\therefore$ The max size scale is: 38 cm — Ans

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Crosscheck

$38 \times 3 = 114$ $38 \times 2 = 76$ $38 \times 4 = 152$

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Whenever there is this kind of sum, i.e the sides of some equilateral triangles are given & need to find out the max scale size that can measure them exactly then we need to do — ① HCF of the given sides no.s ② the result will be our ans

(this can be asked by many ways, i.e instead of equilateral triangle, there can be anything else, just remember "max size scale to measure exact size" is the clue) → it would always be HCF

(14) If $(x-4)$ is the HCF of $x^2-8x+15$ & x^2-kx-1, then what is k?

HCF = $(x-4)$ i.e $(x-4)$ is the factor of both eqn. It means it can divide both the eqn perfectly with 0 remn.

HCF = (can divide (factor)
LCM = can be divided (multiple)

If, $x-4$ is HCF, then if we put $x=4$ in both eqns $x^2-8x+15$ & x^2-kx-1 they would satisfy i.e the result of both eqn will be 0 — v Imp

i.e, $x=4$ → $x^2-8x+15=0$
→ $x^2-kx-1=0$

$x^2-8x+15 = x^2-kx-1$, when $x=4$

⇒ $16-32+15 = 16-4k-1$

⇒ $-17+1 = -4k$; ⇒ $k=4$ (ans)

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Formula: HCF/LCM — v v Imp

traffic signals, 3 m & off together at 6/7 — Page No. of 1 from Date/9 etc

(12) 5 clocks ring automatically at intervals of 12 mins, 8 mins, 3 min, 4 mins & 10 mins, respectively. In 8 hours from the moment they start, how many times will they ring together? ← [5 gs can ring signals, means on when they sounds together TOGETHER]

Always remember, whenever we have to find out how many times they ring together after the start, it will always be the next instance & it it will always be LCM

If would always be LCM (It is future, i.e. next instances, the next instances can be given by LCM)

$2 \rightarrow 2 \rightarrow 12$
$3 \rightarrow 3 \rightarrow 6$
5

Common multiples that is the next instances where both of these means.

LCM(12, 8, 3, 4, 10) = 2 | 12, 8, 3, 4, 10
2 | 6, 4, 3, 2, 5
3, 2, 1, 1, 5

∴ LCM = 120 min

120 min — 120 min — next time

they together after this pair

the next time they will ring together (after 120 ming)

they ring together

120 mins = 2 hrs

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In 8 hrs, from the moment they start, how many times will they ring together.

8 hrs

00 —2 hrs→ 2 —2 hrs→ 4 —2 hrs→ 6 —2 hrs→ 8

→ 4 times

∴ 4 times — Ans

Short cut = Given / mentioned hrs / the hrs after which they ring together

(same concept as per 7n) → 8/2 = 4 times

(13) 3 cyclists cycle along the circumference of a single. They complete 1 round in 27 minutes, 45 mins & 63 mins respectively. Since they start together, when will they meet again at the starting position?

need next instance → LCM to find

9 | 27, 45, 63
3, 5, 7

LCM = 945 min

∴ They will meet again at the starting position after 945 mins — Ans

(14) Manej wants to paste wallpapers on the wall of his room. The wall is 4 meters & 50 cm in length & 3 meters & 50 cm in height.

But the wall should be covered completely only only be square pieces of a wallpaper having same size. What is the no. of minimum sized wallpaper squares needed to cover the walls completely? (The sum is give the max sized scale, so need to find HCF/GCD)

HCF (450, 350) = 50 | 450, 350
9, 7

= 50 cm

Area = 450 × 350

Area of 1 square wallpaper = 50 × 50

∴ The no. of max sized wallpaper squares needed to cover the walls completely =

$\frac{450 \times 350}{50 \times 50} = 63$ — Ans

(15) The sum of 2 no.s is 156 & their HCF is 13. The no.s of such no. pairs is?
(can be solved by logic)

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A+B = 156
HCF = 13 (i.e, 13 can divide this 2 nos
i.e, this 2 no's are multiple of 13)

∴ multiple of 13 =
13 26 39 52 65 78 91 104 117 130 156

(Its max amount of no. is already given (i.e the sum of 2 nos sum) = 156) so we have to go till 156
is 156 that is max

Now the sum of any no. can be 156, but as HCF of this 2 nos is already given, so we need to take only the multiples of 13 to find such pairs ~~which~~ whose sum is 156]

Pairs ✗ (13, 143) (HCF = 13) → 1 pair (now 13 can be combined with any other nos as we already have the actual no. 13 can make 143, if we want to add with other no. so always get < 156)

✗ (26, 130) (HCF = 26) ~~→ 2nd pair~~
✗ (39, 117) (HCF = 39) ~~→ 3rd~~
✗ (52, 104) (HCF = 52) ~~→ 4th~~
✓ (65, 91) (HCF = 13) → 2nd
✗ (78, 78) (HCF = 78)

∴ 2 pairs = (13, 143) & (65, 91)

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(12) What is the least no. which when divided by numbers 3, 5, 6, 8, 10 & 12 leaves in each case a remainder 2, but which when divided by 13 leaves no remainder?

• trick (when in exam time is constraint, & we are not able to solve it by normal method)
Now, we can see that when the no. is divided by 13, it leaves no rem, so, the no. is perfectly divisible by 13.

Here we are given a) 312 b) 962 c) 1562 d) 1586 e) None of the above

(not div by 13)

312 Now, another info is given in the qn = the no. when it's divided by 3, 5, 6, 8, 10 & 12, leaves rem = 2

∴ 312 − 2 = 310 → It has to be perfectly div by 3, 5, 6, 8, 10, 12

But it is not div by 3 so 312 ✗

962 − 2 = 960 → . . . . . .

It is perfectly div by 3, 5, 6, 8, 10, 12 ∴ 962 ✓

1586 − 2 = 1582 → . . . . . .

But it is not div by 10

∴ 1586 ✗

∴ ans is 962

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Simplification (5-6 Sums)

• V BODMAS → Sub (Rank of Parenthesis)

Brackets, of, Division, Mul, Add

{ } ( ) [ ]

Eg $17 + [8 - \{15(36 - 8 - 12)\}]$

$= 17 + [8 - \{15(40)\}]$

$= 17 + [8 - \{600\}]$

$= 17 - 592$

$= -575$ Ans

• Rationalization

Eg $\frac{1}{\sqrt{28} - \sqrt{24}} = \frac{(\sqrt{28} + \sqrt{24})}{(\sqrt{28} - \sqrt{24})(\sqrt{28} + \sqrt{24})}$

$= \frac{(\sqrt{28} + \sqrt{24})}{28 - 24}$

$= \frac{\sqrt{28} + \sqrt{24}}{4}$ Ans

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• Squares & cubes

needed to remind
sq → 1 – 30
cube → 1 – 10

$a \rightarrow a^2 \rightarrow a^3$

$a^{-1} \rightarrow a^{-2} \rightarrow \frac{1}{a^2}$

$(a+b)^{-2} \rightarrow \frac{1}{(a+b)^2}$

sq → cube

• Basic formulae

1) $(a+b)^2 = a^2 + 2ab + b^2$

2) $(a-b)^2 = a^2 - 2ab + b^2$

3) $a^2 - b^2 = (a+b)(a-b)$

4) $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

5) $(a-b)^3 = a^3 - b^3 - 3ab(a-b)$

6) $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

7) $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

8) $(a+b+c)^2 = (a^2 + b^2 + c^2) + 2(ab + bc + ca)$

9) $a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$

10) $(a + \frac{1}{a})^2 = (a^2 + \frac{1}{a^2}) + 2 = (a - \frac{1}{a})^2 + 2 + 2 \times \frac{1}{a} \times a + 2$

11) $(a - \frac{1}{a})^2 = (a^2 + \frac{1}{a^2}) - 2 = (a - \frac{1}{a})^2 + 4$

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

13) $(a - \frac{1}{a})^3 = (a^3 - \frac{1}{a^3}) - 3(a - \frac{1}{a})$

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• Simplifying series

Type: $2 + 4 + 8 + \dots 120$

$= 2(1 + 2 + 3 + \dots 120)$ [1 trick = temporary]

Problem type: $2(x+y+z) =$

$y(x+y+z) =$

2nd trick

(1) (Not all to get the ans)

Problem type: $\frac{3608}{1404}$

div, from the smallest no = 2, 3 ... 20

start

if $\frac{225}{135}$ div starts from = 5 — (Immediately div by 5)

if $\frac{230}{120}$ div — = 10 — (Immediately div by 10)

Pattern type: Time

WORD Problem → detailed explanation in video problem on nos calculate

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① Find value of $m - \frac{1}{m}$ if $m + \frac{1}{m} = 4$?

1st way (Quadratic eqn way)

$m + \frac{1}{m} = 4$

$\Rightarrow \frac{(m+\frac{1}{m})^2}{} = 4^2$ ← not Aspect

$\Rightarrow (m+\frac{1}{m})^2 = 16$

$\Rightarrow m^2 + 2m + 1 = 16m^2$

$\Rightarrow 15m^2 - 2m - 1 = 0$

$\Rightarrow 15m^2 - (5-3)m - 1 = 0$

$\Rightarrow 15m^2 - 5m + 3m - 1 = 0$

$\Rightarrow 5m(3m-1) + 1(3m-1) = 0$

$\Rightarrow (3m-1)(5m+1) = 0$

$m = \frac{1}{3}$ or $-\frac{1}{5}$

if $m = \frac{1}{3}$

$m - \frac{1}{m} = \frac{1}{3} - 3$

$= -\frac{8}{3}$

if $m = -\frac{1}{5}$

$m - \frac{1}{m} = -\frac{1}{5} + 5$

$= \frac{24}{5}$

2nd way

$(m + \frac{1}{m}) = 4$

$\Rightarrow (m + \frac{1}{m})^2 = 16$

$\Rightarrow (m^2 + \frac{1}{m^2}) + 2 = 16$

$\Rightarrow (m - \frac{1}{m})^2 + 2 + 2 = 16$

$\Rightarrow (m - \frac{1}{m})^2 = 12$

$\Rightarrow m - \frac{1}{m} = \sqrt{12} = 2\sqrt{3}$

$(m - \frac{1}{m})^2$

$= (m^2 + \frac{1}{m^2}) - 2$

$= (m + \frac{1}{m})^2 - 2 - 2$

$= (4)^2 - 4$

$= 12$

$\therefore m - \frac{1}{m} = 2\sqrt{3}$

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② Find value of $\frac{a^2 + 2a + b^2}{a^3 - 2a^2}$, if $a + \frac{b^2}{a} = 2$?

$a + \frac{b^2}{a} = 2$

$\Rightarrow \frac{a^2 + b^2}{a} = 2$

$\Rightarrow a^2 + b^2 = 2a$

$\Rightarrow a^2 - 2a + b^2 = 0$

$\Rightarrow a^2 - 2a = -b^2$

$\Rightarrow a^2 + b^2 = 2a$

$\frac{a^2 + 2a + b^2}{a^3 - 2a^2}$

$= \frac{2a + 2a}{a^2(a^2 - 2a)}$

$= \frac{4a}{a \times -b^2} = \frac{-4}{b^2}$

③ Find value of $a^3 + b^3 + 3ab$, when value of $a + b = 1$?

$a^3 + b^3 + 3ab$, $a + b = 1$

$(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

$\Rightarrow (1)^3 = a^3 + b^3 + 3ab \times 1$

$\Rightarrow a^3 + b^3 + 3ab = 1$

④ What is value of $[(3\times3\times3\times3\times3\times3)^6 \div (3\times3\times3\times3\times3\times3)^7 \div 3^4]$?

↳ Concept: Indices & surds

$A^m \times A^n = A^{m+n}$

$a^6 \times a^2 = a^8$

$A^m \div A^n = A^{m-n}$

$a^3 \div a^1 = a^2$

$(A^m)^n = A^{mn}$

$(3^6)^6 \div (3^6)^7 \div 3^4$

$= 3^{36} \div 3^{42} \div 3^4$ [vipin method]

$= 3^8 \div 3^4$

$= 3^{12}$

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(5) What will be the value of $\dfrac{\sqrt{0.0016} \div \sqrt[3]{8.000000}}{\sqrt[3]{0.000512} \div \sqrt[3]{0.064}}$?

$= \dfrac{\sqrt{0.0016} \div \sqrt[3]{8.000000}}{\sqrt[3]{0.000512} \div \sqrt[3]{0.064}}$

$= \dfrac{0.04 \div (2 \div 100)}{0.08 \div 0.4}$

$= 200$

(6) What will be value of c, if a(a+b+c) = 85, b(a+b+c) = 36, c(a+b+c) = 108

a(a+b+c) + b(a+b+c) + c(a+b+c)

$\Rightarrow (a+b+c)(a+b+c) = 289 = 85+36+108$

$\Rightarrow a+b+c = \sqrt{289} = 17$

$\therefore c(a+b+c) = 108$

$\Rightarrow c \times 17 = 108$

$\Rightarrow c = \dfrac{108}{17}$

(7) What is value of $(13.8 \div 1.9 \div 5.7 + 11.2 \text{ of } \frac{1}{16} \div \frac{1}{20})$?

[Ans: 5]

$11.2 \text{ of } \frac{1}{16} = 11.2 \div \frac{1}{16} = 0.7$

$(13.8 \div 1.9 \div 5.7 + 0.7 - \frac{1}{20})$

$= (13.8 \div \frac{19}{5.7} + 0.7 - 0.05)$

$= 13.8 \div \frac{1}{3} + 0.7 - 0.05$

$= 4.6 + 0.7 - 0.05$

$= 5.3 - 0.05$

$= 5.25$

(8) What will be value of (m+n) if we know that $\sqrt{28 - 6\sqrt{3}} = \sqrt{3}m + n$?

$\sqrt{28 - 6\sqrt{3}} = \sqrt{3}m + n$

$\Rightarrow 28 - 6\sqrt{3} = (\sqrt{3}m + n)^2$

$\Rightarrow 28 - 6\sqrt{3} = 3m^2 + 2\sqrt{3}mn + n^2$

$\Rightarrow (3\sqrt{3})^2 + (1)^2 - 2 \times 3\sqrt{3} = (\sqrt{3}m + n)^2$

$\Rightarrow (3\sqrt{3})^2 - 2 \times 3\sqrt{3} + 1 = (\sqrt{3}m + n)^2$

$(1)^2 - 2 \times (3\sqrt{3}) + (3\sqrt{3})^2 = (\sqrt{3}m + n)^2$

$\Rightarrow (3\sqrt{3} - 1)^2 = (1 - 3\sqrt{3})^2 = (\sqrt{3}m + n)^2$

$\Rightarrow (3\sqrt{3} - 1)^2 = (\sqrt{3}m + n)^2$

$\Rightarrow 3\sqrt{3} - 1 = \sqrt{3}m + n$

$\therefore m = 3,\ n = -1 \quad m + n = 2$

(9) on simplification of the following, the result will be $(1-\frac{1}{2})(1-\frac{1}{3})(1-\frac{1}{4})\cdots(1-\frac{1}{100})$?

$(1-\frac{1}{2})(1-\frac{1}{3})(1-\frac{1}{4})\cdots(1-\frac{1}{100})$

$= \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \cdots \frac{98}{99} \times \frac{99}{100}$

$= \frac{1}{100} = 0.01$

(10) $4^{61}+4^{62}+4^{63}+4^{64}+4^{65}$ is divisible by? 3, 4, 5 or 12

$4^{61}+4^{62}+4^{63}+4^{64}+4^{65}$

$= 4^{61}(1+4^{1}+4^{2}+4^{3}+4^{4})$

$= 4^{61}(1+4+16+64+256)$

$= 4^{61} \times 341$

$\therefore$ Ans = 11

(11) If $a = 4.36$, $b = 2.39$ $(= 1.97)$, then the value of $a^3 - b^3 - c^3 - 3abc$ is?

$\boxed{a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2-ab-bc-ca)}$

$a^3 - b^3 - c^3 - 3abc$

$(a)^3 + (-b)^3 + (-c)^3 - 3abc$

$= (a-b-c)(a^2+b^2+c^2+ab-bc+ca)$

$\boxed{a^3 - b^3 - c^3 - 3abc = (a-b-c)(a^2+b^2+c^2+ab-bc+ca)}$

$\therefore a^3 - b^3 - c^3 - 3abc = (4.36 - 2.39 - 1.97)(4.36^2 + 2.39^2 + 1.97^2 + 4.36 \times 2.39 - 2.39 \times 1.97 + 1.97 \times 4.36)$

$= 0$

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(12) If $a*b = 2a+3b$, then the value of $2*3+3*4$ is?

$a*b \neq a \times b$

Here it's just symbolizing that $a*b = 2a+3b$

i.e., $a*b$ can be calculated by $2a+3b$

$\therefore \boxed{a*b = 2a+3b}$

$\therefore 2*3 + 3*4$

$= 2\times2+3\times3+2\times3+4\times6$ $(\because \times)$

$= 31$

(13) If $1^2+2^2+3^2+\cdots+10^2 = 385$, then $3^2+6^2+9^2+\cdots 30^2$ is equal to?

mentioning this or of this we'll able to get the ans

$3^2+6^2+9^2+\cdots+30^2$

$= 3^2\times1^2 + (3\times2)^2 + (3\times3)^2 + \cdots + (3\times10)^2$

$= 3^2\times1^2 + 3^2\times2^2 + 3^2\times3^2 + \cdots + 3^2\times10^2$

$= 3^2(1^2+2^2+3^2+\cdots+10^2)$

$= 3^2 \times 385$

$= 3465$

(14) Simplify:

$$\frac{0.72+0.72+0.72-0.39+0.39+0.39}{0.72+0.72+0.72+0.39+0.39+0.39}$$

$$= \frac{(0.72)^3 - (0.39)^3}{(0.72)^2 + (0.72 \times 0.39) + (0.39)^2}$$

let $0.72 = a$, $0.39 = b$

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$$= \frac{(a^3 - b^3)}{a^2 + ab + b^2}$$

$$= \frac{(a-b)(a^2+ab+b^2)}{(a^2+ab+b^2)}$$

$$= a - b$$

$$= 0.72 - 0.39$$

$$= 0.33$$

(15) For what value of $*$, the statement $\frac{*}{15} \times \frac{*}{135} = 1$ is true?

$$\frac{*}{15} \times \frac{*}{135} = 1$$

$$(*)^2 = 15 \times 135$$

$$* = 45$$

(16) The value of

$$\frac{1}{1+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \cdots + \frac{1}{\sqrt{15}+\sqrt{16}}$$

$$= \frac{(1-\sqrt{2})}{1-2} + \frac{(\sqrt{2}-\sqrt{3})}{2-3} + \frac{(\sqrt{3}-\sqrt{4})}{3-4} + \cdots + \frac{(\sqrt{15}-\sqrt{16})}{15-16}$$

$$= -1 + \cancel{\sqrt{2}} - \cancel{\sqrt{2}} + \cancel{\sqrt{3}} - \cancel{\sqrt{3}} + \cancel{\sqrt{4}} - \cancel{\sqrt{4}} + \cancel{\sqrt{5}} - \cancel{\sqrt{5}} + \sqrt{16}$$

$$= -1 + \sqrt{16}$$

$$= -1 + 4$$

$$= 3$$

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(17) The value of $25.25 - 23.23 + 24.24$ is?

$25.25 - 23.23 + 24.24$ (don't do direct add, sub)

(take the no.s before decimal)

$= 25 - 23 + 24$

$= 26$

(take no.s after decimal point)

$25 - 23 + 24 = 26 \Rightarrow 0.26$

26.26 - Ans

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Fractions & decimals (4-5 pms)

① What will be fraction form of $0.35\overline{23}$?

→ Bar means the no. is repeating, i.e., here

$0.35\overline{23}$ = 32323 ——

↓

$0.3\overline{523}$ Repeating

N 63523 − 35

D 9900

for bar — for no bar

$= \frac{3488}{9900}$

$0.35\overline{23}$

2 digs are below the bar

2 digs are not below the bar

∴ So, at D write ~~V-35~~ two −35

∴ So write two-05 after two-35

For d N, write the full no. (i.e after point what even the no. will be) & subtract the no.s that aren't below the bar.

Eg → $0.4\overline{5}$ → 0.46666 ——

∴ fraction form = $\frac{46-4}{90} = \frac{42}{90}$

∴ $0.\overline{25}$? → 0.2625 25 25 ——

∴ $\frac{25-0}{99} = \frac{25}{99}$

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∴ fraction form of a no. = $\frac{N}{D}$

The no. = 0.yy $\overline{xx}$ for that
← (for eg)

x no. of 9s for x no. of numbers below the bar	y no. of 9s for y no. of numbers below not bar

② What is value of 5.55 + 5.15 6 + 5.555 + 5.551 3.00?

5.550
5.000
5.500
5.555
5.050
+ 5.000
31.655

∴ 31.655

③ What will be value of $\frac{2.4 + 0.72 + 4.5}{0.18 + 0.06 + 0.5} + 3$

$\frac{2.4 + 0.72 + 4.5}{0.18 + 0.06 + 0.5} + 3$

$= \frac{\cancel{24}^{8}}{\cancel{10}} + \frac{\cancel{72}}{\cancel{100}} + \frac{\cancel{45}^{15}}{\cancel{10}} \div \frac{\cancel{100}}{\cancel{18}} \cdot \frac{\cancel{100}^{\cancel{10}\,5}}{\cancel{6}_{2}} \cdot \frac{\cancel{10}}{\cancel{3}_{3}} + 3$

$= 3400$

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④ What will be $(0.\overline{15268} \div 0.\overline{45804})$?

Recurring no.s

$0.\overline{15268} = \frac{15268}{99999}$

$0.\overline{45804} = \frac{45804}{99999}$

$\frac{15268}{99999} \div \frac{45804}{99999} \rightarrow \frac{15268}{45804}$

mul it by 3

$= \frac{1}{3} = 0.333 \ldots$

0.5

⑤ How much would be $\frac{n-m}{n+m}$, if $2.5m = 0.035n$?

$2.5m = 0.035n$

$\frac{25m}{10} = \frac{35n}{1000}$

$5m = 7n$

$\frac{n}{m} = \frac{500}{7}$

2 ways

1st (Ratio)

(ratio & Proportion)

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

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

$\therefore \frac{n}{m} = \frac{500}{7}$

$\frac{n+m}{n-m} = \frac{500+7}{500-7}$

$\frac{n-m}{n+m} = \frac{493}{507}$

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2nd method

$\frac{n}{m} = \frac{500}{7}$

$\frac{n-m}{n+m} = \frac{\cancel{m}(\frac{n}{m}-1)}{\cancel{m}(\frac{n}{m}+1)} = \frac{\frac{500}{7}-1}{\frac{500}{7}+1} = \frac{493}{507}$

⑥ Add $17.\overline{499}$, 17.85 & $17.\overline{333}$?

$\cancel{17.499 = \frac{499-4}{990}}$

$17.\overline{499} = 17 + 0.\overline{499} = 17 + \frac{499-4}{990}$

$= 17 + \frac{495}{990}$

$= 17.5$

$17.\overline{333} = 17 + 0.\overline{333} = 17 + \frac{333}{999}$

$= \cancel{17.333}$

$= 17 + \frac{1}{3}$

$\therefore 17.5 + 17.85 + 17 + \frac{1}{3}$

$= 17 + 0.5 + 17 + 0.85 + 17 + \frac{1}{3}$

$= 51 + 1.35 + \frac{1}{3}$

$= 52.35 + 0.333$

$= 52.683 = 52.683$

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(7) what will be the value of $1 + 0.3 + 0.01 + 0.0003$?
1 2 3 decimal places

$1 + 0.3 + 0.01 + 0.003$

$1 + 3 + 1 + 3 = 9$

0.000009 — decimal place

0.000009

(8) what will be value of $\frac{1}{0.0004655}$ if $\frac{1}{4.655} = 0.2146$?

$\therefore \frac{1}{0.0004655} = \frac{1}{4.655 \times 10^{-4}}$

while shifts 10^{-4} the no. of decimal places you are shifting

$= \frac{1}{4.655} \times 10^{4}$

$= 0.2146 \times 10^{4}$

$= 2146$

let = 3.467
1 decimal place
$= 34.67 \times 10^{-1}$

let = 3.46789
3 decimal place
3.46789×10^{3}
for shifting the decimal forward i.e. while shifts forward 3 to the right, the no. of decimal places you are shifting

(9) $4.142 + 100.8 + ? + 0.053 = 105.153$
? stands for what?

$4.142 + 100.8 + 0.053 + x = 105.153$

$\Rightarrow x = 105.153 - 4.142 - 100.8 - 0.053$

$105 - 4 - 100 - 0 = 1$

$153 - 142 - 80 - 53 = 0 - 842 \rightarrow -0.842$

$1 + (-0.842) = 1 - 0.842 = 0.158$

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This is the way to do add / sub / multiply (shortcut)

$x(?) = 0.158$

(10) $19.999 + 10.33 + 82 + 3.111 = ?$

a) 40.66 ✗
b) 40.650 ✗
c) 9.856 ✗
d) 40.566 ✗

Shortcut

$10 + 10 + 7 + 3 = 30$

60 (as there are 3 dps, so calculating it directly)

(11) what is approximate value of $8459 \div 11.98 - 23.99 \div \frac{7}{140}$?

They want approximate vals.

So, while calculating we can also consider approximate vals.

$\therefore 8459 \div 11.98 - 23.99 \div \frac{7}{140}$

$8460 \quad 12 \quad 24$

$= \frac{8460}{12} - 24 \div \frac{7}{140}$

$= 705 - 24 \times 20$

$= 705 - 480$

$= 225$

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• If there is such critical calculation & approximate word isn't mentioned, then & there are many options & there are huge diff in the b/w the options, then we can take approximate of the given no's & can calculate the approximate ans & then can choose the ans from the o/p that is nearest to our calculated ans.

(12) What is value of 945.34 − 1042.752 + 875.435 + 31.035?

a) 908.004 ✗
b) 910.008 ✗
c) 795.669 ✗
d) 807.009 ✓

945 − 1042 + 8760 + 31
≈ 945 − 1045 + 875 + 31
≈ 806

As there are 2 o/ps & calculate it give that i.e just take the last single dig from the digits often ∴

1 − 2 + 5 + 5 = 9

(13) Which of the following is longest fraction amongst $\frac{5}{8}, \frac{3}{7}, \frac{2}{9}, \frac{4}{5}$?

Compare → [illegible]

→ 2 way often there is such kind of Q

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1st way (Ratio & Proportion's way) | if D > 10 then use this method

2nd way | if the D (difference) is <= 10 then we can divide directly to find the ans

∴ 2nd way,

i) $\frac{5}{8} = 0.62$ ii) $\frac{3}{7} = 0.42$ iii) $\frac{2}{9} = 0.22$ iv) $\frac{4}{5} = 0.8$

0.8 — ans

This is largest

1st way

There are 2 fractions, $\frac{a}{b}$ & $\frac{c}{d}$

Now just cross multiply

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

i) If, ab > bc then, (LHS) > (RHS)

∴ There is $\frac{a}{b}$ in LHS

So $\frac{a}{b} > \frac{c}{d}$

ii) If, ab < bc then LHS < RHS

∴ $\frac{a}{b} < \frac{c}{d}$

iii) If, ab = bc then LHS = RHS

∴ $\frac{a}{b} = \frac{c}{d}$

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$\frac{5}{8}$ $\frac{3}{7}$	$\frac{2}{9}$ $\frac{4}{5}$	$\frac{5}{8}$ $\frac{4}{5}$
35 > 24	10 < 45	25 < 32
$\frac{5}{8} > \frac{3}{7}$	$\frac{2}{9} < \frac{4}{5}$	$\frac{4}{5}$ — ans

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(14) The least of the following $0.\overline{2}$, $(0.2)^2$, $0.\overline{2}$, $1 \div 0.2$?

0.2

$(0.2)^2$ → least

Ans

[∵ after 1 num ∴ $0.2 \times 2 \rightarrow$ after one after point 2 nos. 2th zero place & y before y there will be 0 $= 0.0\overline{2}$]

$0.\overline{2} = \frac{2}{9}$

$= 0.22$

$1 \div 0.2 = \frac{1}{0.2} = 5$

(15) What is increasing order of the fractions $\frac{6}{7}, \frac{8}{9}, \frac{2}{3}, \frac{9}{10}$?

$D < 10$

[method just simply div them, arrange them in ascending order. Another is we can use ratio technique (which is smallest, which is larger & arrange them)]

Trick → [D > N]

For each of cases → [D − N = same]

now whenever D > N & D − N = same, then we can say that [smaller the N → smaller the fraction] in all fraction

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So, [greater # N → greater fraction]

$\frac{6}{7} < \frac{2}{3} < \frac{8}{9} < \frac{9}{10}$

(16) What is increasing order of the fractions $\frac{14}{17}, \frac{10}{12}, \frac{6}{7}, \frac{18}{22}$?

method

D > N

$17 - 14 = 3$ not same
$12 - 10 = 2$

[Here, we can divide or we can do the ratio either technique.]

[Trick → D > N]

i) [Arrange the D from lowest to largest]

$\frac{6}{7} \xrightarrow{\times} \frac{10}{12} \xrightarrow{\times} \frac{14}{17} \xrightarrow{\times} \frac{18}{22}$

ii) [write the corresponding D also]

iii) [N is increasing by some definite fixed val. & D is also increasing by some definite fixed val, then]

iv) [Smaller N → smaller fraction
or N → n fraction]

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$\therefore \frac{6}{7} < \frac{10}{12} < \frac{14}{12} < \frac{18}{22}$

In such cases we always convert fracs in form II & III then jinke ka fr. sabse kaam hoga (Trick)

(17) $\frac{4}{7}$ of $\frac{2}{3}$ of $\frac{5}{6}$ of $\frac{6}{8}$ of 1000 is?

16 min 5 mark

$\frac{4}{\cancel{7}} \times \frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{5}}{\cancel{6}} \times \frac{\cancel{6}}{\cancel{8}} \times 1000$

$= 200$

(18) If a fraction's denominator is decreased by 80% & numerator is increased by 300%, the fraction becomes 2/9. What is the fraction?

let ~~as~~, frac $= \frac{a}{b}$ $\quad n = a$, $d = b$

$n \rightarrow a + \frac{a \times 300}{100} = 4a$ $\quad$ (100+300) = 400% of a = 4a

$d \rightarrow b - \frac{80}{100}b = \frac{20b}{100} = 0.2b$ $\quad$ (100−80) = 20% of b (∵ there is 80% decrease, so remaining will be 20% = 0.2b of b)

$\therefore \frac{4a}{0.2b} = \frac{2}{9}$

$\Rightarrow \frac{\cancel{4}^{2}a \times 10^{5}}{\cancel{2}b} = \frac{2}{9}$

$\Rightarrow \frac{a}{b} = \frac{1}{90}$

(19) In 3 fractions, when the largest fraction is divided by smallest fraction, the result 5/4 is greater than the middle fraction by 1/2.

If sum of the 3 fraction is $2\frac{5}{12}$ what will be the difference b/w largest & smallest fraction?

Sol:

~~Largest fraction = A, m.f = B, sm f.~~

L.f = A, M.f = B, S.f = C

Given, $\frac{A}{C} = 5/4 \rightarrow A = \frac{5C}{4}$ — (i)

also, $\frac{5}{4} = B + \frac{1}{2}$ [∵ 5/4 is greater than the m.f by 1/2]

$\Rightarrow \frac{5}{4} - \frac{1}{2} = B$

$\Rightarrow B = \frac{3}{4}$ — (ii)

given, $A + B + C = 2\frac{5}{12} = \frac{29}{12}$

$\Rightarrow \frac{5C}{4} + \frac{3}{4} + C = \frac{29}{12}$

$\Rightarrow C = \frac{2}{3}$ — (iii)

now, from (i),

$A = \frac{5}{\cancel{4}_{2}} \times \frac{2}{3} = \frac{5}{6}$ — (iv)

$\therefore$ The diff b/w largest & smallest frac $= A - C = \frac{5}{6} - \frac{2}{3} = \frac{1}{6}$

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(20) Express $\frac{2}{3}$ of $\frac{1}{4}$ of Rs. 25.20 as a fraction of $1\frac{1}{2}$ of Rs. 36.

let fraction = m

$\frac{2}{3} \times \frac{1}{4} \times 25.20 = m \times 1\frac{1}{2} \times 36$

$\Rightarrow m = \frac{1.40}{18} = \frac{0.7}{9} = \frac{7}{90}$

(21) $8 - 8 \times \frac{2\frac{1}{5} - 1\frac{1}{7}}{2 - \frac{1}{1-\frac{1}{2}}}$ is equal to?

$= 8 - 8 \times \left(\frac{\frac{11}{5} - \frac{8}{7}}{2 - \frac{6}{35}} \right)$

$= 8 - 8 \times \frac{\frac{32}{35}}{\frac{35}{64}}$

$= 8 - \cancel{8} \times \frac{1}{\cancel{2}}$

$= 4$

(22) $8\frac{1}{6} + 5\frac{1}{8} + 4\frac{2}{3} = ?$

method 1

$= \frac{49}{8} + \frac{41}{8} + \frac{14}{3}$

one method to solve

trick

$8 + 5 + 4 = 17$

$\frac{1}{6} + \frac{1}{8} + \frac{2}{3} = \frac{23}{24}$

$\therefore 17\frac{23}{24}$

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4. Ratio & Proportion (4 - 5 hrs)

Tips & tricks & definition

Meaning of Ratio & Proportion

- Whenever there are 2 quantities & whenever we are comparing them in more then their comparison is expressed in the form of ratios

Ex, P & Q & P : 5Q (P is 5 times faster than Q)

50 m/hr, 10 m/hr

$\therefore$ the ratio of speed of P & Q = 50 : 10 = 5 : 1

P : Q = 5 : 1 (another way (trick)) P = 5Q

Penalty of P is 1 Q

$\frac{P}{Q} = \frac{5}{1} = k$

P = 5x, Q = 1x

P : Q = 5 : 1

5 : 1 → another way of writing ratio $= \frac{5}{1}$

i.e, If a : b = $\frac{a}{b}$, b : a = $\frac{b}{a}$ like that

Ratio can be considered as simple fraction

- Ratio is the simplified form of actual values.

