

## Ratio and proportion

$\rightarrow P$  is to  $Q \rightarrow P:Q$

$\rightarrow a:b = c:d \rightarrow a/b = c/d$  (proportion)

$\rightarrow \frac{a}{b} > \frac{c}{d}$  if  $ad > bc$  then  $\frac{a}{b} > \frac{c}{d}$   
 if  $ad < bc$  then  $\frac{a}{b} < \frac{c}{d}$

$\rightarrow \frac{a}{b} = \frac{c}{d}$  the componendo rule would be

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

$\rightarrow$  the dividendo rule would be  $\frac{a-b}{b} = \frac{c-d}{d}$

$\rightarrow$  the c-d rule would be  $\frac{a-b}{ab} = \frac{c-d}{cd}$

$\rightarrow \frac{a}{b} = \frac{c}{d} \Rightarrow \frac{b}{a} = \frac{d}{c}$  (invertendo)

$\rightarrow a:b:c$  a, c are extremes and b is mean

$\rightarrow a:b:c \Rightarrow a:b::b:c$

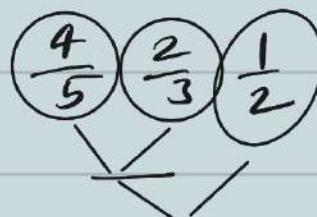
$\rightarrow a:b:c:d \Rightarrow a:b::c:d \Rightarrow \frac{a}{b} = \frac{c}{d}$

1) which of the following two ratios is greater

17:18 and 10:11

$\frac{a}{b} = \frac{c}{d}$      $\frac{17}{18} \quad \frac{10}{11}$      $17 \times 11 \quad 18 \times 10$  so,  $17/18$  is greater  
 $187 > 180$

$\rightarrow$  for three ratio's



2) the 3rd proportional to 18 and 54

$a:b:c$   
 st ↑ ↑ ↑ 3rd  
 d

$$\frac{a}{b} = \frac{b}{c} \Rightarrow b^2 = ac$$

$$54 \times 54 = 18 \times c \Rightarrow c = 162$$

3) The 9<sup>th</sup> proportional in 9, 13 and 153

$$a:b:c:d \leftarrow 9^{\text{th}}$$

1st ↑      9 ↑      2nd ↑      10th ↑      221

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

$$ad = bc \Rightarrow 9 \times 221 = 13 \times 153$$

4) Find the mean proportional between 7 and 63

$$a:b:c \quad \frac{a}{b} = \frac{b}{c} \Rightarrow b^2 = ac \quad b^2 = 7 \times 63 \Rightarrow b = 21$$

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

$$\frac{10+11+21+12}{13+28+11+11} = k = \frac{6}{7}$$

6) Income ratio of Ramesh and Suresh is 5:6

The spending ratio is 7:9. Ramesh saves Rs.

4000 and Suresh saves Rs. 3000. Income and

spending respectively of Ramesh and Suresh

are

I Ratio: 5:6

Income = spending + saving

Actual I Ramesh = 5k      spend = inc - saving

Actual I Suresh = 6k      spend<sub>S</sub> = 5k - 4000

$$\frac{5k - 4000}{6k - 3000} = \frac{7}{9}$$

$$\text{spend}_S = 6k - 3000$$

$$42k - 21000 = 95k - 36000$$

$$I_R = 5 \times k = 25,000 \quad 3k = 15000 \Rightarrow k = 5000$$

$$I_S = 6 \times k = 30,000$$

$$8k - 3000 = \text{spending}_S$$

$$I_R - 4000 = \text{spending}_R$$

7)  $a:b = 3:7$  and  $b:c = 9:5$  what is  $a:b:c$

$$a:b: \begin{matrix} b:c \\ \backslash / \\ \text{not same} \end{matrix} \quad (3:7) 9 \Rightarrow 3 \times 9 : 7 \times 9 \\ (9:5) 7 \Rightarrow 9 \times 7 : 5 \times 7$$

$$27:63 \quad 63:35 \Rightarrow a:b:c = 27:63:35$$

8) How to divide 3395 in ratio of 42:32:23

$$\text{1st method} - \frac{42}{42+32+35} \times 3395 \Rightarrow 1470$$

$$- \frac{32}{42+32+35} \times 3395 \Rightarrow 1120$$

$$3395 - 1470 + 1120 \Rightarrow 805$$

$$\text{2nd method} \quad 42+32+23 = 3395$$

$97k = 3395$  and then find the parts by multiplying  $k$  respectively

9) 285 is summation of 3 numbers? Ratio b/w 1st and 2nd and 3rd numbers is 6:5, ratio b/w 1st and 2nd numbers is 3:7 the 3rd number is

$$\text{1st: 2nd} = (3:7)6 \quad \text{2nd: 3rd} = (6:5)7 \\ 18:42 \quad 42:35$$

$$a:b:c = 18:42:35$$

$$\text{3rd number will be } 35 / (18+42+35) \times 285 \Rightarrow 105$$

10) Ratio of two numbers is 3:8 - on adding 5 to both numbers the ratio becomes 2:5 which is the smallest number of the two?

$$A:B = 3:8 \quad A=3K \quad B=8K$$

$$\frac{3K+5}{8K+5} = \frac{2}{5} \Rightarrow 15K+25 = 16K+10 \Rightarrow K=15$$

small -  $3 \times 15 \Rightarrow 45$

(1) Find  $a:b:c:d$  when  $A:B=2:3$ ;  $B:C=7:9$   
and  $C:D$  is  $5:7$

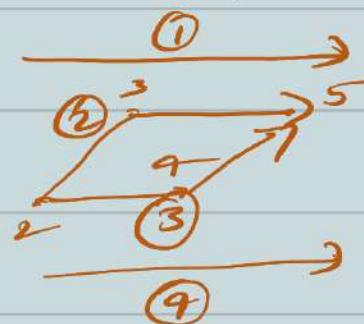
$$\frac{2}{3} = \frac{14}{9} = \frac{5}{7} \quad A : B : C : D \\ 70 : 105 : 135 : 189$$

for first value multiply numerators and denominators to get the last value

to get second value go from 2nd to next and then go parallel ( $2 \rightarrow 3 \rightarrow 5$ )

to get third value go from 2nd to parallel and then next ( $2 \rightarrow 4 \rightarrow 5$ )

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



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

(2) Price of each article of type P, Q, R is RS. 300

RS. 180 RS. 120 respectively. suraj buys articles of each type in ratio  $3:2:3$  in RS. 6980. How many articles of type Q did he purchase?

$$RS\ 6980 \quad P \quad Q \quad R \quad 900K + 360K + 360K = 6980$$

$$300 \quad 180 \quad 120$$

$$1620K = 6980 \Rightarrow K = 4$$

$$\begin{array}{ccc} 3K & 2K & 3K \\ \downarrow & \downarrow & \downarrow \\ 900K & 360K & 360K \end{array} \quad 2K = 4 \times 2 = 8 \text{ particles}$$

of  $Q$

- 13) Ajay and Raju together have Rs. 1050 on taking Rs 150 from Ajay, Ajay will have some amount as what Raj had earlier. Find the ratio of amounts with Ajay and Raj initially.

Initially - A's, R's       $A + R = 1050 -$

$$A - 150 = R$$

$$A - R = 150 \Rightarrow 2A = 1200$$

$$A : R \Rightarrow 600 : 450 \\ \Rightarrow 4 : 3$$

$$A = 600, R = 450$$

- 14) If  $x:y = 3:4$  then  $(7x+3y):(7x-3y)$  equals

1st method     $\frac{x}{y} = \frac{3}{4} \quad \frac{7x+3y}{7x-3y} = \frac{7(3)+3(4)}{7(3)-3(4)} = \frac{11}{3}$

2nd method     $\frac{x}{y} = \frac{3}{4}$  change it to the format

$$\text{multiply by } 7 \Rightarrow \frac{7x}{y} = \frac{21}{4}$$

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

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

- 15) If  $a:b$  is  $5:7$  and  $c:d$  is  $2a:3b$  then  $ac:bd$

$$\frac{a}{b} = \frac{5}{7} \quad \text{①} \quad \frac{c}{d} = \frac{2a}{3b} \quad \text{②} \quad \text{multiply ① and ②}$$

$$\frac{a}{b} \times \frac{c}{d} = \frac{5 \times 2a}{7 \times 3b} \Rightarrow \frac{ac}{bd} = \frac{10a}{21b} \quad \frac{ac}{bd} = \frac{10 \times 5}{21 \times 7} = \frac{50}{147}$$

$$ac : bd \Rightarrow 50 : 197$$

(6) the three numbers are in the ratio is  $1/2 : 2/3 : 3/4$ . the difference between greatest and smallest number is 36. Find the numbers

$$1/2 : 2/3 : 3/4 \quad (\text{smallest}) \quad (\text{greatest})$$

$$k/2 : 2k/3 : 3k/4 \Rightarrow 0.5k, 0.666k, 0.75k$$

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

$$k/2 \Rightarrow 36 \times 4/2 \Rightarrow 72$$

$$2k/3 \Rightarrow 2 \times 36 \times 4/3 \Rightarrow 96$$

$$3k/4 \Rightarrow 3 \times 36 \times 4/4 \Rightarrow 108$$

(7) The ratio of market price of wheat and paddy is 2:3 and the ratio of quantities consumed in a family is 5:4. Find ratio of expenditure of wheat and paddy

$$P_w : P_p = 2:3 \quad w_c : p_c = 5:4$$

$$P_w = 2k \quad w_c = 5a$$

$$P_p = 3k \quad p_c = 4a$$

expenditure<sub>w</sub> = Rate  $\times$  quantity consumed  
expenditure<sub>p</sub> = Rate<sub>p</sub> quantity consumed<sub>p</sub>

$$= \frac{2k}{3k} \times \frac{5a}{4a} \Rightarrow \frac{10}{12} \Rightarrow \frac{5}{6}$$

$$ex \propto R \text{ and } ex \propto V \Rightarrow \frac{e_1}{e_2} = \frac{R_1 \times w_1}{R_2 \times w_2}$$

