

(QA)

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ChapterPercentage

example $\rightarrow 10\% \rightarrow \frac{10}{100}$ increase in price after 10% increase

original month balance becomes 10% of current

$$\rightarrow 10\% \text{ of } 2400 \rightarrow 2400 \times \frac{10}{100} = 240 \text{ rs.}$$

so new price becomes $2400 + 240 = 2640$ rupees

Ans. New price increases by 10% after 10% increase

$$\rightarrow 7200 \text{ RS to } 8100 \text{ RS.}$$

\therefore Increase?

Method 1

$$\therefore \text{Increase} = \left(\frac{8100 - 7200}{7200} \right) \times 100 = 12.5\%.$$

Method 2

$$7200 \rightarrow 100\%.$$

$$8100 \rightarrow (\%) = \frac{100 \times 8100}{7200}$$

of balance added to original price of Rs. 7200
Original off total price of 8100 is 112.5% of original
 $\rightarrow 112.5 - 100 = 12.5\%$

example Ram's salary is 20% less than Mohan's salary.
then Mohan's salary is more than Ram's salary
by how much?

answer

\rightarrow Let Mohan's salary is x .

\rightarrow Ram's salary = $0.8x$

$$\rightarrow 20\% \text{ more} = \left(\frac{x - 0.8x}{0.8x} \right) \times 100.$$

$$\therefore \frac{0.2}{0.8} \times 100 = 25\%.$$

example The price of sugar is increased by 25%. If a family wants to keep its expenses unaltered then family will have to reduce by How much?

answer: [sugar price is x and expense is y and cons. z
 sugar price is $1.25x$ and expense is y and cons. ?]
 $\rightarrow 1.25x \times y = x \times z$ (before and after consumption should same)
 (where y is new consumption)

$$\therefore y = \frac{z}{1.25}$$

$$\boxed{y = 0.8z}$$

$$\therefore \text{reduction \%} = \left(\frac{z - 0.8z}{z} \right) \times 100 = \boxed{20\%} \rightarrow \text{Answer}$$

example A reduction of 20% in price of wheat enables a person to buy 3.5 kg more wheat for ₹70. original Price is —

- (a) 55
- (b) 44
- (c) 33
- (d) 22

answer: original Price is x , buy y kg, expense ₹70.
 after reduction Price is $0.8x$, buy $y + 3.5$ kg, expense ₹70.

$$xy = 70 \quad (\text{before and after expense is same})$$

$$x(y + 3.5) = 70$$

$$xy = 70$$

$$\therefore x = 70/14$$

$$\boxed{x = 55}$$

$$xy = (0.8x)(y + 3.5)$$

$$y = 0.8y + 3.5 \times 0.8$$

$$0.2y = 3.5 \times 0.8$$

$$\therefore y = 3.5 \times 4$$

$$\boxed{y = 14}$$

Original Price

example Due to Increase of 25% in price of Rice/kg.
A Person able to Purchase 20 kg less for 400 Rupees.
What is the increased Price of Rice/kg.

- (a) 4 rupees/kg
- (b) 5 rupees/kg
- (c) 6 rupees/kg
- (d) 7 rupees/kg

answer :-

$$\text{initial Price} = x$$

$$\text{New Price} = 1.25x$$

$$400 = yx$$

$$400 = (y - 20) \cdot 1.25x$$

$$400 = (y)(1.25x) - 20x \cdot 1.25$$

$$400 = (400)(1.25) - 20x \cdot 1.25$$

$$400 = 400 \times \frac{125}{100} - 20x \cdot 1.25$$

$$400 = 500 - 20x \cdot 1.25$$

$$1.25 \times 20x = 100$$

$$x = 4$$

$$\rightarrow \text{increased Price} = (4)(1.25) = 5 \rightarrow \text{Answer}$$

example

If length of rectangle is increased by 30% & width decrease by 20% then Area increased by ?

answer

$$\rightarrow L \rightarrow 30\% \uparrow, W \rightarrow 20\% \downarrow$$

$$\therefore E = a + b + ab/100$$

$$\therefore E = 30 - 20 - 30 \times 20$$

$$\therefore E = 4.1 \rightarrow \text{Answer}$$

example If the radius of circle is diminished by 10 cm then area diminished?