- Whenever we compare 2 ratios or equate 2 ratios it is called as proportion.

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• $a:b:c \xrightarrow[\text{written as}]{\text{can always be}} a:b :: b:c$

• $a:b :: c:d \longrightarrow a:b :: c:d$

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

$a:b :: c:d$

Q. Whenever there is some ratio, say $\frac{5}{6}$ or $5:6$

let, $\frac{40}{48}$ (original vals) $\rightarrow$ How to find actual vals. (not actual vals, they are simplified vals)

from the simplified vals? (in ratio)

$\boxed{5:6;\ \Rightarrow \frac{5}{6} = k\ (\text{let})}$ [K = Common factor]

(*) can just assume K & find it with simplified ratios (another way)

$\boxed{5K, 6K}$ ← actual values

[Always get these common factor & get the actual values]

① Which of the following 2 ratios is greater 17:18 & 10:11?

$\frac{17}{18} \times \frac{10}{11}$

$= 17 \times 11 \quad 180$

$= 187 > 180$

$\therefore \frac{17}{18} > \frac{10}{11}$

let, $\frac{4}{5}\ \frac{2}{3}\ \frac{1}{2}$

$\frac{4}{5}\ \frac{2}{3}$

$= 12 > 10$

$\therefore \frac{4}{5} > \frac{2}{3}$

$\frac{4}{5}\ \frac{1}{2}$

$8 > 5$

$\therefore \frac{4}{5}$

let,

1 2 3 4

compare compare

compare

↓

ans

see Worksheet

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② The 3rd proportional to 18 & 54 is?

$a:b :: c \longrightarrow a:b :: b:c$

1st 2nd 3rd

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

$\Rightarrow \boxed{b^2 = ac}$

18 54 ?

$\Rightarrow (54)^2 = 18 * c$

$\Rightarrow c = 162$

In this case,
If, asked mean then find out b
If, asked a/c/o then this way
If, asked extreme 1. then find a & c first then...

③ What is 4th proportional in 18, 13 & 15?

$a:b :: c:d \rightarrow a:b :: c:d$

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

$\Rightarrow \boxed{ad = bc}\ \boxed{d = \frac{bc}{a}}$

18 13 15 d

$\Rightarrow 18 * d = 13 * 15$

$\Rightarrow d = 221$

④ Find the mean proportional between 7 & 63?

$a:b :: c$ (b)

$a:b :: b:c$

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

$\Rightarrow b^2 = ac$

$\Rightarrow \boxed{b = \sqrt{ac}}$

$\therefore b = \sqrt{7 * 63}$

$\Rightarrow b = 21$

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⑤ $\frac{10}{13} = \frac{11}{28} = \frac{21}{11} = \frac{12}{11} = x$, what is x?

$\Rightarrow \frac{10+11+21+12}{13+28+11+11} = x$ [simply just add nrs & ds & then simplify the ans]

$\Rightarrow x = \frac{54}{63} = \frac{6}{7}$

$\Rightarrow x = \frac{6}{7}$

⑥ Income ratio of Ramesh & Suresh is 5:6. Their spending ratio is 7:9. Ramesh saves Rs. 4000 & Suresh saves Rs. 3000. Income & spending respectively Ramesh & Suresh are?

I. Ratio R:S = 5:6

let common factor = K

∴ Actual I of R = 5K, S = 6K

Income = spend + saving

Spending = Income − Saving

now spend R = 5K − 4000 — (1)

spend S = 6K − 3000 — (1)

Given, S. Ratio R:S = 7:9

$\frac{\text{spend R}}{\text{spend S}} = \frac{7}{9}$

$\Rightarrow \frac{5K - 4000}{6K - 3000} = \frac{7}{9}$; $\Rightarrow K = 5000$

∴ I. R = 5K 5000 = 25,000/-

I. S = 6K 5000 = 30,000/-

∴ spend R = 25000 − 4000 = 21000/-

23,000/- & spend S = 30000 − 3000 = 27000/-

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⑦ a:b = 3:7 & b:c = 9:5, what is a:b:c?

a:b = 3:7 , b:c = 9:5

a:b = 3:7 = 27:63

b:c = 9:5 = 63:35

a:b:c = 27:63:35

⑧ How to divide 3395 in ratio of 42, 32, 23?

2 ways

1st way - Partnership method

$\Rightarrow \frac{42}{97} \times 3395 = 42 \times 35 = 1470$

$\Rightarrow \frac{32}{97} \times 3395 = 32 \times 35 = 1120$

$\Rightarrow \frac{23}{97} \times 3395 = 23 \times 35 = 805$

2nd method

let, common factor = K

∴ Actual vals are = 42K, 32K, 23K

∴ According to the ques =

42K + 32K + 23K = 3395

⇒ K = 35

∴ now ⇒ 42 × 35 = 1470 ; ⇒ 23 × 35 = 805

⇒ 32 × 35 = 1120

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(9) 285 is summation of 3 numbers. Ratio between 1st & 2nd no is 6:5. Ratio b/w 1st & 2nd no is 3:7. The 3rd no is?

1st : 2nd 2nd : 3rd

$\Rightarrow 3 : 7$ $\Rightarrow 6 : 5$

$\times 6$ $\times 7$ $\times 5$

1st : 2nd : 3rd

$\Rightarrow 18 : 42 : 35$

$\therefore \frac{35}{35} \times \cancel{285}^{3} = 3$rd no

$\Rightarrow$ 3rd no = 105

(10) Ratio of 2 no. is 3:8. On adding 5 to both no. the ratio becomes 2:5, which is the smaller no. out of the two?

Let A, B A : B = 3 : 8

Actual no. = 3x, 8x (x = common factor)

$\frac{3x+5}{8x+5} = \frac{2}{5}$

$\Rightarrow x = 15$

$\because$ x is same for both 3x & 8x

$\therefore$ smaller no = 3x = 3 * 15 = 45

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(11) Find A:B:C:D when A:B = 2:3, B:C = 4:3, C:D = 5:7?

Trick

$\frac{2}{3} \times \frac{4}{3} \times \frac{5}{7}$

A : B : C : D

→ 10 : 15 : 45 : 189

multiplication of all NS

mul of all D.

as it's 2nd then start from the 2nd no. in the ratio & jump to 3 & then to 5 & mul all

Start from 2nd, then jump to 4 (just opposite of 3) & then jump to 5 (like the 2nd no) & mul all.

from 1st no. → → (mul all B)

from last no. → → (mul all D.)

from 2nd no. → → (Start from 2nd & then goes then 5 & mul all)

from 3rd no. → → (Start from 2nd & then go to 4, then 5 & mul all)

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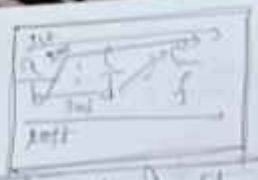

Generalized formula for (1)

$A:B = a:b$ $B:C = c:d$ $C:D = e:f$ then,

$A:B:C = ace : bce : bdf$

(12) Price of each article of type P & S & R is Rs. 300, Rs 180 & Rs. 120 respectively. Suresh buys articles of each type in the ratio 3:2:3 for Rs. 6480. How many articles of type S did he purchase?

Rs 6480 → P : S : R

Rs 300 Rs 180 Rs 120

Ratio 3 : 2 : 3

The ratio of the quantities of the article S, P : S : R = 3 : 2 : 3

Let common factor = K

Actual vals = 3x, 2x, 3x

P's 1 article 300/-

3x — 300 × 3x = 900K/-

∴ S at 360x/-, R → 360x/-

According to the,

900K + 360x + 360x = 6480

⇒ 1620x = 6480

⇒ K = 4

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∴ No of articles of type S = 2x = 2×4 = 8

(13) Ajay & Raj together have Rs. 150 more than Ajay. Ajay will have same amount as what Raj had earlier. Find the ratio of amounts with Ajay & Raj initially.

Let, Ajay has A Rs
Raj has R Rs } initially

∴ A + R = 1050 — (i)

A − 150 = ~~1050~~ R

⇒ A − R = 150 — (ii)

(i) + (ii)

⇒ 2A = 1200

⇒ A = 600/-

∴ R = 450/-

A : R = 600 : 450

= 4 : 3

(14) If $x:y = 3:4$, then $(7x+3y):(7x-3y)$ is equal to?

2ways

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1st method
[Best & shortest]

$\frac{x}{y} = \frac{3}{4}$

Putting the value of x=3 & y=4

$\frac{7x+3y}{7x-3y} = \frac{21+12}{21-12} = \frac{33}{9} = \frac{11}{3}$

2nd method

$\frac{x}{y} = \frac{3}{4}$

$\Rightarrow \frac{7x}{3y} = \frac{7\times3}{3\times4}$

$\Rightarrow \frac{7x}{3y} = \frac{21}{12}$

$\Rightarrow \frac{7x+3y}{7x-3y} = \frac{21+12}{21-12}$ [Compare to dividendo]

$= \frac{33}{9}$

$= \frac{11}{3}$

(15) If a:b = 5:7 & c:d = 24:36, then ac:bd is?

$\frac{a}{b} = \frac{5}{7}$ (i) $\frac{c}{d} = \frac{24}{36}$ (ii)

(i) × (ii) $\frac{a}{b} \times \frac{c}{d} = \frac{5\times24}{7\times36} = \frac{10a}{21b}$

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$\Rightarrow \frac{ac}{bd} = \frac{10a}{21b} = \frac{10}{21} \times \frac{5}{7}$ [from (i)]

$= \frac{50}{147}$

ac:bd = 50:147

(16) The 3 no.s are in the ratio $\frac{1}{2} : \frac{2}{3} : \frac{3}{4}$. The difference b/w greatest & smallest no.s is 36. Find the no.s.

Ratio = $\frac{1}{2} : \frac{2}{3} : \frac{3}{4}$

Let k be the common factor.

∴ the four no.s = $\frac{k}{2}, \frac{2k}{3}, \frac{3k}{4}$

$= 0.5k, 0.666k, 0.75k$

Given, $0.75k - 0.5k = 36$

$\Rightarrow \frac{3k}{4} - \frac{k}{2} = 36$

$\Rightarrow 3k - 2k = 36\times4$

$\Rightarrow k = 36\times4$

$\Rightarrow \frac{k}{2} = \frac{36\times4}{2} = 72$ 3 no.s = 72, 96, 108

2nd = $\frac{2\times36\times4}{3} = 96$

3rd = $\frac{3\times36\times4}{4} = 108$

Teacher's Signature

14 (i) The ratio of market prices of wheat & Pulses is 2:3 & the ratio of quantities consumed by a family is 5:4. Find the ratio of expenditure of wheat & pulses.

A Price of W : Price of Pulses = 2:3

actual WS = 2K, 3K Rs (C.F = K)

Ratio of wheat consumed : Pulses consumed = 5:4

∴ Actual WS = 5A, 4A (C.F = A)

$\boxed{\text{Expenditure} = \text{Rate} \times \text{Quantity consumed (Price)}}$

∴ Exp W = Rate W × Q.W

Exp P = Rate P × Q.P

∴ According to the qn, $\frac{\text{Exp W}}{\text{Exp P}} = \frac{\text{R.W} \times \text{Q.W}}{\text{R.P} \times \text{Q.P}}$

$= \frac{2K \times 5A}{3K \times 4A}$

$= \frac{5}{6}$

∴ Exp W : Exp P = 5:6

(15) Question way as common factor get cancelled we can use the ratio itself. $\boxed{\text{Exp} = \text{R} \times \text{Q}}$ (ratio)

∴ $\frac{\text{Exp W}}{\text{Exp}} = \frac{2}{3} \times \frac{5}{4}$

$= \frac{5}{6}$

(18) Rs 8400 is divided among A, B, C & D in such a way that the shares of A & B, B & C, & C & D are in the ratios of 2:3, 4:5 & 6:7 respectively. The share of A is?

A:B = 2:3, B:C = 4:5, C:D = 6:7

A:B:C:D ✗ (Don't have to calculate)

$\frac{2}{3} \cdot \frac{4}{5} \cdot \frac{6}{7}$

A : B : C : D

= 48 : 72 : 90 : 105

Share of A = $\frac{48}{315} \times 8400$

= 1280/-

(19) In a library, the ratio of no. of non story books to that of non story books was 4:3 & total no. of story books was 1248. When some more story books were bought, the ratio became 5:7. Find the no. of story books bought.

Given, S : N = 4 : 3, total S. Books = 1248

∴ $\frac{S}{N} = \frac{4}{3}$

⇒ $\frac{1248}{N} = \frac{4}{3}$

⇒ N = 936

let no of S bag were bought

$S = (1248 + m)$

ratio $\frac{S}{N} = \frac{5}{3}$

$\Rightarrow \frac{1248+m}{3k} = \frac{5}{3}$

$\Rightarrow m = \underline{312}$ no of S bag were bought

note

S : N = 4 : 3

let c.f = k

$\therefore$ no of S & N = 4k & 3k

$4k = 1248$

$\Rightarrow \boxed{k = 312}$

$1248 + m = 5k$ (∵ 4k, 3k)

$\Rightarrow 1248 + m = 5 \times 312$

$\Rightarrow m = 1560 - 1248$

$= \underline{312}$

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5. **Percentage** (4-5 hrs)

Topics

- Percentage meaning

It means part (i.e. Part of Something)

symbol of Percentage = %

(eg — 25% = $\frac{25}{100}$)

(eg — 30% → A part of whole is 30% of the whole)

entire 100%

- tone

Someone says to give him/her 10%

10% of 80 kit = $\frac{10 \times 80}{100}$ kit

$\frac{1}{10}$ × 8 kit (10% of 80 kit entire)

- Common Percentages

Bread → 100% → 1 entire bread (100%)

Someone asked. he/she wants 1/2 of bread → $\frac{1}{2}$ of 100%

= 50% → $\frac{1}{2}$

$\frac{1}{3}$ → $\frac{1}{3} \times 100\%$

= 33.33 % = $33\frac{1}{3}$% → $\frac{1}{3}$

$\frac{1}{4}$ → $\frac{1}{4} \times 100\%$

= 25% → $\frac{1}{4}$

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10% → ?

Sol

$? \times 100\% = 10\%$

$\frac{x \times 100}{100} = \frac{10}{100}$

$x = \frac{1}{10}$

Trick

10% of 100% $= \frac{10}{100} \times 100 = \frac{1}{10}$

Shortcut

$10\% = \frac{10}{100} = \frac{1}{10}$

x% of something

something of y%

x% of y% = x

91 + 92 x

Eg 10% of 100%

→ 10% → 1 → 10 → 10 + 10%

Eg 1/2 of 100 hours

$\frac{1}{2} \times 100$ hrs

= 50%

- 8.1% → 1 $(\frac{10}{10})$
- 50% → $\frac{1}{2}$ $(\frac{50}{100})$
- $33\frac{1}{3}\%$ → $\frac{1}{3}$
- 25% → $\frac{1}{4}$
- 10% → $\frac{1}{10}$
- 20% → $\frac{1}{5}$
- 75% → $\frac{3}{4}$
- 12.5% → $\frac{1}{8}$

- 100% ← 1 (1 + 100%)
- 50% ← $\frac{1}{2}$ ($\frac{1}{2}$ + 100%)
- $33\frac{1}{3}\%$ ← $\frac{1}{3}$
- 25% ← $\frac{1}{4}$
- 10% ← $\frac{1}{10}$
- 20% ← $\frac{1}{5}$
- 75% ← $\frac{3}{4}$ (another ans $\frac{1}{4}$ → 25%. $(\frac{3}{4})$ → 3 × 33 + 25 → 75%)
- 12.5% ← $\frac{1}{8}$

- TIPS (Quickly find Percentages)

General method

① Q.t.s say 260 = 100% (ans)

Req 10% of 260 = $\frac{10}{100} \times 260$

= 26

Easier method

260 — 100%

26.0 ← 10%

1 decimal shift right from 100% (from 100 to 10)

→ 10% is less than in 100%

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① say, 6547.24 = 100%

10% of 6547.24 ? → 654.724

(1 decimal shift from right from 100%)

② 350 = 100%

20% of 350 → $\frac{20}{100} \times 350$ = 70

Shortcut

20% of 350 → 350 ÷ 2 = 70

③ 603 = 100%

1% of 603 ?

6.03

④ 260 = 100%

85% of 260 → ?

Trick

10%

10% → 4 × 10%

26.0 × 4 = 104

→ 85% − 10% − 1%

= 104 − 2.6

= 101.4

⑤ 63% = 60% + 3%

= (6 × 10%) + (3 × 1%)

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① 56% of y is 182. what is y?

$\Rightarrow \frac{56}{100} \times y = 182$

$\Rightarrow y = \frac{182 \times 100}{56}$

$= \frac{1300}{4}$

$= 325$

② what percent is 42 kg of 336 kg?

When we want to find %, we mul by 100

Q1 → Q2

how much % is Q1 of Q2

method

$\frac{42}{336} \times 100$

$= \frac{100}{8}$

$= 12.5\%$

method

of which we want to find the % ans — Q_1

the % in relation to which we want the quantity / in relation to which the % is calculated — Q_2

$\times 100$ %

Percent of the quantity that (Q_1) we want — $\times 100$

with respect to Q_2 (quantity)

Percent of the quantity that we want / with respect to the quantity

Q1 / Q2 × 100

Q1 / Q2 × 100 %

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④ If 15% of y is same as 21% of z then 12.5% of y is equal to what percent of z? (Rec the thing also imp)

15% of y = 21% of z

25% of y = ? of z

$\Rightarrow \frac{15}{100} y = \frac{21}{100} z$

$\Rightarrow \frac{25}{100} y = \frac{21}{100} z$

$\Rightarrow ? = \frac{5350}{102} \times 100$

$= 17.5\%$

$\therefore$ 12.5% of y = 17.5% of z

⑤ If price of rice is 30% less than that of wheat, then price of wheat is how much % more than that of rice?

In this kind of sum always consider an arbitrary value & the best value for this kind of sum is 100.

Lets say, price of wheat = Rs. 100

$\therefore$ price of rice = 100 − (30% of 100)

$= 100 - 30$

$= 70$ Rs

[30% less than that of wheat]

Teacher's Signature

we need the %, so, follow the prev method,

The price of wheat = 100 RS (A)

The price of rice = 70 RS (B)

we need the price of wheat is how much % more than that of rice

% wheat's % so → A mes 1

we'll find it ~~comparing~~ w.r.t to of rices price → so B mes 2

∴ we know, $\frac{A}{B} * 100 = \frac{100}{70} * 100$

$= 142.85\%$

(this will give us the % that how much it is more / less, then calculate it)

∴ The price of w is 142.85 times of rice's price (ie, the % of S_1 (w's) of S_2 (R's)) 142.85 ⇒ (how much is price of w in relation to rice)

Entire Quantity = 100% (as 100% × max)

∴ How much is extra = (142.85 − 100) %

= 42.85 % more

∴ Price of w is 42.85% more than that of price of rice

n % of less means y 30% more → no we can't say that, the % val. is diff

Expt. No. $\frac{38}{90} * 100 = 42.85\% \leftarrow$ (change * 100 / the same Price) method

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(5) The price of apple is first increased by 10% & then decreased by 10%. What is the change in the price of apple?

let, the price of apple = 100/- (original price)

710% → 710 RS (∵ 10% of 100)

now = 100 + 10 = 110/-

410% → 11 RS (10% of 110)

new price = 110 − 11 = 99 (final price)

∴ change in price = 100 − 99

= 1 RS

Now if we want to represent it in % form

that % is RS 1 of RS 100

$= \frac{A}{B} * 100 = \frac{1}{100} * 100$

$= 1\%$

∴ change in the price of apple = RS 1 or 1% (this is the first and we must have to calculate the %, as we don't know the actual money / price & also in qn they haven't given the %)

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Q. If the price of a sugar is raised by 25%. Then by how much percent should the person reduce his consumption of sugar so that his expenditure remains same?

EXP = same

price × Amount = exp

percent reduction in consumption
$= \frac{25}{100+25} \times 100$
$= 20\%$

Let the price of sugar = 100 RS per kg

let the person used to consume 1 kg of sugar

now, the candy exp = 1 * 100 [∵ 1 kg of sugar is used to consume by the person & per kg is = 100/-]

after 25% price has increased,

initially 100 RS

Increase = $100 \times \frac{25}{100}$

= 25/-

∴ the price increases by 25/-

- the new price = 100 + 25 = 125/-

let, the new consumption (reduced consumption, so let the exp remain same) = C

According to the qn

(1 * 100 = C * 125)

⇒ C = 0.8 kg

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Initially he consumed 1 kg

now he need to consume 0.8 kg

∴ the person need to reduce this consumption quantity by = 0.2 kg (1 − 0.8)

now this 0.2 kg is how much % of 1 kg

$= \frac{0.2}{1} \times 100$

$= 20\%$

∴ the consumption of sugar should reduced by 20%.

(7) Y has to score 40% marks to pass. He gets 20 marks & fails by 40 marks. The max marks of the exam are?

let the max marks = m

40% of m

$= \frac{40m}{100}$

passing marks

according to the qn, Y gets 20 marks, if he would get more 40 marks he would pass.

So, $40 + 20 = \frac{40m}{100}$

⇒ $60 = \frac{4m}{10}$

⇒ m = 150

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(9) A scores 10% & fails by 30 marks B scores 40% marks & gets 30 marks more than the minimum marks needed to pass the exam. What are the maximum marks for the exam?

Let, max marks = m

A → $10\% \cdot \frac{m}{100} = \frac{m}{10}$; $\frac{m}{10} + 30$ → Passing marks

B → $\frac{40m}{100}$

∴ marks of B = $\frac{m}{10} + 30 = \frac{40m}{100} - 30$

(i.e, if B gets 30 marks more than passing marks then if we reduce 30 marks it would be the passing marks)

∴ → $\frac{m}{10} - \frac{40m}{100} - \frac{m}{10} = 60$

⇒ $\frac{4m - m}{10} = 60$

⇒ $\frac{3m}{10} = 60$

⇒ m = 200

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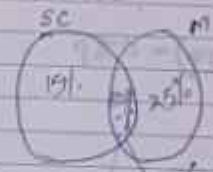
(10) In a class 15% of total no. of students failed in science, 25% of total no. of students failed in maths & 10% of total no. of students failed in both. How much percentage of students passed in both maths & science?



(so remove it)

failed = 15% + 25% − 10%
= 30%

∴ pass = 100% − 30% = 70%

(10) By 20% decrease in the price of rice, people can buy 1 kg more rice in Rs. 100. What is the original price of 1 kg of rice?

Let, the original price of rice = P Rs/kg

Now people used to buy (earlier) 1 kg of rice for Rs. 100.

Exp (earlier) / 100 = Exp (now) / 100 [Exp: amount of rice they make]

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∴ now, ~~Rs~~ exp = A+P

now, price decrease by 20%

∴ current price = $P - \frac{P \times 20}{100}$

$= \frac{80P}{100}$

$= 0.8P$

∴ now, the current exp = $(A+10) \times 0.8P$

according to the ques

$AP = (A+10) \times 0.8P$ [∵ exp remains same]

$\Rightarrow A = (A+10)\frac{8}{10}$

$\Rightarrow A - \frac{8A}{10} = 8$

$\Rightarrow 2A = 80$

$= 40$ kg

40 kg of rice was possible for people to initially buy initially in 100.

And we know the country exp = 100

$\therefore 100 = 40 \times P$

$\Rightarrow 100 = 40 \times P$

$\Rightarrow P = \frac{100}{40} = 2.5$ RS

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(11) In an election which was contested by 2 candidates, one candidate got 40% of total votes & yet lost by 1000 votes. What is the total no. of votes casted in the election?

1 — 2

40% of A — 60% of A

$\frac{40A}{100}$ — $\frac{60A}{100}$

let, the total votes = A

According to the ques. (2nd one get 1000 more votes as 1st one lost by 1000 votes)

$\therefore \frac{40A}{100} + 1000 = \frac{60A}{100}$

$\Rightarrow \frac{60A - 40A}{100} = 1000$

$\Rightarrow \frac{20A}{100} = 1000$

$\Rightarrow A = 5,000$

[another approach]

(1st candidate got 1000 less votes to win, if he get 1000 more votes then he wins the election)

(12) In a country 59% population is female & 50% of the male population is literate. How much % of females are literate if total literacy is 50%?

let population = 100

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$f = 55\%$

i.e 55% of total population is f

$\therefore \frac{55}{100} \times 100 = 55$ females

$\therefore$ males $= 100 - 55 = 45$ males

Literate male $= \frac{80}{100}$ of male population

$= \frac{80}{100} \times 45$

$= 36$ males are literate

total literacy $= 58\%$ (out of 100 people 58 people are literate)

$= 58\%$ of 100 (total population)

$= 58$ people

(36 male literate out of 58 so rest are f literates)

$f_L + m_L = 58$

$\Rightarrow f_L + 36 = 58$

$\Rightarrow f_L = 58 - 36$

$= 22$

now, we have to find the percentage (how much of females are L) [As no, concrete val. of population is given, everything is given in %, so ans has to be % also)

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i.e, how much % is 22 of 55

(Lit. f) (total f)

$\therefore \frac{22}{55} \times 100 = 40\%$

Always have that in % val = the total val. of common thing

(13) If 20% of an electricity bill is deducted, then Rs. 100 is still to be paid. How much was the original bill?

From original 20% is deducted

i.e 80% bill has to be paid

Now given after reducing, the person still have to pay 100

i.e, 80% of original bill = 100 Rs.

$\Rightarrow \frac{80}{100} \times B = 100$ (let, B = original bill)

$\Rightarrow B = \frac{100}{80} = \frac{500}{4} = 125$ Rs

(14) A's salary is 50% more than B's. How much percent is B's salary less than A's

let, B's sal = 100 Rs

A's sal $= \frac{100 + 50}{100} \times 100$

$= 150$ Rs

Change	Recent sal
50	150

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how much % is B's salary less than A's

B's sal = 100%

A's " = 150

i.e, B's sal is 50rs. ↓ (less)

(now we have to express it into %)

$\frac{50}{150} \times 100$

$= 33.33\%$ less than that of A.

(5) Two nos are less than a third no by 30% & 37% respectively. How much % is 2nd no less than the 1st?

let 3rd no = 100

1st no = $100 - \frac{30}{100} \times 100$

$= 70$

2nd no = $100 - \frac{37}{100} \times 100$

$= 63$

2nd no is $(70 - 63) = 7$ less than 1st no.

$\frac{7}{70} \times 100 = 10\%$

(6) 10% of inhabitants of a village having died of cholera, a force set up among which 25% of remaining inhabitants left village. The population is then reduced to 4050. The no. of inhabitants originally was?

let, population of the village = m

10% died of cholera

Remaining % = 100% − 10%

= 90%

let, total inhabitants original in = m

now, 10% of in. died in cholera,

∴ remaining = $m - \frac{10}{100} \cdot m$

$= \frac{9m}{100}$

Out of this 25% of them (remaining) left the village.

∴ now, still remaining = $\frac{9m}{100} - \frac{25}{100} \cdot \frac{9m}{100}$

$= \frac{36m - 9m}{4 \times 100}$

$= \frac{27m}{4 \times 100} = \frac{m}{16}$

25% of remaining left

now we ~~have to~~ can't exclude from ~~30~~ 30% as, we always need to exclude from 100%.

∴ now remaining is 100%

∴ now left = 100% − 25%

= 75% of remainings

$= \frac{75}{100} \times \frac{30m}{100}$

as according to the ins, after that the population reduced to 4050, ie, after that in / pop = 4050

$\frac{75}{100} \times \frac{30m}{100} = 4050$

⇒ m = 6000 inhabitants

∴ initial in / pop = 6000

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6. Problems on Ages (Imp)

• Note

↓ Read the ins carefully, the ans lies in the ins in such problems. (ie, everything is in the problem, we do construct eqn & solve & get the ans)

① Ram is three times as old as Sam 2 years ago. He was five times as old as Sam that is the present age of Ram?

Present age	2 years ago
Ram − R	R − 2
Sam − S	S − 2

↓ given

R = 3S — (i)

↓ R = 3 × 4 (from (i))

= 12 yrs

↓ given

(R − 2) = 5(S − 2)

↓ R − 2 = 5S − 10

↓ 3S − 2 = 5S − 10 [from (i)]

↓ 2S = 8

↓ S = 4 yrs — (ii)

mistake: the ans is wrong

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② 12 years ago age of P was 3 times the age of Q. After 12 years ratio of ages of Q to P will be 2:3. What is the present age of P?

present age → 12 years ago → future 12 years after

P = P yrs → (P−12) yrs → (P+12) yrs

Q = Q yrs → (Q−12) yrs → (Q+12) yrs

given: $(P-12) = 3(Q-12)$

$\Rightarrow P-12 = 3Q - 36$

$\Rightarrow P = 3Q - 24$ — (i)

given: $\frac{Q+12}{P+12} = \frac{2}{3}$

$\frac{3Q-24+12}{P+12} = \frac{2}{3}$

from (i)

$\Rightarrow P = 3Q - 24$

$= 36$ yrs

$\Rightarrow \frac{Q+12}{3Q-24+12} = \frac{2}{3}$

from (i)

$\Rightarrow \frac{Q+12}{3Q-12} = \frac{2}{3}$

$\Rightarrow 6Q - 24 = 3Q + 36$

$\Rightarrow 3Q = 60$

$Q = 20$ yrs — (ii)

③ Rohan is as much younger than Ajay as he is older than Meena. The sum of ages of Ajay & Meena is 108 years. How old is Rohan

Meena < Rohan < Ajay

same diff

same diff

R's age = $\frac{\text{M's age} + \text{A's age}}{2} = \frac{108}{2} = 54$

(sum of ages of A & M = 108 given)

④ Rohan's age is five times Ajay's & seven eighteenth of Meena's age. The sum of the ages of all three of them 102 years. How much younger is Ajay to Meena?

Solve

as same age gap from both M & A, so R is mid, so M & A used to find out the ratio

let A's age = A yrs, M's age = M

R's age = 5A (given) & also

R's age = $\frac{7}{18}$ times of M's age (given)

M's age = $\frac{18}{7}$ R's age (R)

$= \frac{18}{7} \times 5A$

R's age = $\frac{7}{18}$ M (given)

$\Rightarrow 5A = \frac{7M}{18}$

$\Rightarrow M = \frac{90A}{7}$

expressing everyone's age in terms of A (A's age)

given: $k + m + R = 132$

$\Rightarrow k + \frac{k+4}{2} + 59 = 132$

$\Rightarrow k = 49$ yrs

$\therefore R = 59 - 4 = 55$ yrs

$m = \frac{49+7}{2} = 28$ yrs

~~k is (28 - 35) = 3 yrs younger~~ to m.

k's age = 7 yrs m's age = 30 m

$\therefore$ k is $(30 - 7) = 23$ y younger than m.

⑤ Ram & shyam's average age is 65 years. The average age of Ram, shyam & John is 53 years. What is the age of John? (refer average video)

Average
$Avg = \frac{Sum}{total\ no.\ of\ observations}$

$Avg_{Ram\ \&\ Shyam} = 65$ (given)

let, age of Ram = R

Shyam = S

$\frac{S+R}{2} = 65$

$\Rightarrow R + S = 130$ — (i)

$\frac{R+S+J}{3} = 53$

$\Rightarrow R + S + J = 159$

$\Rightarrow 130 + J = 159$ (from (i))

$\Rightarrow J = 29$ y — (ii)

age

⑥ The average of 10 students & their teacher is 15 years. The average age of first seven students is 15 years. Sum of the last three is 11 years. What is the teacher's age?

$Avg_{10} = 15$ y (Avg age of 10 students & their teacher is 15 y)

$\therefore$ Age of 10 st & age of their teacher / total no. of people (10 s + 1)

let, the ~~avg~~ total age of 10 students = S_{10} (sum of the ~~avg~~ age of their teachers = T (the age of teacher)

$\therefore$ according to the ques,

$\frac{S_{10} + T}{11} = 15$

$\Rightarrow S_{10} + T = 165$ y — (i)

let, ~~avg~~ total age of 1st 7 students = S_7

~~avg~~ age of last 3 students = S_3

$\frac{S_7}{7} = 15$, $\Rightarrow S_7 = 105$ y — (ii)

$\frac{S_3}{3} = 11$, $\Rightarrow S_3 = 33$ y — (iii)

$\Rightarrow S_{10} = S_7 + S_3$

$\therefore$ from (i), $S_{10} + T = 165$

$\Rightarrow 105 + 33 + T = 165$

$\Rightarrow T = 27$ y

Teacher's Signature

(7) The average age of group of 4 friends is 36 years. The youngest friend amongst them is 6 years old. What was the average age of the group at the time of the birth of the youngest friend?

Given $Avg_4 = 36$

Let, sum of the ages of 4 friends $= S_4$

$\therefore \frac{S_4}{4} = 36$

$\Rightarrow S_4 = 144y$

(∵ we need the avg age of the group at the time of birth of the youngest friend & youngest friend is now 6 years old, so he was born 6 years ago)

6 years ago

$-6 - 6 - 6 - 6$

$-24y$ (6 years ago everyone's age was 6 less so -6 from everyone's age)

total reduction

$\therefore$ Sum of the ages of 4 friends 6 years ago, $= 144 - 24$
$= 120y$

now, there are 4 friends & 6 years ago their sum of their ages $S = 120y$, 6 years ago the youngest friend was just born, so his age at 6 years ago $= 0$. That means '120y' is the sum of the ages of rest of 3 friends as that youngest friend was just born at that time.

$\therefore$ The avg age of the group 6 years ago $= \frac{120}{3} = 40y$

Expt. No.

(8) Average age of a family of 4 members was 10 years 4 years back. Birth of a new child and the avg age of the family same today. The child is now 1 year old. Find the present age of the child.