18) 8500 is divided among A, B, C and D in such a way that the shares of A and B, B and C and C and D are in the ratios of 2:3, 4:5 and 6:7 respectively. The share of A is

$$A:B = 2:3 \quad B:C = 4:5 \quad C:D = 6:7$$

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

$$A:B:C:D \\ 48:72:90:105$$

$$A = \frac{48}{48+72+90+105} \times 8500 \Rightarrow 1280$$

after ratios

(1) In a library, the ratio of number of story books to that of non-story books was 4:3 and total number of story books was 1298. When some more story books were brought the ratio becomes 5:3. Find the number of story books brought.

$$\frac{SB}{NSB} = \frac{4}{3} \quad \frac{1298}{NSB} = \frac{4}{3} \Rightarrow NSB = 936$$

$$\frac{1298+n}{936} = \frac{5}{3} \Rightarrow n = 312$$

### Mixtures and allegations

Cheap - Goods

To get Ratio of Quantities

Costlier - Goods

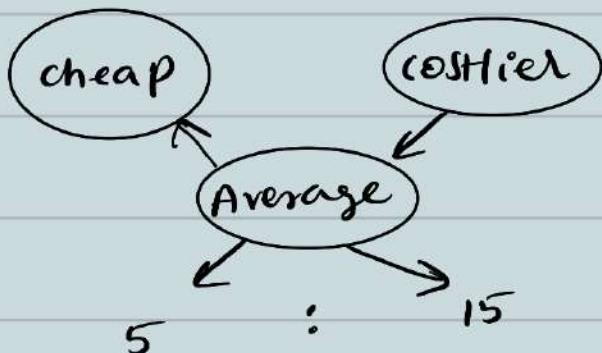
If (costly > average) Subtract

Average - Goods

If (cheap < average) Subtract

$$80 - 75 \rightarrow 5$$

$$75 - 60 \rightarrow 15$$



$$x \left(1 - \frac{R}{2}\right)^t$$

x - initial

R - Removed

t - no. of times

so, Ratio of cheap : costlier is 5 : 15

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(1) One can is completely filled and contains 100% water. Another similar can is completely filled with a solution of 50% wine and 50% water. When both the cans are emptied in a steel vessel, what will be ratio of water to wine in the vessel?

can 1 = 100l water

can 2 = 50l wine + 50l water

100l + 50l : 50l  $\rightarrow$  3 : 1

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(2) Resultant price of mixture of golden rice is Rs. 480 per kg. This mixture is made from two varieties of golden rice which are having price of Rs. 420 per kg and Rs. 520 per kg. What should be ratio of quantities of both types of golden rice?

420                    520  
    \                  /  
    980  
    \                  /  
40 :        60  $\rightarrow$  2 : 3 (cheap : costly)

(3) A mixture consists of some amount of sandalwood oil and 240 litres of water. It is priced at Rs. 275 per litre. Sandalwood oil is priced Rs. 325 per litre. How much oil is there in the mixture?

if price of water is not given take ORS/L

$$\begin{array}{c} \text{ORS} \quad 325 \text{ PS} \\ \swarrow \quad \searrow \\ 275 \text{ R} \\ \swarrow \quad \searrow \\ 50 : 275 \Rightarrow 2 : 11 \end{array}$$
$$\frac{2}{11} = \frac{240}{x}$$
$$x = \frac{120}{\frac{240 \times 11}{2}}$$
$$x = 1320 \text{ l}$$

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(4) How much milk should be added in a milk solution to make milk quantity in it 75%, if 80 L of milk solution has 45% milk in it?

$$80 \text{ L} \rightarrow 45 \text{ l}$$

$$80 \times \frac{45}{100} \rightarrow 36 \text{ L (milk)}$$

80+x → solution

$$36+x \rightarrow \text{milk}$$

$$36+x = \frac{75}{100} \times 80+x \quad 36 \times \frac{4}{9} + \frac{x}{9} = 240 + 32$$
$$x = 240 - 19 \rightarrow 96 \text{ l}$$

(5) A pot contains 40 litres of juice. How much juice will be there in the pot, if 4 litres of juice was removed and was replaced by water and this process was again repeated twice?

40 l juice or water

① 4 l juice removed  $\rightarrow 40 - 4 = 36 \text{ l juice}$

② 4l of mixture (Because juice and water mixed)  
 initially they are in ratio  $x:y$  if we remove some  $Q$  quantity of mixture the removed  $Q$  quantity of mixture will be in the ratio  $x:y$

$$J = \frac{36}{36+40} \times 4 = 3.6 \text{ l Juice was removed}$$

$$4 - 3.6 = 0.4 \text{ l water was removed}$$

$$\text{Juice} - 36 \text{ l} - 3.6 \text{ l} \rightarrow 32.4 \text{ l juice}$$

$$\text{water} - 4 \text{ l} - 0.4 \text{ l} + 4 \text{ l} \rightarrow 7.6 \text{ l water (as)}$$

$$90 \text{ l} - 32.4 \text{ l} \rightarrow 7.6 \text{ l water}$$

$$32.4 \text{ l juice} : 7.6 \text{ l water} \rightarrow 32.4 : 7.6$$

$$J = \frac{32.4}{32.4+7.6} \times 4 \rightarrow 3.24 \text{ l juice was removed}$$

$$32.4 - 3.24 \text{ l} \rightarrow 29.16 \text{ l juice present}$$

$$90 \text{ l} - 29.16 \text{ l} \rightarrow 10.84 \text{ l water present}$$

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(6) One glass has juice and water in the ratio  $5:2$  while other glass has them in ratio  $7:4$ , respectively. If both glasses poured in a vessel, then what will be final ratio of water to juice in the vessel?

$$1^{\text{st}} \text{ glass} \rightarrow 5:2 \quad J = \frac{5}{7} \quad w = \frac{2}{7}$$

$$2^{\text{nd}} \text{ glass} \rightarrow 7:4 \quad J = \frac{7}{11} \quad w = \frac{4}{11}$$

$$\text{vessel} \rightarrow J+w \rightarrow \frac{5}{7} + \frac{7}{11} : \frac{2}{7} + \frac{4}{11}$$

$$\frac{55+99}{77} : \frac{22+28}{77}$$

$$\frac{50}{77} : \frac{104}{77} \rightarrow 25:52$$

(7) Ramesh mixes 60 litres of Type-1 acid with some litres of Type-2 acid. Type-1 acid rate is Rs. 32 per litre while Type-2 rate is Rs. 23 per litre. Ramesh sells this acid-mix at rate Rs. 28 per litre. How much Type-2 acid is needed to make it a no profit no loss transaction?

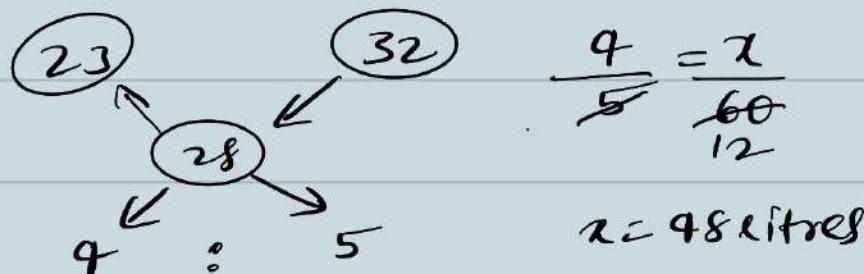
Type 1	Type 2	
60L	5L	$60 \times 32 + 5 \times 23 = 28(60+5)$
$\times 32$	$\times 23$	

no profit or loss

$$60 \times 32 + 5 \times 23 = 28(60+5)$$

$$60 \times 32 + 23S = 60 \times 28 + 28S$$

$$\frac{60(4)}{12} = 28S \Rightarrow S = 48 \text{ litres}$$



(8) In a mixture of 90 L the ratio of acid and water is 2 : 1. If the ratio of acid and water is to be 1 : 2, then the amount of water (in litres) to be added to the mixture is?

logic

$$90L \rightarrow 2:1 \quad \frac{90 \times 2}{3} \rightarrow 60 \text{L acid}$$

$$A:W \rightarrow 1:2 \quad 30 \text{L water}$$

$$\frac{1}{2} = \frac{60}{x} \rightarrow x = 120 - 60 = 90 \text{ litres}$$

(9) 3 types of Sugar got mixed by accident in a shop. First was of the rate Rs. 145 per kg and Second of Rs. 165 per kg. Only thing the shop owner knew that quantities of 3 sugar types were in the ratio 2:1:3 respectively. He finally sold the mix at rate of Rs. 180 per kg. What was price of 3rd type?

Ques. ②

1st	2nd	3rd	Average
P = ₹ 145	₹ 165		₹ 180
Q = 2	1	3	
2K	1K	3K	6K

if not given profit or loss then take as no profit and no loss

$$\begin{aligned}
 145 \times 2K + 165 \times K + x \times 3K &= 180 \times 6K \\
 290 + 165 + 3x &= 1080 \\
 3x &= 1080 - 290 - 165 \\
 3x &= 625 \\
 x &= \frac{625}{3} \text{ Rupees}
 \end{aligned}$$

(10) A mixture of two food items has a salt to sugar ratio of 7 : 32. The ratio of salt to sugar is 2 : 11 and 5 : 21, in the two individual types of food items. In what proportion are the 2 food items mixed?