answer

$$A = \pi r^2$$

$$\therefore A = -10 - 10 + (-10)(-10)$$

$$\frac{100}{100}$$

$$\therefore A = -20 + 1$$

$$\therefore A = [-19 \cdot 1] \rightarrow \text{Answer}$$

example The radius of cylinder is increased 15 cm and its height decreased by 20 cm . find $\% \text{ change in volume of cylinder.}$

answer

$$V = \pi r^2 h$$

$$\therefore R = 15 + 15 + \frac{(15)(15)}{100}$$

$$\therefore R = 30 + 2.25$$

$$\therefore R = 32.25 \text{ cm}$$

$$\therefore V = 32.25 - 20 + \frac{(32.25)(-20)}{100}$$

$$\therefore V = 12.25 - \frac{32.25}{5}$$

$$\therefore V = 12.25 - 6.45$$

$$\therefore V = 5.8 \text{ cm}^3 \rightarrow \text{Answer}$$

example In a examination 49.1% of students fail in english, 36.1% in Hindi, while 15.1% fail in both. If total Number of Passed students is 450 then How many students appeared in examination.

answer:- \rightarrow Total fail students % = $49 + 36 - 15 = 70$,

$$\begin{array}{l} \therefore 30 \rightarrow 450 \\ \therefore 100 \rightarrow (?) \end{array} \quad (\text{means } 30\% \text{ students pass})$$

$$100 \times 450$$

$$\frac{100}{30}$$

1500 students \Rightarrow Answer.

example A Ratio of Number of Boys and Girls is 3:2. if 20% of boys and 25% of girls are scholarship holder then what is the percentage of student did not get scholarship?

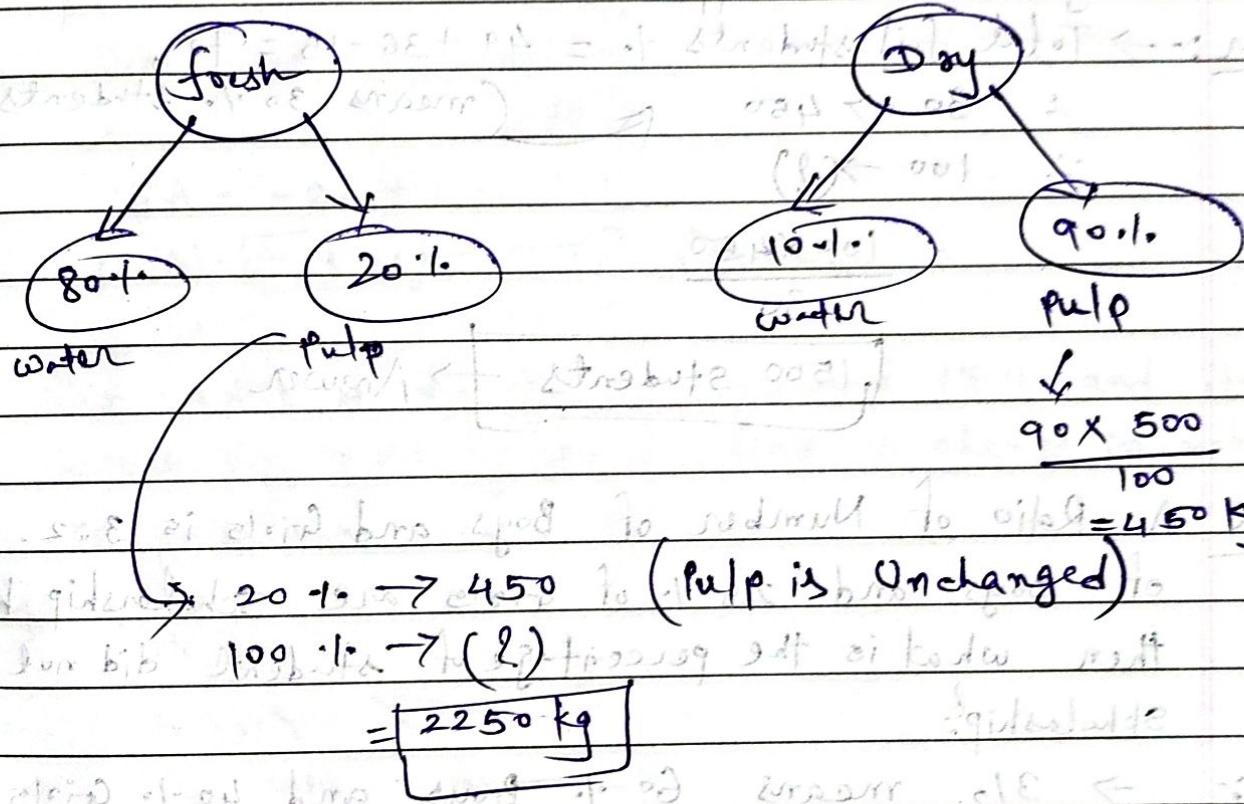
answer:- \rightarrow 3/2 means 60% Boys and 40% Girls.
 \rightarrow Out of 100 students 60 Boys and 40 Girls.
 \rightarrow Out of 100 students $\frac{20 \times 60}{100}$ Boys and $\frac{40 \times 25}{100}$ Girls