Given, $Avg_4 = 10y$ (4 years ago)

4 years back — present

ages of — 4 years ago

Let sum of total family now $= S_4$

$\therefore \frac{S_4}{4} = 10 \therefore S_4 = 40y$

$\therefore$ After 4 years (present)

$4 + 4 + 4 + 4$
$= 16$ (total increment)

$\therefore$ Sum of the ages of 4 members today (in years after) $= 56 + 16 = 72y$

Let present age of child $= 'k'$

Avg age (present) $= \frac{72 + k}{5}$

Given, Avg today $= 13$

$\frac{72 + k}{5} = 13$

$\Rightarrow k = 3y$

NAME - Rajasree
CLASS - XII
ROLL - 23 SEC -
REGISTRATION N
B - Physics
tool - Balaragam

Aptitude

Quantitative
- Numbers system
- Profit, loss, interest
- time & work
- Speed, distance, time etc
- topics

Logical
- series
- Odd One out
- Blood relations
- clock etc
- topics

Quantitative Aptitude

Q. Time & work

A → 2 day A → 3 day
$\frac{1}{2}$ + $\frac{1}{2}$ $\frac{1}{3}$ + $\frac{1}{3}$ + $\frac{1}{3}$

B → x hours | days etc [B do a work in x hrs]
work per i.e, x hrs → 1 work ; 1 hr → $\frac{1}{x}$ work

∴ at 1 hr | day m etc B does $\frac{1}{x}$ work

Q1) A can do a piece of work in 12 hrs & B alone can do it in 15 hrs. In how much time will they finish the whole work, working together

A → 12 hrs B → 15 hrs

A in 1 hrs → $\frac{1}{12}$ B in 1 hrs → $\frac{1}{15}$ 3 | 12, 15 / 4, 5

(A & B) in 1 hrs → $\frac{1}{12}$ + $\frac{1}{15}$ → $\frac{5+4}{60}$

→ $\frac{\cancel{9}\,3}{\cancel{60}\,20}$

like previous, if A → 12 hrs

then A doing work in 1 hr = $\frac{1}{12}$

~~i.e. if A is doing a work in~~

i.e. if $\frac{1}{12}$ work is done by A in 1 hr

then A will finish the work in 12 hrs.

(reciprocal)

like that if (A & B) in 1 hrs → $\frac{3}{20}$ work

then (A & B) will finish the work in $\frac{20}{3}$ hrs

Q2) A & B → 12 days

B → 30 days

A → ?

A & B → 12 days

(A & B) in 1 day → $\frac{1}{12}$ work

B → 30 days

B in 1 day → $\frac{1}{30}$ work

∴ A + B $\xrightarrow{\text{in 1 day}}$ $\frac{1}{12}$

⇒ A + $\frac{1}{30}$ = $\frac{1}{12}$ [∵ B in 1 day → $\frac{1}{30}$ work]

⇒ A = $\frac{1}{12} - \frac{1}{30}$

= $\frac{5-2}{60}$

= $\frac{3}{20}$

$$\begin{array}{r|l} 3 & 12, 30 \\ \hline 2 & 4, 10 \\ \hline & 2, 5 \end{array}$$

= A in 1 day → $\frac{1}{20}$ work

∴ A will finish the work in 20 days by alone.

Q3) A & B → 18 days, B & C → 24 days, C & A → 36 days

A, B & C → ?

A → ?

(A & B) in 1 day = $\frac{1}{18}$ work

B & C " " = $\frac{1}{24}$ "

C & A " " = $\frac{1}{36}$ "

2(A + B & C) in 1 day = $\frac{1}{18} + \frac{1}{24} + \frac{1}{36} = \frac{4+3+2}{72} = \frac{9}{72}$

⇒ A + B & C (Both) ---- = $\frac{1}{16}$ "

∴ A, B & C will finish the work by 16 days

A + B + C = $\frac{1}{16}$

⇒ A + $\frac{1}{24}$ = $\frac{1}{16}$

⇒ A = $\frac{1}{16} - \frac{1}{24}$

= $\frac{1}{48}$

∴ A will ---- = 48 days

NAME - Rajasree Saha

CLASS - 5th

ROLL - 23 SEC - A

REGISTRATION No. - 4193

IB - Physics

HOME - Balurghat, WB

Q4) A & B can do a piece of work in 45 & 40 days respectively. They began the work together but A leaves after some days & B finished the remaining work in 23 days. After how many days did A leave?

In 1 day, A → $\frac{1}{45}$ work

B → $\frac{1}{40}$ "

A & B (Avg) → $\frac{1}{45} + \frac{1}{40} = \frac{17}{360}$

work A & B did together

B in 1 day → $\frac{1}{40}$

B has worked for 23 days by alone

∴ B in 23 days → $23 \cdot \frac{1}{40}$ work

work A & B did together $\left(1 - \frac{23}{40}\right)$.

$= \frac{17}{40}$ work

[as total work 1 as A does $\frac{1}{45}$, B does $\frac{1}{40}$]

A & B in 1 day → $\frac{17}{360}$ work

A & B did $\frac{17}{40}$ work together

A & B did $\frac{17}{360}$ work → 1 day

1 " → $\frac{360}{17}$ "

$\frac{17}{40}$ " → $\frac{360}{17} \cdot \frac{17}{40}$ " ∴ 9 days

A & B $\frac{17}{360}$

1 → $\frac{9}{360}$

(5) let A & B did the work together (17/40) by x days

$\frac{17x}{360} = \frac{17}{40}$

⇒ x = 9 days

∴ A & B did the work together for 9 days. After 9 days A left & B did the work for 23 days

∴ Ans- 9 days

Q5) If 4 men or 6 boys can finish a piece of work in 20 days, in how many days can 6 men & 11 boys finish it?

4 men or 6 boys → 20 days

~~So In 1 day, 4 men → 20 days~~

~~∴ 4 men in 1 day → $\frac{1}{20}$ day work~~

~~1 " 1 day → $\frac{1}{20} \cdot \frac{1}{20}$~~

~~$= \frac{1}{80}$ "~~

∴ In 1 day →

4 men = 1/20 | 1 men = $\frac{1}{80}$

6 boys = 1/20 | 1 boy = $\frac{1}{120}$

6 men & 11 boys, $\frac{6}{80} + \frac{11}{120} = \frac{18+22}{240} = \frac{40}{240}$

∴ 6 men & 11 boys in 1 day → $\frac{1}{6}$ work

NAME - Rajasree Saha
CLASS - XII
ROLL - 23 SEC - A
REGISTRATION NO. - 41923
IB - Physics
HOME - Bahragora [illegible]

∴ they can finish the work ~~together~~ in = 4.

Q6) If Rajesh can do a piece of work in 8 days & Antony can do a piece of work in 5 days, in how many days will both of them do it together?

In 1 day,

Rajesh → $\frac{1}{8}$ work

Antony → $\frac{1}{5}$ "

∴ Rajesh & Antony in 1 day → $\frac{1}{8} + \frac{1}{5}$

→ $\frac{5+8}{40}$

→ $\frac{13}{40}$ work

Both of them will work together and finish the work together by do the $\frac{40}{13}$ days.

Q.7) To complete a piece of work, A takes 50% more time than B. If together they take 18 days to complete the work, how much time shall B take to do it alone?

Let B takes x days to complete a work

∴ A = $x + x \times \frac{50}{100} = \frac{3x}{2}$ " "

∴ In 1 day, B → $\frac{1}{x}$ work

A → $\frac{2}{3x}$ "

Given, $\frac{1}{x} + \frac{2}{3x} = \frac{1}{18}$ [∵ 18 days 1 day → $\frac{1}{18}$ work]

→ $\frac{3+2}{3x} = \frac{1}{18}$

→ $\frac{5}{3x} = \frac{1}{18}$

→ $3x = 5 \times 18$

→ $x = 30$ days

∴ B will take 30 days to do it alone.

Q.8) A takes 3 days to complete a work while B takes 2 days. Both of them finish a work & earn Rs.150. What is A's share of money? (Hint: money should be divided in the ratio of how much work a person does in 1 day)

a) Rs 70 b) Rs 30 c) Rs 60 d) Rs 75.

In 1 day, A → $\frac{1}{3}$ work

B → $\frac{1}{2}$ work

~~Let A's share of money~~

Given, money ------ in 1 day

∴ their work ratio = $\frac{1}{3} : \frac{1}{2} = 2 : 3$

NAME - Rajasree Saha
CLASS - 5th
ROLL - 23 SEC - A
REGISTRATION No. - 41
SUB - Physics
TOPIC - Behrington world

$\therefore \frac{n_1 + 2n + 2}{2n} = \frac{n_2 + 2n + 2}{2n}$ [as from both cases 1 and 2 exam papers have the]

$\therefore n_1 = n_2$ Ans

Marking,

In 1st case, 1st part not giving 5 marks

2 " " " " 5 + 5 "

1 mark is getting from 1st part

2 " " " " 10 marks

If there are 2n number of exam papers

n_1 no. of exam papers have first - 10 + 1 marks

$\frac{10n+1}{n}$

n_2 are same n.

$\frac{n_1 + 2n + 2}{2n}$

$\therefore \frac{10n+1}{n} = \frac{n_1 + 2n + 2}{2n}$ [as from both cases 1 and 2 exam papers have the]

$\therefore n_1 = 8$ Ans

[D: Days
W: Work]

we can go D → W
or W → D
By just simple inversion

We know, if ↑work, then ↑time, ↓days
↑men, then ↑work, ↓days, ↓time

If A can work 5 times faster than B & takes 60 days less than B to complete the work. In how many days does A & B individually can complete the work?

Let B → n days
A → n-60

"A = 5B" ← A 5 times faster B
as B is 5 times slower than A then it will take 5 times more time than A

as A = 5B
so time taken by A will be $\frac{1}{5}$ of time taken by B

$\therefore \frac{1}{5}(n-60) = \frac{n}{5}$

$\frac{1}{5}n - \frac{n}{5} = 60$

$\frac{1}{5}n = 60$

$n = 300$

$n = 75$ days $\frac{1}{5}n - 60 = 15$ days

B takes 75 days to complete a work
A (75-60) = 15

work speed ∝ $\frac{1}{\text{time taken}}$

↑work ↓time ↓days
i.e work ∝ $\frac{1}{\text{time taken}}$ ∝ $\frac{1}{\text{days taken}}$
more work, less time, less day

↑men ↑amount of work ↓time retirement / days
no. of men ∝ amount of work ∝ $\frac{1}{\text{days taken}}$

2) If 24 men can finish a work in 10 days, then find the no. of days required to complete the same work by 30 men?

~~24 men → 10 days~~
~~1 day → $\frac{1}{10}$ days work~~

24 m 10 days 1 day $\frac{1}{10}$ amount of work
30 m ?
~~desire~~

24 $\frac{1}{10}$
30 1 (at x)

$24 \times x = \frac{30}{10}$

$x = \frac{30}{240} = \frac{1}{8}$

$\therefore$ 8 days [$\because$ 1 day → $\frac{1}{8}$ work
$\therefore$ can finish work by 8 days]

NAME - Rajasree Loho
CLASS - XII
ROLL - 23 SEC - A
REGISTRATION No - 41523152
IB - Physics
SCHOOL - Balurghat Girls High

NAME- Rajasree Saha
CLASS- XII
ROLL- 23 SEC- A
REGISTRATION NO - 41232153
IB- Physics
SCHOOL- Balurghat Girls High

3) A can do work in 3 days. B can do the same work in 6 days & C can do the same work in 7 days. If they work together, in how many days will they take to complete the work?

		1 day
A →	3 days	$\frac{1}{3}$ amt of work
B	6 "	$\frac{1}{6}$ "
C	7 "	$\frac{1}{7}$ "

$A+B+C = \frac{1}{3}+\frac{1}{6}+\frac{1}{7}$

$\frac{14+7+6}{42}$

$= \frac{27}{42}$

$= \frac{9}{14}$ amt. of work

1 day $\frac{9}{14}$ " "

They will complete the work in $\frac{14}{9}$ days together.

4) P & Q can do work in 12 days. Q & R can do the same work in 16 days, & R & P can do it in 24 days. Find the time in which P, Q & R can finish the work together?

		1 day
P & Q →	12 days	$\frac{1}{12}$ amt of work
Q & R →	16 "	$\frac{1}{16}$ "
R & P →	24 "	$\frac{1}{24}$ "

$\therefore P+Q \rightarrow \frac{1}{12}$

$Q+R \rightarrow \frac{1}{16}$

$R+P \rightarrow \frac{1}{24}$

$2(P+Q+R) = \frac{1}{12}+\frac{1}{16}+\frac{1}{24}$

$= \frac{4+3+2}{48}$

$= \frac{9}{48} = \frac{3}{32}$

$\Rightarrow P+Q+R = \frac{3}{32}$

$\therefore P+Q+R \longrightarrow \frac{3}{32}$ 1 day amt. of work

$\therefore$ P, Q & R can finish the work together in $\frac{32}{3}$ days.

1 days → $\frac{3}{32}$ work
7 days $\frac{3}{32} \times 7$ (means)
$\frac{3}{32} \times 7 = 1$
$\frac{3}{32} \times x = 1$
$x = \frac{32}{3}$

[Any total work = 1
$\frac{3}{32} \times \frac{32}{3} = 1$
1 day → $\frac{3}{32}$ work
to finish the work
is work it takes
2) we need $\frac{32}{3}$ days]

NAME - Rajasree Saha
CLASS - XII
ROLL - 23 SEC - A
REGISTRATION No. - 41922315 25
IB - Physics
HOSL - Bakrangan Girls High

6) P can do a work in 30 days, B is 25% more efficient than P in completing the work. Since work in how many days will B complete the work?

P → 30 days $\frac{1\,day}{30}$ amt. of work

B is 25% more efficient than P
So, if P's efficiency is = 100%
∴ B's " is = (100+25)
= 125%

100% → 30
125% → x

P can do $\frac{1}{30}$ amt. of work in 1 day [∵ eff. of P]
∴ B " 125% of $\frac{1}{30}$ [∵ 125% eff]
$= \frac{125}{100} \times \frac{1}{30}$
$= \frac{1}{24}$ amt. of work

∴ B's work is finished in 24 days, in order

6) If 3 men can do a work in 2 days & 4 boys can do the same work in 6 days, then in how many days with the same work be completed by 3 men & 8 boys?

3m → 2 days
4b → 6 days

4b are taking 3 times more time than 3m.
i.e 3m are doing more work than 4b, so they are taking 3 times less than the time taken by 4b.
the working speed of the 3m = 3×(4b)
i.e 3m are working 3 times more than 4b

∴ 3m = 3×4b
∴ $\boxed{1m = 4b}$ → [chain rule]

3 times less than 4b
3 times more speed

8m + 8b
= 8×4b + 8b
= 40b

4b → 6 d $\frac{1\,day}{1/6}$
40b → ?

4b $\frac{1\,day}{1/6}$
40b ?(b)
$x = \frac{40 \times 5}{3}$
$x = \frac{5}{3}$ (1 day)

∴ 40b can do the entire work in $\frac{3}{5}$ days.
(8m+8b)

NAME - Rajasree Saha
CLASS - XII
ROLL - 23 SEC - A
REGISTRATION NO. - 41923151
2B - Physics
HOSTEL - Balurghat Girl's High

Q) Sita & Gita can do a work in 20 days & 25 days, respectively. Both begin together but after a few days, Sita leaves & Ram Gita finishes the remaining in 10 days. After how many days did Sita leave?

S+G S+G G
1/5 1/5 1/25
10 days total

→ line diagram

[total time = 1]

S → 20 days 1 way $\frac{1}{20}$ amt of work

G → 25 " $\frac{1}{25}$ "

∴ 10 " $\frac{10}{25}$ "

$= \frac{2}{5}$ "

∴ $1 - \frac{2}{5} = \frac{3}{5}$ amt of work is done by S+G

(total amt of work)

S+G $= \frac{1}{20} + \frac{1}{25} = \frac{9}{100}$ (100)

S+G: n days, G: 10 days

Let → $\frac{9}{100}$ amt of work

n " → $\frac{9n}{100}$ "

we know, S+G $= \frac{3}{5}$

$\frac{9n}{100} = \frac{3}{5}$

$n = \frac{20}{3}$ days

S & G have done the work together for $\frac{20}{3}$ days

& after that G worked alone.

i.e Sita left the work after $\frac{20}{3}$ days

Q) When P alone does a work, he takes 25 days more than the time taken by P & Q working together to complete the work. But Q alone takes 9 days more than the time taken by P & Q working together to complete the work. In what time, P & Q together finish this work?

P+Q → lets they take 'n' days together to finish a work.

P → (n+25) days

Q → (n+9) "

• Formula → $n = \sqrt{\text{Extra days of P} \times \text{Extra days of Q}}$

∴ $n = \sqrt{25 \times 9}$

$= \sqrt{5 \times 3}$

$= 15$ days

∴ P & Q together takes 15 days to finish the work.

Q) A can complete a work in 12 days & B can complete in 8 days. A works for 8 hours every day while B works for 10 hrs everyday. If A & B together start working 8 hrs per day, in how many days will they complete the work?

A → 12 days to complete a work
And, at 1 day A works for 8 hrs

∴ A works for → 12 × 8 hrs
Completing the work in = 96 h

B → 8 days to complete a work
And, at 1 day B works for 10 hrs

∴ B completes the work in = 8 × 10
= 80 hrs

A → 96 hrs $\frac{1 \text{ hr}}{\frac{1}{96}}$ amt of work

B → 80 hrs $\frac{1}{80}$ "

$A + B = \frac{1}{96} + \frac{1}{80}$

$= \frac{176}{96 \times 80}$ amt of work [1 hr]

∴ A & B together will complete the work in $\frac{96 \times 80}{176}$ (hrs)

∴ Now, given A + B will work 8 hrs/day
At 1 day A + B works for → 8 hrs.

8 hrs → 1 days

1 → $\frac{1}{8}$ "

$\frac{96 \times 80}{176}$ → $\frac{96 \times 80}{8 \times 176} = \frac{60}{11}$ days

In $\frac{60}{11}$ days A & B will complete the work together.

NAME- Rajasree Saha
CLASS- XII
ROLL- 23 SEC- A
REGISTRATION NO.- 4132
PB- Physics
HOOL- Bakrampur Girls

10) Raj can build a house alone in 16 days but Suraj alone can build it in 12 days. Raj & Suraj work on alternate days. If Raj works on first day, the house will be built in how many days?

R → 16 days $\frac{1 \text{ day}}{1/16}$ amt of work

S → 12 " $\frac{1}{12}$ "

(R S R S R S) ....

1st day = $\frac{1}{16}$ amt of work is done as Raj is working

2nd day = $\frac{1}{12}$ " " as Suraj " "

In 2 days → $\frac{1}{16} + \frac{1}{12}$

$= \frac{7}{48}$ amt of work

∴ In 2 × 6 = 12 days → $\frac{7 \times 6}{48} = \frac{7}{8}$ amt of work

[Now why we need 6 times? 6 times work,
~~As if we mul 7 days, then~~ 7 times,
As if we do 7 times repeat, then,
2 × 7 = 14 days
$\frac{7}{48} \times 7 = \frac{49}{48} > 1$ ✗ [∵ work done can never be > 1]
∴ So we have to take such a multiple that will give the work done = 1. (i.e. 6 times)]

[6 times we need to repeat this i.e., 2 days & $\frac{7}{48}$ amt of work will be repeated for 6 times]

the work left = 1 − 7/8 [∵ 7/8 amt work has been done already]

= 1/8 amt of work

12 days have already passed.

on 13th day Raj will come & he will do → 1/16 amt of work

now, 1/8 > 1/16

So, Raj ~~can~~ will do 1/16 amt of work & the work left

= 1/8 − 1/16

= 1/16 amt of is still left

on 14th day Sunil come & he will ~~do~~ do

→ 1/16 amt of work

now, 1/12 > 1/16 [∵ S can more than the work left]

∴ he can finish that left amt of work in,

1/16 = 1/12 × x [let, he takes x days to complete]

x = 16/12 = 4/3 days [1 day → 1/12 and 4/3 amt work will be done by]

∴ he will complete 1/16 amt of work in 4/3 days.

∴ 13 days are completed & 14th day only 4/3 amt is used.

~~total days taken = 13 + 4/3 = 15/4 days~~

∴ total no. of days / amt of time taken by P & S to complete the house = 13 3/4 days

Work & Wages

tips – 1st 7 money

2 days → fast (as it takes 7 money less days to complete)

A – 2 days

B – 3 days → slow (as it takes more days (time) to complete) 1 money

Both of them are doing the same work

∴ 1 days 7 money

∴ Income ∝ 1/days

Ratio days A : B = 2 : 3

Ratio Income A : B = 3 : 2 [∵ Income ∝ 1/days, $A_I : B_I$ = 1/2 : 1/3 exactly opposite as = 3 : 2 exactly inverse]

Q) share of B = 2/5 × (total income)

cutoff, Income total

share of A = 3/5 × (total money)

cut of total income

$\boxed{\text{Income} \propto \text{Work}}$

4) ↑w ↑money considering this concept solⁿ the problem then

A – 2D
B – 3D
both of them are doing the same work

So then how the money is distributed, we have to are considering work here not the no. of days. At ② we were considering no. of days.

A → 2D ⇒ 1/2 amt. of work } ↑m time & work concept
B → 3D ⇒ 1/3 " " " ↑m

Ratio. A : B = $\frac{1}{2} : \frac{1}{3}$ (in 1 day) = 3 : 2
~~of income work~~

Ratio of income = 3 : 2 [∵ Income ∝ work]

3) Invert,

total work is done by n days

∴ $\boxed{\text{In 1 day} = \frac{1}{n} \text{ amt. of work (just invert)}}$

Surely,

If, in 1 day $\frac{1}{n}$ amt. of work is done

∴ $\boxed{\text{total work would be done in } n \text{ days (invert)}}$

So, eg – A → $\frac{1}{8}$ amt. of work → 1 Day

∴ total work would be done in 8 days.

1) Ramesh can do a work in 5 days. Suresh do the same work in 7 days. The total amount given for this work to them is Rs. 480. If both are working together, then what will be the share of Suresh.

↑w ↑m

[but here the work is same, so we need to see the time taken by both & we know,]

↑d ↓m

R → 5D → fast ↑money
S → 7D → slow ↓money

Ratio of days = 5 : 7

Ratio of income = $\frac{1}{5} : \frac{1}{7}$
= 7 : 5

If we will get by ↑w ↑m – this concept we will get the same ans

Income Ramesh : Suresh = 7 : 5

∴ Share of Suresh = $\frac{5}{7+5} \times 480$
= 200/-

Share of Ramesh = $\frac{7}{12} \times 480$ (480 – 200)
= 280/-

2) Ramesh can do a work in 15 days. Vijay & Ramesh together do the same work in 10 days. They received Rs 1155 for that work. What is share of Ramesh & Vijay?

NAME – Rajasree Saha
CLASS – XII
ROLL – 23 SEC – A
REGISTRATION NO. – 4192315855
UB – Physics
HOME – Baharagora Girls High Sc

R → 15D → $\frac{1}{15}$ part of work

V → 30d → $\frac{1}{30}$

WR → 10d → $\frac{1}{10}$

$\frac{1}{R} + \frac{1}{15} = \frac{1}{10}$

$\Rightarrow \frac{1}{R} = \frac{1}{10} - \frac{1}{15}$

$= \frac{3-2}{30}$

$= \frac{1}{30}$ ∴ V = 30 days

$\frac{1}{30}$ work done by Vijay in 1 day = $\frac{1}{30}$

∴ the no. of days taken by Vijay to complete the task = (Ans) = 30 days

Ratio of days = R : V
= 15 : 30
= 1 : 2

Ratio of income = $\frac{1}{R} : \frac{1}{V}$
= 2 : 1

∴ share of R = $\frac{2}{3} \times 1155 = 770$/-

V = $\frac{1}{3} \times 1155 = 385$/-

3) wages of 44 women for 56 days comes to Rs. 29568. How many men are needed for 47 days to receive Rs. 16920, if the daily wages of a man being 5 times those of a woman?

44 W for 56 d = 29568 Rs

44 W for 1 d = $\frac{29568}{56}$

1 W = 1 d = $\frac{29568}{56 \times 44}$ Rs (for 1 W → 1 day)

= Rs. 12

∴ 1 M = 5 × 12 = 60 [∵ wages of a man is 5 times ~~than~~ those of a woman]

let the no. of men = m

1 m for 1 day = Rs. 60

m " 1 day = Rs. 60m

m " 47 days = Rs. 60m × 47

~~We know that~~ ~~6~~ According to the ques.

60m × 47 = 16920

⇒ m = 6 men.

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P, Q & R have a job for RS 640. P & Q together finish 2/5th of the work & rest is done by R alone. What is the share of R?

P&Q → $\frac{2}{5}$

R → $1 - \frac{2}{5} = \frac{3}{5}$ → R alone

$\frac{3}{5}$th of work (more work) → $\frac{3}{5}$ of the money (more money)

[Here we are applying this as we can see directly how much work is done by them. it is easy to sol^n by this method]

$\boxed{\text{How much work, that much money}}$

Share of R = $\frac{3}{5} \times 640$

= 384 RS

(ii) Ratio of work = P&Q : R

$\frac{2}{5} : \frac{3}{5}$

= 2 : 3

Ratio of income = 2 : 3 [∵ work ∝ income]

∴ Share of R = $\frac{3}{5} \times 640$

= 384 Rs

S & P can do a job in 30 days, while Q alone can do it in 45 days. They work together for 15 days & rest of the job is done by R in 6 days. They get RS. 15000 for the whole job. What will be R's share?

[Sir or ma'am can't apply normal approach for money on this one]

P → 30d → $\frac{1}{30}$ amt of work (1 day)

Q → 45d → $\frac{1}{45}$

P+Q → 15d →

$\frac{1}{30} + \frac{1}{45} = \frac{5}{90}$

In 1 day P+Q → $\frac{1}{18}$

15 " P+Q → $\frac{15}{18} = \frac{5}{6}$

Rest of work is done by R

work done by R = $1 - \frac{5}{6} = \frac{1}{6}$ amt of work

[Given R completed that remaining work in 6 days, hence we can see in 1 day R can do $\frac{1}{6}$ amt of work, so R can complete the rem work in 6 days]

∴ $\frac{1}{6} \times 15{,}000$

= 2500/-

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6) A man & a boy received Rs. 1800 for 3 days for a job they did together. The man's efficiency in work was 5 times that of the boy. What is the daily wages of the

M+B = 1800 = 3 days = 1800/-

M+B 1 day = $\frac{1800}{3}$ = 600/-

M = 5B

∴ M does 5 times more work than that of B

1W 1M
times times.

∴ Ratio of income = M : B

= 5 : 1 [5 : x, M : B]

∴ share of B = $\frac{1}{5+1}$ (total daily wages)

= $\frac{1}{6}$ 600 [as 1800/- for 3 days, at 1 day 600/-]

= 100/-

7) Prabhu was appointed for a 100 days job. The condition was that he will be paid Rs. 24 for every working day. But he will also be fined Rs. 12 for every day he is absent. At the end, he got Rs. 420. For how many days he was absent?

The job was for 100 days.
The condition was that he will be paid Rs. 24 for every working day.
∴ He should have gotten Rs. = 24 × 100 = 2400

But he got Rs 420 only.
Let us assume that he was absent for x days.
∴ He was present for = (100 − x) days
For every present day he get 24/-

∴ (100 − x) 24 − 12x = 420 [1d → 12, xd → 12x]

⇒ 2400 − 420 = 36x

⇒ x = 55 days

∴ P was absent for 55 days. [Problem on numbers] [It can be solved in least time]

8) Total wages of 6 men, 4 women & 8 boys is Rs. 26. If the wages of 6 men is equal to that of 8 women & the wages of 4 women is equal to that of 6 boys, then find out the total wages of 8 men, 6 women & 4 boys?

1 m → m Rs
1 w → w Rs
1 b → b Rs

6m = 8w
⇒ m = $\frac{8}{6}$w — (i)

4w = 6b
⇒ b = $\frac{4w}{6}$ — (ii)

8m + 4w + 8b = 26
⇒ 8 × $\frac{8}{6}$w + 4w + 8 × $\frac{4w}{6}$ = 26

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$\Rightarrow$ 2W + 12W + 16W = 264
$\Rightarrow$ W = 1.5 Rs

$m = \frac{3 \times 1.5}{6} = 2$ Rs

$b = \frac{4 \times 1.5}{6} = 1$ Rs

Sum of 6 wks 4b = ?

$\Rightarrow$ 3 × 2 + 4 × 1.5 + 4 × 1
= 29 Rs

3) P & Q and R get Rs. 10800 for doing a work in 18 days. P & R get Rs 3960 for doing the same work in 10 days, while Q & R get 6080 for doing the same work in 20 days. Find the amount receive by R per day?

P & Q & R → 10800 → 18d
1d → 10800/-
1 → $\frac{10800}{18}$ (in 1 day)
= 600/- (i)

P & R → 3960 → 10d → $\frac{3960}{10}$ (ii)
= 396/- (1 day)

Q & R → 6080/- → 20d → $\frac{6080}{20}$ (iii)
= 304/- (1 day)

P + Q + R = 600/-
$\Rightarrow$ 376 + Q = 600 [from (i)]
$\Rightarrow$ Q = 224/-

P + Q + R = 600
$\Rightarrow$ P + 304 = 600 [from (iii)]
$\Rightarrow$ P = 296/- [from (ii)]

P + Q + R = 600
$\Rightarrow$ 296 + 224 + R = 600
$\Rightarrow$ R = 80/-

$\therefore$ R = 80/- per day (in 1 day)

10) The amount of money with which A's wage can be paid for 18 days, when A is working alone is enough for paying B's wage for 12 days, when B is working alone. If A & B start working together, then the same amount would be enough for wages of both for how many days?

Let, Amount = x Rs
(total amount)

A → 18 days, i.e., for 18 days x Rs is enough to pay wage to A
1 day $\frac{x}{18}$

B → 12 days, i.e., 12 days x Rs B
1 " $\frac{x}{12}$

A + B = $\frac{x}{18} + \frac{x}{12} = \frac{5x}{36}$ Rs are paid
working together

As $\frac{5x}{36}$ Rs → x Rs (y)
$\frac{x}{x} \times \frac{36}{5}$ $\Rightarrow$ y = $\frac{36}{5}$ days

For $\frac{36}{5}$ days the same amount would be enough for wages of both A & B

If Johny employs 5 workers to work for 6 hrs per day. In total the pays them Rs. 630 for a week. How much should Johny pay if 3 workers working 4 hrs per day for a week?

Sol: 3 → 6 hrs/k → i.e. 6 hrs for 7 days

∴ total hrs = 6 × 7 = 42 hrs

5W → 42 hrs → 630 Rs

5W → 1 hr → $\frac{630}{42}$

1W → 1 hr → $\frac{630}{42 \times 5}$

= $\frac{15}{5}$ Rs

3W → 1 hrs → $\frac{15 \times 3}{5}$ = $\frac{45}{5}$ Rs

~~3W → 4 hrs → 135 Rs~~ [∵ 4 hrs / week]

4 hrs/day × 7 = 28 hrs [∵ 4 hrs/day, 1 day → 4 hrs, 7 day → 7 ×]

3W → 28 hrs → $\frac{45 \times 7}{5}$ Rs [∵ 1 day → 4 hrs, 7 day → 7 ×]

= 945/-

If Ram & Shyam have been given a task of painting a house for Rs. 800. With the help of Rita they complete the job in just 3 days. Had Ram alone be doing the task, he would need 6 days. If Shyam alone would be doing the task, he would need 8 days. How much money will Rita get?

R → 6d → $\frac{1}{6}$ part of work

S → 8d → $\frac{1}{8}$

R → xd → $\frac{1}{x}$

let Rita takes x days to complete the work.

R + S + Ri = $\frac{1}{6} + \frac{1}{8} + \frac{1}{x}$ (in 1 day)

But given R + S + Ri complete the task in 3 days

∴ in 1 day they do → $\frac{1}{3}$ part of work

∴ we can see

$\frac{1}{6} + \frac{1}{8} + \frac{1}{x} = \frac{1}{3}$

→ $\frac{1}{x} = \frac{1}{3} - \frac{1}{6} - \frac{1}{8}$

→ $\frac{1}{x} = \frac{1}{24}$

→ x = 24 (Ri takes 24 days → $\frac{1 \text{ day}}{24}$ part of work)

Ratio of work done by R : S : Ri (in 1 day) = $\frac{1}{6} : \frac{1}{8} : \frac{1}{24}$ [∵ work done ∝ 1/time]

= 4 : 3 : 1

∴ R : S : Ri = 4 : 3 : 1 [∵ work income]

[R & S was given the task with 800 Rs. But with help of Ri they finish the task in 3 days. I.e now Ri will also be paid from that 800/-]

∴ the Ri will get = $\frac{1}{8}$ × 800

= 100/-

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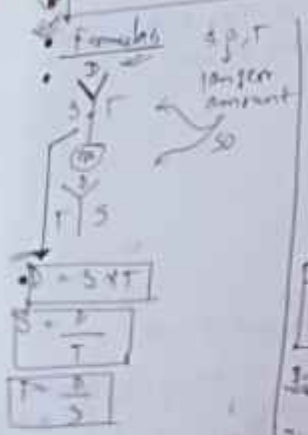
26/6/24

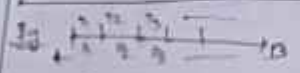
Time, distance & speed (m & 1ms)

- Formulas



- Types of Sum (4)
  - D same
  - S same
  - T same
  - Avg speed

$$\text{Avg } S = \frac{\text{Total distance (T.D)}}{\text{Total time (T.T)}}$$



$T.T = T_1 + T_2 + T_3 + \dots + T_n$

$T.D = D_1 + D_2 + D_3 \dots + D_n$

① A boy increases his speed to 3/5 times of his speed. By this he reaches his school since 30 mins before the usual time. How much time does he takes usually?

Here, D is same

$D = D$

$\Rightarrow S_1T_1 = S_2T_2$ [Let, S_1 (usual speed) = S]

$\Rightarrow S \times T = \frac{3S}{5} \times (T - 30)$ $T_1 = T$

$\Rightarrow 5T = 3T - 270$ $S_2 = \frac{3S}{5}$

$\Rightarrow 2T = 270$

$\Rightarrow T = 67.5$ mins $T_2 = (T - 30)$

(as he takes 30 min before than usual time)]

② Ramesh sees a thief at a distance of 80 m. Ramesh starts chasing the thief who is running at a speed of 5 m/s. Ramesh is chasing him with a speed of 7 m/s. How much distance does the thief cover before Ramesh catches him?