Type 1	Type 2
$\frac{2}{13}$	$\frac{5}{26}$

$$\frac{1}{39} \leftarrow \begin{array}{c} \swarrow \\ \frac{5}{26} - \frac{7}{39} \end{array} \quad \begin{array}{c} \searrow \\ \frac{7}{39} - \frac{2}{13} \end{array}$$

$$\frac{5 \times 39 - 7 \times 26}{26 \times 39}$$

$$\frac{13(15-14)}{26 \times 39} = \frac{1}{78}$$

$$\frac{7 \times 13 - 2 \times 39}{39 \times 13}$$

$$\frac{7-6}{39} = \frac{1}{39}$$

$$\frac{1}{78} : \frac{1}{39} \rightarrow 1:2$$

(11) A solution of honey and water is 28 litres, with honey and water in ratio 4:3. To this a 21 litre honey-water solution is added that has honey to water ratio as 2:1. Again a 51 litre honey-water solution that has honey to water ratio as 9:8 is added to this. After this 10 litre of the solution is replaced with pure honey. What is ratio of water to honey in the final mixture?

$$28l \rightarrow H:W \rightarrow \frac{9}{7} \times 28; \frac{3}{7} \times 28 \rightarrow 16l; 12l$$

$$21l \rightarrow H:W \rightarrow \frac{2}{3} \times 21; \frac{1}{3} \times 21 \rightarrow 14l; 7l$$

$$51l \rightarrow H:W \rightarrow \frac{9}{17} \times 51; \frac{8}{17} \times 51 \rightarrow 27l; 24l$$

$$\text{Total mixture} \rightarrow 28 + 21 + 51 \rightarrow 100l$$

$$\text{Total honey} \rightarrow 16 + 14 + 27 \rightarrow 57l$$

$$\text{Total water} \rightarrow 12 + 7 + 24 \rightarrow 43l (100 - 57)$$

$$H:W \rightarrow 57:43$$

$$10l \text{ removed } H \rightarrow \frac{57}{100} \times 10 \rightarrow 5.7l$$

$$W \rightarrow 10 - 5.7l \rightarrow 4.3l$$

$$H - 5x - 5 \cdot 7x \rightarrow 51 \cdot 3x + 10x \text{ (added)} = 61 \cdot 3x$$

$$W - 43x - 4 \cdot 3x \rightarrow 38 \cdot 7x$$

$$H:W \rightarrow 61 \cdot 3 : 38 \cdot 7 \rightarrow 613 : 387$$

(12) Rohit buys some rice at Rs. 10.40 per kg. He mixes it with some rice having price Rs. 8.8 per kg. The final mixture becomes 15 kg in weight and with total worth Rs. 146.40. What is the quantity of rice priced at Rs. 8.8 per kg?

$$\begin{array}{c} 8.8 \quad 10.40 \\ \swarrow \quad \searrow \\ 9.6 \\ \swarrow \quad \searrow \\ 0.64 : 0.96 \rightarrow 64 : 96 \rightarrow 2 : 3 \rightarrow (2k+3k) \text{ kg} \\ 2k+3k = 15 \rightarrow k=3 \\ 2 \times 3 = 6 \end{array}$$

(13) Sunil started a juice (lemon syrup + water) counter. Initially he had 140 litre juice which had 30% water in it. He sold 20 litres of the juice. Then he added equal amount of lemon syrup and water. Now the ratio of water to lemon syrup became 1:2. How much water was added later on.

$$140l \rightarrow 30\% \text{ water}, 70\% \text{ Syrup}$$

$$140 - 20 \rightarrow 120l \rightarrow 30\% \text{ water}, 70\% \text{ Syrup}$$

$$\frac{30}{100} \times 120 \rightarrow 36l \text{ water}, 120 - 36 = 84l \text{ Syrup}$$

$$\frac{84+x}{36+x} = \frac{2}{1} \quad 72+x = 84+x \\ x = 12l$$

(14) A milkman had water and milk mixture in a can with water to milk ratio 5:7. He accidentally spills 9 liters of the mixture. He then fills the can with water equal in quantity to spilled mixture. This makes the water to milk ratio 9:7. How much milk did the can initially have?

$$W:M = 5:7$$

$$W=5K, M=7K$$

$$9\text{ l was spilled} \rightarrow \frac{5}{12} \times 9^3 = \frac{15}{4} = 3.75\text{ l water removed}$$

$$9 - 3.75 \rightarrow 5.25\text{ l milk removed}$$

$$W \rightarrow 5K - 3.75 + 9 \rightarrow 5K + 5.25$$

$$M \rightarrow 7K - 5.25 \rightarrow 7K - 5.25$$

$$\frac{5K + 5.25}{7K - 5.25} = \frac{9}{7} \Rightarrow$$

$$7(5K + 5.25) = 9(7K - 5.25)$$

$$K = 3 \rightarrow$$

$$M \rightarrow 7K \rightarrow 7 \times 3 \rightarrow 21$$

Q) 8 litres are drawn from a cask full of wine and is then filled with water. This operation is performed three more times. The ratio of the quantity of wine now left in the cask to that of water is 16:65. How much wine did cask originally hold?

$x \rightarrow$  original wine     $0 \rightarrow$  water

$x(1 - \frac{8}{x})^4 \rightarrow$  wine remaining

$$\frac{x(1 - \frac{8}{x})^4}{x} = \frac{16}{16+65} \Rightarrow (1 - \frac{8}{x})^4 = 2^4 / 3^4$$

$$1 - \frac{8}{x} = \frac{2}{3} \Rightarrow x = 24 \text{ litres}$$

Simple interest

$$S \cdot I = PTR/100$$

Amount = Principal + simple interest

$$R \cdot - \text{Yearly} \rightarrow PTR/100$$

for half yearly  $\rightarrow T \rightarrow 2T, R \rightarrow R/2$

$$\frac{PTR}{100} = \frac{P \times 2T \times R/2}{100}$$

for 1 month  $\rightarrow T \rightarrow 12T, R \rightarrow R/12$

$$\frac{P \times 12T \times R/12}{100}$$

for quarterly  $\rightarrow T \rightarrow 4T, R \rightarrow R/4$

$$\frac{P \times 4T \times R/4}{100}$$

(1) An amount of Rs. 6500, at simple quarterly interest of 8%, will yield how much in 2 and half years?

$$P = 6500 \quad R = R/4 \quad T = 4T$$

$$S \cdot I = \frac{6500 \times 8/4 \times (2.5 \times 4)}{100} = 65 \times 2 \times 2.5 \times 4 \\ = 65 \times 5 \times 4 = 1300$$

$$\text{Amount} = P + S \cdot I = 6500 + 1300 \rightarrow 7800$$

(2) An amount becomes 7 times in 15 years. In how many years will the same amount become 10 times? The rate of interest remains the same for both cases.

$$2P \xrightarrow{15 \text{ years}} 7P$$

$$7P = P + S \cdot I \rightarrow S \cdot I = 6P = \frac{P \times 15 \times R}{100} \Rightarrow R = \frac{600}{15}$$

$$R = 40\%$$

$$S \cdot I = PTR/100 \rightarrow 10 - P = P \times TX40$$

$$98 = \frac{P \times T \times 100^2}{100^2} \quad T = 22.5 \text{ years}$$

(3) A sum becomes Rs. 3000 at the rate of 12% per annum (simple interest). The same sum becomes Rs. 3300 at the rate of 15% per annum (simple interest) in the same duration. Find the sum and the duration.

$$P \xrightarrow[12\%]{T \text{ yrs}} 3000 \quad P \xrightarrow[15\%]{T \text{ yrs}} 3300$$

$$\text{Amount}_2 - \text{Amount}_1 = 300$$

$$P + SI_2 - P - SI_1 = 300 \Rightarrow SI_2 - SI_1 = 300$$

$$\frac{P \times 15 \times T}{100} - \frac{P \times 12 \times T}{100} = 300 \Rightarrow \frac{PT}{100} = \frac{100}{300}$$

$$PT = 10000 \quad SI_1 = \frac{P \times T \times 12}{100} \Rightarrow \frac{10000 \times 12}{100} = 1200$$

$$3000 = P + 1200 \Rightarrow P = 1800$$

$$1800 \times T = 10000 \quad T = 50/9 \text{ yrs}; \quad P = 1800 \\ = 55/9 \text{ yrs}$$

(4) A man got Rs. 130 less, as simple interest, when he invested Rs. 2000 for 4 years as compared to investing Rs. 2250 for same duration. What is the rate of interest?

$$SI_2 = SI_1 + 130$$

$$\frac{2250 \times 4 \times R}{100} = \frac{2000 \times 4 \times R}{100} + 130$$

$$\frac{2250 \times 4 \times R}{100} - \frac{2000 \times 4 \times R}{100} = 130$$

$$250 \times 4 \times R - 130 = R = 13\%$$

120

(5) 1/5 part of an amount was given at 3% simple interest, 1/3 part was given at 5% simple interest, 2/5 parts at 9% simple interest and remaining part at 11% simple interest. The total interest received was Rs. 297. How much amount was originally given?

$$2P \rightarrow P/5, 3\% \\ P/3, 5\% \\ 2P/5, 9\%$$

$$P - P/5 - P/3 - 2P/5$$

$$15P - 3P - 5P - 6P/15 \rightarrow P/15, 11\%$$

$$297 = \frac{P \times 1 \times 3}{5 \times 100} + \frac{P \times 1 \times 5}{3 \times 100} + \frac{2P \times 9 \times 1}{5 \times 100} + \frac{P \times 1 \times 1}{15 \times 100}$$

$$297 = \frac{3P}{5 \times 100} + \frac{5P}{3 \times 100} + \frac{18P}{5 \times 100} + \frac{11P}{1500}$$

$$297 \times 100 = \frac{7P}{5} + \frac{5P}{3} + \frac{18P}{5} + \frac{11P}{15}$$

$$15(297 \times 100) = 9P + 25P + 54P + 11P$$

$$15(\frac{3}{297} \times 100) = 9P \Rightarrow P = \text{₹ } 4500$$

(6) Rs. 20400 was divided in two parts and then invested. One part invested at 6.25% for 8 years yields the same interest as the other part invested at 7% for 5 years. What is the value of smaller part?