are scholarship eligible

\rightarrow Total = $(12 + 10)$ students eligible for scholarship.
 $\rightarrow \frac{100 \times 78}{100} = 78\%$ students not eligible for scholarship.

example Fresh Grapes contains 80% water, while Dry grapes contains 10% water. If the weightage of Dry grapes is 500 kg. then what is total weight when it is fresh.

answer :-



example An alloy of gold and silver weights 50 gram. It contains 80% gold. How much gold should be added to alloy so that percentage of gold should increase to 90% .

answer:-

before		after	
80%	20%	10%	90%
Gold	Silver		
$\rightarrow 50 \times \frac{20}{100} = 10 \text{ gram}$		$\therefore 10 \text{ gram} = (\text{Total weight}) \times \frac{10}{100}$	
$\rightarrow 50 \times \frac{80}{100} = 40 \text{ gram}$		$100 = \text{Total weight}$	
Gold		$\rightarrow \text{Gold weight} = 90 \text{ gram}$	
		$\rightarrow \text{Gold Added} = 90 - 40 = 50 \text{ gram}$	

example 1 In an examination it is required 296 marks out of aggregate marks. a student gets 222 marks and is declared fail by 10%. what are maximum aggregate marks a student get?

answer :- → Marks required to Pass = 296
 → marks get and fail by 10% = 222
 $\rightarrow 296 - 222 = 74$ marks sort to pass examination.

$$10\% \rightarrow 74 \quad \left\{ \begin{array}{l} \text{for 100} \\ \text{for 100} \end{array} \right. \quad \frac{100 \times 74}{100} = 740 \text{ marks}$$

example 2 At a election involving, 2 candidates got 68 votes declared invalid. Winning candidate secured 52% & wins by 98 votes. what are the total votes.

answer :-

Invalid Votes $\rightarrow 68$ votes.

Valid Votes $\rightarrow x$.

$\angle 52\% \text{ of } x - 48\% \text{ of } x = 98$

$\angle \left(x \right) \left(\frac{52}{100} \right) - \frac{48x}{100} = 98$

$x = 2450 \rightarrow$ Valid Votes.

$$\begin{aligned} \text{Total Votes} &= \text{Valid} + \text{Invalid Votes} \\ &= 2450 + 68 \\ &= 2518 \end{aligned}$$

example 10% of votes did not cast votes in election of 2 candidate. 10% of votes were found invalid. The successful candidate get 54% of valid vote & won by majority 1620 votes. Number of votes enrolled in voter list?

answer : → 10% votes did not cast votes in election
(remaining votes = 90%) AP = 100 - 30%
→ Out of 90%, 10% votes is invalid so remaining
votes = $(90 - \frac{90 \times 10}{100}) = 81\%$
→ valid votes = x .

$$\frac{54x}{100} - \frac{46x}{100} = 1620$$

$$54x - 46x = 162000$$

$$\therefore x = 20,250 \rightarrow \text{Valid Votes.}$$

$$\therefore 81 \rightarrow 20,250$$

$$100 \rightarrow (1) \rightarrow (100)$$

$$= \frac{100 \times 20,250}{81}$$

$$= 25000$$

example Population of city is 7,00,000. If it increases at a rate of 5%. per annum. then what population after 2 years.