$D = S \times T$

T is same

let, T runs x m before Ramesh catches him

Both of them started at same time & stopped at the same time, i.e the time taken by both is same (Both of them were running for the same amt of time)

$\therefore T_R = T_T$

$\Rightarrow \frac{D_R}{S_R} = \frac{D_T}{S_T}$

$\Rightarrow \frac{x+80}{7} = \frac{x}{5}$ [∴ Ramesh covers (80 + x) m to catch the thief]

$\Rightarrow 5x + 400 = 7x$

$\Rightarrow 2x = 400$

$\Rightarrow x = 200$ m

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(2) P & Q are in a cycle race of 4500 meters. P cycles twice as fast as Q. R cycles 1/3rd as fast as Q. R completes the race in 45 minutes. Then how far was Q from the finishing line when P finished the race?

$D = S*T$

$P = 2Q$
$S_P = 2S_Q$
$S = \frac{1}{2}P$

[here the D is same, as it's a race, so they have to travel/have the same dist]

Still $P = 4500$ m
$Q = ?$
$\therefore Q = \frac{4500}{2} = 2250$

Approach

$D = S*T$ $\quad$ $D = \text{same}$, $D = 4500$

now, $P = 2Q \longrightarrow Q = \frac{1}{2}P$
$S_P = 2S_Q \longrightarrow S_Q = \frac{1}{2}S_P$

& we know $D \propto S$
$S \propto D$

if $S \uparrow$, the D will be covered fast & vice versa.

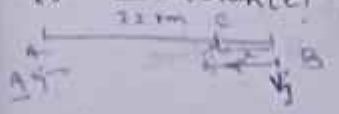
~~Aim for when~~

$S_Q = \frac{1}{2}S_P$
$D_Q = \frac{1}{2}D_P$ [$\because D \propto S$]
$D_Q = \frac{4500}{2} = 2250$

another approach (simple) Lak

When P finished the race, he covered 4500 m
we know $S_P = 2S_Q \rightarrow S_Q = \frac{1}{2}S_P$ & $S \propto D$
So, when P will be at 4500 m, then Q can cover $\frac{4500}{2} = 2250$ m will be at 2250 m
as $S_Q = \frac{1}{2}S_P$ $\therefore D_Q = \frac{1}{2}D_P$. [$\because S \propto D$]

(4) Ajay & Vijay travel from A to B at 17 km/hr & 19 km/hr respectively. A is 72 km away from B. Vijay reaches B first & returns immediately & meets Ajay at C. Find BC distance?



T is same (as both of them start together & after reaching the finish line B meets A at C, so both of them stop together)

[Here, D isn't same, as B covers more distance (72) then A as B's speed is fast than A]

$\cancel{T_{Aj} = T_{Vj}}$ $\quad$ $T_{Aj} = T_{Vj}$ $\quad$ [$D = S*T$]

$\Rightarrow \frac{D_{Aj}}{S_{Aj}} = \frac{D_{Vj}}{S_{Vj}}$

$\Rightarrow \frac{22 - x}{17} = \frac{72 \text{ km}}{19}$ $\quad$ $\Rightarrow x = 4$ km

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⑤ Suresh travels from home to office by car with an avg speed of 50 km/hr he is late by 30 mins. But when he comes with a speed of 60 km/hr, he reaches his office 10 mins earlier. How far is his office from his home?

2 ways

1) Easy way

$D = S \times T$

Diff b/w this = hands of clock
$= 30 + 10 = 40$ min

this is the diff of time

$\therefore T_1 - T_2 = 40$ min

$\frac{D_1}{S_1} - \frac{D_2}{S_2} = \frac{40}{60}$ hrs

$\Rightarrow \frac{x}{50} - \frac{x}{60} = \frac{2}{3}$

[Here, S & T are different but D is same]

$\Rightarrow x\left(\frac{1}{50} - \frac{1}{60}\right) = \frac{2}{3}$

$\Rightarrow x \cdot \frac{10}{300} = \frac{2}{3}$

$\Rightarrow x = 200$ km

2) Regular method

S, T = not same
D = same

$D = D$

$\Rightarrow S_1 T_1 = S_2 T_2$

$\Rightarrow 50\left(x + \frac{30}{60}\right) = 60\left(x - \frac{10}{60}\right)$

[let, regularly S reaches in office within x hrs]

$\Rightarrow x = 3/2$ hrs

$\therefore D = S \times T_1 = 50\left(\frac{3}{2} + \frac{30}{60}\right)$
$= 300$ km

⑥ Rohit drives from his home at a speed of 30 km/hr & reaches his bank 20 mins late. Then the next day he increases his speed by 15 km/hr but still he is late by 8 mins. How far is his bank from his home?

Diff $= 20 - 8 = 12$ mins

$\therefore T_1 - T_2 = \frac{12}{60}$ hrs

$\Rightarrow \frac{x}{30} - \frac{x}{(30+15)} = \frac{12}{60}$

$\Rightarrow x\left(\frac{1}{30} - \frac{1}{45}\right) = \frac{12}{60}$

$\Rightarrow x \cdot \frac{15}{30 \times 45} = \frac{12}{60}$

$\Rightarrow x = 18$ km

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⑦ Prantic travels 96 kms at a speed of 16 km/hr using a bike, 124 kms at 31 km/hr by car & another 105 kms at 7 km/h in horse cart. Then find his avg speed for the entire distance travelled?

$D = S \cdot T$ $\quad$ avg S = ?

$\therefore S = \frac{D}{T}$ $\quad$ Avg $S = \frac{T \cdot D}{T \cdot T}$

$$\text{Avg } S = \frac{T \cdot D}{T \cdot T} = \frac{\overset{(1)}{96} + \overset{(2)}{124} + \overset{(3)}{105}}{25 \text{ hrs}} \text{ km}$$

$$= \frac{325}{25} = \underline{13 \text{ km/hr}}$$

$T \cdot T = T_1 + T_2 + T_3$

$= \frac{D_1}{S_1} + \frac{D_2}{S_2} + \frac{D_3}{S_3}$

$= \frac{96}{16} + \frac{124}{31} + \frac{105}{7}$

$= 25$ hrs

⑧ Rohit covers one-fourth ($\frac{1}{4}$) of the total distance at 20 km/hr, one-fourth at 10 km/h & rest of his journey at 80 km/hr. Find Rohit's avg speed for the whole distance?

$D = S \cdot T$ $\quad$ Avg S = ?

$\therefore S = \frac{D}{T}$ $\quad$ $\therefore$ Avg $S = \frac{T \cdot D}{T \cdot T}$

Let total $D = x$ km

$\frac{x}{4} = 20$ km/hr

$\frac{x}{4} = 10$ km/hr

$x - \frac{x}{4} - \frac{x}{2} = \frac{x}{2} = 80$ km/hr

$T \cdot T = T_1 + T_2 + T_3$

$= \frac{x}{4 \times 20} + \frac{x}{4 \times 10} + \frac{x}{2 \times 80}$

$= \frac{x}{2 \times 10}\left(\frac{1}{2 \times 2} + \frac{1}{2 \times 1} + \frac{1}{1 \times 8}\right)$

$= \frac{x}{20} \times \left(\frac{1}{4} + \frac{1}{2} + \frac{1}{8}\right)$

$= \frac{x}{20} \left(\frac{1 \times 2 + 4 + 1}{4 \times 2 \times 8}\right)$

$= \frac{x}{20} \times \frac{7}{8}$

$= \frac{7x}{160}$

$\therefore$ Avg $S = \frac{x \times 160}{7x}$

$= \underline{\frac{160}{7} \text{ km/hr}}$

Imp

⑨ A walks from Jammu to Delhi & at the same time B starts walking from D to J after passing each other, they complete their journeys in 361 hours & 289 hours, respectively. Find the ratio of speed of A to that of B?

$\boxed{S_1 : S_2 = \sqrt{y} : \sqrt{x}}$ ← method

we now, $x = 361$
$y = 289$

$S_1 : S_2 = \sqrt{289} : \sqrt{361}$
$= 17 : 19$

(Tp) A car travelling with 5/7 th of its actual speed covers 42 km in 1 hr 40 mins 48 secs. Find the actual speed of the car.

$D = S \times T$
$S = \frac{D}{T}$

let S of the car x
car is currently travelling 5/7 th of its actual speed $\longrightarrow \frac{5x}{7}$

T = 1 hr 40 min 48 s
= 60×6 + 40×60 + 48
= 6048 sec

D = 42 km = 42 000 m

km/h → $\frac{5}{18}$ m/s
m/s → $\frac{18}{5}$ km/h

$S = \frac{D}{T}$

$\Rightarrow \frac{5x}{7} = \frac{42000}{6048}$

$\Rightarrow x = \frac{350}{36}$ m/s $= \frac{350 \times 18}{36 \times 5} = 35$ km/hr

(11) Profit & loss (2-3)

• Formula

let,
RS. 200 → C.P (Cost Price) ← Amnt we spend to create the book / textbook

If you're want to sell the book with 100 Rs profit, after selling the book, then we'll sell the book at price = 200 + 100 = 300 Rs.

∴ selling price of the book = Rs 300 (S.P)

∴ • $\boxed{SP = CP + \text{Profit in Rs.}}$

If we want to express the profit into % then

• $\boxed{\% \text{ Profit} = \frac{\text{Profit in Rs.}}{C.P} \times 100}$ → [As Profit is always calculated on the C.P]

~~% loss~~

let, C.P = Rs. 200
S.P = Rs. 150
∴ loss is = 50 Rs.

∴ $\boxed{SP = C.P - \text{loss in Rs.}}$
~~SP = CP + loss in Rs~~

• $\boxed{\% \text{ loss} = \frac{\text{loss in Rs.}}{C.P} \times 100}$ → [As loss is always calculated on C.P]

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For Profit

Box → Rs 500 = CP

let Profit = 10%, then ~~Profit in Rs~~ SP ?

SP = CP + Profit Rs

$\boxed{SP = (100 + 10)\% \times CP}$ [As, whole thing is taken as 100%.]

Here,

$SP = (100 + 10)\% \times 500$

$SP = \frac{110}{100} \times 500$

$= 550/-$

For loss

→ CP = 500 Rs.

let, sold the book in 20% loss, then SP ??

(at what price did I sell the book)

$\boxed{SP = (100 - 20)\% \times CP}$ [As, whole thing is taken as 100%]

Here,

$SP = (100 - 20)\% \times 500$

$= \frac{80}{100} \times 500$

$= 400$ Rs

Vijay incurred loss of 20% by selling a vase for Rs 2880. To get a profit of 20% at what price should he sell the vase?

According to the Qn,

$SP = (100 - 20)\% \times CP$

$\Rightarrow 2880 = (100 - 20)\% \times CP$

$\Rightarrow 2880 = \frac{80}{100} \times CP$

$\Rightarrow CP = \frac{2880 \times 100}{80}$

$= 3600$

Now, CP = 3600

SP = ?

P = 20%

$\therefore SP = (100 + 20)\% \times CP$

$= \frac{120}{100} \times 3600$

$= 4320$

$\therefore SP = 4320/-$

② Rambabu sells papers planes at the rate of 20 planes for Re. 1. If he gets profit of 20%, how many planes did he buy in 1 rupee?

$\% P = \frac{P_{ins}}{CP} \times 100$

$\% L = \frac{L_{ins}}{CP} \times 100$

$SP = (100 + P)\% \cdot CP$

$SP = (100 - L)\% \cdot CP$

$SP = Rs\ 1 = (100 + P)\% \times CP = (100 + 20)\% \times CP$

$\Rightarrow 1 = \frac{120}{100} \times CP$ 20 planes are

$\Rightarrow \boxed{CP = \frac{100}{120}\ Rs}$ ← bought in

20 → 100/120

(x)? → 1

$\Rightarrow 20 \times 1 = \frac{100 \times x}{120}$

$\Rightarrow x = 24$ planes

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(8) Uma wants to gain 15% profit on her sale of sugar. She buys 120kg of sugar at RS 24 per kg to mix with 180kg of sugar bought at RS 28 per kg. She sells the sugar mix at ? — (what price?)

$SP = (100+15)\% \times CP$
$= (100+15)\% \times CP$
$= \frac{115}{100} \times CP$

CP

120kg in 24 Rs/kg
∴ she spends $= 24 \times 120 = 2880$ Rs.

180kg in 28 Rs/kg
∴ she spends $= 28 \times 180 = 5040$ Rs.

She mixes Rs two
total expe = diffence / total amnt spent
$= 2880 + 5040$
$= 7920$ Rs
$CP = 7920$

$SP = \frac{115}{100} \times 7920$
$= 9108$ Rs

(9) Gaddi buys some oranges in a shop at 4 per rupee. She goes to other shop & buys same no. of oranges at 5 per rupee. She then combines them in a basket & sells them at 4 per rupee. Will she get a profit or loss? And how much?

if, $\boxed{SP - CP > 1}$ (+ve) → profit $\boxed{SP - CP < 1}$ (−ve) → loss

CP of orange
1st shop

4 oranges in 1 Rs.
∴ Price of 1 orange → $\frac{1}{4}$ Rs

2nd shop

5 oranges in Rs 1
∴ Price of 1 orange → $\frac{1}{5}$ Rs.

if she mixes 1 orange from the 1st shop with 1 orange of the 2nd shop, i.e 2 oranges
The cost CP of this 2 oranges $= \frac{1}{4} + \frac{1}{5}$
$= \frac{5+4}{20}$
$= \frac{9}{20}$ Rs.

2 oranges (mixed) → $\frac{9}{20}$ Rs.
1 orange (cost price of the 2nd shop) → $\frac{9}{40}$ Rs.
~~SP of oranges~~ = (Rs 1 orange mixed / total no. of mixed)
∴ CP of 1 orange $= \frac{9}{40}$ Rs.

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SP of orange

4 oranges sold in 1 Rs

1 orange → $\frac{1}{4}$ Rs

∴ SP of 1 orange = $\frac{1}{4}$ Rs.

now

$SP - CP = \frac{1}{4} - \frac{9}{40}$

$= \frac{10-9}{40} = \frac{1}{40}$ → (+ve)

∴ she gets Profit

$\% P = \frac{1}{40} \times 100$

$= \frac{100}{9}\% \text{ or } 11\frac{1}{9}\% \text{ or } 11.11\%$

(5) Ramesh gets a profit of 20% in one trade & suffers a loss of 20% in the second when he sells 2 cycles for Rs 4000 each. What is his profit or loss in the entire trade?

[2 trades → 1st cycle, 2nd cycle
+20% −20%
same]

SP = Same = 4000 Rs / cycle

Whenever, there will be this kind of cases, where $\boxed{\% P = \% L}$ & also $\boxed{SP's \text{ are also same}}$, for 2 trades or something then the person will always face a $\boxed{\text{loss}}$ & the $\boxed{\text{loss percentage is}}$ $\boxed{\% \text{ Profit} / \text{loss}}$ (least have the no of not $\frac{\%}{100}$)

100

$\% P = \% L$
$\therefore \% L = \frac{P^2}{100}$

$\boxed{\frac{(\% \text{ P or } \% L)^2}{100}}$

∴ Here, $\% L = \frac{(20)^2}{100} = \frac{400}{100} = 4\%$

∴ 4% loss in the entire trade

(6) Simran bought pet food worth Rs 56000. She then sold 1/3rd of it incurring a loss of 40%. What profit she must earn on rest of the supplies to nullify this loss?

1 | 2 (−40%) | 3 (+40%) (in total)

∴ She must earn +40% profit on the rest of the supplies to nullify this loss.

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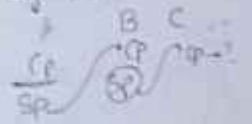
(7) A sold a car to B at a profit of 20%. B incurred loss of 15% while selling the same car to C. A spent Rs. 50,000 for this car. At what price did C buy it?



A,

CP = 50,000

SP = (100 + 25)% of CP

$= \frac{125}{100} \times 50,000$

= 62500 Rs

B

CP = 62500

SP = (100 − 15)% of 62500

$= \frac{85}{100} \times 62500$

= 53,125 Rs

C

CP = SP of B = 53125 Rs

(8) A cheater manipulated his weighing machine so that it shows 1 kg for 970 grams. How much profit does he get?

→ Can consider the actual wt = CP = 970 g

the fake wt = SP = 1 kg

~~SP = 100 g = (100 + 30)% of 970~~

∴ SP = CP + Pr (in Rs)

⇒ 1000 = 970 + Pr

⇒ Pr = 30 Rs [for every kg he gets 30 grams profit]

this is profit in grams

∴ % Pr = $\frac{30}{970} \times 100$

$= \frac{300}{97}\% = 3\frac{9}{97}\%$

(9) Rohit got profit of $11\frac{1}{2}\%$ by selling his old car. However he realized that had he sold it for Rs. 8100 more, his profit would be 38.5%. At what price did he buy the car?

11.5% (profit)

If, 8100 Rs → 38.5% (profit)

the diff. b/w this 2 % Pr = 38.5 − 11.5%

= 27%

∴ If he sold his car for 8100 Rs more, the % Pr would be ~~38~~ 27% more.

∴ 27% of CP = 8100

⇒ $\frac{27}{100} \times CP = 8100$

CP = 30,000 Rs

(10) Chaman sells 40 lamps at 10% profit. He wants a total of 20% profit on the entire sale. Since he got 160 lamps at rate of Rs. 100

each, at what profit must he sell the remaining fans?

160 fans → Rs 100 for each

40 fans → 10% loss

120 fans → ? } to be sold

Total Pr in Rs = Pr in Rs (for 40 fans) + Pr in Rs (for 120 fans)

$\frac{\text{SP}_{(40)} \times 100}{100}$ $\frac{\text{SP}_{(120)} \times 100}{100}$ $\frac{\text{SP}_{(120)} \times 100}{100}$

$\frac{\text{SP}_{(120)} \times 100}{100}$ = 4000 + 120x

$\frac{\text{SP}_{(120)} \times 100}{100}$ = 4000

3200 = 120x

x = 26.66

[let x be the profit %]

(11) Sumana bought 160 chocolates from Rs. 100 she wanted to earn 30% profit by selling them. But Ramesh visited her & she gave him 25% of those chocolates at the cost price itself. But even after doing this, she earned a profit of 30% as desired. For how much did she sell each chocolate?

160 c → CP = 100 Rs

1 c → 3 Rs

CP for 1 c = 3 Rs

25% of 160 c gone

Remaining = 75%

160 c → 120 c

30% profit is assumed by here

$\% P = \frac{\text{Profit}}{CP} \times 100$

$\frac{33p + 48p}{100} = Pr$

Pr (in Rs) = 144 Rs

Pr of 120 c → 144 Rs as profit

1 c → ? (x)

120x = 144

x = $\frac{144}{120}$ = 1.2 Rs as profit

Per cost + profit

SP = 3 + 1.2

= 4.2 Rs

(12) Ramesh sold a statue for a price 25% higher than the original price of the statue. He had however bought the statue at 20% discount on the original price. With the profit of Rs. 2025, find the original price of the statue.

let original price of the statue = x Rs

original price − 20% ← x Rs

CP = x − 0.2x

SP = 1.25x

[for − full off = 100% is given discount]

Profit = 125% of x − 80% of x = 45% of x

Profit = 2025 = 45% of x

x = 4500 Rs

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(10) A shopkeeper earns a profit of 15% after selling an item at 20% discount on the printed price. The ratio of the cost price & printed price of the item is?

Let printed price = x Rs

$SP = (100+15)\% \text{ of } CP$ | $SP = (100-20)\% \text{ of } x$

$\Rightarrow SP = \frac{115}{100} \times CP$ | $= 80\% \text{ of } x$

$\Rightarrow SP = \frac{80}{100} \times x$

$\therefore SP = SP$

$\Rightarrow \frac{115}{100} \times CP = \frac{80}{100} \times x$

$\Rightarrow \frac{CP}{x} = \frac{80}{115} = \frac{16}{23}$ $\therefore CP : x = 16 : 23$

(11) The ratio of cost price & selling price is 4:5. The profit percent is?

$CP : SP = 4:5$ Let, $CP = 4$ Rs (let, x)

$SP = 5$ Rs

$\therefore Pro = 1$ Rs

$\Rightarrow Pro = \frac{1}{4} \times 100$

$= 25\%$

(12) If selling price of 40 articles is equal to cost price of 50 articles, the loss or gain percentage is?

$CP_{50} = SP_{40}$

$\Rightarrow 50 \text{ CP} = 40 \text{ SP}$ (let)

Now, CP → 50 units → 100 Rs, 1 → 2 Rs

SP → 40 units → 100 Rs, 1 → 2.5 Rs (selling price)

Now, $Pr = SP - CP$

1 Pr = 2.5 − 2

each = 0.5 Rs

$\% Pr = \frac{0.5}{2} \times 100$

$= 25\%$

(13) A fruit seller buys 11 mangos at 2 Rs a piece & sells them at 3 Rs 3 pieces. His gain percent is?

Price: 2 mangos → 4 Rs

1 → $\frac{4}{2}$ = 2 Rs

11 → 11 × 2 = 22 Rs

3 → 3 Rs

11 → $\frac{3}{3} \times 11$ = 11 Rs

$Pr = 11 - 22 = -11$ Rs

$\% Pr = \frac{-11}{22} \times 100$

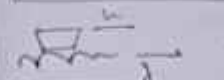
$= -50\%$

(14) Boats & Streams (1-29 ms)

Formula

B & S

Speed Given by Speed Boat



⇒ Downstream

$D_S = x + y$

⇒ Upstream

$U_S = x - y$

(1) What will be the boat's speed in still water & speed of river, if the boat takes 12 hrs to row 48 km upstream & 8 hrs to row the same distance downstream?

Sol: Let, x = S_{boat} in still water (In general, we consider the speed of boat in still water not in running water)

$D = S \times T$

$\Rightarrow S = \frac{D}{T}$

Upstream

$U_S = \frac{48}{12}$

$= 4$ km/hr

$\therefore x - y = 4$ — (i)

Downstream

$D_S = \frac{48}{8}$

$= 6$ km/hr

$x + y = 6$ — (ii)

$x + y = 6$

$x - y = 4$

$2x = 10$ $\Rightarrow x = 5$ km/hr, $y = 1$ km/hr

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② A man takes twice as long to swim up as to swim down the river & has a speed of 12 km/hr in still water. What is river's speed?

$x = 12$ km/hr $y = ?$

as long = time

$t_u = 2 \times T_D$

$\frac{D_U}{S_U} = 2 \times \frac{D_D}{S_D}$

$\Rightarrow \frac{D}{x-y} = 2 \times \frac{D}{x+y}$

$\Rightarrow x - y = 2x + 2y$

$\Rightarrow x - x = 3y$

$\Rightarrow \frac{x}{-3} = y$

$\Rightarrow y = -\frac{12}{3}$

$\Rightarrow y = -4$ km/hr

[Here, we always have to consider that $D_U = D_D$] as [let $D_U = D_D = D$] [As the distance of river is same].

③ It takes P 1 hr to row a place & come back. If the river is running at 2.4 km/hr & P has a speed of 12 km/hr in still water, what distance is the place from P's starting point?

$x = 12$, $y = 2.4$

P ← River — Place (Up)

let the distance = d

$T_U + T_D = 1$ hr

$\Rightarrow \frac{D}{x-y} + \frac{D}{x+y} = 1$

$\Rightarrow D\left[\frac{x+y+x-y}{(x+y)(x-y)}\right] = 1$

$\Rightarrow D \times \frac{2x}{x^2 - y^2} = 1$

$\Rightarrow D \times \frac{2 \times 12}{12^2 - 2.4^2} = 1$

$\Rightarrow D = 5.76$ km

④ An ocean current flows at a rate of 1.5 km/hr. A shark can swim in still water at the rate 4.5 km/hr. What is the average speed for the entire distance travelled if the shark swims from India to Australia & comes back?

down ← d → in, up

Avg $S = \frac{\text{Total } d}{\text{total } t}$

$= \frac{d+d}{t_1+t_2}$ — ①

$T_U + T_d = t_1 + t_2$

$\Rightarrow T = \frac{d}{x-y} + \frac{d}{x+y}$

$= d\left(\frac{2x}{x^2 - y^2}\right)$

$= d \times \frac{2 \times 4.5}{(4.5)^2 - (1.5)^2}$

$= \frac{d}{2}$

$y = 1.5$ let d = total dist.
$x = 4.5$

∴ from ①,

Avg $S = \frac{2d \times 2}{d}$

$= 4$ km/hr

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⑤ Jay takes 4 hrs more while swimming upstream than downstream. His speed in still water is 10 km/hr. The speed of stream is 2 km/hr. What is the distance?

$x = 10$ km/hr, $y = 2$ km/hr

$T_u = 4 + T_d$ [let dist = d]

$\Rightarrow \frac{d}{x-y} = 4 + \frac{d}{x+y}$

$\Rightarrow \frac{d}{10-2} = 4 + \frac{d}{10+2}$

$\Rightarrow \frac{d}{8} = 4 + \frac{d}{12}$

$\Rightarrow \frac{d}{8} = \frac{48+d}{12}$

$\Rightarrow 3d = 96 + 2d$

$\Rightarrow d = 96$ km

⑥ Raj swims 26 km downstream in same time as 14 km upstream. What is his speed in still water if speed of stream is 3 km/hr?

$x = ?$ $y = 3$ km/hr

$T_d = T_u$

$\Rightarrow \frac{26}{x+3} = \frac{14}{x-3}$

$\Rightarrow 13x - 39 = 7x + 21$

$\Rightarrow 6x = 60$

$\Rightarrow x = 10$ km/hr

⑦ Ratio of Guddi's swimming speed in still water to the speed of river is 7:1. She swims 4.2 km up the river in just 14 min. How much time will Guddi take to swim 18.4 km down the river?

$x : y = 7 : 1$ $\Rightarrow \frac{x}{y} = \frac{7}{1}$

$\Rightarrow x = 7y$

$t_u = 14$ min, $d_u = 4.2$ km

$T_d = ?$ $d_d = 18.4$ km

$S_u = \frac{4.2}{14}$

$= 0.3$ km/min

$\Rightarrow x - y = 0.3$

$\Rightarrow 7y - y = 0.3$

$\Rightarrow 6y = 0.3$

$\Rightarrow y = \frac{0.3}{6}$

$= 0.05$ km/min

$\therefore x = 7 \times 0.05$

$= 0.35$ km/min

$T_d = \frac{18.4}{x+y}$

$= \frac{18.4}{0.35 + 0.05}$

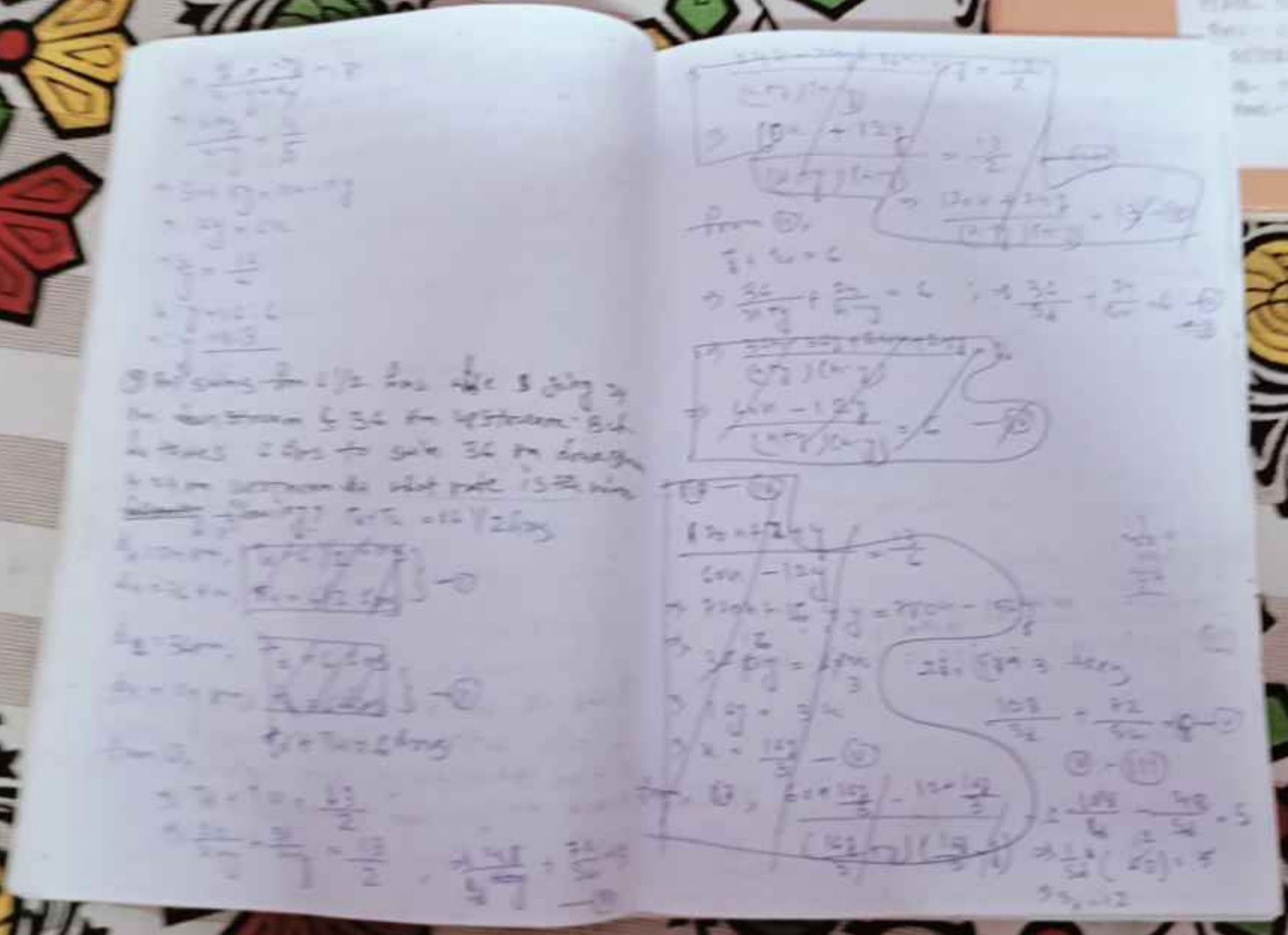
$= \frac{184}{4}$

$= 46$ min

⑧ Find the ratio of swimming speed of Raj in still water to speed of river, if ratio of time taken to go 10 km upstream to time taken to go 10 km downstream is 11:5?

Why? $T_u : T_d = 11 : 5$ [$d = t_u = 10$ km]

$\Rightarrow \frac{T_u}{T_d} = \frac{11}{5}$



$x+y = 12$ — (VI)

$\frac{x}{y} = \frac{3}{2}$, put value in eq (1)

$\frac{3y}{2} + \frac{y}{2} = 13$

$\frac{3y+y}{2} = 13$

$\frac{4y}{2} = 13$

$2y = 8$

$y = 8$ — (VII)

$x+y = 12$

$y = 8$

$x = 20$

$\therefore x = 10$ km/h, $y = 2$ km/h

$\therefore$ river is flowing 2 km/h

Algebra (4-5 hrs)

Remainders & factors

(method)

(Q) $(5x^3+29x^2+17x+42) \div (x+a)$, Rem?

$f(x) = (5x^3+29x^2+17x+42) \div (x+a)$

$x+a=0$

$x = -a$

$5(-a)^3+29(-a)^2+17(-a)+42$

$= -5a^3+29a^2-17a+42 =$ Rem

Remainder theorem method

In actual x, a can be $x, 1, 2, \ldots, -1, -2, \ldots$

In this case the ans. is the rem.

If absolutely, completely exactly these are mentioned, i.e. the rem. said that the divisor completely/exactly/absolutely divides the dividend/poly that means, $\boxed{Rem \neq 0}$, otherwise $\boxed{Rem = 0}$

(1) $(4x^3+13x^2-5x+1) \div (x+4)$. Find the remainder

$f(x) = 4x^3+13x^2-5x+1$ | $x+4=0$, $x=-4$

$= 4(-4)^3+13(-4)^2-5(-4)+1$

$= -256+208+20+1$

$= -27 =$ Rem

[f(x) = polynomial]

(2) $(5x^3-3x^2+cx+2) \div (x+3)$. Find the value of c if the remainder is 5.

$f(x) = 5x^3-3x^2+cx+2$, $x+3=0$, $x=-3$

given,

$\Rightarrow 5x^3-3x^2+cx+2 = \text{Rem}$

$\Rightarrow 5(-3)^3-3(-3)^2+c(-3)+2 = 5$

$\Rightarrow -135-27-3c+2 = 5$

$\Rightarrow -3c = 165$

$\Rightarrow c = -55$

(3) $(x^{5\times9}-1) \div (x-1)$. Find the remainder

$f(x) = x^{5\times9}-1$, $x-1=0$; $x=1$

$= (1)^{5\times9}-1$

$= 0$

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If the 9th should be $(x^{999}-1) \div (x+1)$, then how?

$x+1=0$
$\Rightarrow x=-1$

$x^{999}-1$
$\Rightarrow (-1)^{999}-1$ [odd power so ↓]
$= -1-1$
$= -2$

[Even Power then +1]

(4) $(3x^3+6x^2+ax) \div (x^2-4)$ leaves out remainder $12x$. Find the value of 'a' in the expression

$x^2-4=0$
$\Rightarrow x^2=4$

$\therefore 3x^3+16x^2+4a = 12x$ (given) — Rem

$\Rightarrow 3(x^2)x + 6(x^2) + 4a = 12x$
$\Rightarrow 3\times 4x + 16\times 4 + 4a = 12x$
$\Rightarrow 12x + 24 + 4a = 12x$
$\Rightarrow a = -6$

(5) $(x^{101}+5x^{999}+a)$ is completely divisible by $(x+1)$. Find the value of 'a'.

$x+1=0$
$\Rightarrow x=-1$

Completely divisible, means Rem=0

$\therefore x^{101}+5x^{999}+a=0$
$\Rightarrow (-1)^{101}+5(-1)^{999}+a=0$
$\Rightarrow -1-5+a=0$
$\Rightarrow a=6$

(6) If $5^x - 5^{x-1} = 500$. Find the value of x^x.