1st part -  $x$ , 2nd part -  $20400 - x$

$$\frac{x \times 6.25 \times 8}{100} = \frac{(20900 - x) \times 7 \times 8}{100}$$

$$10x = 20400 \times 7 - 7x \Rightarrow$$

$$17x = \frac{1200}{20900} \times 7$$

$$x = 1200 \times 7 \Rightarrow 8400 \rightarrow \text{smaller part}$$

$$20900 - 8400 = 12500$$

(7) If simple interest on a certain sum for 15 months at  $7\frac{1}{2}\%$  per annum exceeds the simple interest on the same sum for 8 months at  $12\frac{1}{2}\%$  per annum by Rs. 32.50, then the sum (in Rs.) is..

$$\frac{P \times 7.5 \times 15}{100 \times 12} - \frac{P \times 12.5 \times 8}{100 \times 12} = 32.50$$

$$\frac{95P}{1200} - \frac{40P}{1200} = 13 \Rightarrow SP = 1200 \times 13 \\ = 15600$$

(8) If simple interest for 2 years for a sum is Rs. 600 and compound interest for the same sum for 2 years and same rate of interest is Rs. 645, what will be the rate of interest?

$$600 = SI_1 + SI_2 = 300 + 300$$

$$600 = CI_1 + CI_2 = 300$$

$$CI_2 = 345$$

$CI_2 = \text{Principal} + \text{Previous year interest}$

$$345 = P + \text{Interest on } 300$$

$395 = 300 + \text{interest on } 300$

Interest on 300 =  $395 - 300 = 95$

$$\frac{95}{100} = \frac{300 \times 1 \times R}{100} \rightarrow R = 15\%$$

(9) Aman invests Rs. 8000 at some rate of interest. Being simple interest the money doubles in 5 years. Raj sees this and invests Rs. 6250 for 3 years at same rate of interest. How much interest does Raj get?

$$A = 16,000 \quad P = 8000$$

$$SI = PTR/100 \Rightarrow 8000 = \frac{8000 \times 5 \times R}{100} \Rightarrow R = 20\%$$

$$\frac{6250 \times 3 \times 20}{100} = 3750$$

(10) Aman got a salary of Rs. 8600. The salary was invested by him in two parts. Find the difference between the two parts of his salary, if in first part he got some simple interest at 15% per annum in 4 years, which was same as the second part which he invested at 20% for 3 years?

$$\frac{P \times 15 \times 4}{100} = \frac{(8600 - P) \times 20 \times 3}{100} \Rightarrow 2P = 8600$$

$$8600 - 4300 = 4300 - 4300 = 0$$

1st      2nd

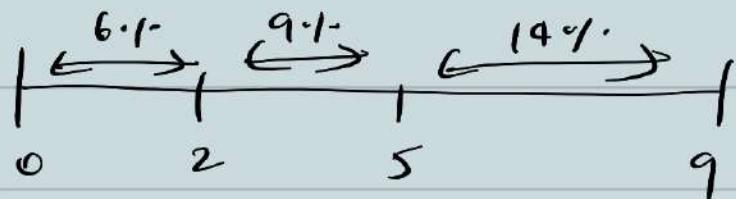
(11) Ram gets Rs. 2600 for Rs. 2000 in 5 years at some rate of simple interest. Had he invested in other places where rate of simple interest is 3% more than current rate, how much would have Ram got in same time?

$$\frac{600}{100} = \frac{2000 \times 5 \times P}{100} \Rightarrow P = 6\%$$

$$\frac{2000 \times 5 \times 9}{100} \Rightarrow \text{Rs } 900 + \text{Rs } 2000 \Rightarrow \text{Rs } 2900$$

(12) Raman paid Rs. 11400 as interest after 9 years. He had borrowed some money at rate of 6% for first two years, 9% for next three years and 14% for rest of the period. How much money did he borrow?

$$SI = 11400 \quad T = 9 \text{ yrs}$$



$$11400 = \frac{P \times 2 \times 6}{100} + \frac{P \times 3 \times 9}{100} + \frac{P \times 4 \times 14}{100}$$

$$11400 \times 100 = 12P + 27P + 56P$$

$$\begin{array}{rcl} 11400 \times 100 & = & 95P \\ 2280 & & 49 \\ 120 & & \end{array} \Rightarrow P = \text{Rs } 12,000$$

(13) Suresh for 2 years invested Rs. 500 in SBI. He also invested Rs. 300 in ICICI for 4 years. At the end he received Rs. 220 from both banks as simple interest. What must have been rate of interest?

$$220 = \frac{500 \times 2 \times R}{100} + \frac{300 \times 4 \times R}{100}$$

$$220 \times 100 = 1000R + 1200R$$

$$\frac{220 \times 100}{1000 + 1200} = 220 \times R \Rightarrow R = 10\%$$

For 1st year, C.I and S.I are same

Compound interest (tricky calculations)

$$\text{Amount after } n \text{ yrs} = P \left(1 + \frac{R}{100}\right)^T$$

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

There are 4 types of compound interest

$$\rightarrow \text{simple } P \left(1 + \frac{R}{100}\right)^T$$

$$\rightarrow \text{diff b/w CI \& SI for 2 years } P \left(\frac{R}{100}\right)^2 = \frac{SI \times R}{200}$$

$$\rightarrow \text{diff b/w CI \& SI for 3 years } P \left(\frac{R}{100}\right) \left(\frac{R}{100} + 3\right)$$

$\rightarrow$  instalments

Population sums

$$\text{Population after } n \text{ yrs} = P \left(1 + \frac{R}{100}\right)^n$$

P - present population

R - rate of increase (or) decrease

n - no. of years

1<sup>st</sup> year - 8% ↑      2<sup>nd</sup> year - 2% ↓

3<sup>rd</sup> year - 10% ↓      4<sup>th</sup> year - 12% ↑

$$P \left(1 + \frac{8}{100}\right)^1 \left(1 - \frac{2}{100}\right)^1 \left(1 - \frac{10}{100}\right)^1 \left(1 + \frac{12}{100}\right)^1$$

(1) What will be the interest earned on sum of Rs. 6400 kept for 6 months at 25% interest rate compounded quarterly?

6 months = 0.5 yrs

Quarterly,  $n=4$ ,  $R=25/4 = 25/4\%$

$$n = 4(0.5) \Rightarrow 2 \text{ years}$$

$$\begin{aligned}\text{Amount} &= 6400 \left(1 + \frac{25}{4 \times 100}\right)^2 \\ &= 6400 \left(1 + \frac{1}{16}\right)^2 \\ &= 6400 \left(\frac{17}{16}\right)^2 = \text{₹}7225\end{aligned}$$

$$7225 = 6400 + CI \Rightarrow CI = \text{₹}825$$

Learn aptitude the easiest way

(2) What compound interest will Rs. 5000 fetch in 3 years 10 months at 30% per annum?

$$n = 3 \text{ years } 10 \text{ months} = 3 \frac{10}{12} \text{ yrs } (n \text{ } \frac{9}{12} \text{ years})$$

$$\begin{aligned}\text{Amount} &= P \left(1 + \frac{R}{100}\right)^n \left(1 + \frac{\frac{9}{12} \times R}{100}\right) \\ &= 5000 \left(1 + \frac{30}{100}\right)^3 \left(1 + \frac{10/12 \times 30}{100}\right) \\ &= 5000 \left(1 + \frac{3}{10}\right)^3 \left(1 + \frac{1}{4}\right) \\ &= 5000 \left(\frac{13}{10}\right) \left(\frac{13}{10}\right) \left(\frac{13}{10}\right) \left(\frac{5}{4}\right) = \text{₹}13731.25\end{aligned}$$

$$CI = 13731.25 - 5000 = \text{₹}8731.25$$

(3) How much money invested at compound interest will yield Rs. 6350.40 at the end of 3 years? For the first year the rate of interest is 5%; for second year it increases to 12% and for third year it decreases to 8%.

$$P \left(1 + \frac{5}{100}\right)^1 \left(1 + \frac{12}{100}\right)^1 \left(1 + \frac{8}{100}\right)^1 = 6350.40$$

$$6350.40 = P \left(\frac{105}{100}\right) \left(\frac{112}{100}\right) \left(\frac{108}{100}\right)$$

$$P = \frac{6350.40 \times 100 \times 100 \times 100}{105 \times 112 \times 108} = \text{₹}5000$$

(4) An amount becomes 4 times in 6 years. In how many years

(4) An amount becomes 16 times in 8 years. In how many years will it become 64 times if the rate of interest remains unchanged?

$$A \xrightarrow{6\text{ yrs}} 9A \xrightarrow{6\text{ yrs}} 16A \xrightarrow{6\text{ yrs}} 64A = 18 \text{ years}$$

(5) Rs. 400 is simple interest for a sum for 4 years at 10% rate of interest per annum. Find the compound interest for the same sum at same rate of interest for same time period?

$$S.I = 400$$

$$\frac{P \times 4 \times 10}{100} = 400 \Rightarrow P = \text{Rs } 1000$$

$$A = 1000 \left(1 + \frac{10}{100}\right)^4 \\ = 1000 \left(\frac{11}{10}\right)^4 = \text{Rs } 1464.10$$

$$C.I = 1464.10 - 1000 = 464.10$$

(6) In 3 years by compound interest, a sum becomes Rs. 900. But in 4 years by compound interest, the same sum becomes Rs. 1000. What is the sum and the rate of interest?

$$x \xrightarrow{3 \text{ yrs}} 900 \quad P = 900 \xrightarrow{1 \text{ yr}} A = 1000$$

$$x \xrightarrow{4 \text{ yrs}} 1000 \quad \text{As time difference is 1 year,}$$

simple interest and compound interest are same

$$\frac{P+R}{100} = 1000 - 900$$

$$\frac{900 \times R \times 1}{100} = 100 \Rightarrow R = \frac{100}{9} = 11.\overline{1}\%$$

$$900 = P \left(1 + \frac{100}{9 \times 100}\right)^3$$

$$900 = P \left(\frac{10}{9}\right)^3 \Rightarrow P = \text{Rs } 656.10$$

(7) The population of a city is 50,000 at present. It increases at the rate of 10% per annum. What will be its population 3 yr from now?

$$P \text{ after } n \text{ years is} = P(1 + \frac{R}{100})^n$$

$$\begin{aligned} P_3 &= 50,000 \left(1 + \frac{10}{100}\right)^3 \\ &= 50,000 \left(\frac{11}{10}\right)^3 = \text{₹} 66550 \end{aligned}$$

(8) The population of a city is 50,000 at present. It increases at the rate of 10% per annum. What was its population 4 years ago from present?

$$P \text{ before } n \text{ years} = P / (1 + \frac{R}{100})^n$$

$$\begin{aligned} P_4 &= 50,000 \left(1 + \frac{10}{100}\right)^4 \\ &= 50,000 \times \left(\frac{11}{10}\right)^4 = \text{₹} 34150.67 \approx 34151. \end{aligned}$$

(9) What will be difference in population 3 years ago and 2 years ago of Devon village, whose current population is 100000 and which is increasing at a rate of 25% every year?