answer : Method 1

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

$$\text{Population} = 7,00,000 \left(1 + \frac{5}{100}\right)^2$$

$$\text{Population} = 771750$$

Method 2

$$\therefore E = a + b + \frac{ab}{100}$$

$$\therefore E = 5 + 5 + \frac{25}{100}$$

$$\therefore E = 10.25 \%$$

$$\text{Population} = 7,00,000 \times 110.25$$

$$\text{Population} = 771750$$

example Gaurav spends 30% income on food. 40% remaining on clothes. 50% remaining saves. Gaurav has monthly income of 18,400. then How much he save?

answer :

$$\rightarrow = 18,400 - \frac{18400 \times 30}{100}$$

$$= 18400 - 5520$$

$$\rightarrow = 12880 \text{ remaining}$$

$$\rightarrow 12880 - 12880 \times \frac{40}{100}$$

$$12880 - 5152$$

$$\rightarrow 7728 \text{ remaining}$$

$$\rightarrow 3864 \text{ saves every month}$$

example A Number is decreased by 20. The decreased Number is increased by $\frac{1}{20}$. The resulting Number is less than original number by 36. what is original Number.

answer:

$$\rightarrow \text{Original Number} = x$$

$$\rightarrow \text{Decreased Number} = 0.8x$$

$$\rightarrow \text{Increased Number} = (0.8 + 0.8 \times 0.2)x$$

$$= (0.8 + 0.16)x$$

$$= 0.96x$$

$$x - 0.96x = 36$$

$$0.04x = 36$$

$$\therefore x = 900 \rightarrow \text{Original Number}$$

example A Number is mistakenly divided by 10 instead of multiplying. What is the error in percentage.

answer: \rightarrow Number is x .

$$\text{error \%} = \left(\frac{x \times 10 - \frac{x}{10}}{x \times 10} \right) \times 100$$

$$\text{error \%} = \frac{100 - 1}{100} \times 100$$

$$\text{error \%} = 99\%$$

Simple Interest & Compound Interest

→ P = Principal Amount

R = Rate of Interest (1%)

T = Time Period (years)

SI = Simple Interest

CI = Compound Interest

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

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

$$A = P + CI$$

$$CI = A - P$$

example A sum of 12500 rupees. amount to be 15000 in 4 years. In simple interest, what is rate of interest?

answer

$$\frac{15000 - 12500}{100} = \frac{(12500)(R)(4)}{100}$$

$$\text{Interest} = \frac{PRT}{100}$$

$$2500$$

$$\frac{125 \times 4}{2500} = R$$

$$\frac{2500}{500} = R$$

$$(R = 5\%)$$

example A Man took a loan from a bank at rate of 12% per annum SI after three years he had to pay 5400 Interest. then what is principal amount borrowed by him?

answer

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

$$\therefore 5400 = \frac{(P)(12)(3)}{100}$$

$$5400 = P \times 36$$

$$150000 = P \times 36$$

$$P = 15000 \text{ Rupees}$$

example A sum of Money at Simple Interest amounts to Rupees 815 in 3 years and Rupees 854 in 4 years then find sum

answer

$$\therefore 1 \text{ year SI} = 854 - 815$$

$$\therefore 1 \text{ year SI} = 39$$

$$\therefore 3 \text{ year SI} = 39 \times 3 = 117$$

$$\therefore SI + P = 815 \quad (\text{for 3 years})$$

$$\therefore 117 + P = 815$$

$$P = 698 \text{ Rupees}$$

example How much time it will take for a amount of 450 to yield 81 Rupees as interest at 4.5% per annum of SI.

answer

$$81 = \frac{(450)(4.5)T}{100}$$

$$81 = \frac{(45)(45)T}{100}$$

$$\frac{9 \times 9}{100} = \frac{(45)(45)T}{100}$$

$$T = 4 \text{ years}$$

example what will be ratio of SI earned by certain amount at same rate of Interest for 5 and 9 years.