$5^x - 5^{x-1} = 500$
$\Rightarrow 5^{x-1}(5-1) = 500$
$\Rightarrow 5^{x-1} \times 4 = 500$ | 125
$\Rightarrow 5^{x-1} = 5^3$
$\Rightarrow x-1 = 3$
$\Rightarrow x = 4$
$\therefore x^x = 4^4 = 256$

Algebra tips - the Power of substitution

Cases
- Find the val. of length algebraic expression
- Which 2 algebraic expressions are same?
- Insufficient no. of equations are given

method
→ Substitution method

Assume the value of the variable → substitute → Find answer
(smaller vals) (substitute the val. of the variable in the actual exp. to get the ans & check if the ans matches with the given ans)
eg - 0, 1, 2 ...

- Assume such values that don't make the denominator zero

eg $\frac{a}{x-1} \to$ we'll try to assume x anything that is smaller but not 1 (this will make $1-1=0$) [in the ans as well as in ans]

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(7) Express the following as rational expressions:

$$\frac{2(x+3)}{3(x-3)} - \frac{2(x+1)}{3(x-3)}$$

$$\frac{2(x+3)}{3(x-3)} - \frac{2(x+1)}{3(x-3)}$$

Now we have x

can assume $x+1=0$ (1, 2, 3)

(as in the 1st O/P it has $x-1$, if $x=1$, then $0=0$)

$\therefore$ taking $=0$

$$= \frac{2\times(-3)}{3\times(-7)} - \frac{2\times 1}{3\times(-3)}$$

$$= \frac{-2}{3}\,1 + \frac{2}{9}$$

$$= \frac{-7}{9}$$ (Ans. got from solving the exp in 3rd)

$$= \frac{-14+2}{18} = \frac{-12}{18}$$

op a) $\frac{2\times(-7)}{3\times(-3)\times(-7)}$

$= \frac{-14}{63}$ ✗

op b) $\frac{2\times(-7)}{3\times(-3)\times(-7)} = \frac{-7}{9}$ ✓

op c) $\frac{-14}{3\times(-7)\times 3} = \frac{7}{9}$ ✗

$\therefore \frac{2(x-7)}{3(x-3)(x-7)}$

(8) $\frac{(a+1)}{(a-1)} + \frac{(a-1)}{(a+1)}$ is same as:

a can be $= 0, (1)$ ✗ (zero)

let $a=0$

$$\frac{a+1}{a-1} + \frac{a-1}{a+1} = \frac{1}{-1} + \frac{-1}{1}$$
$$= -1-1$$
$$= -2$$

op i) $\frac{(a^2+1)}{2(a^2-1)} = \frac{1}{2\times(-1)} = -\frac{1}{2}$ ✗

op ii) $\frac{(a^2+1)}{(a^2-1)} = \frac{1}{-1} = -1$ ✗

op iii) $\frac{2(a^2+1)}{(a^2-1)} = 2\times -1 = -2$ ✓ $\frac{2(a^2+1)}{(a^2-1)}$

op iv) $\frac{a^2-1}{a^2+1} = \frac{-1}{1} = -1$ ✗

(9) Find the sum of $\frac{3x^2+4y}{x-4}$ & its reciprocal, if $x+y=1$.

$$\frac{3x^2+4y}{x-4} \xrightarrow{\text{reciprocal}} \frac{x-4}{3x^2+4y}$$

$$\therefore \frac{3x^2+4y}{x-4} + \frac{x-4}{3x^2+4y} \quad \text{--- (1)}$$

$$= \frac{3\times 0}{1-4} + \frac{1-4}{3}$$

$$= \frac{3}{-3} - \frac{3}{3} = -2$$

given,
$x+y=1$
assume 0
$\therefore x=1$

2 vars, 1 eqn
extra var = 0 (assume)

(∵ there are 2 variables, y is extra so we can assume it anything that makes it 0=0)

(problem make it 0=0)

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(10) If $x+3y+3=0$, find the value of $x^3+3y^3+12xy+27$.

$x+3y+3=0$

let, $y=0$

$\therefore x+3=0$

$\Rightarrow x=-3$

$\therefore x^3+3y^3+12xy+27$

$=(-3)^3+27$

$=-27+27$

$=0$

(11) If $a+b+c=25$ & $a^2+b^2+c^2=225$. Find the value of $4a^2b^2+c(a-b)$.

$a+b+c=25$ — (i)

$a^2+b^2+c^2=225$ — (ii) } $c=0$ (det)

from (i) & (ii)

$\therefore a+b=25$ — (iii)

$a^2+b^2=225$ — (iv)

from (iii),

$(a+b)^2=(a^2+b^2)+2ab$

$\Rightarrow 625=(225)+2ab$

$\Rightarrow 2ab=400$

$\Rightarrow ab=200$

$\therefore 4a^2b^2+c(a-b)$

$=4a^2b^2$

$=(2ab)^2$

$=(400)^2$

$=160000$

(12) $x=(a+2/a)$; $y=(2a-2/a)$. Find $\frac{(x^2-y^2)(y^2+3)}{(x^2-c)}$

$x=a+\frac{2}{a}$ — (i)

$y=2a-\frac{2}{a}$ — (ii)

4 eqn, 3 variables, 1 extra var = a (& also, a is common in both eqn)

let, $a=0$

from (i), $x=3$

from (ii), $y=0$

$\frac{(x^2-y^2)(y^2+3)}{(x^2-c)}$

$=\frac{-9\times 3}{(9-6)}$

$=-9$

more algebra tips

1) If $x+\frac{1}{x}=a$, then $x^2+\frac{1}{x^2}=?$

$\left(x+\frac{1}{x}\right)^2=a^2$

$\Rightarrow x^2+\frac{1}{x^2}+2=a^2$

$\Rightarrow x^2+\frac{1}{x^2}=a^2-2$

whatever will be the value of a^2, just subtract 2 from it

let, $x+\frac{1}{x}=7$ (i.e $a=7$)

$x^2+\frac{1}{x^2}=49-2=47$

2) If $x-\frac{1}{x}=a$, then $x^2+\frac{1}{x^2}=?$

$\left(x-\frac{1}{x}\right)^2=a^2$

$\Rightarrow x^2+\frac{1}{x^2}-2=a^2$

$\Rightarrow x^2+\frac{1}{x^2}=a^2+2$

let, $a=7$

$\therefore x^2+\frac{1}{x^2}=49+2=51$

Square both sides & get the value

Greatest Power (Determined) = Square

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⇒ $x^2+\frac{1}{x^2}=a^2$, $x+\frac{1}{x}=?$

$x^2+\frac{1}{x^2}=a^2$

$\Rightarrow (x)^2+\left(\frac{1}{x}\right)^2=a^2$

$\Rightarrow \left(x+\frac{1}{x}\right)^2-2\cdot x\cdot\frac{1}{x}=a^2$

$\Rightarrow \left(x+\frac{1}{x}\right)^2=a^2+2$

$\Rightarrow x+\frac{1}{x}=\sqrt{a^2+2}$

whatever will be the value of a, put it add it with 2 & root the result.

let, $a^2=25$

$\therefore x+\frac{1}{x}=\sqrt{27}$
$=3\sqrt{3}$

(13) a) Find $x^2+\frac{1}{x^2}$; if $x+\frac{1}{x}=\sqrt{47}$

$\left(x+\frac{1}{x}\right)^2-2$ $x+\frac{1}{x}=\sqrt{47}$

$\Rightarrow \left(x+\frac{1}{x}\right)^2=47$

$\Rightarrow x^2+\frac{1}{x^2}+2=47$

$\Rightarrow x^2+\frac{1}{x^2}=45$

$\Rightarrow x^2+\frac{1}{x^2}=a^2$, $x-\frac{1}{x}=?$

$\left(x-\frac{1}{x}\right)^2+2\cdot x\cdot\frac{1}{x}=a^2$

$\Rightarrow \left(x-\frac{1}{x}\right)^2=a^2-2$

$\Rightarrow x-\frac{1}{x}=\sqrt{a^2-2}$

let, $a^2=4$

$\therefore x-\frac{1}{x}=\sqrt{4-2}=\sqrt{2}$

Simplify the LHS & find the value (after simplifying it value felt in front for sure)

Less Pow (odd) = Negativity

b) Find, $x^8+\frac{1}{x^8}$, if $x+\frac{1}{x}=\sqrt{6}$

$x+\frac{1}{x}=\sqrt{6}$

$\Rightarrow x^2+\frac{1}{x^2}+2=6$

$\Rightarrow x^2+\frac{1}{x^2}=4$ — (i)

$\Rightarrow \left(x^2+\frac{1}{x^2}\right)^2=16$

$\Rightarrow x^4+\frac{1}{x^4}+2=16$

$\Rightarrow x^4+\frac{1}{x^4}=14$

$\Rightarrow \left(x^4+\frac{1}{x^4}\right)^2=(14)^2$

$\Rightarrow x^8+\frac{1}{x^8}+2=196$

$\Rightarrow x^8+\frac{1}{x^8}=194$

(14) a) $x+\frac{1}{x}=7$, find $\sqrt{x}+\frac{1}{\sqrt{x}}$

$x+\frac{1}{x}=7$

$\Rightarrow \left(\frac{\text{dem}}{\sqrt{x}}\right)^2+\left(\frac{1}{\sqrt{x}}\right)^2=7$

$\Rightarrow \left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2-2=7$

$\Rightarrow \left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2=9$

$\Rightarrow \sqrt{x}+\frac{1}{\sqrt{x}}=3$

(15) a) If $x-\frac{1}{x}=5$, find $x^2+\frac{1}{x^2}$

$x-\frac{1}{x}=5$

$\Rightarrow \left(x-\frac{1}{x}\right)^2=25$

$\Rightarrow x^2+\frac{1}{x^2}-2=25$

$\Rightarrow x^2+\frac{1}{x^2}=27$

b) $x^2+\frac{1}{x^2}=23$, find $\sqrt{x}+\frac{1}{\sqrt{x}}$

$x^2+\frac{1}{x^2}=23$

$\Rightarrow \left(\frac{\text{dem}}{\sqrt{x}}\right)^2+\left(\frac{1}{\sqrt{x}}\right)^2=23$

$\Rightarrow \left(\sqrt{x}\right)^2+\left(\frac{1}{\sqrt{x}}\right)^2-2=23$

$\Rightarrow \left(\sqrt{x}\right)^2+\left(\frac{1}{\sqrt{x}}\right)^2=25$

$\Rightarrow \left(\sqrt{x}\right)^2+\left(\frac{1}{\sqrt{x}}\right)^2=5$

$\Rightarrow \left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2-2=5$

$\Rightarrow \sqrt{x}+\frac{1}{\sqrt{x}}=\sqrt{7}$

b) If $x-\frac{1}{x}=3$, find $x^4+\frac{1}{x^4}$

$x-\frac{1}{x}=3$

$\Rightarrow \left(x-\frac{1}{x}\right)^2=(3)^2$

$\Rightarrow x^2+\frac{1}{x^2}-2=9$

$\Rightarrow \left(x^2+\frac{1}{x^2}\right)^2=(11)^2$

$\Rightarrow x^4+\frac{1}{x^4}+2=121$

$\Rightarrow x^4+\frac{1}{x^4}=119$

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(16) If $x+\frac{1}{x}=3\sqrt{2}$, find $x^3+\frac{1}{x^3}$

$(x+\frac{1}{x})^2=(3\sqrt{2})^2$

$\Rightarrow x^2+\frac{1}{x^2}+2\times 3\times 2$

$\Rightarrow x^2+\frac{1}{x^2}=16$

$x^3+\frac{1}{x^3}$

$=(x)^3+(\frac{1}{x})^3$

$=(x+\frac{1}{x})(x^2+\frac{1}{x^2}-1)$

$=3\sqrt{2}\times(16-1)$

$=3\sqrt{2}\times 15$

$=45\sqrt{2}$

(or)

$x+\frac{1}{x}=3\sqrt{2}$

$\Rightarrow (x+\frac{1}{x})^3=(3\sqrt{2})^3$

$\Rightarrow (x^3+\frac{1}{x^3})+3\times 3\sqrt{2}=27\times 2\sqrt{2}$

$\Rightarrow (x^3+\frac{1}{x^3})+3\times 3\sqrt{2}=54\sqrt{2}$

~~$\Rightarrow (x^3+\frac{1}{x^3})+3=54\sqrt{2}$~~

$\Rightarrow (x^3+\frac{1}{x^3})=54\sqrt{2}-9\sqrt{2}$

$\Rightarrow x^3+\frac{1}{x^3}=45\sqrt{2}$

(17) a) If $x=5+2\sqrt{6}$, find $\frac{1}{x}$

$\frac{1}{x}=\frac{1}{5+2\sqrt{6}}$

$=\frac{5-2\sqrt{6}}{25-24}$ (rationalising)

$=5-2\sqrt{6}$ $=a-b$

If $(5)^2-(2\sqrt{6})^2=1$ (if the diff b/w 2 terms is 1, then we can easily find $a-b$ (rationalising) as $\frac{1}{(a+b)}$ (a+b))

b) If $x^{133}=4+\sqrt{15}$, find $1/x^{133}$

$\frac{1}{x^{133}}=\frac{1}{4+\sqrt{15}}$

$=\frac{4-\sqrt{15}}{16-15}$

$=4-\sqrt{15}$

$y=4+\sqrt{15}$

$(4)^2-(\sqrt{15})^2=16-15$

$=1$

$\therefore \frac{1}{y}=4-\sqrt{15}$

(18) If $x=5+2\sqrt{6}$, find $x+\frac{1}{x}$

$x=5+2\sqrt{6}$

$(5)^2-(2\sqrt{6})^2=1$

$\therefore \frac{1}{x}=5-2\sqrt{6}$

$\therefore x+\frac{1}{x}=5+2\sqrt{6}+5-2\sqrt{6}$

$=10$

(or) $x+\frac{1}{x}$

$=5+2\sqrt{6}+\frac{5-2\sqrt{6}}{1}$

$=10$

If $x=5+2\sqrt{6}$, find $x-\frac{1}{x}$

$x=5+2\sqrt{6}$

$\therefore \frac{1}{x}=5-2\sqrt{6}$

$\therefore x-\frac{1}{x}=4\sqrt{6}$

If, $x=a+b$ & $(a)^2-(b)^2=1$, & $x+\frac{1}{x}=?$ (given) then → 2x biggest no.
& $x-\frac{1}{x}=?$ (given) then → 2x smallest no.

(or) $x=5+2\sqrt{6}$, ~~$\therefore \frac{1}{x}=5-2\sqrt{6}$~~

$(5)^2-(2\sqrt{6})^2=1$

$\therefore x+\frac{1}{x}=10\ (2\times 5)$

$x-\frac{1}{x}=2\times 2\sqrt{6}$

$=4\sqrt{6}$

(19) a) If $x=13+3\sqrt{2}$, find $\frac{1}{x}$

$\frac{1}{x}=\frac{13-3\sqrt{2}}{169-18}$

$=\frac{1}{151}\times(13-3\sqrt{2})$

b) If $x^{45}=12+3\sqrt{7}$, $\frac{1}{x^{45}}$

Hint (a),

$\frac{1}{x^{45}}=\frac{12-3\sqrt{7}}{(12)^2-(3\sqrt{7})^2}=\frac{1}{81}\times(12-3\sqrt{7})$

(20) If $x+y=1$, find $x^5+y^5-2x^4+2y^4+x^3y^3-2x^2y-7xy$

$x+y=1$ (1st term)

let y (2nd term) $=0$

$\therefore x=1$

$\therefore x^5+y^5-2x^4+2y^4+x^3y^3-2x^2y-7xy$

$=1-2$

$=-1$

(21) If $x=27+5\sqrt{7}$, find $1/x$

$\frac{1}{x}=\frac{27-5\sqrt{7}}{(27)^2-(5\sqrt{7})^2}$

$=\frac{27-5\sqrt{7}}{554}$

(14) ~~Compound interest~~ | Permutation & combination (1-2 qns)

Formula (basic)

- Factorial, $\boxed{5! = 5\times4\times3\times2\times1}$

$\therefore \boxed{n! = n\cdot(n-1)\cdot(n-2)\cdots\times3\times2\times1}$

- Id, there are 7 things, & we want to arrange them in a single line, so in how many ways we can arrange this 7 things? (no side)

$\underline{|||||||} \longrightarrow 7!$ ways

$\therefore$ for arranging 'n' things in (linear fashion) we have $\boxed{n!}$ ways possible.

- If we have 7 things & we want to arrange them in a circular manner/fashion, then we have $(7-1)!=6!$ ways possible.

$\therefore$ For arranging 'n' things in $\boxed{\text{circular fashion}}$ $\boxed{\text{manner}}$, there are $\boxed{(n-1)!}$ ways possible

Formula (P & C)

2 concepts / 2 things

1) Select 2) Select & arrange

- $\boxed{\text{Combination}}$ means $\boxed{\text{Select}}$
- $\boxed{\text{Permutation} = \text{Select \& arrange}}$
- 'n' things in a box

we have to select 'r' things

$\Rightarrow {}^nC_r$ (combination / select)

can be $n-r$, $r>n$

$$\boxed{{}^nC_r = \frac{n!}{r!(n-r)!}}$$ [$\because r \leq n$]

[C - combination]

• we have n things in a box
we have to select r things 1st, then have to arrange them

$\boxed{}_{n}$ = arrange ⟶ ${}^{n}P_{r}$ (permutation/arrange)

$${}^{n}P_{r} = \frac{n!}{\cancel{r!}(n-r)!} * \cancel{r!}$$

(select) (arranging r things in r! ways)

$$\boxed{{}^{n}P_{r} = \frac{n!}{(n-r)!}}$$ [r-Permutation]

① In Jaya's bag there are 3 books of history, 4 books of science & 2 books of maths. In how many ways can Jaya arrange the books so that all the books of same subject are together?

select (isn't there)
arrange (is there)
∴ permutation

but, it's not select & arrange, just arrange. So instead of using P, we normal '!'

(3H) 1st (4S) 2nd (2M) 3rd sub

∴ total = 3 books

↓

3 names can be arranged in 3! ways (By doing this, we will move each group, the individual book will not be moved. By that we can keep the books of same subject together.

Now, in each group there are multiple no of books, they can be arranged as—

3H ⟶ 3! ways
4S ⟶ 4!
2M ⟶ 2!

∴ total ways to arrange the books so that books of same subj remain together

TS = 3! * 3! * 4! * 2! [∵ 3! - total ways b/w 3 groups, 3! 4! 3! 2!, so '*']

= 1728 ways

② In how many ways can we arrange the word 'FUZZTONE' so that all the vowels come together?

F U Z Z T O N E

(3)

total words = 8

Now (3) ⟶ 1 grp ⟶ 3!

left alphabets = 8 − 3 = 5

F, Z, Z, T, N

∴ 5 alphabets + 1 grp = 6 ⟶ 6!

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$\therefore$ 8 ways should be $= 6! \times 2!$, but ✗

$\because$ 2 gets repeated twice

1, 2, 3, 4, ...

↓

repetition (2 times)

$\therefore$ total no. of ways to arrange that word so that all vowels come together,

$= \frac{6! \times 3!}{2!}$

$= \underline{2160 \text{ ways}}$

Note:
Let's n things out of them 1 thing gets repeated for 4 times
⇓
$\frac{n!}{4!}$

(3) If sir doesn't want vowels together then in how many ways can he arrange letters of the word 'MARKER'?

MARKER

vw (2)

total words = 6

vows = 2 → 1 way → 2!

left words = 6 − 2 = 4 M, R, K, R

~~to arrange a way such that vows come together are 2!~~

~~doesn't~~

Total ways = vow together + vow not together

$\because$ In general total ways = n!, but here the statement is such a way where vows are together, so then the total ways are is = together (+) not together → mine

→ If vows not together = ~~vow toge~~ total ways − vows together

$= \frac{6!}{2!}$ (repetation) − vows together —(1)

Now, the no. of ways, by which the vows remain together is,

4 + 1 grp = 5 → 5! ways

2! → 2 vows can be arranged in 2! ways

$\therefore \frac{5! \times 2!}{2!}$ (for repetation of R)

$= 5!$

$= 120$ ways

$\therefore$ # no. of ways vows aren't together

$= \frac{6!}{2!} - \frac{5! \times 2!}{2!}$

$= \frac{6! - 5! \times 2!}{2!}$

$\frac{6!}{2!} - 120$

$= 6 \times 5 \times 4 \times 3 - 120$

$= 360 - 120 = \underline{240 \text{ ways}}$

(4) without repetition, using digits 2, 3, 4, 5, 6, 8, 0, how many no.s can be made which are b/w 500 & 1000?

2 methods

(1st) way
Same syll logic,

3 — — (500 – 1000)

2, 3, 4, 5, 6, 8, 0

Now, no repetition,

(5, 3, 4, 5, 6, 8, 0)

7 no.s in b/w

3 is already used

∴ So, total no.s left now = 6

3 6 5 (possible choices)

same way

∴ $3 \times 6 \times 5 = 90$ no.s can be made in b/w 500 – 1000.

[If repetition was be allowed,
3 7 7 So = 147]

(2nd) way
Formula based

$^3C_1 \quad ^6C_1 \quad ^5C_1 = 90$ no.s possible

$^6C_1$ → select

[When mentioned, 'Unique digits', select this digits' etc, we'll understand it is combination.]

(5) 4 members from a group out of total 8 members. i) In how many ways it is possible to make the group if 2 particular members must be included. ii) In how many ways it is possible to make the group if 2 particular members must not be included?

total 8 members a b c d e f g h

i) must members = 2

∴ left members = 8 – 2 (∵ In 1 group 4 members)

now from 8 mems, 2 are selected

rem = 8 – 2 = 6 → from these we have to select 2 rem members for the grp

$^6C_2 = \frac{6!}{2!\,4!} = 15$	2 particular members can be selected by 1 ways & from rest of 6 mems, we are choosing 2 members

∴ total no. of ways possible $= 1 \times {}^6C_2$ (when order is not imp)

$= \underline{15}$ ways

Now 2 boys must be included, & 2 out of 6 have to choose 4 more (1 imp)

∴ total no. of ways possible

$= {}^6C_4$

$= \underline{15}$ ways

(6) There are 8 routes from London to Delhi. And there are 6 routes from Delhi to Tokyo. In how many different ways can Raj travel from London to Tokyo ~~to~~ via Delhi?

L —8— D —6— T

1st way L—D₁ → 6 choices from D—T

2nd " L—D₂ → 6 " " D—T

8th " L—D₈ → 6 " " D—T

∴ 8 × 6 = 48 choices

(7) There are 35 people in a group. There are 12 school girls, 10 school boys, 5 senior citizens & 8 babies in the group. The organizer of the group wants to select a school girl or school boy as leader of the group. In how many ways can he do so?

2 ways

Method a

1 leader from 1 school girl / school boy

$12 + 10 = 22$

∴ total ways $= {}^{22}C_1 = \underline{22}$

Logic

$12 + 10 = 22$ out of them → 1 leader

to select 1 leader from 22 people the organizer has 22 choices

(8) In a class, there are 15 students. During a christmas party all of them shook hands with eachother only once. How many handshakes took place in the class?

15 students → n (total students)

(1) no. of (2) for a handshake

$\therefore {}^{15}C_2 = 15 \times 7 = 105$ handshakes $({}^{n}C_2)$

• let, there are 9 teams & they are playing match with eto only two once, then, ${}^{9}C_2$ (∵ for a match 2 teams are must)

• If 'only once' not given, $\boxed{{}^{n}C_2 \times 2}$ (not that way)

(3) A bank has 6 digit account no. with no repetition of digits within an account no. The first & last digit of the account nos are fixed to be 4 & 7. How many such account nos are possible?

0, 1, 2, 3, 5, 6 & 3

4 3 5 4 5 7 ways

no. of accounts possible = 8 × 7 × 6 × 5

= 1680

(4) A trekking group is to be formed having 6 members. They are to be selected from 3 girls, 4 boys & 5 teachers. In how many ways can the group be formed so that there are 3 teachers & 3 boys or 2 girls & 4 teachers?

3g, 4b, 5t

(3t & 3b) or (2g & 4t)

$\boxed{\begin{array}{l} \& \rightarrow * \\ \text{or} \rightarrow + \end{array}}$

(3t AND 3b) OR (2g AND 4t)

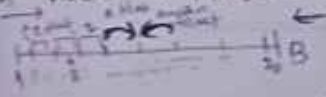
$\Rightarrow ({}^{5}C_3 * {}^{4}C_3) + ({}^{3}C_2 * {}^{5}C_4)$

$= (10 \times 4) + (3 \times 5)$

$= 40 + 15$

$= 55$ ways

(5) On a railway line there are 20 stops. A ticket is needed to travel b/w any 2 stops. How many different tickets would the ~~st~~ need to prepare to cater to all possibilities



no. of stops = 20 (n)

ticket is b/w 2 stops (r)

∴ the no. of tickets needed = ${}^{20}C_2$ = 190 t

travelling from 1 side 190 t ${}^{20}C_2 \times 2$

opposite 190 t

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∴ total tickets = 380 (matine) tickets

(12) 17 students are present in a class. In how many ways can they be made to stand in 2 circles of 8 & 9 students?

17 students

First way

1st → select 9 students & arrange them

∴ select = $^{17}C_9$ & arrange = $(9-1)! = 8!$

2nd → arrange the rest of students

Rest = 17 − 9 = 8 S

∴ arrange = $(8-1) = 7!$

∴ total no of ways = $^{17}C_9 \times 8! \times 7!$

$= \frac{17! \times 7!}{9!}$ — (By 1st way)

Second way

1st → select 8 students & arrange them

∴ $^{17}C_8 = \frac{17!}{9!\,8!}$ & arrange = $7!$ $\boxed{^{17}C_8 \times 7!}$

2nd → arrange rest of the students

Rest = 17 − 8 = 9 S

∴ arrange = $(9-1) = 8!$

$\boxed{^{17}C_9 \times 7! \times 8! = \frac{17!}{9!\,8!} \times 7! \times 8!}$

∴ total no of ways = $\frac{17! \times 7!}{9!}$ — (By 2nd way)

Find total no of ways = (1st way) OR (2nd way)

$= \frac{17! \times 7!}{9!} + \frac{17! \times 7!}{9!}$

$= \frac{17!}{9!}(7! + 8!)$

• If 'linear fashion' is mentioned (rather than circle), then we can use directly 'permutation' formula (^nP_r)

[Let, linear fashion is mentioned,

17 S — 8 — 9

1st → select 9 S & arrange = $^{17}P_9 = \frac{17!}{8!}$

2nd → arrange rest of 8 S = $8!$

∴ total ways = $\frac{17!}{8!} \times 8! = 17!$ } 1st method

1st → select 8 S & arrange = $^{17}P_8 = \frac{17!}{9!}$

2nd → arrange rest 9 S = $9!$

∴ total way = $\frac{17!}{9!} \times 9! = 17!$ } 2nd method]

(13) A locker in bank has 3 digit lock. Mahesh forgot his password & was trying all possible combinations. He took 6 seconds for each try. The problem was that each digit can be from 0 − 9. How much time will be needed to by mahesh to try all of the combinations?

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$\frac{10}{1}$ $\frac{10}{1}$ $\frac{10}{1}$ → 0 – 9

10×10×10 = 1000

1 try (1 way) → 6 s

1000 × (1 min/60 s) → 16 × 1000 = 6000 s

∴ $\frac{6000}{60}$ = 100 m to try all combination

(14) In a room there are 2 green chairs, 3 yellow chairs & 4 blue chairs. In how many ways can Raj choose 3 chairs so that atleast 1 yellow chair is included?

2 Gn, 3 y, 4 B

1 y chair	2 y chair	3 y chair
1 y & 2 others = $^5C_1 \cdot {}^6C_2$	2 y & 1 others = $^3C_2 \cdot {}^6C_1$	$^3C_3$

∴ no of ways possible = 1 y or 2 y or 3 y

= 3 × 15 + 3 × 6 + 1

= 45 + 18 + 1 = 64 ways

(a) total ways – choosing atleast 1 y chair + choosing no. of chairs

(b) choosing atleast 3 y chair = total ways – choosing no. of chairs

= $^9C_3 - {}^6C_3$

= 84 – 20

= 64 ways

(15) How many combinations are possible while selecting 4 letters from the word 'SMOKEJACK' with the condition that J must appear in it?

SMOKEJACK

→ 1 will be J (no choice, so = 1)

(∵ arranging isn't given, given is selection)

→ K K C or $^6C_1$

→ K K $^6C_2$

→ $^6C_3$

$^6C_1 + {}^6C_2 + {}^6C_3$

= 6 + 15 + 20

= 41 ways

(Ps) Averages (Bhent 27ms)

Thinks

• equitable distribution (eg. 100 Rs & 5 children if you want equal distribution then
1 → 20/- 4 → 20/-
2 → 20/- 5 → 20/-
3 → 20/-
∴ Avg amt (100/5 = 20/-) with each (= 20/-)

Eg
1) D m & Dae
10/- 20/- 35/- 75/-
total 20 + 25 + 75 = 400/-
equal distribution = 400/4 = 100/-
100/- 100/- 100/- 100/- (avg amt with each person)

• Avg = Sum of all the observations / total observations | Sum / total

ii) 3 batsman → 20 m (total)
total score → 750 (total sum)
∴ Avg = 750/20 = 37.5 per match

• Total sum or sum

F.D or Avg = Sum / Total no.
⇒ Sum = Avg × total no.

Eg

1	2	3	4	5
150	100	50	200	1000

— total sum? (total money Ram)
⇓
150 + 100 + 50 + 200 + 1000 = 1500/-

iv) Ages

1	2	3	4
15	25	50	

total age = 15 + 25 + 50 = 80 years

• total sum = nothing but addition

Q) Knowing that vijay's expenditure for first 3 days is Rs. 100, Rs 125 & Rs. 85, what is his 4th day expenditure as his 4 days avg expenditure Rs. 90?

Avg = 90
Avg = Sum / total no.
⇒ 90 = (100 + 125 + 85 + x) / 4
⇒ x = 50/-

Q) what will be average price of all the goods bought, if Ajay buys 30 erasers for Rs. 3 each, 35 chocolates for Rs. 10 each & Rs 4 clips at the rate of Rs. 4 each?

1 eraser → 3/-
30 " → 3 × 30 = 90/-
1 chocolate → 10/-
35 " → 10 × 35 = 350/-

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$\Rightarrow$ 84,000/-

$\therefore$ he gets 84,000 from 8 cycles

$S = 84,000$

$T = 8$

Avg cost of 8 cycles $= \frac{84,000}{8}$

$= 10,500/-$

(4) Without considering the salary of the boss, the average salary increased by Rs. 1000. What will be salary of boss if avg salary of 11 employees & the boss is Rs 18,000?

Avg = 18,000 of 11 emp & boss

~~Avg sal of 11 emp & Avg~~

Avg of 12 people = 18000

$\Rightarrow$ Avg $= \frac{S}{T}$

$\Rightarrow 18,000 = \frac{S}{12}$

$\Rightarrow S_{12} = 216,000$

Excluding boss's sal, Avg of 11 people = 17000

$\Rightarrow \frac{S}{11} = 17,000$

$S = 17,000 \times 11$

$= 187,000$

$\therefore$ Boss's sal $= S_{12} - S_{11}$

$= 2,16,000 - 1873000$

$= 29,000/-$

Sl no 1 — 41/-
Sl no 2 — 25
Sl no 3 — 50
$= 116/-$

$\therefore$ Avg $= \frac{50 + 35 + 116}{3} = \frac{116}{3}$

$= 39/-$

Avg = 61/-
of all goods

(3) Of the 20 cycles sold by Ajay, average cost of 12 cycles is Rs. 18000. In total he earned Rs 3,00,000. What was the average cost of remaining cycles?

20 — 8 — Avg?
12

Avg = 18,000/-

total earned = 3,00,000

$\Rightarrow 18,000 = \frac{\text{Sum}(S)}{12}$

$\Rightarrow S = 12 \times 18,000$

$= 216,000$

$\therefore$ From 12 cycles he earned = 2,16,000/-

$\therefore$ Rest amt he earned from 8 cycles = 3,00,000 − 216,000

(5) Avg age of 5 people is 42 years. Another group has 3 people who have avg age of 81 years. When both groups are mixed what is the avg age of all people?

$Avg_5 = \frac{S_5}{5}$

$\Rightarrow 42 = \frac{S_5}{5}$

$\Rightarrow S_5 = 210$ yrs

$Avg_3 = \frac{S_3}{3}$

$\Rightarrow 81 \times 3 = S_3$

$\Rightarrow S_3 = 243$ yrs

Both groups are mixed,

now, $Avg_{mixed} = \frac{210 + 243}{5+3}$

$= \frac{453}{8}$

$= 56.6$ yrs

(6) 3 boxes have some avg weight, when one box which weights 89 kg is replaced by another box, the avg weight increase by 5 kg, how much the new box weight?

$Avg_3 = \frac{S_3}{T}$

$\Rightarrow Avg_3 = \frac{S_3}{3}$

$\Rightarrow Avg_3 = \frac{89 + S_2}{3}$ —(1)

$Avg_{new} = \frac{S_3}{3}$

$\Rightarrow Avg_3 + 5 = \frac{x + S_2}{3}$

$\Rightarrow \frac{89 + S_2}{3} + 5 = \frac{x + S_2}{3}$

$\Rightarrow 89 + \cancel{S_2} + 15 = x + \cancel{S_2}$

$\Rightarrow x = 104$ kg

formula: new x = replacing x's weight increased/decreased by the weight of the new box

(If avg increased then the actual weight of the other boxes increased by same x)

(7) How old will be if ratio of Rajs age & one of his twin grandson's is 11:2 & avg age of his & his both grandson is 50 years?