Population is greater 2 years ago compared to the population 3 years ago

$$\begin{aligned} &1,00,000 / \left(1 + \frac{25}{100}\right)^2 - 1,00,000 / \left(1 + \frac{25}{100}\right)^3 \\ &= 1,00,000 \left( \left(\frac{125}{100}\right)^2 - \left(\frac{125}{100}\right)^3 \right) \\ &= 1,00,000 \left( \frac{16}{25} - \frac{64}{125} \right) \\ &= 1,00,000 \left( \frac{80 - 64}{125} \right) = 1,00,000 \left( \frac{16}{125} \right) \\ &= \text{₹} 800 \times 16 = \text{₹} 12,800 \end{aligned}$$

(10) The difference between simple and compound interest on a certain sum of money for 2 years at 4 percent per annum is Re. 1. The sum of money is?

Diff b/w CI & SI for 2 years

$$CI - SI = P \left( \frac{R}{100} \right)^2 = \frac{SI \times R}{200}$$

$$1 = P \left( \frac{4}{100} \right)^2 \Rightarrow P = ₹ 625$$

(11) Sarang invested some money in HDFC at 3% rate of interest. What would be the corresponding simple interest if after 2 years, Sarang got Rs. 101.50 as compound interest?

CI = ? then SI = ? → too long

$$CI - SI = P \left( \frac{R}{100} \right)^2 = \frac{SI \times R}{200}$$

$$101.50 - SI = \frac{SI \times 3}{200}$$

$$20300 - 200SI = 3SI \Rightarrow SI = ₹ 100$$

(12) Find the principal amount invested if the difference between Compound Interest and Simple Interest obtained for 3 years at rate of interest of 25% is Rs. 320.

diff b/w CI and SI for 3 years

$$CI - SI = P \left( \frac{R}{100} \right)^2 \left( \frac{R}{100} + 3 \right)$$

$$320 = P \left( \frac{25}{100} \right)^2 \left( \frac{25}{100} + 3 \right)$$

$$320 = P \left( \frac{1}{16} \right) \left( \frac{13}{4} \right) \Rightarrow$$

$$P = \frac{320 \times 16 \times 4}{13} \Rightarrow \frac{16 \times 20 \times 16 \times 4}{13}$$

$$= \frac{256 \times 80}{13} \Rightarrow \frac{20480}{13}$$

P = 21575.38

## Reasoning - Number Series

Types of series

→ numeric

→ letters

→ alpha-numeric

Types of questions

→ next letter/number

→ Find the missing

→ odd man out

### Numeric

→ first try to find the diff b/w the numbers,

→ if the diff is not the same, if it is increasing

slowly, (not rapid) then the series must be

related to addition/ subtraction

→ if the diff is rapidly increasing, then the relation b/w them must be related to squares/cubes

(or) multiplication

#### ① Addition series

19, 25, 32, 40, ?, 59 → ans: -49

+6 +7 +8 +9 +10

(Increasing) (+/\*)

#### ② Subtraction series

02, 85, 60, ?, 31 → ans: 51

-17 -17 -17 -17 (decreasing) (-1, 1)

③

**multiplication series**

1, 3, 6, 24, 120 → ans: prev no. × the

$\frac{2}{1 \times 2}$   $\frac{4}{2 \times 3}$   $\frac{18}{6 \times 4}$   $\frac{96}{24 \times 5}$  position of no.

④

**division series**

216, 72, 36, 12, ?, 2 → ans: 6

$\frac{216}{3}$   $\frac{72}{2}$   $\frac{36}{3}$   $\frac{12}{2}$   $\frac{6}{3}$

⑤

**Squares/cubes/Close to it**

0, 3, 8, 15, 24, 35, ? 63

3 5 7 9 11

1-1 4-1 9-1 16-1 25-1 36-1 64-1 → ans: 98

1<sup>2</sup>-1 2<sup>2</sup>-1 3<sup>2</sup>-1 4<sup>2</sup>-1 5<sup>2</sup>-1 6<sup>2</sup>-1 7<sup>2</sup>-1 8<sup>2</sup>-1

↑

The numbers are closer to squares (check for numbers if they are closer)

⑥

**prime series**

The difference may be prime or the relation may be prime and the numbers

⑦

**fibonacci series**

not just prev cle, try seeing the last two prev

if needed three, don't limit your ability to j

one element

⑧

**Increase/decrease series**

There might be two different series given or

one (or) There might two different operations going on simultaneously

### Alphabet Series

- write numbers accordingly
- also check from reverse position ( $2=1$ )  
To get reverse position of alphabet subtract from 27

#### Types of questions

- vowels and consonants
- Alphabet position
- also make groups to get the pattern if alphabets alone don't make sense
- letters will be grouped sometimes, find relation between group of letters and then find relation between letters in a group
- also consider the direction of the pattern, and eliminate some options

### Alpha-numeric series

- check if the alphabet present is related to position and relate the number to it
- check if these numbers are related to each other

→ Check if numbers are related to the numbers of the group

→ Try to find the relations for letters as well

2E2, 1H9, 1K6, 1N3

22, E 19, H 16, K 13, N

27-E, E 27-19, H 27-16, K 27-13, N

22 19 16 13 → 10 → ans: 1Q0  
-3 -3 -3 -3  
E H K N → Q  
+2 +2 +2 +2

H8, L12, O15, S19

8 12 15 19 → ans:  $\sqrt{22}$   
+4 +3 +4 +3

### Addition series

→ Break the numbers into parts if the combined number doesn't make sense

→ 2, 5, 10, 17, 28 ? → ans:  $28+13=41$   
3 5 7 11 13

→ 21, 34, 55, 89,  $\overbrace{144}^{+13}, ? \ 377 \rightarrow$  ans: 233  
 $\underbrace{13 \ 29 \ 39 \ 55}_{\text{already in the series}}$

→ L, O, S, Q, H ?

12 15 10 17 8  
↗ ↘ ↗ ↘ ↘ → Increasing, decreasing

$$\begin{array}{r} 12, 10, 8 \\ -2 \quad -2 \end{array}$$

$$\begin{array}{r} 15, 17 \\ +2 \quad +2 \end{array} \rightarrow \text{ans: } S(19)$$

$\rightarrow V, S, P, L, G$

$$\begin{array}{r} 21, 19, 16, 12, 7 \\ -2 \quad -3 \quad -4 \quad -5 \quad -6 \end{array} \rightarrow \text{ans: AC(1)}$$

$$\begin{array}{ccccccccc} & 10, & 14, & 28, & 34, & 64, & 68, & 136 \\ & \circled{4} & \circled{14} & & & \circled{4} & \circled{68} & \\ & \downarrow & \downarrow & & & \downarrow & \downarrow & \\ & 6 & 30 & & & 64 & & \\ & +4 \rightarrow 32 & \xrightarrow{\times} & & & \checkmark & & \\ & & & & & & & \end{array} \text{ (wrong number)}$$

$\rightarrow q$  is there, number becomes double

$$\rightarrow 15, 16, 20, 30, 45, 70 \text{ (wrong number)}$$

$$\begin{array}{ccccccccc} 1 & 4 & 10 & 21 & 15 & 25 \\ \uparrow & \uparrow & \uparrow & \uparrow & \uparrow & \uparrow \\ 1^2 & 2^2 & 3^2 & 4^2 & 5^2 & \end{array}$$

$$\begin{array}{ccccccccc} 1, & 3, & 10, & 21, & 63, & 129 & \text{(wrong number)} \\ \uparrow 2 & \uparrow 7 & \uparrow 11 & \uparrow 42 & \uparrow 66 & \uparrow & \text{quickly increasing} \\ 1 \times 2 + 1 & 3 \times 7 + 1 & 10 \times 2 + 1 & 21 \times 3 + 1 & 69 \times 2 + 1 & & \end{array}$$

$$\rightarrow 3, 2, 8, 12, 13, 24, 18, 32, 23, 42$$

$$-1 + 4 + 4 + 1 + 11 - 6 + 14 - 9 + 1$$

$$\begin{array}{ccccccccc} 3, & 8, & 13, & 18, & 23 & 2, & 12, & 24, & 32, & 42 \\ +5 & +5 & +5 & +5 & & +10 & +12 & +8 & +10 & \\ & & & & & +10 & +10 & +10 & +10 & \\ & & & & & 2 & 12 & 22 & 32 & 42 \end{array}$$

$$\rightarrow 1, 11, 34, 75, 139 ?$$

$$\begin{array}{ccccccccc} 10 & 23 & 41 & 69 & 92 & & \\ \swarrow & \searrow & \swarrow & \searrow & \swarrow & & \\ 13 & 18 & 23 & 28 & & & \\ 5 & 5 & 5 & & & & \\ & & & & & & \end{array} \rightarrow \text{ans} \rightarrow 231$$

(use triangular pattern)

$$\rightarrow 28, 33, 31, ?, 34, 39 \quad \text{ans} \rightarrow 36$$

$5 -2 \downarrow \nearrow 5 \rightarrow 5, -2, 5, -2, 5$

### → Time & work

Just invert

$$N \rightarrow 1/N$$

→ total work 30 days, in one day  $\frac{1}{30}$  amount of work

→ if one day he is doing  $\frac{1}{30}$  amount of work,  
then total work can be done in 30 days

↑ work ↓ days

→ ↑ men ↑ work ↓ days

Time and Work - Shortcuts & Tricks for Placement Tests, Job Interviews & Exams  
(1) A can work 5 times faster than B and takes 60 days less than B to complete the work. In how many days does A and B individually can complete the work?

$$\frac{B}{n} \quad \frac{A}{n-60} \quad A = 5B$$

$$\frac{n}{5} = n-60 \Rightarrow n=5n-300 \Rightarrow 4n=300 \Rightarrow n=75 \text{ days}$$

$$n-60 = 15 \text{ days}$$

(2) If 24 men can finish a work in 10 days, then find the number of days required to complete the same work by 30 men?