answer

$$\therefore \text{SI} \propto T \quad (\text{SI} = \frac{PRT}{100})$$

$$\therefore \text{SI Ratio} = \frac{5}{9}$$

$$\boxed{\text{SI Ratio} = \frac{2}{3}}$$

→ 1. Difference between New SI & CI

(for 1 year No diff. between SI & CI)

Condition:- (for Mula Valid (for same rate of interest))

for 2 years:-

$$P = \frac{D \times 100^2}{R^2}$$

for 3 years:-

$$P = \frac{D \times 100^3}{R^2 (R+300)}$$

example find diff. between SI and CI at 5% per annum for 2 years on principal amount

2000 ₹. to know the diff. between simple interest and compound interest.

answer Method 1

$$P = \frac{D \times 100^2}{R^2}$$

$$2000 = D \times 100 \times 100 \\ \therefore D = \frac{2000}{5 \times 5} = 400$$

$$D = 5 \text{ ₹}$$

Method 2

$$SI \rightarrow 10 \cdot 1 \cdot (2 \text{ years Interest rate for SI})$$

$$CI \rightarrow 5 + 5 + \frac{25}{100} \text{ %}$$

$$= 10.25 \% \quad (2 \text{ years effective Interest rate for SI})$$

$$\therefore \text{diff} = CI - SI = 10.25 - 10$$

$$= 0.25 \text{ %}$$

$$100 \times 1.0 \rightarrow 2000$$

$$0.25 \times 1.0 \rightarrow$$

$$\frac{2000 \times 0.25}{100}$$

$$= 5 \text{ ₹}$$

example If diff. between SI and CI for some amount at 20% Interest per annum for 3 years, then what is Principal Amount?

answer :-

$$P = D \times 100^3$$

$$R^2 (R+300)$$

$$P = \frac{48 \times 100 \times 100 \times 100}{20 \times 20}$$

$$(320)$$

$$P = 375 \text{ Rupees}$$

example The diff. between CI and SI on Rupees 15,000 for 2 years is 96. What is rate of interest per annum?

answer

$$P = D \times 100^2$$

$$R^2$$

$$15000 = 96 \times 100 \times 100$$

$$150 = \frac{96 \times 100}{R^2}$$

$$R = 8.1.$$

example On a Particular Amount the Compound Interest at the end of 1 year is 50 & for 2 years is 52. How much money was deposited?

answer

$$\therefore 52 - 50 = 2 \text{ rupees.}$$

$$\therefore 50 \rightarrow 2 \text{ rupees}$$

Amount after 1 year $\rightarrow 100 \rightarrow$ the amount after 2 years

$$\text{Interest for 1 year} = \left(\frac{2}{50} \right) \times 100 \\ = 4 \cdot 10$$

$$\therefore 4 \cdot 10 \rightarrow 50 \text{ rupees}$$

$$\therefore 100 \cdot 10 \rightarrow (?)$$

$$= \frac{100 \times 50}{4}$$

$$= 1250 \text{ Rupees}$$

example CI for two years is 1452, and for 3 years is 1597.2 find rate per annum.

answer :- $\rightarrow \text{Rate} = \frac{1597.2 - 1452}{1452} \times 100$

$$\rightarrow \text{Rate} = \frac{145.2 \times 100}{1452}$$

$$\rightarrow \text{Rate} = 10 \cdot 10$$

\rightarrow	(1 year)	(6 Month)	(3 Month)	(2 years)
Yearly (SI)	Half Yearly (SI)	Quarterly (SI)	Biennially (SI)	
$P = 1000$ Rs.	$P = 1000$ Rs	$P = 1000$ Rs	$P = 1000$ Rs	
$R = 20\% \text{ p.a.}$	$R' = \frac{20}{2} = 10\% \text{ p.a.}$	$R' = \frac{20}{4} = 5\% \text{ p.a.}$	$R' = 20 \times 2 = 40\% \text{ p.a.}$	
$T = 2 \text{ years}$	$T' = 2 \times 2 = 4 \text{ T.P.}$	$T' = 2 \times 4 = 8 \text{ T.P.}$	$T' = 2 \text{ T.P.}$	

example A sum of Rupees $40,000$ invested for 18 months at $20\% \text{ p.a.}$ on C.I. If interest compounded Half yearly then what will be interest to be paid.