Raju's age : his grandson's age = 11 : 2

$\therefore$ R's age $= 11x$

his age $= 2x$

Avg A of his & his both grandson $= \frac{S_R + S_1 + S_2}{3}$

$\Rightarrow 50 = \frac{11x + 2x + 2x}{3}$ ($\because S_1 = S_2$ = twins)

$\Rightarrow 150 = 15x$

$\Rightarrow x = 10$ yrs

$\therefore$ R's age $= 11 \times 10$

$= 110$ yrs

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② Had Ajay scored 18 runs more in his 3rd innings & 4 runs more in his 7th innings, his avg would have become 66 runs. But it is 64 runs. How many innings did he play?

Let total innings $= x$

Avg $= 64$

$\Rightarrow 64 = \frac{S}{x}$ —(i)

$\Rightarrow S = 64x$ —(I)

In 3rd $= 18$ runs

7th $= 4$ "

Avg $= 66$

$\Rightarrow 66 = \frac{S' + 18 + 4}{x}$ (new sum)

$\Rightarrow 66 = \frac{64x + 22}{x}$ [from (I)]

$\Rightarrow 64x + 22 = 66x$

$\Rightarrow 2x = 22$

$\Rightarrow x = 11$ runs

③ In a group of people, the oldest & the youngest have an age difference of 100 years. If these 2 are left out of counting, then the avg age of the remaining 40 people is 28. The avg age of entire group being 30, how old is the eldest person?

Let oldest $= x$ years, youngest $= y$ are yrs

$x - y = 100 \Rightarrow y = x - 100$ —(II)

According to q. $\Rightarrow \frac{\text{Avg}_S}{40} = 28$, $\Rightarrow S = 40 \times 28 = 1120$ —(I)

Now, then,

$\Rightarrow 30 = \frac{S + x + y}{42}$

$\Rightarrow 30 \times 42 = 1120 + x + y$ (from (I))

$\Rightarrow 1260 = 1120 + x + x - 100$ (from (II))

$\Rightarrow 1260 - 1120 = 2x - 100$

$\Rightarrow 2x = 1260 + 100 - 1120$

$\Rightarrow x = 120$ yrs

④ A batsman played 11 innings & has a certain average. This avg increases by 2 runs when his innings of 32 runs, 33 runs & 34 runs are replaced by 3 innings. Find the average of these 3 new innings?

$\text{Avg} = \frac{34 + S + 33 + 32}{11}$

$\Rightarrow \text{Avg} = \frac{\text{ans} + S}{11}$

$\Rightarrow (\text{Avg} - 11) - 99 = S$ —(I)

$\text{Avg} + 2 = \frac{S_3 + S}{11}$ (S₃ → new avg, S → old avg)

$\Rightarrow (\text{Avg} + 2) \times 11 = S_3 + 11\text{Avg} - 99$ (from (I))

$\Rightarrow 11A + 22 = S_3 + 11A - 99$ [Avg = A]

$\Rightarrow S_3 = 121$

$\therefore \text{Avg}_{S_3} = \frac{121}{3} = 40\frac{1}{3}$ runs

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(4) Series → Number series (2-3 Trs)

Types & tips

- numeric
- letters/alphabet
- alphanumeric

Qn types

- next no/letters/group of nos/gr of alphabet
- missing nos/letters/ ... etc/.
- odd man out (find the odd no/letters like that)

Tips

① Find the relation b/w the given elements.
② solve the relation/fn & get the ans.

Eg

1 2 3 4 5 6 → Pattern → Using it we can solve the fn.

Eg → 1 2 3 4 5 6 → 621

Ans, 1 = 25 20 5500 → like this (increasing) always remember

The series (7) must be related to sq of no, cube of numbers, multiplication etc.

Eg → 1, 3 7 10 15 (increasing but slowly increasing) always remembers

The series must be related to addition, substraction, mul, div (or) the series must be of prime nos (or) Fibonacci series

1st type

Numeric series

i) Addition series

Eg 19 25 32 40 ? Eg (Increasing → Add, Spring (or) mul ...)

25-19 = 6 → 1076 → 43
32-25 = 7 → 25+2 → 27
→ 32+3 → 40
→ 40+9 → 49
→ 49+10 → 59

40+9 = 49
∴ ? = 49

ii) Substraction series

Eg 10 2 8 5 6 3 ? 34 (decreasing → Sub, Spring (or) div ...)

∴ ? = 51

iii) multiplication series

Eg 1 2 6 24 12 0

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It is increasing very very fastly So → It can might be mul

1 3 6 24 120 ? = 720

? = 720

Eg 6 12 24 48 96 ? = 192

⑤ Division series

Eg 216 72 36 12 ? 2

It is falling very fastly So → It might be mul div

216 72 36 12 ? 2

? = 6

Mixed numeric series [mostly asked]

① Squares (upto 30) ② Prime no. series ④ Composite no series
③ cubes (upto 15) ⑤ Fibonacci series
⑥ mean to it

① Square series / nos mean to it

Eg 0 3 8 15 24 35 ? 63

1 = 48 [Steady increasing → mul & add]

0 3 8 15 24 35 ? 63

1-1 4-1 9-1 16-1 25-1 36-1 49-1 64-1

0^2-1 2^2-1 3^2-1 4^2-1 5^2-1 6^2-1 7^2-1 8^2-1

$? = 49-1$
$= 7^2-1$
$= 48$

Eq of squares

• When there will be a series where pattern is not directly (we can't directly recognize the pattern, then we need to apply tricks of square, cube & mean to it. 'mean to it' means if the no. mean to it or mean to square or mean to cube like that):—

ii) Cube series / nos mean to it

Eg 64 125 216 343

ii) Prime no. series

2, 3, 5, 7, 11, 13, 17, 19, — (prime no.)

Composite nos → the nos that are not prime

4, 6, 8, 9, 10, 12, (composite no series)

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1) Fibonacci series

0, 1, 1, 2, 3, 5, 8, 13, 21, ...

(Fibonacci series)

2) 1, 5, 8, 13, 21, 34, 55 ← Fibonacci series (skipping)

3) 5, 8, 13, 21, 34, 55, 89 ← not fibo series

Time

8, 2, 7, 3, 6, 4, 5, 6, 4 ← (not increasing / decreasing / it is mixed up)

There are 2 series / 2 pattern writing on alternating on going on

Here 1, 2, 3, 4, 5 → (odd)

8, 7, 6, 5, 4 → (even)

Imp

Alphabet series

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

(always write in 5 place no.)

New pos of letters → [original pos] ± [whole number of pos + 1] → [original pos]

z → 26 + 1 − 26 = 1

1 st new pos of D → 27 − 4 = 23

[(total of alphabets + 1) − existing pos of letter]

Alphabet series (2 types) → words & combinations / alphabet position (eg A, D, ...)

2 types → Single alphabetical letters / group of letters on alphabetically

(A?) (B) (C D) ?

(ABC) DEF GHI JKL

CEH ? OQT UWZ

IKN

from the pattern = (skip series)

? = IKN or MOR or ACF have to find (depended on it)

(BDA) (FHE) ? (NPM)

[1C = 1S → 1 letter 1 skip time]

(C many combinations)

JLI

(1 . . . . . 1)

? = JLI or . . . . .

AFD NLJ OM O XVT

KM

?! → KM

Test type

Alpha numeric series

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

Reverse pos of letters − [27 − original pos of letter]

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(odd & even series)

1 4 9 1 6 1 4 3 ?

- Question no. will be here and need to check if they are related to the position of the alphabet?
- If not then check, if they are related to each other or not
- If not try to check if if they have any thing with the nos & other maps

Same thing / check for letters too

2 ways/logics

1st way

2 E 2 1 H 8 1 F 6 1 C 3 ?

3 3 3 3

1 8 0

∴ ? = 180

2nd way

H 8 L 12 O 15 S 19 ?

V 22

mine

3rd way

∴ ? V22

① 9, 5, 1, 17, 28, ?

Prime no.

? = 41

(Prime no series)

Try in this way to find out the pattern

Add → Sub → mul → div → Prime no → fibonacci → (combination of all)

② 21, 34, 55, 89, 144, ?, 377

fibonacci no.

? = 233

233

21, 34, 55, 89, 144 → when this happens then always remember it is a fibonacci series.

③ L, O, J, G, I, ?

S

2 diffe. series

? = S

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What rule? Line diagram?

(4) U, S, P, Z, G, ? → A

? = A

(5) U, S, P, Z, G, ? → A

? = A [S=SKIP]

(5) Find the wrong term in the following series.

10, 14, 28, 32, 64, 68, 136

∴ wrong term = 34 (as, if 28+6 ✗ 28+4 = 32 4 - doubling)

Correct series = 10, 14, 28, 32, 64, 68, 136

(6) Find the wrong term in the following series.

15, 16, 20, 30, 45, 70

15, 16, 20, 28, 45, 70 (Correct series)

∴ wrong term = 30

(7) Find the wrong term in the following series - 1, 3, 10, 21, 63, 129

∴ Correct series

1, 3, 10, 21, 64, 129

∴ wrong term = 63

(8) Find the wrong term in the following series -

3, 2, 8, 12, 13, 24, 18, 32, 23, 42

Correct series 3 2 8 12 13 22 18 32 23 42

∴ wrong term = 24

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	Teacher's Sign/Remarks

7

Partnership (2 qns) atleast

Partnership formula

Ratio of Investment × Time = Ratio of profit

Eg- (A's investment × A's Time) : (B's investment × B's time) = A's Profit : B's Profit

Q Eg P & Q jointly buy a hotel. P invests 6 times the investment of Q. On receiving profit of Rs- 84000 what will be P's share in it?

P Q → Invested for the same time period

If, P's amount invest ↑ Profit P ↑

Q ------ ↑ profit Q ↑

Given, P invests 6 times the inv. of Q

∴ Profit of P = 6 times profit of Q

let ↳ P let ↳ Q ✓

$\Rightarrow P = 6Q$ $P : Q = 6 : 1$

$\Rightarrow \frac{P}{Q} = \frac{6}{1}$

P's share $= \frac{6}{6+1} \times 84000$ (total profit)

$= 72000/-$

Q's ---- $= 84000 - 72000$ or $\frac{1}{7} \times 84000$

$= 12000/-$

$= 12000/-$

② Rohit starts a travel agency by investing Rs. [illegible]. After 4 months Raj joins the agency. Raj invests Rs. 50000. What will be profit share of Raj if they earn a total of Rs 187,000 as profit in the entire year?

Formula = $\boxed{I \times T = P}$

Rohit's profit : Raj's profit [as, investments, they earned a total of Rs. 187000 as profit in the entire year]

$\Rightarrow 40000 \times 12 : 50000 \times 8$

$= 6 : 5$

Profit share of Raj:

$\frac{5}{11} \times 187,000 = 17,000$

$= \underline{85000/-}$

③ M invests Rs 400 in coaching classes. After 3 months N comes along with Rs. 8000. P comes in with Rs 20,000. The classes earn a profit of Rs 11,200 at the end of the year. If profits of M, N & P are in ratio of 6:9:5, for how many months was P involved?

$I \times T = P$

$P_M : P_N : P_P = 6:9:5$

$\Rightarrow \underbrace{400 \times 12 : 8000 \times 9 : 20,000 \times T}_{\text{actual values}} = 6:9:5$ (given)

actual values

let, common factor = K

let, P's time of involvement = T (time period of P)

not actual value

∴ actual values = 6x, 9x, 5x

$\Rightarrow 400 \times 12 : 8000 \times 9 : 20000 \times T = 6x : 9x : 5x$

$\Rightarrow \underbrace{48,000 : 72,000 : 20000T}_{\text{actual val}} = \underbrace{6x : 9x : 5x}_{\text{actual val}}$

$\therefore 48,000 = 6x$

$\Rightarrow x = 8000$

$\therefore 20000T = 5 \times 8000$

$\Rightarrow \underline{T = 2 \text{ months}}$ (as rest of units (Rs, Rs) are in months)

④ Ratio of profits of P, Q & R are 5:8:9 respectively. What is their investment ratio if their investment time period ratio is 2:5:8 respectively?

$I \times T = P$

$\Rightarrow \boxed{I = \frac{P}{T}}$

	P	Q	R
P_n =	5	8	9
T_n =	2	5	8

$I_P : I_Q : I_R$

$= \frac{P_P}{T_P} : \frac{P_Q}{T_Q} : \frac{P_R}{T_R}$

$= \frac{5}{2} : \frac{8}{5} : \frac{9}{8}$ } fraction, but we need ~~what~~ int not fractions

method-2 (wire)

$\frac{5}{2} : \frac{8}{5} : \frac{9}{8}$

$= \frac{5 \times 25}{2 \times 25} : \frac{8 \times 25}{5 \times 25} : \frac{9 \times 25}{8 \times 25}$

$= 200 : 125 : 90$

$= 100 : 64 : 45$

method-1

So, $LCM(2, 5, 8) = 40$ (HCF not applicable, but it will take more time in real as HCF is greater than LCM (general case) here) → $\boxed{\text{mine}}$

$= \frac{5}{2} \times 40 : \frac{8}{5} \times 40 : \frac{9}{8} \times 40$

$= \underline{100 : 64 : 45}$

(5) Ajay & Vijay's investment is in ratio 5:2. Ajay gets Rs. 3420 as profit after donating 10% of total profit to orphanage. What is Vijay's share?

$I \propto T \propto P$ (As T is not given, so we consider that their time periods are same so we need not to consider T)

$\boxed{I = P}$

$I_A : I_V$ (given)

$= 5 : 2$

as $I = P$, $\therefore P_A : P_V = 5 : 2$

now, A's share $= \frac{5}{7} \times$ total profit
(A's profit)

$\Rightarrow 3420 = \frac{5}{7} \times 7P$

$\Rightarrow 7P = 684 \times 7$

$= 4788$ /-

$\therefore$ V's share $= \frac{2}{7} \times 4788$ (684×7)

$= 684 \times 2$

$= \underline{1368}$ /-

[overall profit $= \cancel{4788 \times \frac{10}{100}}$ x (let)

$x - \frac{x}{10} = 4788$

$\Rightarrow 9x = 4880$

$\Rightarrow x = 5320$ /-] (not needed)

$\boxed{\text{Intro}}$

$T = P$ $\quad I_A : I_V = 5 : 2$

$\Rightarrow \frac{I_A}{I_V} = \frac{P_A}{P_V}$; $\Rightarrow \frac{5}{2} = \frac{3420}{P_V}$; $\Rightarrow P_V = \underline{1368}$ /-

(6) P, Q & R start a hotel. Q & R invest equally but P invests one fifth of the total investment amount. On getting profit of Rs. 225,000, how much would be difference between profit of P & R? no T is given, ∴ same T

if $I \uparrow$ $P \uparrow$

$P = \frac{1}{5}$

P invests $\frac{1}{5}$ of total investment amount

∴ Profit of P will be also $\frac{1}{5}$ of total in a (i.e. profit)

∴ P's Profit $= \frac{1}{5} \times 225000$

$= \underline{45000}$ /-

$\boxed{\text{Multiple amount time invested in the same period gives the same profit (in general)}}$

$T_Q = T_R$

$P_Q = P_R$

now profit left $= 225000 - 45000$

$= 180000$ /-

This will be divided equally among Q & R (as they invested same amt, they will get same profit)

∴ R's Profit $= \frac{180000}{2} =$ Q's Profit

$= 90000$ /-

Diff b/w P_P & P_R

$P_R - P_P$ (∵ $P_R > P_P$) $= 90000 - 45000$

$= \underline{45000}$ /-

$P_R - (P_Q - P_P)$, ans, it means P's profit is 45,000 less than Q's profit

⑦ P & Q start a cafe with capital Rs 20,000 & Rs 40,000 respectively. After a year, out of the profit of Rs 15,000, P gets his share of profit plus some money as his salary. To total it plus same money as his salary. To total it P gets Rs 7000, what is the salary amount he received?

I.T = P

$P_P : P_Q$ (as T.I 1 year & given S.Y is same for both P & Q)

$= 20000 : 40000$

$= 2 : 4$

$= 1 : 2$

$P_P : P_Q = 1 : 2$

Given - out of the profit of 15,000/-

i.e, total profit = 15,000/-

∴ P's share ~~of profit~~ $= \frac{1}{3} \times 15,000$

$= 5000/-$

Given,

P's share + ~~some money~~ Salary of P = 7000

⇒ 5000 + salary of P = 7000

⇒ P's sal = 2000/-

- Active Partner = manager, who gets profit along with sal.
- Silent Partner = Investment Partners (who get the share as to his/her investment)

② Rs 1500 were invested by Ram & Shyam together to start a small business. They got a profit of Rs 2000 at the end of the year. Shyam took his profit share of Rs 600. How much did Ram invest?

I.T = P

$P_{Ram} : P_{Shyam}$

$= R \times 12 : S \times 12$

invest R — invest S

Given $P_S = 600/-$

total profit = 2000/-

∴ $P_R = 2000 - 600$

$= 1400/-$

∴ $P_R : P_S = 600 : 1400$

$= 14 : 6$

$= 7 : 3$

(as T = same for both P & S you can also not write it)

∴ ⇒ $R \times 12 : S \times 12 = P_R : P_S$

⇒ $P : S = 7 : 3$

∴ Investment ratio R : S = 7 : 3

∴ R's invest $= \frac{7}{10} \times 1500$ (total investment)

$= 10,500/-$

Here, in profit share share's share/profit = Sharing ratio / Investment

(7) (b) Numbers — Imp (time)

(a) 1, 11, 34, 75, 139, ? (mixed growth)

• Triangular method

1, 11, 34, 75, 139, 231

∴ ? = 231

(b) 28, 35, 31, ?, 34, 39 (not mono growth → 6, 4, 6 (adding) i.e. 2 series)

28, 33, 31, ?, 34, 39

∴ ? = 36

(7) Probability (2-3 Qns)

P = chance

$P = \frac{\text{what I want}}{\text{Total}}$

• 4R & 2G Balls

$P(\text{picking a R ball}) = \frac{4_1}{6_1} = \frac{4}{6} = \frac{2}{3}$

• AND → × (mul)
• OR → + (add)
• Total P = 1 (always)

✓ why

Same eg (we can only get 2 type of balls from 2 type of balls)

$P_R + P_G = \frac{4}{6} + \frac{2}{6} = 1$

$P + \bar{P} = 1$

Common types

i) Coin → {H, T} 2 possibilities

ii) Cards → {52 cards} 52 "

Spade 13 (B) | Heart 13 (R) | Club 13 (B) | Diamond 13 (R)

26 B, 26 R

→ Each has 4 special card (Jack, King, Queen, Ace)

Card no. = 2 – 10

J, K, Q, A

3) Dice → 6 faces → each faces has 1, 2, 3, 4, 5, 6

6 possibilities

Eg (i) Sores, balls, marbles, shirts etc (identical)

Possibilities depend upon no of s, b, m, s etc

& i.e

case by case

① Suresh keeps all his socks in a single drawer. He has 24 pairs of white socks & 18 pairs of grey socks. Suresh picks 3 socks randomly. Find the prob of Suresh choosing a matching pair?

$\boxed{2 \mid 18}$

$\frac{18}{2}$

48 socks

$18 \times 2 = 48$

48 pairs

$24 \times 2 = 96$

$\frac{48}{2} = 24$

$\frac{48}{84}$

$A = P(2w \,\&\, 1w) = \frac{{}^{48}C_2 \times {}^{36}C_1}{{}^{84}C_3}$

$B = P(2g \,\&\, 1w) = \frac{{}^{36}C_2 \times {}^{48}C_1}{{}^{84}C_3}$

$A + B = \frac{{}^{48}C_2 \times {}^{36}C_1 + {}^{36}C_2 \times {}^{48}C_1}{{}^{84}C_3}$

$= \frac{40608 + 30240}{{}^{84}C_3} = \frac{432}{581}$

ALWAYS happens ← (first guarantee)

∴ the prob is 1

(Q) what will be the probability of drawing a face or a spade from a well shuffled standard deck of 52 playing cards?

$$\frac{13+4-1}{52} = \frac{16}{52} = \frac{4}{13}$$

(Q) A box has 6 black, 4 red, 2 white & 3 blue shirts. When 2 shirts are picked randomly, what is the probability that either both are white or both are blue?

$$P(A) = \frac{{}^{2}C_2 + {}^{3}C_2}{{}^{15}C_2} = \frac{1+3}{105} = \frac{4}{105}$$

2 shirts → 1st & 2nd

$$P(A) = \frac{{}^{2}C_1 \cdot {}^{3}C_1}{{}^{15}C_2} = \frac{6}{105}$$

2W OR 2B

$$\left(\frac{2}{15} \times \frac{1}{14}\right) + \left(\frac{3}{15} \times \frac{2}{14}\right) = \frac{2}{15 \times 14} + \frac{6}{15 \times 14} = \frac{8}{15 \times 14} = \frac{4}{105}$$

(4) A pot has 24, 6B, 4G & 8 green balls. If one ball is picked randomly from the pot, what is the prob of it being blue or green?

$$P(A) = \frac{{}^{6}C_1 + {}^{8}C_1}{{}^{24}C_1}$$

$$= \frac{\cancel{14}\,7}{\cancel{24}\,10}$$

$$= \frac{7}{10}$$

(5) There are 2 pots. One pot has 5 red & 3 green marbles. Other has 4 red & 2 green marbles. What is the probability of drawing a red marble?

CR, 4R, 2G, 5R

~~Drawing a R marble~~

$$P(A) = \frac{{}^{5}C_1}{{}^{8}C_1} + \frac{{}^{4}C_1}{{}^{6}C_1}$$

$$= \frac{5}{8} + \frac{\cancel{4}\,2}{\cancel{6}\,3}$$

$$= \frac{15+16}{24} = 1$$

But we have to consider the P of choosing an I pot.

Let, we are choosing pot I & drawing a R marble.

$$P(A) = \frac{1_{C_1}}{2_{C_1}} \cdot \frac{5_{C_1}}{8_{C_1}}$$

pot 2 &

$$P(B) = \frac{1}{2} \cdot \frac{4_{C_1}}{6_{C_1}}$$

$$\therefore P(A) \text{ or } P(B) = P(A) + P(B)$$

$$= \frac{1}{2} \cdot \frac{5}{8} + \frac{1}{2} \cdot \frac{2}{3}$$

$$= \frac{1}{2}\left(\frac{5}{8} + \frac{2}{3}\right)$$

$$= \frac{1}{2} \cdot \frac{15+16}{24}$$

$$= \frac{1}{2} \cdot \frac{31}{24}$$

$$= \frac{31}{48}$$

(6) In a set of 30 game cards, 17 are white & rest are green. 4 white & 5 green are marked IMPORTANT. If a card is chosen randomly from this set, what is the probability of choosing a green card or an 'IMPORTANT' card?

30 game cards

17 W, 13 G

IMPORTANT cards = 4W & 5G

A = green card, B = IMPORTANT

$$P(A) = \frac{{}^{13}C_1}{{}^{30}C_1} \qquad P(B) = \frac{{}^{9}C_1}{{}^{30}C_1}$$

$$P(A \text{ OR } B) = P(A) + P(B) - P(A \cap B) = \frac{{}^{5}C_1}{{}^{30}C_1}$$

$\frac{13}{30} + \frac{12}{30} + \frac{4}{30} + \frac{5}{30} - \frac{5}{30}$

$\frac{30}{30} \quad \frac{1}{1}$

$\frac{30}{30} \quad \frac{1}{1}$

A or B → A ∪ B → A + B

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ [If A & B are mutually exclusive $P(A \cap B) = 0$]

$= \frac{13}{30} + \frac{9}{30} - \frac{5}{30}$

$= \frac{17}{30}$

[∴ Algebraic meaning, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A \cap B) = 0$ only when A & B are mutually exclusive i.e. they are happening independently, there is no common.

Logical meaning, $P(A \cup B)$ or $A \cup B$ → while doing it here, if we are drawing 1 ♠ card, it can happen that it's ♠, namely while choosing ♠ card, it can happen that it's green & it's ♠ or it's i.e. we are adding same event is added for 2 times, so we are removing 1 time to eliminate that Double Counting.]

(7) A bag has 6 blacks, 4 red, 2 white & 3 blue shirts. Find the probability of drawing 2 blue shirts if they are picked randomly?

6B
4R
2W
3Bl

15 shirts

[Nothing is told about replacement → No replacement]

$P(A) = \frac{{}^3C_1}{{}^{15}C_1} \cdot \frac{{}^2C_1}{{}^{14}C_1}$ [∴ they haven't told that we're picking together, we normally take 1 by 1]

$= \frac{3}{15} \cdot \frac{2}{14}$

$= \frac{1}{7}$

(8) A box has 6 blacks, 4 red, 2 white & 3 blue shirts. What is the probability that 2 red shirts & 1 blue shirt get chosen during a random selection of 3 shirts from the box?

6B
4R
2W
3Bl

15 shirts

$P(A) = \frac{{}^4C_2 \cdot {}^3C_1}{{}^{15}C_3}$

$= \frac{6 \times 3}{\frac{15 \times 14 \times 13}{3}}$

$= \frac{3}{\ldots}$

$$= \frac{36 + 36 + 36}{15 \times 14 \times 13}$$

$$= \frac{18 \times 36 \times 3}{15 \times 14 \times 13}$$

$$= \frac{18}{455}$$

(4) [illegible]

∴ Given 3 random selection, then we can calculate $P(R)$ on taking 3 shirts at 1 random selection

$$P(R) = \frac{{}^4C_2 \times {}^3C_1}{{}^{15}C_3}$$

$$= \frac{6 \times 3}{455}$$

$$= \frac{18}{455}$$

Given, taking 3 no. of ways taking for → [illegible]

Given, - - - - - - 1 random selection → [illegible]

(5) A box has 6 blue, 4 red, 2 white & 3 blue shirts. What is the probability of taking at least 1 red shirt in 4 shirts taken one randomly

$P(\text{red})$

13 shirts

Picking atleast 1 R shirt in 4 shirts

$= 1R + 2R + 3R + 4R$

$$= \frac{{}^6C_1 \times {}^{13}C_3}{{}^{15}C_4} + \frac{{}^6C_2 \times {}^{13}C_2}{{}^{15}C_4} + \frac{{}^6C_3 \times {}^{13}C_1}{{}^{15}C_4} + \frac{{}^6C_4 \times {}^{13}C_0}{{}^{15}C_4}$$

$$= \frac{6 \times 11 \times 5 \times 3 + 6 \times 4 \times \frac{13}{2} + 6 \times 4 \times 13 + 15}{5 \times 7 \times 3 \times 13}$$

$$= \frac{23}{27}$$

(6) Picking atleast 1R from 4

$$\text{no } R = \frac{{}^{13}C_4}{{}^{15}C_4} = \frac{11 \times 3 \times 5}{5 \times 7 \times 3 \times 13} = \frac{22}{91}$$

$$\therefore P(R) = 1 - \frac{22}{91} = \frac{91 - 22}{91} = \frac{23}{27}$$

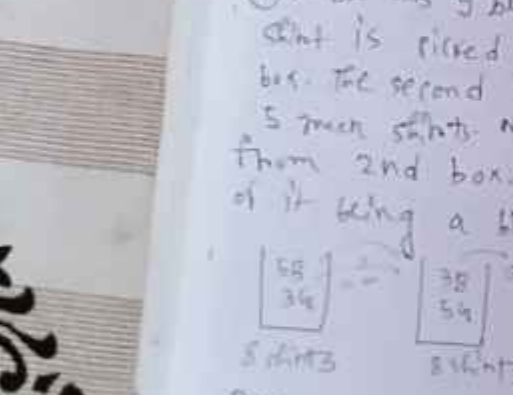
⑩ On rolling a dice 2 times, the sum of 2 numbers that appear on the upper surface is 8. What is the probability that the first throw of dice yields 4?

$P(A) =$ ~~$\frac{1}{6}$~~ finding 5 and 4

$= \frac{1}{6} \cdot \frac{1}{6}$

$= \frac{1}{36}$

⑪ A box has 5 black & 3 green shirts one shirt is picked randomly & put in another box. The second box has 3 black & 5 green shirts. Now a shirt is picked from 2nd box. What is the probability of it being a black shirt?



$P(A) =$ Picking B shirt from 1st box * picking a B shirt from 2nd box

$= \frac{5C_1}{8C_1} \cdot \frac{3C_1}{9C_1} = \frac{5}{18}$

$P(B) =$ picking 1 B shirt from 1st * picking 1 B shirt from 2nd

$= \frac{3C_1}{8C_1} \cdot \frac{3C_1}{9C_1}$

$= \frac{3}{24}$

$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{5}{18} + \frac{3}{24} - 0$ [$\because$ A & B are mutually exclusive, i.e they are independent events].

$= \frac{20+9}{72}$

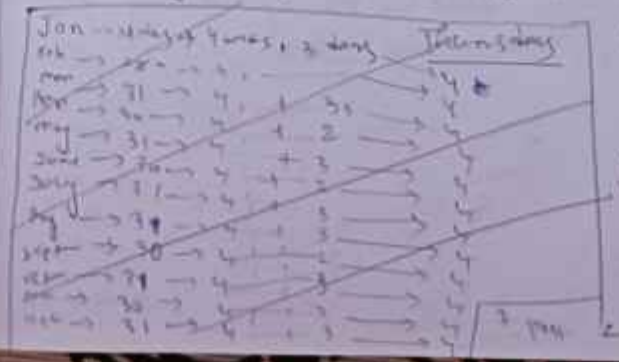
$= \frac{29}{72}$

$3 \,|\, 18, 24$
$2 \,|\, 6, 8$
$3, 4$

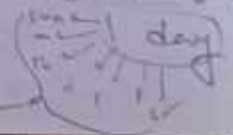
Imp

⑫ What is the possibility of having 53 Thursdays in a non leap year?

No leap year → Feb - 28 days



non leap year
↓
365 days
↓
52 weeks + 1 day



$P(A) = \frac{1}{7}$

[∵ from 52 weeks we are given 52 Thursdays, there are 1 day left. We can have 53 Thursdays if that 1 day is Thur, the P of the next day is Thur is $\frac{1}{7}$]

Other eg

(1) In a leap year, what is the prob. of getting the left 2 days as Tue-Wed?

366 days → 52 weeks & 2 days

7 poss. { (Sat-Sun), (Sun-Mon), (Mon-Tue), (Tue-Wed), (Wed-Thur), (Thurs-Fri), (Fri-Sat) }

∴ Prob of the given event = $\frac{1}{7}$

(13) In a drawer there are 4 white socks, 3 blue socks & 5 grey socks. Two socks are picked randomly. What is the probability that both the socks are of same color?

12 socks

$P(A) = \frac{4}{12_{c_1}} \cdot \frac{3}{11} + \frac{3}{12_{c_1}} \cdot \frac{2}{11} + \frac{5}{12} \cdot \frac{4}{11}$

[∵ no 2 random selection from the 1 bag]

[No replacement, so no replacement]

$= \frac{12 + 6 + 20}{12 \times 11}$

$= \frac{38}{\frac{12 \times 11}{6}}$

$= \frac{19}{66}$

(14) A = Both socks are not same colour

$= \frac{4}{12} \cdot \frac{8}{11} + \frac{3}{12} \cdot \frac{9}{11} + \frac{5}{12} \cdot \frac{7}{11}$

$= \frac{32 + 27 + 35}{12 \times 11}$

$= \frac{94}{\frac{12 \times 11}{6}}$

$= \frac{47}{66}$

$P(A) = 1 - \frac{47}{66} = \frac{19}{66}$

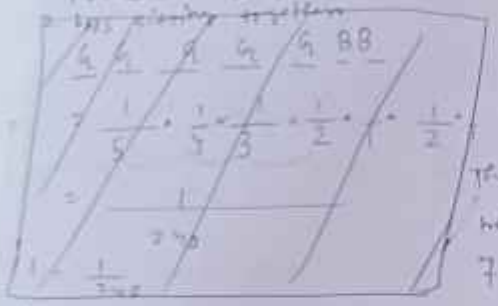
(15) What is the probability of drawing two clubs from a well shuffled pack of 52 cards?

$P(A) = \frac{13}{52} \cdot \frac{12}{51}$

$= \frac{1}{17}$

[nothing is mentioned so, no replacement & single step selection]

(15) What are the chances that no two boys are sitting together for a photograph if there are 5 girls & 2 boys? → Prob



5G + 2B = 7 children

The no. of ways we can arrange 7 children = 7!

In no. of ways 2 boys are sitting together

5G + (BB) 1 arr = 6

∴ 6!

In BB we can arrange 2 boys by 2! ways

∴ total ways = 6! × 2!

A = 2 boys are not sitting together

A + Ā = total [i.e. 1] [From Pg. 1 of the 3, take not 1 Rem]

Ā = sitting together + not sitting together = total

∴ A = total − sitting together

= 7! − 6! × 2!

= 6! × 5

$P(A) = \frac{6! \times 5}{7!} = \frac{5}{7}$

(OR) mine

A = 2 boys not sitting together

P(A) = 1 − P(Ā)

= 1 − (two boys sitting together)

$= 1 - \frac{6! \times 2!}{7!}$ $\left(\frac{\text{fav. we want}}{\text{total}}\right)$

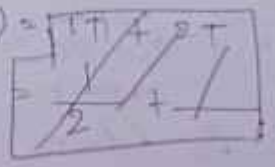
$= \frac{7! - 6! \times 2!}{7!}$

$= \frac{6! \times 5}{7!}$

$= \frac{5}{7}$

(16) When 2 coins are tossed simultaneously, what are the chances of getting at least one tail?