24 men  $\rightarrow$  10 days  $\rightarrow$  1 day  $\rightarrow$  1/10 amount of work

$$24 \rightarrow 1/10$$
$$\frac{30}{10} \geq \frac{8}{24} \times x$$
$$x = 1/8$$

30  $\rightarrow$  1/8 amount of work (1 day)

Just invert so, 1/8  $\rightarrow$  8 days

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

A  $\rightarrow$  3 days 1 day  $\rightarrow$  1/3 amount of work

B  $\rightarrow$  6 days 1 day  $\rightarrow$  1/6 amount of work

C  $\rightarrow$  7 days 1 day  $\rightarrow$  1/7 amount of work

$$A+B+C \rightarrow 1/3 + 1/6 + 1/7$$

$$\rightarrow 14 + 7 + 6 / 42 \rightarrow 27/42$$

$$\rightarrow 9/14 \text{ amount of work}$$

So, 14/9 days are taken to complete

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

P, Q  $\rightarrow$  12 days  $\rightarrow$  1/12  $\rightarrow$  P+Q

Q, R  $\rightarrow$  16 days  $\rightarrow$  1/16  $\rightarrow$  Q+R

R, P  $\rightarrow$  24 days  $\rightarrow$  1/24  $\rightarrow$  R+P

$$2P + 2Q + 2R = 1/12 + 1/16 + 1/24$$

$$2(P+Q+R) = 4 + 3 + 2/48$$

$$2(P+Q+R) = \frac{9}{98} = \frac{3}{16}$$

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

So,  $\frac{32}{3}$  days is taken to complete the work

(5) P can do a work in 30 days. Q is 25% more efficient than P in completing the same work. In how many days will Q complete the work?

$$P \rightarrow 30 \text{ days} \quad \frac{1}{30} \text{ amt. work}$$

$$P \rightarrow 100\% \quad Q \rightarrow 125\%$$

$$\frac{1}{30} \quad 125\% \times \frac{1}{30}$$

$$\frac{8}{100} \times \frac{1}{30} = \frac{1}{24} \text{ in a day}$$

So, 24 days will be taken

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

$$3 \text{ men} \rightarrow 2 \text{ days} \quad \left. \right\} 3 \text{ times}$$

$$4 \text{ Boys} \rightarrow 6 \text{ days} \quad 8 \text{ men} + 8 \text{ Boys}$$

$$3 \text{ men} = 3(4 \text{ Boys})$$

$$4 \times 8 + 8b = 32b + 8b$$

$$\text{men} = 4 \text{ Boys}$$

$$\Rightarrow 40 \text{ Boys}$$

$$\frac{10}{40} \times \frac{5}{3} = 4x$$

$$x = \frac{5}{3}$$

It will take  $\frac{3}{5}$  days

$$9b \quad 6 \text{ days} \rightarrow \frac{1}{6} \text{ work}$$

$$9b - 1/6$$

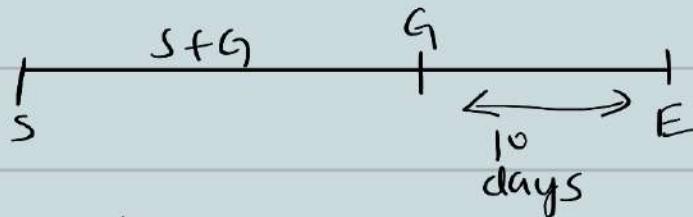
$$90 - ?$$

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

$$S \rightarrow 20 \text{ days}$$

$$G \rightarrow 25 \text{ days}$$

→ use line diagram for these sums leaving and joining



$$S \rightarrow 1/20 \text{ amt. work}$$

$$G \rightarrow 1/25 \text{ amt. work}$$

$$10 \text{ days} \rightarrow 1/25 \text{ amt. work} \rightarrow 10 \times \frac{1}{25} = 2/5$$

$$\text{TOTAL WORK} = 1$$

$$\text{So, remaining work} = 1 - 2/5 = 3/5$$

$$S+G = 1/20 + 1/25 = \frac{95}{20 \times 25} = \frac{1}{100} \text{ (1 day)}$$

$$(x) \frac{1}{100} = \frac{3}{20} \Rightarrow x = \frac{20}{3} \text{ days}$$

so, sita left after  $\frac{20}{3}$  days

Time and Work - Shortcuts & Tricks for Placement Tests, Job Interviews & Exams

(8) When P alone does a work, he takes 25 days more than the time taken by P and Q working together to complete the work.  
But Q alone takes 9 days more than the time taken by P and Q working together to complete the work. In what time, P and Q together finish this work?

$$P = 25(P+Q)$$

$$\frac{P+Q}{N}$$

$$\frac{P}{25+N}$$

$$\frac{Q}{9+N}$$

$$Q = 9(P+Q)$$

$$N = \sqrt{\text{extra P} \times \text{extra of Q}}$$

$$= \sqrt{25+9} = 15 \text{ days}$$

Time and Work - Shortcuts & Tricks for Placement Tests, Job Interviews & Exams

(9) A can complete a work in 12 days and B can complete in 8 days. A works for 8 hours every day while B works for 10 hours every day. If A and B together start working 8 hours per day, in how many days will they complete the work?

A  $\rightarrow$  12 days,  $12 \times 8$  hrs  $\rightarrow$  96 hours  $\rightarrow 1/96$

B  $\rightarrow$  8 days,  $8 \times 10$  hrs  $\rightarrow$  80 hrs  $\rightarrow 1/80$

$A+B \Rightarrow \frac{1}{\frac{96}{96+80}}$  amt. work in 1 hour

$\frac{96+80}{176}$  hours needed for A+B to complete work

$$\frac{2}{6} \cancel{\frac{96+80}{176}} \cancel{\times 10} \Rightarrow \frac{60}{11} \text{ days}$$

(10) Raj can build a house alone in 16 days but Suraj alone can build it in 12 days. Raj and Suraj work on alternate days. If Raj works on first day, the house will be built in how many days?

R  $\rightarrow$  16 days  $\rightarrow 1/16$

S  $\rightarrow$  12 days  $\rightarrow 1/12$

$$\text{1 or 2 days} = \frac{1}{16} + \frac{1}{12} = \frac{7}{48}$$

so, we will take 6 times, that is 6 times each 2

$$\text{days } \frac{7}{48} \times 6 = \frac{42}{48} = \frac{7}{8} \quad 6 \times 2 = 12 \text{ days}$$

we can't take 7 times, because work done will be greater than 1. work done can never be greater than one

$$1 - 7/8 = 1/8 \text{ work remaining}$$

then Raju comes  $1/8 > 1/16$  so, work left is

$$\frac{1}{8} - \frac{1}{16} = \frac{1}{16}$$

Raju can do  $1/12$  work,  $1/12 > 1/16$ , so Suraj can complete the work

$$\frac{1}{16} = \frac{x \times \frac{1}{12}}{\cancel{12}} \Rightarrow x = 3/4^{\text{th}} \text{ of one day}$$

$$\text{so, } 12 \text{ days} + 1 \text{ day} + 3/4 \text{ day} \Rightarrow 13 \frac{3}{4} \text{ day}$$

### → Profit and loss

$$SP = CP + \text{profit}$$

$$P\% = \frac{\text{Profit}}{CP} \times 100 \quad L\% = \frac{L}{CP} \times 100$$

→ The cost of book is 500 and he sold at 10% profit

then what is SP

$$SP = (100+P)\% \times CP$$

$$SP = (100-L)\% \times CP$$

- (1) Ajay 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?

$$SP = 2880 \quad SP = (100 + p) \cdot 1 \cdot CP$$

$$= (100 + 20) \cdot 1 \cdot CP$$

$$2880 = 80 \cdot 1 \cdot CP$$

$$2880 = \frac{80}{100} \times CP \Rightarrow CP = \frac{2880 \times 100}{80}$$

$$SP = (100 + p) \cdot 1 \cdot CP = (100 + 20) \cdot 1 \cdot \frac{2880 \times 100}{80}$$

$$= \frac{120}{100} \times \frac{2880 \times 100}{80} = 24320 \rightarrow \text{ans}$$

(2) Rambabu sells paper 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?

$$SP = 1 = (100 + p) \cdot 1 \cdot CP$$

$$= (100 + 20) \cdot 1 \cdot CP = \frac{120}{100} \times CP \Rightarrow 1$$

$$CP = \frac{100}{120}$$

so, 20 planes are bought for  $\frac{100}{120}$

$$20 \rightarrow \frac{100}{120}$$

$$\cancel{X} \quad ? \rightarrow 1$$

$$2 \times \frac{100}{120} = 20$$

$$x = \frac{2 \times 100}{120} \Rightarrow 20 \text{ planes}$$

(3) Uma wants to gain 15% profit on her sale of sugar. She buys 120 kg of sugar at Rs. 24 per kg to mix with 180 kg of sugar bought at Rs. 28 per kg. She sells the sugar mix at ....

$$SP = (100 + p) \cdot 1 \cdot CP \Rightarrow \frac{115}{100} \times CP$$

$$180 \text{ kg} \rightarrow 221 \rightarrow 100 \times 21 \rightarrow \text{₹} 280$$

$$180 \text{ kg} \rightarrow \text{₹} 28 \Rightarrow 180 \times 28 = \underline{\underline{\text{₹} 5090}}$$

$$\text{SP} = \frac{23}{45} \times 3920$$

$$\cancel{100} \quad \cancel{396}$$

$$\Rightarrow 23 \times 396 = \text{₹} 9108$$

(4) Guddi buys some oranges in a shop at 4 per rupee. She goes to other shop and buys same number of oranges at 5 per rupee. She then combines them in a basket and sells them at 4 per rupee. Will she get a profit or loss? And how much?

$$\text{SP} - \text{CP} \rightarrow +\text{ve} (\text{profit}) \quad \text{SP} - \text{CP} \rightarrow -\text{ve} (\text{negative})$$

1st  $\rightarrow$  4 per rupee  $\rightarrow$  4 oranges for 1 rupee

2nd  $\rightarrow$  5 per rupee  $\rightarrow$  5 oranges for 1 rupee

1st  $\rightarrow$  1 orange  $\rightarrow$  ₹ 1/4

2nd  $\rightarrow$  1 orange  $\rightarrow$  ₹ 1/5

$$\frac{1/4 + 1/5}{1+1} \rightarrow \frac{9/20}{2} (\text{2 oranges})$$

$$(2 \text{ oranges}) \quad \frac{9/20}{2} (1 \text{ orange})$$

SP  $\rightarrow$  4 per rupee  $\rightarrow$  1 orange  $\rightarrow$  ₹ 1/4

$$\text{SP} - \text{CP} = \frac{1}{4} - \frac{9}{20} = \frac{1}{90}$$

$$\% \text{P} = \frac{P}{C.P} \times 100 \Rightarrow \frac{1/40}{9/20} \times 100 \Rightarrow \frac{1}{90} \times \frac{90}{9} \times 100$$

$$\Rightarrow 11\frac{1}{9}\% \rightarrow \text{profit}$$

(5) Ramesh gets a profit of 20% in one trade and 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 objects  
 ↘ 1st cycle  
 ↗ 2nd cycle

+20%, -20% → same profit & loss

SP → same → ₹ 4000

→ In this type of case, the person will always suffer a loss

$$\rightarrow \text{Loss \%} \rightarrow \frac{(\text{loss/profit})^2}{100} = \frac{(-6/20)^2}{100} \rightarrow 4\% \text{ Loss}$$

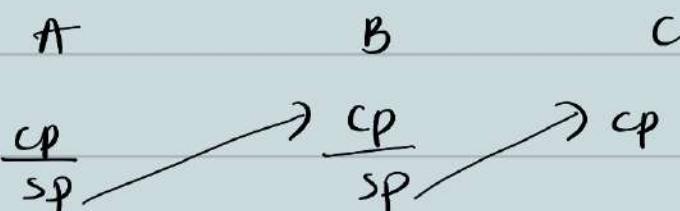
(6) Simran bought pet food worth Rs. 56000. She then sold 1/3rd of it incurring a loss of 40%. What profit she must earn on rest of the supplies to nullify this loss?