P(A) =



1T + 2T

$= \frac{1}{2} + \frac{1}{2} \cdot \frac{1}{2}$ (T, T)

$\frac{3}{4}$

no need

(OR)

P(Ā) = no T $= \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$ ∴ P(A) = 1 − $\frac{1}{4}$ = $\frac{3}{4}$

(2) possibilities = (H, H), (T, T), (H, T), (T, H)

$\therefore P(A) = \frac{3}{4}$

(18) Pipes & cisterns (1-2 hrs)

Tips & tricks

- just invert (like time & work)

$\boxed{N \rightleftarrows \frac{1}{N}}$

(1) pipe fills tank in 8 hrs,

$\therefore$ then in 1 hrs → $\frac{1}{8}$ part of tank is filled (just like time & work)

- when we invert

$T \xrightarrow{\text{empty}} W$

$W \longrightarrow T$

- whenever we are filling water we → add

" " removing " " → subtract

(1) Two pipes m & n can fill a tank in 22 hrs & 33 hrs respectively. In how much time will the tank be full, if both the pipes are opened simultaneously?

m → 22 hrs, 1 hr: $\frac{1}{22}$ part of tank is filled

n → 33 hrs, $\frac{1}{33}$ part of tank is filled

Both pipes are opened simultaneously,

$\therefore$ In 1 hrs,

$\frac{1}{22} + \frac{1}{33}$ (m can fill the tank $\frac{1}{22}$ part in 1 hrs, n " " " $\frac{1}{33}$ ")

$= \frac{33+22}{22 \times 33}$

$= \frac{55}{22 \times 33}$

$= \frac{5}{66}$ part of tank will be full

$\therefore$ The tank will be full in $\frac{66}{5}$ hrs, if both pipes are opened simultaneously

(2) pipe P can fill a tank in 38 hours. pipe Q so alone can fill it in 19 hours. pipe R can empty the full tank in 133 hours. If all the pipes are opened together, how much time will be needed to make the tank full?

P → Fill, 38 hrs, 1 hr: $\frac{1}{38}$ part of tank will be filled

Q → 19 " $\frac{1}{19}$ " " " "

R → empty, 133 " $\frac{1}{133}$ " " " " empty

If all of the pipes are opened,

P+Q+R

$= \frac{1}{38} + \frac{1}{19} - \frac{1}{133}$

$= \frac{38, 19, 133}{2, 1, 7}$

$= \frac{7+14+2}{28 \cdot 7}$

$= \frac{18}{28 \cdot 7}$

$= \frac{1}{14}$ amt of tank will be filled in 1 hr.

the tank will be full in 14 hrs.

(3) A tap can fill a tub in 24 hrs. Due to leak at the bottom of the tub, the tap fills the tub in 36 hours. If the tub is full, how much time will the leak take to empty it?

	Fill	1 hr
Tap	24 hrs	$\frac{1}{24}$ amt of the tub is filled
Tap + leak	36	$\frac{1}{36}$

$\frac{1}{24} - \frac{1}{x} = \frac{1}{36}$ (let the leak will empty it in x hrs) leaking in 1 hr

$\Rightarrow \frac{1}{x} = \frac{1}{24} - \frac{1}{36}$

$= \frac{36-24}{36 \cdot 24}$

$= \frac{12}{36 \cdot 24}$

$= \frac{1}{72}$

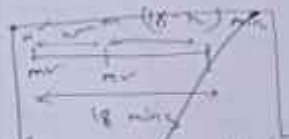
$x = 72$ hrs

P, Q & R filling the total amt of tank in 1 hr

(filling) (leaking) filling the total amt of tank in 1 hr

(4) Two pipes M & N can fill a tank in 22.5 & 15 minutes, respectively. If both the pipes are opened simultaneously, after how much time should N be closed so that the tank is full in 18 minutes?

	Fill	1 min
M	22.5 mins	$\frac{1}{22.5}$ amt of tank is filled
N	15	$\frac{1}{15}$



when N & M were opened together, they together can fill the tank,

$M + N$

$= \frac{10}{225} + \frac{1}{15}$

$= \frac{30+45}{45}$

$= \frac{75}{45}$

$= \frac{5}{3}$

$\frac{1}{3}$ amt of tank in 1 min

Let, after x mins N is closed

~~Pipe m is filling the tank alone.~~

~~In 1 min m can fill → $\frac{1}{25}$ amount of tank~~

~~the tank needs to be filled in 18 mins~~

~~∴ In 1 min → $\frac{1}{18}$ amt of tank should be filled~~

~~The m & n already filled $\frac{1}{5}$ amt of tank~~

~~left amt, now B to be filled $= \frac{1}{5} - \frac{1}{18}$~~

~~$= \frac{5-1}{18}$~~

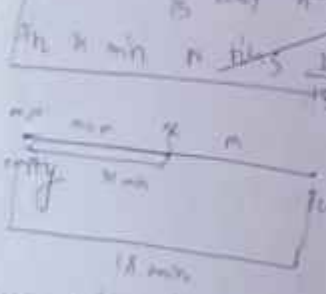
~~$= \frac{4}{18}$~~

~~has to fill it in (18-x) min~~

~~In 1 min n fills $= \frac{1}{18-x}$ amt of tank~~

~~$\frac{1}{15}$ amt of tank~~

~~In x min n fills $\frac{x}{15}$ amt of tank~~



~~Now, n is closed after x mins.~~

~~But, m & n at the end be for 18 mins~~

~~In 1 min m can fill $\frac{10}{225}$ amt of tank~~

$\therefore$ In 18 $\frac{10 \times 2}{225 \times 5} = \frac{4}{5}$ amt of the tank

$\frac{4}{5}$ amt of tank is already filled by m, so the left amt = total − already filled

$= 1 - \frac{4}{5}$

$= \frac{1}{5}$ amt of tank is left to be filled

This left amt is filled by only n, as we already have considered m (in time)

Now, n is on for x mins

In 1 min n fills $\frac{1}{15}$ amt of tank

In x ... $\frac{x}{15}$

$\therefore \frac{x}{15} = \frac{1}{5}$ [∵ n was on for x mins & in 1 min he can do $\frac{1}{15}$ amt of work & his work done is $\frac{1}{5}$]

$\therefore x = \underline{3 \text{ mins}}$

∴ n has to be closed after <u>3 mins</u>, so that the entire tank gets filled in 18 mins

(5) Pipe A can fill a tank 3 times faster than Pipe B & takes 32 minutes less than Pipe B to fill the tank. If both the pipes are opened together then in how much time

the tank would be full?

A = 5B (from the pair of workers)

A → x mins → 32 | B → x → 1/x amt

∴ A is 5 times faster than B — i.e., if B = 1, A = 5
B = 1 5 times slower than A — i.e., A = 1, B = 1/5

Here, A takes x − 32 mins
B " x
⇒ x − 32 = 5x
⇒ 4x = −32
⇒ x = −8 mins

∴ the ratio of time taken by B
B = 5A (∵ B is 5 times slower than A)
(∵ A takes 1 min, B takes 5 mins)

Here A takes x − 32 mins
B " x
x = 5x − 32

∴ A takes T min
B " 5T min

From Qn,

(5T − 32) = time taken by A

[∵ In the Qn 'time taken' is said so we did it from time taken' part]

⇒ 5T − 32 = T
⇒ 4T = 32
⇒ T = 8 min

∴ A = 8 min → 1 min → 1/8 amt
B = 5×8 = 40 " → 1/40 "

∴ the total time taken by them,

A + B
1/8 + 1/40
= (5+1)/40
= 6/40 amt in 1 min

∴ 40/6 min will be required by them

⑦ A tank has 3 taps P, Q & R. Taps P & Q can fill the tank in 1.5 & 2 hrs, respectively. Tap R can empty the completely filled tank in just half hour. Tap P is opened at 8 am, tap Q is opened at 9 am & the R is opened at 10 am. At what exact time will the tank be empty?

→ let the tank will be empty after T hrs.

∴ P is on for T hrs
Q " " (T − 1)
R " " (T − 2)

P → fill / 1.5 hrs → 1 hr / 3/2 amt of tank
Q → 2 " → 1/2 " " "
R → empty / 1/2 " → 2 " " "

empty empty

work done = 0

$W_P + W_B + W_R = 0$ [W = work done]

work done (simply) [work done = (pump (rate of work can it do)) × time]

W_P,

P fills

In 1 hr P fills $\frac{2}{3}$ amt of tank

$T \times \frac{2T}{3}$

$\therefore W_P = \frac{2T}{3}$

Like wise,

$W_B = \frac{T-1}{2}$, $W_R = 2(T-2)$

$\Rightarrow \frac{2T}{3} + \frac{T-1}{2} - 2(T-2) = 0$

$\Rightarrow \frac{4T + 3T - 3 - 12T + 24}{6} = 0$

$\Rightarrow 3T = 27$

$T = \frac{27}{5}$

$= 4.2$ hrs

$= 4$ hrs $+ 0.2$ hrs

1 hr → 60 mins

0.2 → $\frac{1}{5} \times 12$ min

∴ The tank will be empty after 4 hrs 12 mins (after P was on).

∴ R + 4 hrs 12 mins (∵ P was on at 8 am)

→ 12 pm 12 min

But this isn't correct

As we know that these 3 taps are filling & emptying the tank with those given flow. But we don't know about tank's capacity. i.e. it may happen that the tank is already filled & overflowing or the tank isn't full by P & B or maybe the tank is underflowing. I mean, we don't know what is tank's capacity. If the water is overflowing / underflowing / fully filled. Like this cases then we can't do it by formulas. In formula those cases i.e. when over/under flow happen, what we need to do is not considered. So we just need to understand & do it from our logic.

↓ with

P is opened at 8 am. (2 hrs before all three are opened together) & needs 1.5 hrs to fill the tank (i.e. ~~1 hr → $\frac{2}{3}$ of tank can be filled by P~~) P alone can fill the tank in 1.5 hrs + half from water is wasted).

At 9 am tap Q is opened (1 hr before all three are opened together) & needs 2 hrs to fill the tank; but since P can alone fill the tank, lets consider all the water of Q is wasted.

Now at 10 am tap R is opened & needs $\frac{1}{2}$ hrs to empty the tank.

At 10 am the tank is full & all of 3 taps are opened together.

Total work done by all 3 taps (in 1 hr)

$= \frac{36}{18} + \frac{1}{2} - 2$

$= -\frac{5}{6}$ (in 1 hr)

So, when all 3 taps are open together they will empty a filled tank in $6/5$ hrs i.e 1.2 hrs (1 hr 12 mins)

Therefore, the tank will be empty at 11:12 am

(7) A cistern can be filled in 6 hrs by taps P & Q. If tap R also joins them, then cistern is filled in 5 hrs. Tap P can fill the cistern at twice the rate of tap Q. In what time tap Q & R fill the cistern?

P & Q → 6 hrs → $\frac{1}{6}$ part of cistern

P+Q+R → 5 hrs → $\frac{1}{5}$ " " "

$\frac{1}{P} = 9$

$P + Q = \frac{1}{6}$

$\Rightarrow Q\left(\frac{P}{Q}+1\right) = \frac{1}{6}$

$\Rightarrow 2+1 = \frac{1}{6Q}$

$\Rightarrow 18 = 18$

Let's P alone can fill it in x hrs

Q " " " " y "

P " " " " z "

∴ In 1 hr

P → $\frac{1}{x}$ part of cistern

Q → $\frac{1}{y}$ " "

R → $\frac{1}{z}$ " "

The new P & Q together fill the cistern in 6 hrs (i.e in 1 hr → $\frac{1}{6}$ part of cistern)

∴ P + Q = $\frac{1}{6}$ (the work done by P & Q together in 1 hr)

$\Rightarrow \frac{1}{x} + \frac{1}{y} = \frac{1}{6}$ (∵ In 1 hr P does $\frac{1}{x}$ part of work, Q " $\frac{1}{y}$ " ") — (i)

Now, Similarly,

P + Q + R = $\frac{1}{5}$ — (ii)

$\Rightarrow \frac{1}{x} + \frac{1}{y} + \frac{1}{z} = \frac{1}{5}$

$\Rightarrow \frac{1}{6} + \frac{1}{z} = \frac{1}{5}$

$\Rightarrow \frac{1}{z} = \frac{1}{30}$

∴ R ~~does~~ fill the cistern in 30 hrs

[illegible] P can fill the cistern at twice the rate of Q

If P alone is 2 times faster than Q

So, we have that P is 2 times of Q

In 1 hr, ~~[illegible]~~

$P = 2Q$ [∵ P is 2 times faster than Q]

[So P can do 2 times more work than Q]

$\Rightarrow \frac{1}{k} = 2 \times \frac{1}{j}$ [Comparing by P: $\frac{1}{k}$, Q: $\frac{1}{j}$]

$\Rightarrow \frac{1}{k} = \frac{2}{j}$ — (ii)

From (i)

$\frac{2}{k} + \frac{2}{j} = \frac{1}{6}$

$\Rightarrow \frac{2}{j} + \frac{2}{j} = \frac{1}{6}$

$\Rightarrow \frac{4}{j} = \frac{1}{6}$

$\Rightarrow j = 24$

∴ P can fill it in 24 hrs

So,

$\frac{1}{24} + \frac{1}{30}$

$= \frac{5+4}{120}$

$\Rightarrow \frac{9}{120} = \frac{3}{40}$ hrs

$\Rightarrow \frac{120}{40} = 3$

(1) A cistern is fitted by pipe A & pipe B together in 3 hrs. Pipe A alone can fill the cistern at the rate of 120 litres per hour. Pipe B alone can fill the cistern in 4 hours. What is the capacity of the cistern?

A + B → $\frac{120}{3}$ litres, $\frac{120}{4}$

$\frac{x}{3}$ litres

A → 1 hrs $\frac{1}{3}$

$A + B = \frac{5}{12}$

$\Rightarrow \frac{1}{x} + \frac{1}{y} = \frac{5}{12}$

$\Rightarrow \frac{1}{x} = \frac{5}{12} - \frac{1}{3}$

$= \frac{5-3}{12}$

$= \frac{2}{12}$

6 hrs (2 can fill it)

So, B can fill the cistern only by alone 1 hr in this 120 lit

6 " " " 60 lit

Since it fill the cistern in 6 hrs, it is only 60 lit of litres that must be present

∴ the cistern is 60 lit

While R can empty a full tank in 30 hrs but two pipes P & Q can fill a tank in 15 hrs & 10 hrs respectively. Form unknown reasons all three taps after 2 hours stopped working & closed pipe R due to pipe mistake. How much time more would it take to fill the tank?

Total R $= \frac{1}{15} + \frac{1}{10} - \frac{1}{30}$

$= \frac{2+3-1}{30}$

$= \frac{2}{30}$ 15 part of cistern

~~P, Q & R together, tank is in $\frac{15}{2}$ hrs can fill in 2 hrs R is closed, now P & Q together can fill its~~

~~P+Q~~

~~$= \frac{1}{15} + \frac{1}{10}$~~

~~$= \frac{2+3}{30}$~~

~~$= \frac{5}{30}$~~

~~36 hrs~~

∴ P, Q, R can fill $\frac{2}{15}$ part of cistern in 1 hr

∴ In 2 hrs they can fill, $\frac{2 \times 2}{15}$

$= \frac{4}{15}$ part of ch

∴ The left part of cistern remains $1 - \frac{4}{15}$

$= \frac{11}{15}$

Now we know R is stopped & this left part will be filled by P & Q

P & Q together can fill ~~[illegible]~~

$= \frac{1}{15} + \frac{1}{10}$

$= \frac{1}{6}$ part of a cistern

Let, P & Q ~~was at~~ did the work in x hrs

∴ In 1 hr they can do $\frac{1}{6}$ part of work

∴ In x hrs they can do $\frac{x}{6}$

$\frac{x}{6} = \frac{11}{15}$

$\Rightarrow x = \frac{22}{5}$ hrs

$= 4.4$ hrs

∴ total time taken $= 2 + 4.4$

$= 6.4$ hrs (due to the mistake)

If the mistake wouldn't happen then P & Q would have done

P+Q $= \frac{1}{6}$ part of cistern;

i.e. in 6 hrs the cistern

$8 \cdot 4 = 6$

$= 0 \cdot 4$ hrs

$0 \cdot 4$ hrs more would be taken

$\frac{0 \cdot 4}{20}$ hrs

20 mins

(19) Arithmetic Progression (3-4 hrs)

• **Bases**

$a_1, a_2, a_3 \ldots a_n \longrightarrow$ A.P? or not

The only condition or the most imp condition for a series to be A.P is the consecutive difference / The diff. b/w the consecutive terms should be equal throughout the series. i.e

$a_1, a_2, a_3 \ldots a_n$ ($a_2 - a_1$, $a_3 - a_2$)

i.e $a_2 - a_1 = a_3 - a_2 = \ldots$ ~~from~~ $= a_n - a_{n-1}$

Common difference $= d$

Let's say, the 1st no of a series $= a$

In that case if the common diff. is d, the 2nd term will be $= a + d$

3rd " " $= a + 2d$

4th " " $= a + 3d$ ——

} as the diff is increasing & that is the common diff

So, a (1st), $a+d$ (2nd), $a+2d$ (3rd), $a+3d$ (4th) ——— $a+(n-1)d$ (nth term)

$\boxed{\text{the } n\text{th term } (a_n) = a + (n-1)d}$ $= T_n$

Also denoted as T_n i.e nth term of A.P

where, n = total no of terms in A.P

a = first term, a_n = n^{th} term (last term)

d = C.d.

$$\boxed{n = \frac{\text{last term} - \text{first term}}{d} + 1}$$

derived from this

Eg 1, 3, 5, 7, ... 15. Total no. of terms (n) in the series?

$a = 1$, C.d. $= 2$, $a_n = 15$

$\therefore n = \frac{15-1}{2} + 1$

$= 8$ (i.e 8th term is 15)

Crosscheck (8th term should be 15)

$\therefore a = 1$, C.d. $= 2$, $n = 8$

$a_n = 1 + (8-1) \cdot 2$

$= 15$

• **Sum of an A.P series**

$a, a+d, a+2d, a+3d, \ldots a+(n-1)d \longrightarrow n$ terms

$= a + (a+d) + (a+2d) + \dots + (a+(n-1)d)$

$= (a + a + a + \dots n \text{ times}) + (d + 2d + 3d + \dots (n-1)d)$

$= na + d(1+2+3+\dots(n-1))$

$= an + d \cdot \frac{(n-1)(1+(n-1))}{2}$

$= \boxed{an + \frac{d \cdot n(n-1)}{2}}$

[∵ the sum of natural nos. $1+2+3+\dots+n = \frac{n(n+1)}{2}$]

[Here $n = n-1$]

[$n = n$ and then n & $n-1$]

Sum of the series $= S_n$

$S_n = an + d \cdot \frac{n(n-1)}{2}$

$\boxed{S_n = \frac{n}{2}[2a + (n-1)d]}$

$= \frac{n}{2}[a + a + (n-1)d]$

$\boxed{S_n = \frac{n}{2}[a + a_n]}$

$\boxed{S_n = \frac{n}{2}(\text{first term} + \text{last term})}$

• Arithmetic mean (A.M)

If arithmetic series of odd no. of terms (say)

⊙ a (b) c → $\boxed{b = \frac{a+c}{2}}$ $\boxed{\text{A.M}}$

(Also, $a_1, a_2, a_3 \dots a_n$)

$\boxed{A.M = \frac{a_1 + a_2 + a_3 + \dots + a_n}{n}}$

⊙ Let's say the AP will be like,

a ——— b / last term

Insert n arithmetic means into these 2 given nos.

first term

$a, \underbrace{m_1, m_2, m_3, \dots, m_n}_{\text{considering}}, b$

$\boxed{C.d = d = \frac{b-a}{n+1}}$

(∵ If we know c.d we can get $m_1, m_2 \dots m_n$)

∴ 2nd term $= m_1$
$= a + d$

$m_1 = \boxed{a + \frac{b-a}{n+1}}$

$\boxed{\text{Sub} = a + (\text{say})d \Rightarrow \frac{b-a}{m_1} = d}$

∴ $m_2 = \boxed{a + \frac{2(b-a)}{n+1}}$

∴ $m_3 = \boxed{a + \frac{3(b-a)}{n+1}}$

∴ $m_n = a + (n-1)d$

(last term) $m_n = \boxed{a + \frac{(n-1)(b-a)}{n+1}}$

• Interesting thing about AP

1) $\boxed{\text{Add / substract a particular number}}$ from all the terms of an AP → the resulting series is again $\boxed{\text{An AP}}$

Eg

1, 3, 5, 7, ...
+2 +2 +2 +2 ....

↓

3, 5, 7, 9, ... (AP)
2 2 2

2) multiply / divide all terms of an AP by a constant $\xrightarrow[\text{series}]{\text{resultant}}$ An AP

eg. 1, 3, 5, 7, ——
×2 ×2 ×2 ×2

↓

2, 6, 10, 14, —— (AP)
4 4 4

3) Add a AP series $\xrightarrow[\text{series}]{\text{resulting}}$ An AP

eg. 3, 4, 6, 8, ——
+2, 6, 9, 12, ——

↓

5, 10, 15, 20, —— (AP)
5 5 5

① If 3rd & 7th terms of an AP are 13 & 29 respectively. Find the its first term

3rd term = $a+(3-1)\cdot d = 13$

$\Rightarrow a+2d = 13$ —— ① ×2

7th term $\Rightarrow a+6d = 29$ —— ⑪ ×2

$\therefore$ Contd = 114
$\Rightarrow 2a + 12d = 58$

$\Rightarrow 4a = 56$

$\Rightarrow a = 14$

$\therefore$ First term = 14

② 5th term of an AP is 7 while its 7th term is 17 - which of the following is its nth term?

i) $8n-20$ ii) $\frac{1}{2}\times(10n-36)$ iii) n^2-25 iv) none of the above.

5th term = 7
$\Rightarrow a+4d = 7$ —— ①

the term = 17
$\Rightarrow a+6d = 17$ —— ⑪

$a+4d = 7$
$a+6d = 17$
$\Rightarrow 2d = 10$
$\Rightarrow d = 5$

from ①
$\therefore a+4\times5 = 7$
$\Rightarrow a+20 = 7$
$\Rightarrow a = -13$

$\therefore$ nth term
$a+(n-1)d$
$= -13+(n-1)5$
$= -13+5n-5$
$= 5n-18$
$= \frac{1}{2}(2\times5n-2\times18)$
$= \frac{1}{2}\times(10n-36)$

(Verification)
i.e., the (i)n should satisfy the 5th term (7) & 7th term (17).

$t = 5n-18$
$= 5\times5-18$
$= 7$ (5th term) ✓

$5n-18$
$= 5\times7-18$
$= 17$ (7th term) ✓

other way (through options)

i) $6n - 30$
$= 8 \times 6 - 30$
$= 18$ (5th term) ✗

ii) $\frac{1}{2}(10n - 36)$
$= 5n - 18$
$= 5 \times 5 - 18$
$= 7$ (5th term) ✓

iv) $n^2 - 25$
$= 25 - 25$
$= 0$ (5th term) ✗

Some of the above ✗ as ∴ the → (ii) (the only satisfying)

⑥ The ratio of 2nd to 7th term of an AP is 1:3. 9th term is 9. Find 15th term. Find the sum of 18th's AP with 18 terms.

given, $\frac{\text{2nd term}}{\text{7th term}} = \frac{1}{3}$

$\Rightarrow \frac{a+d}{a+6d} = \frac{1}{3}$

$\Rightarrow 3a + 3d = a + 6d$

$\Rightarrow 2a = 3d$

$\Rightarrow a = \frac{3}{2}d$ — (i)

$= \frac{3}{2} \times 2$ (from (ii))

$= 3$

$\boxed{a = 3, d = 2}$

9th term

$\Rightarrow a + 3d = 9$

$\Rightarrow \frac{3d}{2} + 3d = 9$

$\Rightarrow 3d + 6d = 18$

$\Rightarrow 9d = 18$

$\Rightarrow d = 2$ — (ii)

∴ 15th term $= 3 + (15-1) \times 2$
$= 3 + 14 \times 2$
$= 31$

The AP series $= 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31$

1st way. $\frac{3+5+7+9+11+13+15+17+19+21+23+25+27+29+31}{15}$
$= 17$

2nd way (the way we get the mean of a series)

3, 5, 7, 9, 11, 13, 15, (17), 19, 21, 23, 25, 27, 29, 31

mean = 17
A.m = 17

$\frac{\text{1st term} + \text{last term}}{2} = \frac{3+31}{2}$
A.m = 17

3rd way (most solution)

Where ever there is a series of odd no. of terms the A.m is middle term.

Now, the middle of 15 terms = 8th term
(∵ A.m)

$= a_8$
$= a + 7d$
$= 3 + 7 \times 2$
$= 17$

(Here, the d is small as well as the series is of small nos so we can do 1st & 2nd methods but for long d & long no. of digits series, it will be most time consuming. So we'll always do this 3rd one.)

③ Find the value of 12th term of the AP whose 5th term is equal to 10 times its 10th term.

Given,

$\Rightarrow 5^{th}$ term $= 10 \times 10^{th}$ term

$\Rightarrow \frac{5}{2}[a + 4d] = 10 \times \frac{10}{2}[a + 9d]$

$\Rightarrow 3a + 12d = 5a + 45d$

$\Rightarrow 2a = -33d$

$\Rightarrow a = -16d$

12th term $= a + 11d$

$= -16d + 11d$

$= 0$

④ If $T_p = a$, $T_q = b$, $T_r = c$. What is the value of $a(q-r) + b(r-p) + c(p-q)$?

$\Rightarrow T_p = a$, $T_q = b$, $T_r = c$

pth term, qth term, rth term

$T_p = a$	$T_q = b$	$T_r = c$
$\Rightarrow a = x + (p-1)d = a$	$\Rightarrow x + (q-1)d = b$	$\Rightarrow x + (r-1)d = c$
$\Rightarrow \frac{a-x}{d} + 1 = p$	$\Rightarrow \frac{b-x}{d} + 1 = q$	$\Rightarrow \frac{c-x}{d} + 1 = r$

$\therefore a(q-r) + b(r-p) + c(p-q)$

$\Rightarrow a\left[\frac{b-x}{d} + 1 - \frac{c-x}{d} - 1\right] + b\left[\frac{c-x}{d} + 1 - \frac{a-x}{d} - 1\right] + c\left[\frac{a-x}{d} + 1 - \frac{b-x}{d} - 1\right]$

$= a \cdot \frac{b-c}{d} + b \cdot \frac{c-a}{d} + c \cdot \frac{a-b}{d}$

$= \frac{1}{d}[ab - ac + bc - ab + ac - bc]$

$= \frac{1}{d} \cdot 0$

$= 0$

⑤ 12th term of an AP is -10 & the sum of first 4 terms is 36. Find the first term & common difference.

Given, (i.e. $m = 12$)

$\Rightarrow$ 12th term $= -10$

$\Rightarrow a + 11d = -10$ — (1) $\times 2$

$\Rightarrow S_4 = 36$ (i.e. $n = 4$)

$\Rightarrow \frac{4}{2}[2a + 3 \cdot d] = 36$

$\Rightarrow 2a + 3d = 18$ — (11) $\times 1$

$24 - 22 = d = -20$

$26 - 24 = d = 18$

$\ominus \quad \ominus \quad \ominus$

$\Rightarrow 19d = -38$

$\Rightarrow d = -2$

from ①

$\Rightarrow a - 22 = 10$

$\Rightarrow a = 12$

(7) What is the greatest possible sum of the AP 23, 21, 19, ... ?

The AP series is 23, 21, 19, 17, 15, ... 53, 51, ... 3, 1, 5, ...

(-2, -2, -2) (decreasing)

~~If we want~~ It's a falling AP series. If we want to find the greatest possible sum, we need to find out the smallest positive no, as often that the nos will become 0 & that will give +sum i.e sum will get reduced. The smallest positive no here is 1 & as the series is of odd nos, the smallest positive is also an odd no.

If we want to get the greatest positive sum of that series (basically we don't know how many terms are there, some don't know what is the 11th term, so we can consider it as an series) we have to consider the series till 1 (as it we consider more, the sum will be reduced, as said earlier)

Now the series becomes,

23, 21, 19 ... 1

$\therefore$ the sum (i.e the greatest possible sum of the series) $= \frac{n}{2}(23+1)$ — ①

Now $n = \frac{1 - 23}{-2} + 1$

$= \frac{\cancel{-22}^{11}}{\cancel{-2}} + 1$

$= 12$

$\therefore$ from ①, $\frac{12}{\cancel{2}}(\cancel{24}^{12})$

$= 144$

~~Alt method~~

(8) $1 + 3 + 4 + 5 + 7 + 7 + 10 + 51$ ... 60 terms?

(The qn is, a series is given, ~~the~~ upto 60 terms what is the sum of the series (S_n)?)

$1 + 3 + 4 + 5 + 7 + 7 + 10 + 51$ ... 60

1st we need to check it's an AP or not (while this type of sum will be given, we need to check it 1st).

~~we can write it like~~ It's a mixup of 2 series ~~1 + 4 + 7 + 10 + ... + 60~~ (3 series, 1 + 3 + 4 + 5 + 7 + 7 + 10 + 51 ... 60)

[Add consecutive 2 terms]

$S = 4 + 9 + 14 + 19 + \ldots$ — 25 terms

So (∵ we are adding terms / terms 2 and 1 are 5 apart)

$\therefore S_n = \frac{n}{2}[2a + (n-1)d]$

$= \frac{25}{2}[8 + 24 \times 5]$

$= 12.5[8 + 145]$

$= 12.5 \times 153$

$= 1912.5$

(a) First term of an AP is 3. The sum of first 5 terms is equal to 1/4 of the sum of next five terms. What is the 25th term?

Given,

$a = 3$

Sum of 1st 5 terms $= \frac{1}{4}$ sum of next 5 terms

$\frac{5}{2}[2 \times 3 + 4 \times d] = \frac{1}{4} \times \frac{5}{2}[2a + 4d]$

1st 5 terms

Next 5 terms

$\Rightarrow 6 + 4d = \frac{1}{4} \times 2(a + 2d)$

Hence 25 terms for S5 considered where next term to the 25th term there are 20 terms

i.e. 25th term

$\Rightarrow 12 + 8d = a + 2d$

$\Rightarrow a - 6d = 12$

the sum of 25 terms

$\Rightarrow S_5 =$

Here,

$a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}$ (there are total 10 terms given in the info about 10 terms, so we consider the series till 10th term)

S_5 $\quad S_{10} - S_5$

$\Rightarrow S_5 = \frac{1}{4} \times (S_{10} - S_5)$

$\Rightarrow 4S_5 = S_{10} - S_5$

$\Rightarrow 5S_5 = S_{10}$

$\Rightarrow \frac{5}{2}[2 \times 3 + 4 \times d] = \frac{10}{2}[2 \times 3 + 9d]$ [∵ a = 3 given]

$\Rightarrow 5[6 + 4d] = 2[6 + 9d]$

$\Rightarrow 30 + 20d = 12 + 18d$

$\Rightarrow 2d = -18$

$\Rightarrow d = -9$

$\therefore a_{25}$ or $T_{25} = 3 + 24 \times -9$

$= 3 - 216$

$= -213$

(10) Sum of 3 nos in an AP is 18. Sum of their squares is 158 what is the smallest no?

Here we'll take the 3 terms as =

$a-d,\ a,\ a+d$ (In general we take them like $a,\ a+d,\ a+2d$ —)

(∵ if we take them like this we will not be able to check them like this.)

now, $a-d+a+a+d=18$ (given)

$\Rightarrow 3a=18$

$\Rightarrow a=6$ —(1)

now, $(a-d)^2+a^2+(a+d)^2=158$ (given)

$\Rightarrow a^2-\cancel{2ad}+d^2+a^2+a^2+\cancel{2ad}+d^2=158$

$\Rightarrow 3a^2+2d^2=158$

$\Rightarrow 3\times 36+2d^2=158$ (from (1))

$\Rightarrow 108+2d^2=158$

$\Rightarrow 2d^2=50$

$\Rightarrow d=\pm 5$

now, the terms are,

1, 6, 11 ← (considering +5)

11, 6, 1 ← (considering −5)

In both cases the smallest no is 1, so the smallest no is 1.

(11) What is the sum of nos in nth row of the following series?

1

2 3 4

5 6 7 8 9

(more nos)

i) n^2+1, ii) $(n)^2-1$, iii) $n^3+(n-1)^3$

1 → sum = 1

2 3 4 → sum = 9

5 6 7 8 9 → sum = 35

∴ we try that my data get fitted into these columns

[n = no of rows]

i) n^2+1 (∵ sum of the nth row is that that the eqn should satisfy for each of rows i.e. each n vals, n = (1, 2 ... n))

1st → $1+1=2$ ✓

2nd → $(2)^2+1$ = 5 ✗ (not satisfying)

ii) $(n)^2-1$

1st → $(2\cdot1)^2-1$ = 2 − 1 = 1 = 1 ✓

2nd → $(2\times2)^2-1$ = 16 − 1 = 15 ≠ 9 ✗ (not satisfying)

iii) $n^3+(n-1)^3$

1st → $(1)^3+(1-1)^3$ = 1 = 1 ✓

2nd → $(2)^3+(2-1)^3$ = 8 + 1 = 9 = 9 ✓

3rd → $(3)^3+(2)^3$ = 27 + 8 = 35 = 35 ✓ (satisfying)

∴ $n^3+(n-1)^3$ → nth row

Sol (22) Read problems on numbers → numbers system → Problems on numbers

[3 - 4 Jan 3]

• Important note

Understand the Pr → find the eqn

↓

Find ans

① The sum of 2 numbers is 36 & their product is 248. What will be the sum of their reciprocals.

$a + b = 36$

$ab = 248$

$b = \frac{248}{a}$ — (1)

(from (1))

$a + \frac{248}{a} = 36$

$\Rightarrow a^2 + 248 = 36a$

$\Rightarrow a^2 - 36a + 248 = 0$

$\frac{36 \pm \sqrt{(-36)^2 - 4 \cdot 1 \cdot 248}}{2 \cdot 1}$

$\frac{248}{31}$

$2 \mid 248$
$2 \mid 124$
$2 \mid 62$
31

$a + b = 36$

$ab = 248$

$\frac{1}{a} + \frac{1}{b} = \frac{a+b}{ab} = \frac{36}{248} = \frac{9}{62}$

② In a poultry farm having hens & pigs, Pohan can see 84 heads & 282 legs. How many hens are there?

H → 1 head, 2 legs

P → 1 head, 4 legs

$H + P = 84$ — (I)

$2H + 4P = 282$

$\Rightarrow H + 2P = 141$ — (II)

$H + P = 84$ — (I)

$H + 2P = 141$ — (II)

$\Rightarrow -P = -57$

$P = 57$

$H = 84 - 57$

$= 27$

1 hen → 2 legs

H ... → 2 H

$\frac{141}{-84}$
57

③ Summation of 5 consecutive numbers is found out to be 335. If we add the largest & smallest no. what will we get?

$(x) + (x+1) + (x+2) + (x+3) + (x+4) = 335$

$\Rightarrow 5x + 10 = 335$

$\Rightarrow 5x = 325$

$\Rightarrow x = 65$

$\therefore (x) + (x+4) = 265 + 4$

$= 134$

Consecutive no's: 5, 6, 7, 8, 9 (in 11)

$\frac{65}{+69}$
134

3 (a) Since Raj wasn't paying attention in class, instead of multiplying m by 3/4, he divided by 3/4. This led to a difference of 14. Given the 2 answers, what is the value of m?

$$\left(m \times \frac{3}{4}\right) - \left(\frac{m}{\frac{3}{4}}\right) = 14$$

$$\Rightarrow \frac{3m}{4} - \frac{4m}{3} = 14$$

$$\Rightarrow \frac{9m - 16m}{12} = 14$$

$$\Rightarrow -7m = 14 \times 12$$

$$\Rightarrow m = \underline{24}$$

(Raj didn't know which number is greater)

(b) Raman has 2 urns. Both these urns have some pebbles. If 20 pebbles from urn B are shifted to urn A then, the no. of pebbles in each urn become interchanged. But if 10 pebbles from urn A are put into urn B, then number of pebbles in B are thrice the no. in A. How many pebbles do A & B have respectively?

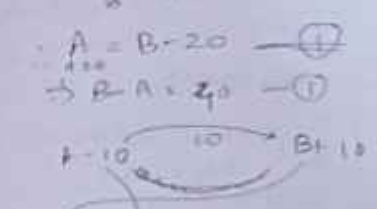
Initially

On shifting the no. of pebbles, each urn become interchanged

A B
↓ ↓
B A

$\therefore A_{ini} = B - 20$ — (I)

$\Rightarrow B - A = 40$ — (I)



$\Rightarrow B + 10 = 3(A - 10)$

$\Rightarrow B + 10 = 3A - 30$

$\Rightarrow 3A - B = 40$ — (II)

$-A + B = 40$ — (I)

$3A - B = 30$ — (II)

$\Rightarrow A = 70$

$-70 + B = 40$

$\Rightarrow B = 110$

$\therefore A = 70,\ B = 110$

(c) On exchanging the digits in unit's & ten's place, the difference b/w original & new no.s become 27. The digit in the unit's place is 2 times the digit in the hundred's place. The digit in the ten's place is 3 times the digit in the

Q. Rajendra's place. What is 75% of the original number?

original no = x

new no = y

x − y = 27 — (1)

given,

197H − 123H = 27

⇒ 74H = 27

⇒ H = 3

∴ U = 6

T = 9

∴ HTU (original no) = 396 ⇒ 75% of = 396 × 75/100 = 297

original no = H + U

= (H × 100 + T × 10 + U × 1) — (1)

U = 2H, T = 3H } applicable for both original & new

from (1) H × 100 + 3H × 10 + 2H × 1

= 132H (original no)

Now, H × 100 + T × 10 + U × 1

exchange

⇒ H × 100 + U × 10 + T × 1 — (ii)

from (ii), H × 100 + 2H × 10 + 3H × 1

= 123H (new no)

Q. In an area 2% families have 5 children each. But 8% have no children at all. Amongst the rest of the families 18% have 4 children & 27% have only one child. How many families live in the area, if 297 families have either 2 or 3 children each?

If there are 100 families, the data says

27% + 8% = 10% ⟶ either no children or 5 children

(100 families)

Hence 100 − 10 = 90%

rest of 100 families = 90 families

18% − 12% = 45% of 90 (4 or 1)

= 45/100 × 90 = 67.5 families

Rest either 2 or 3

~~90 − 45 = 45% of 90~~

90 − 67.5 = 22.5 families

Now,

100 ⟶ 22.5

? ⟶ 297

$\frac{100 \times 297}{22.5} = 1320$

$\frac{90}{100} \times 90 = \frac{81}{2} = 40.5$

100 ⟶ 40.5

? ⟶ 297

$\frac{100 \times 297}{40.5} = 733$

Let the no. of families = x

families with no / 1 / 2 / 3 children

18 + 2 + 18 + 27 %

= 55 %

Total = 100 %

Rem = 45 %

Rem families have 2/3 children

Families with 2/3 = 55 %

= 45 %

Then,

45% of x = 297

⇒ 45x = 297

⇒ x = 660

② 3/4 Part of tank is full of water when 30 liters of water is taken out it becomes empty. The capacity of the tank is?

~~whole tank = 1~~

~~tank = 3/4, empty = 1/4~~

~~tank capacity = x~~

~~then, 1/4 = 30~~

i.e the tank has 30 lit free, i.e 3/4 of the tank is full of 30 lit water.

3/4 → 30 lit

1 → ?

3/4 × ? = 30

⇒ ? = 40 lit (capacity = how much water the tank can contain)

mine

3/4 → 30

1/4 → ?

1/4 × 30 = 3/4 × x

⇒ x = 10

∴ 30 + 10 = 40 lit (tank capacity)

⑤ A group wanted to renovate their club. Each members contributed an amount equal to twice the no. of members in the club. But the government contributed same

11. Amount as the no. of members. If each members had contributed the same amount as the no. of members & the government had given an amount while the no. of members, then they would have Rs. 216 less. How many members are there?

x - members

amt contributed by 1 member $= 2x$

x — $= 2x^2$ } total amt $2x^2+4$

g — govt $= 2x$

If $x-1$ — mem $= x^2$

— govt $= 2x$ } total amt x^2+2x

Given $(x^2+2x)+216 = 2x^2+4$

$\Rightarrow x^2 - x - 216 = 0$

$\frac{1 \pm \sqrt{1+4\times 216}}{2\times 1}$

$= \frac{1 \pm \sqrt{865}}{2}$

$= \frac{1 \pm 29}{2}$

$x = 15$ $x = -14$ ✗ (not possible)

10. Two digit no. A is formed by reversing the digits of B. B is 45 less than A. The sum of the digits of B is 9. What is A?

B: $T\ U$ A: $T\ U$

$S(10\times T + U = 1)$ $(10\times U + T = 1)$

Given $T + U = 9$ — (1) & 9

$B + 45 = A$

~~$\Rightarrow 10T + U - 10U - T = 45$~~

$\Rightarrow A - B = 45$

$\Rightarrow 10U + T - 10T - U = 45$

$\Rightarrow 9U - 9T = 45$ — (11) ÷1

$9U + 9T = 81$

$9U - 9T = 45$

$\Rightarrow 18U = 126$

$\Rightarrow U = \frac{126}{18} = 7$

$\therefore T = 2,\ U = 7$

$\therefore A = UT = 72$

(10) 280 oranges are divided among some boys & girls whose total number is 50 so that each boy gets 5 oranges & each girl get 7 oranges the number of girls is?

$B + G = 50$ — (I)

B → 5	Girl → 7
1B → 5	1G → 7
B → 5B	G → 7G

$5B + 7G = 280$ — (II) (given)

$B + G = 50$ — (I) × 5

$5B + 7G = 280$ — (II) × 1

$5B + 5G = 250$

$5B + 7G = 280$

$2G = 30$

$G = 15$ ∴ $B = 35$

Problems on Trains (1-2 hrs)

• Formula

D, S, T → D: S T ⟹ D: T S

D = S × T

T = D/S

S = D/T

• Types

D same
T "
S "
Rel S

Trains Sums → 1) length of the train is distance travelled will be considered

2) length of pole, car, man etc = 0 (by default)

If mentioned some map any other units then only consider it.

3) Relative speed

Whenever it's said the train is travelling 45 km/hr this is respect to stationary obj

Speed of obj 1 in relation to obj 2 or vice versa = Relative speed

• when we are trying to find out the speed or velocity of a moving object in relation to another moving obj.

• Relative speed

Normal speed of an obj

car → (moving)

↑ (not moving)

stationary obj

∴ speed is related to stationary obj = normal speed

↳ Relative speed of an obj

car1 → moving

car2 → moving

→ Relative speed

∴ speed is related to moving obj → Relative speed

• 2 moving obj —find out→ Relative speed

2 concepts

• train (speed) → T_1 ← train (speed) T_2

Relative speed of T_1 WRT T_2 = $x+y$

opposite dir → (+) added

train (speed) → T_1

train (speed) → T_2

relative speed of T_1 WRT T_2 = $x-y$

same dir → (−) on subtract

Q 2 trains with lengths 126 m & 119 m respectively are moving towards e/o their speeds are 12 m/s & 23 m/s, respectively what will be the time needed by the trains to cross e/o?

T_1 126 → 12 m/s ← 119 T_2 23 m/s

The trains will completely cross e/o

T_2 ← T_1

Distance travelled by T_1 = T_2'l distance = 119 m

T_2 = T_1's = 126

∴ total distance travelled = $T_1 + T_2$ = 119 + 126 = 245 m

• while 2 trains are crossing e/o & it asked how much total distance is travelled by trains → addition of their lengths

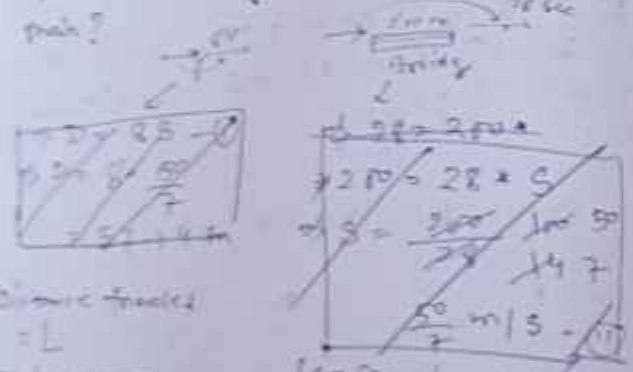
total speed = 15 + 20

= 35 m/s

$T = \frac{245}{35}$

$= 7 sec$

Q. A train passes a stationary pole in 8 seconds the train also passes a 200 m long bridge in 28 seconds. find its length & the speed of the train?



Distance travelled = L

Time taken = 8

So ?

Bridge are diff, so speed must be same, attaining the same train, so it's have same speed.

Length of the train has to be included in distance travelled.

200 + L = Distance travelled

28 S = Time taken

So ?

$S_P = S_B$

$\frac{L}{8} = \frac{200+L}{28}$

$7L = 400 + 2L$

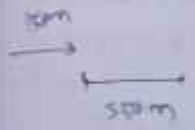
$5L = 400$

$L = 80 m$

$\therefore L = 80 m$

$S_P = S_B = \frac{80}{8} = 10 m/s$

Q. A train having length 150 m passes a platform of 550 m length. The time taken in it is 56 seconds. In how much time will this train take to pass the platform of 250 m length?



D = 150 + 550

T = 56

$S = \frac{700}{56} = \frac{25}{2} m/s$

L = 150, P_L = 250

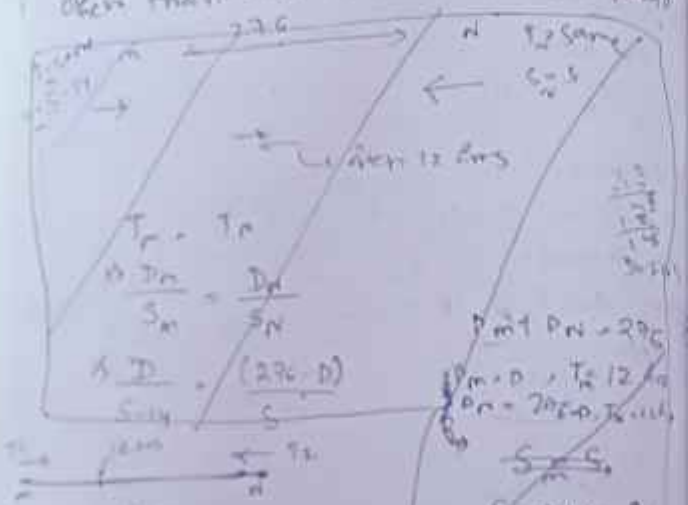
$T = \frac{150+250}{25/2}$

$= \frac{400 \times 2}{25}$

$= \frac{160}{5}$

$= 32 s$

(11) Stations m & n are 276 apart. At the exact same time, a train starts from m & other from n towards m & n respectively. They trains meet after 12 hrs. The train travelling from m to n is slower by 14 km/hr in comparison to the other train. What is speed of slower train?



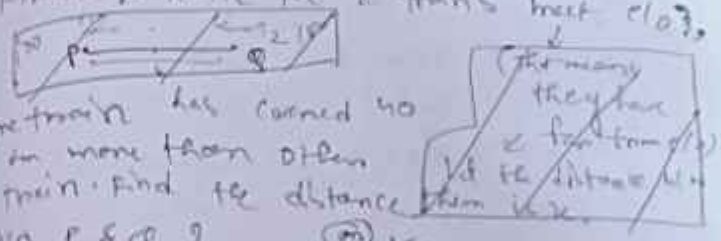
$\Rightarrow 2x + 14 = 23$

$\Rightarrow 2x = 9$

$\Rightarrow x = \frac{9}{2}$ km/hr

$= 4.5$ km/hr

(3) From P & Q, two trains start moving towards each other at the same time. Their speeds are 120 km/hr & 100 km/hr respectively. When the 2 trains meet each other, the train has covered 40 km more than other train. Find the distance b/w P & Q.



$\Rightarrow t_1 = t_2$

$\Rightarrow \frac{x+40}{120} = \frac{x}{100}$

$\Rightarrow 6x = 5x + 200$

$\Rightarrow x = 200$

Distance b/w P & Q = 200 + 40

= 440 km

(2) 2 trains A & B leave Kolkata for Sikkim at 8:00 pm & 8:30 pm respectively run at 30 km/hr & 120 km/hr respectively. At what distance from Kolkata will the 2 trains meet?

Distance same for both

$3 \times T = 4 \times (T - \frac{1}{2})$

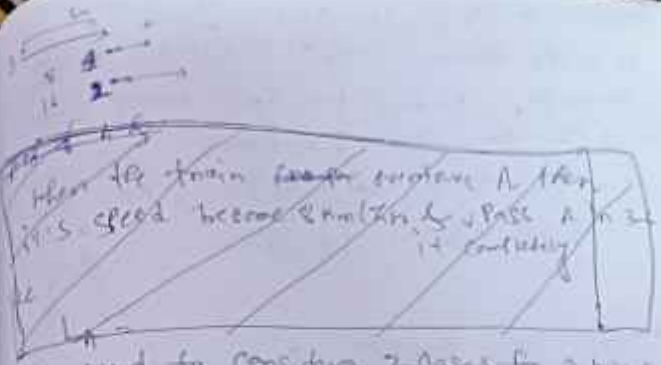
$\Rightarrow 3T = 4T - 2$

$\Rightarrow T = 2$ hrs

$T_A = 2$ hrs, $T_B = 2 - \frac{1}{2}$
$= \frac{3}{2}$ hrs

$D_A = D_B = x = 90 \times 2$
$= 180$ km

(3) A train overtakes 2 boys who are moving at the rate of 8 km/hr & 16 km/hr in the same direction as the train. The train completely passes them in 36 seconds & 40 seconds respectively. What is the length of the train?



Then the train ~~[illegible]~~ overtake A 1 km/hr. It's speed become 8 km/hr & pass A in 36 sec completely

We need to consider 2 cases for 2 boys

$D = D$ (from both cases the train is maintaining length)

$\Rightarrow x \times T_1 = S_2 \times T_2$ [let speed of train = S, find from the speed is relative speed $S_1 = S - 8$, $S_2 = S - 16$]

$\frac{1}{5}(S - 8) \times \frac{36}{60 \times 60} = (S - 16) \times \frac{40}{60 \times 60}$

$\Rightarrow 5S - 72 = 80 - 160$

$\Rightarrow S = 88$ km/hr

~~Distance of train = S~~

Distance travelled by train (D) = length of train (L)

$= (88 - 8) \times \frac{36}{60 \times 60}$

$= 80 \times \frac{36}{60 \times 60}$

$= \frac{4}{5} = 0.8$ km or 800 m

① With stoppage, the speed of a train is 36 km/hr. However without stoppage, it is 40 km/hr. Find out for how many times does the train stop for hour?

Let's the train travels for 1 hr

∴ if stoppage it covers = 36 km

if no — — — = 40 km

Because of stopping the train is wasting time

The time the train is wasting = The time which it is stopping

$T = \frac{4}{40}$ → (Always we have to take the ideal / good speed (i.e, the speed while not not stopping)

$\Rightarrow T = 0.1$ hr

$\therefore 0.1 \times 60 = 6$ min

② There are 2 trains P & Q like that, & moving in same direction. They are of equal length & crosses stationary pole in 5 sec & 6 sec respectively. In how much time would they cross each other?

Here, $T = \frac{D}{R.S}$

P → $\frac{L}{5}$

Q → $\frac{L}{6}$

when they cross e/o the distance travelled = $L_a + L_n$ (∵ crossing)

$= L + L$

$= 2L$

P → $S_P = \frac{L}{5}$ | $S_Q = \frac{L}{6}$

$R.S = \frac{L}{5} - \frac{L}{6}$

$= \frac{L}{30}$ (~~If get (-) ans, then it's implying direction neglig.~~)

$T = \frac{2L \times 30}{L}$

$= 60$ sec (if get (-) then neglect it, as we don't know which one is greater)

② Resonation & Geometry

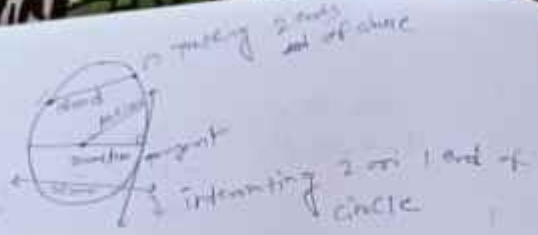
① Which of the following statement is incorrect in regard to a circle?

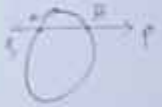
i) Every chord is secant ✗ (3 independent sets)

ii) Every secant is chord ✗

iii) Secant is technically not a chord, but it contains a chord ✓

iv) Every secant line defines a unique chord ✓

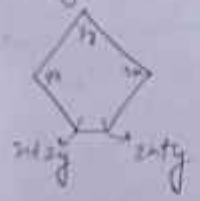




AB → chord
A, B → Secant
AP → secant
BP → secant

- Chord & Secant are 2 independent sets & mutually exclusive (no relation) ∴ mig I & II - Incorrect

② If the expression shown are the degree measures of the angle if the pentagon fitted the value xty.



Common angle
Extension
Equation & Inequation
Poly gone - (concept)

- Pentagon & algon

Interior angle (angles inside) Sum = $(n-2) \times 180°$ [n = no. of sides]

Free regular polygon [all sides & angles are equal]

(sum of all angles)

If not regular → Irregular

Individual angle = $\frac{(n-2) \times 180}{n}$ (for regular ply)

∴ Int what 3x + x+2y + x+y = (5-2) × 180°

⇒ 12x + 10y = (5-2) × 180

⇒ 10(x+y) = 540°

⇒ x+y = 54

③ one angle of a regular polygon measures 177° This polygon has total on 'n' sides, 'n' is a multiple of which the following numbers?

given, $\frac{(n-2) \times 180}{n} = 177$

⇒ 180n − 360 = 177n

⇒ 3n = 360

⇒ n = 120

∴ It's the multiple of 3, 5, 12, i.e

All of the above

(iii) 1 angle → 177°

there are n angles

∴ 177n = (n-2) × 180 (sum of all angles)

(4) Find the sum of the measures of one interior & one exterior angle of a regular 540-gon.

- A: Interior angle
  B: Exterior angle

$A + B = 180°$

$\boxed{\text{Interior + corresponding exterior} = 180°}$

↳ valid for all polygons $\boxed{\text{Regular + irregular}}$

$\boxed{\text{Any interior + any exterior} = 180°}$

↳ valid only for $\boxed{\text{regular polygons}}$

$n = 540°$

It's Regular ∴ any interior + any exterior = 180°

∴ 180°

(5) What is the measure of the radius of the circle inscribed in a triangle whose sides measure 8, 15 & 17 units?

→ $\boxed{\text{Incircle}}$ (touching 3 sides of tri)

Inradius

- r : inradius

$\boxed{r = \frac{\text{area of } \Delta}{\text{Semi perimeter of } \Delta}}$

$\boxed{\text{Semi-perimeter} = \frac{\text{Perimeter}}{2}}$

$\boxed{\text{Perimeter} = a + b + c}$

$\boxed{\therefore S = \frac{a+b+c}{2}}$

$a = 8,\ b = 15,\ c = 17$

$S = \frac{a+b+c}{2}$

area of Δ

Heron's formula

$\boxed{A(\text{area}) = \sqrt{S(S-a)(S-b)(S-c)}}$

$\boxed{S = \frac{a+b+c}{2}}$

$S = \frac{a+b+c}{2} = \frac{8+15+17}{2} = \frac{40}{2} = 20$

$A = \sqrt{20(20-8)(20-15)(20-17)}$

$= \sqrt{20 \times 12 \times 5 \times 3}$

$= \sqrt{3600}$

$= 60$

$r = \frac{60}{20} = 3$

• For right angle Δ (1 side, 1 perpendicular, 1 hypotenuse) (1 angle 90°)

perimeter = $b + p + h$

$= \frac{b+p+h}{2}$

r = inradius $= \frac{\text{area}}{\text{semi perimeter}}$

$= \frac{\frac{1}{2} \times b \times p}{\frac{b+p+h}{2}}$ (p = altitude, b = base)

$$\boxed{r = \frac{bp}{b+p+h}}$$

Direct formula for RΔ

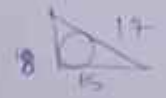
$$\boxed{r = \frac{b+p-h}{2}}$$

Eg

$13^2 = 169$

$15^2 + 8^2 = 289$

$\therefore$ It's a right angle Δ



$\therefore r = \frac{8+15-17}{2}$

$= \frac{6}{2} = 3$

(or) $r = \frac{b \times p}{b+p+h}$

$= \frac{8 \times 15}{8+15+17}$

$= \frac{120}{40} = 3$

Q. What is the measure of the radius of the circle inscribed in a triangle whose sides measure 8, 15, 17 units?

For equilateral Δ (all sides are same)

ΔBCR

$a^2 = h^2 + \left(\frac{a}{2}\right)^2$

$\Rightarrow h^2 = a^2 - \frac{a^2}{4}$

$\Rightarrow h^2 = \frac{3a^2}{4}$

$\Rightarrow h = \frac{\sqrt{3}a}{2}$

$$\boxed{\text{height of equilateral } \Delta = \frac{\sqrt{3}a}{2}}$$

Now, from equilateral Δ,

r (inradius) $= \frac{\text{area}}{\text{semi-perimeter}} = \frac{\frac{\sqrt{3}}{4} \times a^2}{\frac{a+a+a}{2}}$

$= \frac{\sqrt{3}a^2 \times a}{2 \times 3a \times \sqrt{3}}$

$$\boxed{r = \frac{a}{2\sqrt{3}}}$$

$h = \frac{\sqrt{3}a}{2}$

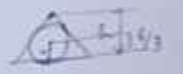
$\Rightarrow a = \frac{2h}{\sqrt{3}}$

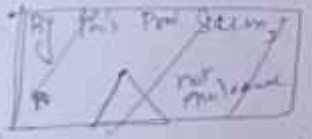
$\therefore r = \frac{\frac{2h}{\sqrt{3}}}{2\sqrt{3}}$

$= \frac{h}{3}$

$\boxed{r = \frac{h}{3}}$

In radius of circumscribed $\triangle$ = $\frac{\text{height of it}}{3}$





(6) Find the radius of the circle inscribed in the triangle ABC, having sides 10 cm, 10 cm, 12 cm.

not multiplied

Having right angle or not

$12^2 = 256$

$10^2 + 10^2 = 200$

$r = \frac{\text{area } (\Delta)}{\text{semi-p } (s)}$

$s = \frac{10 + 10 + 12}{2}$

$= \frac{36}{2}$

$= 18$

$\therefore A = \sqrt{18(18-10)(18-10)(18-12)}$

$= \sqrt{18 \times 8 \times 8 \times 6}$

$= \sqrt{2 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3}$

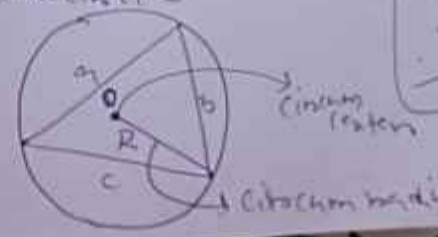
$= 2 \times 2 \times 2 \times 3 \times 2 \times 2$

$= 48$

$\therefore r = \frac{48}{18} = \frac{8}{3}$

$= 2.66$

• Circum circle



$$R\,(\text{circumradius}) = \frac{\text{Product of sides of } \Delta}{4 \times \text{area of } \Delta}$$

$$R = \frac{abc}{4 \times A} \qquad (A = \text{area of } \Delta)$$

• For right angle Δ

$$R = \frac{a \cdot b \cdot c}{2 \cdot \frac{1}{2} \cdot a \cdot b \cdot c} = \frac{a}{2} = \frac{\text{hypotenuse}}{2}$$

• Equilateral Δ

$$R = \frac{\text{Product of sides}}{4 \times A} = \frac{a \cdot a \cdot a}{4 \cdot \frac{\sqrt{3}}{4} a^2}$$

$$R = \frac{a}{2\sqrt{3}}$$

$$R = \frac{\text{side}}{\sqrt{3}}$$

Q) Find the radius of the circle ~~that~~ ~~out~~ where a triangle ABC is inscribed, having sides 10, 10, 16 cm.

ABC → not Equilateral, not right angle

normal case → $R = \frac{10 \times 10 \times 16}{4 \times A}$ (circumradius)

$$= \frac{\cancel{10} \times \cancel{10} \times \cancel{16}^{4}}{\cancel{4} \times \cancel{3}\cancel{8}_{16}} \qquad 16 \div 3$$

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

$$= 8.33$$

Elementary Statistics

• n items arranged in ascending / descending order –

i) n → odd, median $= \left(\frac{n+1}{2}\right)^{th}$ term

ii) n → even, median $= \frac{\left(\frac{n}{2}\right)^{th} + \left(\frac{n}{2}+1\right)^{th}}{2}$ term

• If median n → odd, median → In b/w the two given terms

n → even, median → may / may not be in the given terms

• mode

↳ term with most occurrance s

(or)

term having highest freq

eg: 5 5 6 3 5

mode = 5

• mode will be definitely from these given terms

• mean may / may not from the given terms

① The heights (in cm) of 9 students of a class are as follows

155 160 149 150 147 152 149 148 145

Find the median of this data.

144 145 147 148 149 150 152 155 160

↓ median = 149

A dog has 5 puppies the weights of the puppies right after they were born. Their weights were 657 grams, 770 grams, 589 g, 635 g & 446 g. What was the mean weight of the puppies?

589 5 657 4 770 3 635 2 446 1

(ascending)

$$\text{mean} = \frac{\text{observations sum}}{n} = \frac{\text{Int}}{n}$$

∴ mean × n = ~~Sum~~ Int (not decimal)

589 · 6 + 6 = Int (from other options, we've got Int)

② Find the mode of the following set of numbers -

25 27 36 32 41 22 28 33 44 51 31 32

= 3 2

③ In 50 numbers 10 are threes, 15 are ~~fours~~ fours, 18 are fives, & remaining are sixes. If a, b, c respectively represent the mean, mode & median of data, what is the value of a+2b−c?

~~a = 10 (threes), b = 15 (fours), c = 18 (fives)~~

~~Ans = 7 (5.x)~~

~~a = mean~~ $= \frac{3+6}{2} = 3$ | ~~b = median~~ $= 4$ | ~~c = mode~~ $= 5$

~~a + b − c~~

~~$= 3 + 8 - 5$~~

10 (three)
15 (five)
18 (five)
7 (six)

$\therefore a(\text{mean}) = \frac{10 \times 3 + 15 \times 4 + 18 \times 5 + 7 \times 6}{50}$

$= \frac{30 + 60 + 90 + 42}{50}$

$= \frac{222}{50} = \frac{444}{100} = 4.44$

b (median) =
n = 50 (even)

$\frac{\frac{n}{2} + \left(\frac{n}{2}+1\right)th}{2} = \frac{25th + 26th}{2}$

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

$= \frac{9}{2}$

$= 4.5$

c (mode) = 5

~~$\frac{a+b-c}{2} = \frac{113}{2} = 5 - 5 = 113.5$~~

$\therefore a + b - c$

$= 4.44 + 2 \times 4.5 - 5$

$= \cancel{8.35}\ 8.94$

3) Given mean = 66, mode = 60, find median

- $\boxed{3 \times \text{median} = \text{mode} + 2 \times \text{mean}}$

$3\,\text{med} = \frac{60 + 2 \times 66}{3}$

$= \frac{60 + 132}{3}$

$= \frac{192}{3}$

$= 64$

4) If the ratio of mode & median of a distribution is 6:5, then the ratio of it's mean & median is?

$\frac{mo}{med} = \frac{6}{5} = 1.2$ | $\frac{me}{med} = ?$

∵ a mode is need to be distinct ultimately, $\boxed{50 \times 1}$

2 mo = 6
med = 5

$me = \frac{3 \times 5 - 6}{2} = \frac{9}{2} = 4.5$

$\therefore \frac{me}{med} = \frac{4.5}{5} = \frac{9}{10}$ 9:10

② Identify the statement which is not true?

a) It is possible to have mean, mode & median for a given data set?

b) We can't have more than 1 mean, one median & one mode for a given data set.

c) mean, mode, median has to be a value from given data set.

d) All the above are not true.

③ The salary in pieces of 10 employees in a company per day is 50, 55, 60, 65, 70, 72, 75, 80, 82, 89.
What is the standard deviation in the above data?

- $\boxed{\begin{array}{l} sd = \sigma = \sqrt{var} \\ var = \sigma^2 \end{array}}$

- $\boxed{\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{n}}}$

  x_i → no.; var; n → total obs.; μ → mean

- $\mu = \frac{50 + 55 + 60 + 65 + 70 + 72 + 75 + 80 + 82 + 89}{10}$

  $= \frac{700}{10}$

  $= 70$

$\sigma = \sqrt{\frac{(20)^2 + (15)^2 + (10)^2 + (5)^2 + 0 + (2)^2 + (5)^2 + (10)^2 + (14)^2 + (19)^2}{10}}$

$= \sqrt{\frac{400 + 225 + 100 + 25 + 4 + 25 + 100 + 196 + 361}{10}}$

$= \sqrt{\frac{1436}{10}}$

$= \sqrt{143.6}$

$\sigma = 11.983$ (var = 143.6)

④ The mean of a set of data is 5. What will be the mean of ten is subtracted from each?

- $\boxed{\text{Effect of mean} \mid \text{Effect of avg}}$ (i.e. 0)

$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = 5$ — (1)

$\frac{(x_1 - 10) + (x_2 - 10) + \dots (x_n - 10)}{n} = ?$

$\bar{x}' = \frac{(x_1 + x_2 + \dots x_n) - 10n}{n}$

$\bar{x}' = \cancel{\frac{5 - 10n}{n}}$ $\quad \frac{x_1 + x_2 + \dots x_n}{n} - 10$

$= 5 - 10$

$= -5$

(9) If [illegible] avg 24 & 7 is added with the data, [illegible] outlook

new avg = $\boxed{24 + m}$

Simply for $\boxed{+} \to \boxed{x + m}$

$\boxed{-} \to \boxed{x - m}$

$\boxed{/} \to \boxed{x / m}$

∴ In our sum 5 − 10 = −5

(10) With what value should the lightest quality in the data: (5) 52, 18, 26, 18, 35, 37, 38 be replaced so that the mean & median become equal? (a) 61, (b) 60, (c) 50, (d) 53

altered mean = $\frac{65 + 52 + 18 + 26 + 18 + 35 + 37 + 38}{8}$

$\frac{289}{8} = \frac{280}{8}$

median = $\frac{35 + 37}{2}$ = 36

mean = 36

$\frac{x + 215}{8} = 36$

x + 215 = 268

x = 53

(Q) will not be changed as the letting any value be replaced

means 33, med = 33.5

so med score (always) & given mean = med

∴ mean = 33.5

now mean need to reduced as it's 35 now.

so how much we need to reduce mean in the we need

35.0
33.5
1.5

∴ 1.5 ~~need to reduce~~ will be reduced to get 33.5

now if mean is reduced by 1.5, that implies from each data points 1.5 is reduced (∵ effect of mean)

∴ 8 data points

1 → 8 1.5 reduced

8 → 8 × 1.5

⟩ 12 = total reduction

Now → ans = The val. which we need to replace — total reduction

∴ 65 − 12 = 53

(11) If the mean of 26 obs is 29. & on adding four more obs, the new mean becomes 32. what is the mean of the last four obs?

$\frac{S_{26}}{26} = 29$

$\Rightarrow S_{26} = 29 \times 26$

Now,

$\frac{S_{26} + S_4}{30} = 32$

$\Rightarrow 29 \times 26 + S_4 = 32 \times 30$

$\Rightarrow S_4 = 32 \times 30 - 29 \times 26$

$= 960 - 754$

$= 206$

$\therefore S_4 = 206$

$\therefore A_4 = \frac{S_4}{4} = \frac{206}{4} = \underline{51.5}$

(12) Pipes & cisterns

- It is same as time & work, time & wages
- $\boxed{n \longrightarrow \frac{1}{n}}$
- Pipe pipes work in chain
  - 2m 1 hr $\longrightarrow \frac{1}{8}$ part of tank is filled

  i.e. $\boxed{\begin{array}{l} 1 \longrightarrow 2m \\ 2m \longrightarrow 1 \end{array}}$
- filling $\rightarrow +$

  Removing $\rightarrow -$
- $\boxed{P + (-P) = \text{filling the total part of tank in 1 hr}}$

  filling removing
- $\boxed{\text{Tap} - \text{leak} = \text{Filling the total part of tank in 1 hr}}$

  (filling) (removing / leaks)
- If in the qn, time taken on any different pov is given, then solve the ans by that method i.e. that pov
- $\boxed{\text{While doing sums, verify it belonging to not from this topics, but from any topic}}$