1st part    2nd part    3rd part

-40%            20%            20%

→ remaining parts are 2, 90% to be nullified so,  
 $90\% / 2 \rightarrow 20\% \rightarrow \text{any}$

(7) A sold a car to B at a profit of 25%. B incurred loss of 15% while selling the same car to C. A spent Rs. 50000 for this car. At what price did C buy it?



$$SP_A = (100 + 25)\% \times 50,000$$

$$= \frac{125}{100} \times 50,000 \Rightarrow 62,500 (\text{SP}_A, \text{CP}_B)$$

$$\text{SP}_B = (100 - 15) \% \times 62,500$$

$$\frac{85}{100} \times 62,500 \Rightarrow 53,125 (\text{SP}_B, \text{CP}_C)$$

(8) A cheater manipulated his weighing machine so that it shows 1 kg for 970 grams. How much profit does he get?

$$1\text{kg} \rightarrow 970\text{gm}$$

$\rightarrow 30\text{gm profit}$

$$\text{Profit \%} = \frac{\text{Profit}}{\text{Actual Value}} \times 100 \Rightarrow \frac{30}{970} \times 100 \Rightarrow \frac{300}{97} \%$$

(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?

$$11.5\% \quad 38.5\% \quad 38.5\% - 11.5\% \Rightarrow 27\%$$

$$\text{Rs } 8100 \text{ more} \quad 27\% \times CP = 8100$$

$$27\% \times CP = 8100 \Rightarrow \frac{27}{100} \times CP = \frac{8100}{100} \Rightarrow CP = 30,000$$

(10) Chaman sells 40 fans at 10% profit. He wants a total of 20% profit on the entire sale. Since he got 160 fans at rate of Rs. 100 each, at what profit must he sell the remaining fans?

$$160 \text{ fans} \rightarrow \text{Rs } 100 \rightarrow 16,000$$

$$40 \text{ fans} \rightarrow \text{Rs } 100 \rightarrow \underline{4000}$$

12,000

$$10 = \frac{P}{9000} \times 100 \Rightarrow P = \text{₹}900 \text{ for 90 fans}$$

$$\text{Total profit} = P_{(90)} + P_{(120)}$$

$$\text{₹}3200 = \text{₹}900 + 120 \times A\%$$

$$20 = \frac{P}{160 \times 100} \times 100 \Rightarrow P = \text{₹}3200$$

$$A\% = \frac{P}{120 \times 100} \times 100 \Rightarrow P = 120 \times A\%$$

$$A\% = \frac{2800}{120} \Rightarrow 23.33\%$$

(11) Suman buys 160 chocolates for Rs. 480. She wanted to earn 30% profit by selling them. But Rakesh visited her and she gave him 25% of those chocolates at the cost price itself. But even after doing this, she earned a profit of 30% as decided. For how much did she sell each chocolate?

$$160 \text{ choc} \rightarrow 480 \quad 1 \text{ choc} \rightarrow \text{₹}3$$

$$160 \times \frac{25}{100} \Rightarrow 40 \Rightarrow 160 - 40 \Rightarrow 120 \text{ chocolates}$$

$$30 = \frac{P}{480} \times 100 \Rightarrow P = \frac{30 \times 480}{100} \Rightarrow \text{₹}144$$

$$120 \text{ c} \rightarrow \text{₹}144 \quad \frac{144}{120} = \text{₹}1.2$$

$$1 \text{ c} \rightarrow \text{₹}1.2 \quad \text{sp} = \text{cp} + p = 3 + 1.2 \Rightarrow \text{₹}4.2$$

(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.

$$100\% \rightarrow \text{original}$$

$$100 + 25\% \rightarrow 125\% \rightarrow SP$$

$$100 - 20\% \rightarrow 80\% \rightarrow CP$$

$$125\% - 80\% \rightarrow 45\% P$$

$$P = 45\% P$$

$$2025 = \frac{95}{100} \times P \Rightarrow P = \frac{2025}{95} \times 100 = 214500$$

(13) A shopkeeper earns a profit of 15% after selling a book at 20% discount on the printed price. The ratio of the cost price and printed price of the book is

$$SP = (100 + 15\%) \times CP \Rightarrow SP = \frac{115}{100} \times CP$$

PP = Printed price

$$SP = (100 - 20)\% \times PP \Rightarrow 80\% \times PP \Rightarrow \frac{80PP}{100}$$

$$\frac{115CP}{100} = \frac{80PP}{100} \quad \frac{CP}{PP} = \frac{80}{115} = 16:23 \rightarrow \text{ans}$$

(14) The ratio of cost price and selling price is 4:5. The profit percent is

EASY

CP:SP

$$CP:SP = 4:5$$

$$SP = 25, CP = 20, PR = 25\%$$

$$\text{Profit \%} = \frac{P}{CP} \times 100 = \frac{5}{4} \times 100 = 25\%$$

(15) If selling price of 40 articles is equal to cost price of 50 articles, the loss or gain percent is?

$$CP_{50} = SP_{40}$$

$$C.P_{(1)} = 100/50 = 2$$

$$2 \times 100 = 200$$

$$S.P_{(1)} = 100/40 = 2.5$$

$$\text{Price} = 2.5 - 2 = 0.5$$

$$P.I. = \frac{0.5}{2} \times 100 = 25\%$$

(16) A fruit seller buys lemons at 2 for a rupee and sells them at 5 for three rupees. His gain percent is?

$$2 \text{ lemons} \rightarrow 1$$

$$\text{for } 100 \rightarrow 200 \text{ lemons}$$

$$5 \rightarrow 3 \Rightarrow \frac{200 \times 3}{5} = 120 \text{ (S.P.)}$$

$$200 \rightarrow ?$$

$$P = \frac{20}{100} \times 100 \Rightarrow 20\%$$

→ Percentages

→ common percentages

$$50\% \rightarrow 1/2$$

$$10\% \rightarrow \frac{1}{10}$$

$$12.5\% \rightarrow 1/8$$

$$33.3\% \rightarrow 1/3$$

$$20\% \rightarrow \frac{1}{5}$$

$$25\% \rightarrow 1/4$$

$$75\% \rightarrow 3/4$$

→ Quickly find no. conversion

→ convert into percentages

$$260 \rightarrow 100\%$$



$$26.0 \rightarrow 10\% \text{ (one zero is less)}$$

→ put the decimal to one place left

$$350 \rightarrow 100\%$$

$$70 \rightarrow 20\% \text{ (} 2 \times 10\% \text{)}$$

→ so put a decimal to left so, 35.0 and then

multiply by 2

$$693 \rightarrow 100\%$$

$$6.93 \rightarrow 1\%$$

$$260 \rightarrow 100\%$$

$$\rightarrow 39\% \text{ (near to } 40\%)$$

$$\begin{array}{r} 26 \\ \times 9 \\ \hline 104 \end{array} \rightarrow 10\%$$

$$104 \rightarrow 10 \times 4\%$$

$$39\% \rightarrow 40 - 1\%$$

$$1\% \text{ of } 260 \rightarrow 2.6$$

$$\text{so, } 40\% - 1\% \rightarrow 104 - 2.6 \Rightarrow 101.4$$

$$63\% \rightarrow 60\% + 3\% \rightarrow 60\% + (1\% \times 3)$$

→ 56.1% of y is 182, y?

$$\frac{56}{100} \times y = 182 \Rightarrow y = \frac{182 \times 100}{56} \Rightarrow \frac{18200}{56} \Rightarrow 325$$

→ what percent is 92kg of 376kg

City 1      City 2

$$92 \text{ kg} \quad 336 \text{ kg} \quad \frac{92}{336} \times 100 \Rightarrow \frac{100}{8} \Rightarrow 12.5\%$$

→ when we want to find percent multiply by 100

→ if 15% of y is same of 21% of z, then 12.5% of y is equal to what percent of z

$$15\% \text{ of } y = 21\% \text{ of } z$$

$$12.5\% \text{ of } y = ?$$

$$15\% \times ? = 21\% \times 12.5\%$$

$$? = \frac{21 \times 12.5}{15} \% = \frac{21 \times 5}{15} \% = 17.5\%$$

→ if price of rice is 30% less than that of wheat,  
then price of wheat is how much percent more than  
that of rice

→ arbitrary value = 100

$$\text{wheat} = ₹ 100$$

$$\text{rice} = ₹ 70 \quad (30\% \text{ of } 100)$$

$$\frac{A}{B} \times 100 = \frac{100}{70} \times 100 \Rightarrow \frac{1000}{7} = 142.85\%$$

how much more?  $142.85\% - 100\% \Rightarrow 42.85\% \text{ more}$

→ The price of apple is first increased by 10% and then decreased by 10%. What is the change in the price of apple?

₹ 100

$$\uparrow 10\% \Rightarrow 100 + 10 \Rightarrow ₹ 110$$

$$\downarrow 10\% \rightarrow 110 - 10 \Rightarrow 110$$

$$110 - 110 \Rightarrow ₹ 99$$

$$\text{Change in price of apple} = 100 - 99 = ₹ 1$$

→ if the price of sugar is raised by 25%, then by how much percent should a person reduce his consumption of sugar, so that his expenditure remains same?

$$\text{exp}_{\text{Before}} = \text{exp}_{\text{After}} \quad 1 \times 100 = 125 \times x$$

$$₹ 100 \text{ per kg} \rightarrow 1 \text{ kg}$$

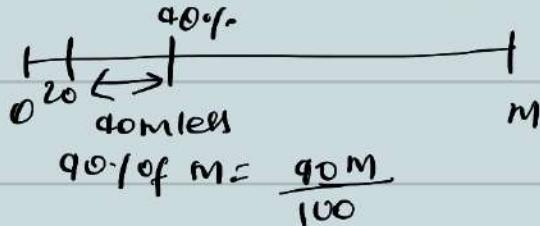
$$x = \frac{100}{125} = 0.8 \text{ kg}$$

$$\text{exp}_{\text{Before}} = 100 \times 1 = ₹ 100$$

$$= 100 + 25 = ₹ 125 \quad 1 \text{ kg} - 0.8 \text{ kg} \rightarrow 0.2 \text{ kg}$$

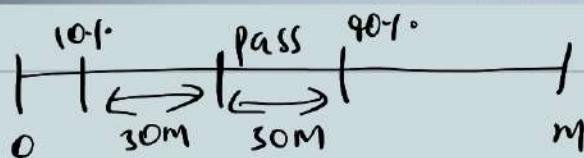
$$\frac{0.2}{1} \times 100 \Rightarrow 20\% \text{ reduction in consumption}$$

→ If he has to score 40% marks to pass, he gets 20 marks and fails by 90 marks, the max marks of exam are



$$\frac{20 + 90}{(gets) \quad (fails by)} = \frac{90}{100} \text{ (pass criteria)} \Rightarrow M = 150 \text{ marks}$$

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



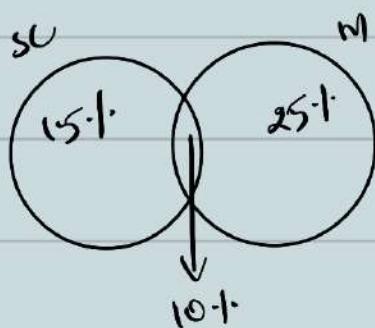
$$A \rightarrow 10\% \cdot M = \frac{10M}{100} + 30M \Rightarrow \text{pass}$$

$$B \rightarrow 40\% \cdot M = \frac{40M}{100} + 30 = \frac{40M}{100} - 30$$

Pass

$$\frac{10M}{100} + \frac{40M - 3000}{100} \Rightarrow 200 \text{ marks}$$

(9) In a class, 15% of total number of students failed in Science, 25% of total number of students failed in Maths and 10% of total number of students failed in both. How much percentage of students passed in both Maths and Science?



mistake

$$100\% - \text{failed} = \text{pass}$$

$$\text{fail} = 15.1. + 25.1. - 10.1.$$

we are counting 10.1. 2 times

$$100\% - 10.1. \Rightarrow 70\% \quad \text{in both } 15.1. \text{ and } 25.1., \text{ so, we}$$

$$100\% - 30.1. = 70.1. \text{ passed} \quad \text{remove one}$$

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

EASY

$$\text{original price} = EP/\text{kg}$$

$$EP \rightarrow 100 \rightarrow A \text{ kg}$$

$$EP \rightarrow 20\%$$

$$28 \rightarrow (A+10) \text{ kg}$$

$$\frac{28}{100} \times 10$$

$$\exp_{\text{before}} = \exp_{\text{after}} \Rightarrow 0.28$$

$$A \times \cancel{\frac{1}{10}} = (A+10) \times 0.28 / \cancel{\frac{100}{90 \text{ kg}}} = 2.5 \text{ kg}$$

(11) In an election which was contested by 2 candidates, one candidate got 40% of total votes and yet lost by 1000 votes. What is the total number of votes casted in the election?

$$\begin{array}{ccc} P_1 & P_2 & x \text{ votes} \rightarrow \text{total} \\ 40\% \cdot x & 60\% \cdot x & \\ \frac{40}{100}x & \frac{60}{100}x & \end{array}$$

$$\frac{40}{100}x + 1000 = \frac{60}{100}x \quad \frac{2}{5}x + 1000 = \frac{3}{5}x$$
$$2x + 5000 = 3x$$

$$x = 5000$$

(12) In a country 55% population is female. 80% of the male population is literate. How much of females are literate if total literacy is 58%?

$$P = 100$$

$$f = 55 \quad m = 45 \quad M_L = 45 \times \frac{80}{100} \rightarrow 4.5 \times 8 = 36.0$$

$$M_L = 36 \Rightarrow$$

$$P_L = 58 \rightarrow P_L = m_L + f_L \Rightarrow 58 = 36 + x \Rightarrow f_L = 22$$

→ everything given in %, so ans should be %.

$$\frac{22}{55} \times 100 = 40\% \text{ females are literate}$$

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

80% To Pay

$$\frac{80}{100} \text{ L} = \text{₹}100$$

$$k = \frac{1000}{8} = \text{₹}125$$

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

$$B = \text{₹}100$$

$$A = 50\% \uparrow = 100 + 50 = \text{₹}150$$

$$150 - 100 = \frac{50}{150} \times 100 \Rightarrow 33.33\%$$

(15) Two numbers are less than a third number by 30% and 37% respectively. How much percent is the second number less than the first?

1st num      2nd num      3rd num

70                63                100

$$\frac{7}{30} \times 100 = 10\%$$

(16) 10% of inhabitants of a village having died of cholera, a panic set in, during which 25% of remaining inhabitants left the village. The population is then reduced to 4050. The number of inhabitants originally was

Population - M

$$10\% \text{ died} \rightarrow \text{left} = \frac{90M}{100}$$

$$25\% \text{ leave} \rightarrow 75\% \text{ left} = \frac{75}{100} \times \frac{90M}{100} = \frac{27M}{40} = 4050$$

$$M = 6000$$

→ Percentages always subtracted from 100%.

→ permutations and combinations

→ arrange n things in single line  $\rightarrow n!$  ways

→ arrange  $n$  things in circular  $\rightarrow (n-1)!$  ways

Types :-

→ Select (combination)

→ select and arrange (permutation)

→ Combination

→ Out of  $n$  things we have to select  $r$  things, so,  
 $nCr$  ways ( $n > r$ )

$$nCr = n! / r!(n-r)!$$

→ Out of  $n$  things we have to select  $r$  things, and  
arrange them in  $nPr$  ways ( $n > r$ )

$$nPr = n! / (n-r)!$$

(1) In Daya's bag there are 3 books of History, 4 books of Science and 2 books of Maths. In how many ways can Daya arrange the books so that all the books of same subject are together?

Select - comb    Select & arrange - perm  
                       factorial

3H, 4S, 2M

→ When we want smtg together, consider groups

$\frac{3H}{1^{st} G}, \frac{4S}{2^{nd} G}, \frac{2M}{3^{rd} G} \rightarrow$  so,  $3!$  ways

→ The group of  $n$  things can arrange itself in  $n!$  ways

$H \rightarrow 3! \text{ ways}$

$$S \rightarrow 4! \text{ ways} \rightarrow \frac{3! \times 4! \times 2! \times 3!}{\text{each groups} \quad \text{all groups}} = 1728 \text{ ways}$$

$M \rightarrow 2! \text{ ways}$

(2) In how many ways can we arrange the word 'FUZZTONE' so that all the vowels come together?

Arrange  $\rightarrow$  factorial

FUZZTONE  $\rightarrow$  vowels (3)  $\rightarrow$  total (8)  
 $\rightarrow$  consonants (5)  $\rightarrow$  F, Z, Z, T, N

They have to be together, So consider as a group

$\rightarrow$  vowels group can be arranged among themselves

In  $3!$  ways

$\rightarrow$  5 alphabet + 1 group  $\rightarrow$  6 things

so, 6 things in  $6!$  ways

$\rightarrow$  so,  ~~$6! \times 3!$~~

$\rightarrow$  we see Z repeating twice, so we need to handle duplicates

$\rightarrow$  we have n things, and 1 thing repeats 4 times

so, we write  $n!/4!$

$\rightarrow$  so,  $\frac{3! \text{ ways}}{(\text{vowels})} \times \frac{6! \text{ ways (Total)}}{2! \text{ ways (duplicate 'Z')}} \Rightarrow 2160 \text{ ways}$

(3) If Suraj doesn't want vowels together, then in how many ways can he arrange letters of the word 'MARKER'?

M A R K E R  $\rightarrow$  2 vowels, 4 consonants  
A, E, M, R, K, R

Total ways = vowels always together + vowels are not always together

Vowels are not always together = total ways - Vowels always together

$$= \frac{6!}{2!} - \frac{5! \times 2!}{2!} \Rightarrow 360 - 120 = 240 \text{ ways}$$

Vowels always together M, R, K, R, A, E  $\rightarrow$  2! ways  
 $\frac{4}{4} + 1 = 5$  things

(4) Without repetition, using digits 2, 3, 4, 5, 6, 8 and 0, how many numbers can be made which lie between 500 and 1000?

So, number should be 3 digit 2, 3, 4, 5, 6, 8, 0

3 digits   6 digits   5 digits      7 numbers

2X      (7-1)      (7-2)  
 3X

9X      one 9's      two already  
 5V      already used      used

6V

8V

0X

$$3 \times 6 \times 5 \Rightarrow 90 \text{ ways}$$

Repetition allowed

$$\underline{3 \text{ dig}} \quad \underline{7 \text{ dig}} \quad \underline{7 \text{ dig}} \rightarrow 3 \times 7 \times 7 = 147 \text{ ways}$$

By using formula

$\overbrace{5, 6, 8}^{\rightarrow} - -$

$3c_1 \ 6c_1 \ 5c_1 \rightarrow 3c_1 \times 6c_1 \times 5c_1 \Rightarrow 90 \text{ ways}$