answer

$$T = 18 \text{ months}$$

$$P = 40,000 \text{ Rupees.}$$

$$R = 20\% \text{ p.a.}$$

$$\rightarrow \text{Half Yearly} = R' = 10\% \text{ p.a.}$$

$$= T' = 3 \text{ T.P.}$$

$$A = P \left(1 + \frac{R'}{100}\right)^T$$

$$A = 40,000 \left(1 + \frac{10}{100}\right)^3$$

$$A = 40,000 \left(1.1\right)^3$$

$$A = 40,000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}$$

$$A = 40 \times 133$$

$$A = 53240$$

$$I = 53240 - 40000$$

$$I = 13240$$

example what is difference between compound Interest on

Rupees 5000 for 1.5 years at 4% per annum compounded yearly and half yearly.

answer:-

Yearly

$$P = 5000$$

$$T = 1.5 \text{ years}$$

$$R = 4\%$$

$$\therefore C.I = 4 + 2 + \frac{(4)(2)}{100}$$

$$\therefore C.I = 6.08 \%$$

$$100 = 5000$$

$$6.08 = (?)$$

$$C.I = \frac{(6.08)(5000)}{100}$$

$$C.I = 304$$

Half yearly

$$P = 5000$$

$$T = 3 \text{ T.P.}$$

$$R = 2\%$$

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

$$A = 5000 \left(1 + \frac{2}{100}\right)^3$$

$$A = 5000 (1.02)^3$$

$$A = 5306.04$$

$$C.I = 5306.04 - 5000$$

$$C.I = 306.04$$

$$\text{difference} = 306.04 - 304$$

$$= 2.04 \text{ Rupees}$$

example In what time, Rupees 64000 amount to 68,921 at 5% per annum compounded half yearly?

answer :-

$$\therefore CI = \left(\frac{68921 - 64000}{64000} \right) \times 100$$

$$\therefore CI = \frac{4921}{64000} \times 100 (00)$$

$$\therefore CI = \frac{4921}{640}$$

$$\therefore CI \approx 7.689\%$$

→ 5% per annum so 2.5% Half yearly

$$7.689 \approx 2.5 + 2.5 + 2.5$$

(This method easy on SI but we can use in CI)

→ 1.5 years

example A sum of money is lent out at compound rate of interest 20% per annum for two years. It would fetch ₹ 1205 more if interest is compounded Half yearly. find the sum?

answer :-

1 Yearly :-

$$\therefore CI = 20 + 20 + \frac{(20)(20)}{100}$$

$$\therefore CI = 44\%$$

Half yearly.

$$10\%, 10\%, 10\%, 10\%$$

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

$$= 21\%$$

$$= 21 + 10 + \frac{(21)(10)}{100} = 33.1 \quad \boxed{33.1}$$

$$43.1 + 3.3 \quad \boxed{46.4}$$

$$\rightarrow \text{Difference} = 46.41 - 44 \quad \text{less than 1%}$$

$$= 2.41\% \quad \text{Ans}$$

$$\rightarrow 2.41\% = 120.5 \quad \text{P.F.} \\ 100\% = (?)$$

$$= \frac{(100)(120.5)}{2.41} \quad \text{P.F.} \\ = 50,000 \quad \text{Ans}$$

$$= 50,000 \quad \text{Ans}$$

Note:-

for SI :-

$$R.T = 100(N-1) \quad \text{P.F.} \quad \text{No. of times}$$

for CI :-

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

Example find Rate of Simple Interest At which sum becomes 4 times itself in 15 years.

Answer :-

$$R.T = 100(N-1)$$

$$R.(15) = 100(4-1)$$

$$R = \frac{100 \times 3}{15} \quad (1)(15) + (1)(15) - 1 = 13$$

$$R = 20\%$$

example find time at which sum becomes 4 times itself
at 5% per annum.

answer

$$\text{Given } A = P + SI \quad \text{where } A = 4P \quad \text{and } R = 5\%$$

$$4P = P + (P)(5)(T) \quad | \quad \text{SI} = 4P - P = 3P$$

$$100 \quad | \quad \text{so } T = \frac{3P}{5P} = \frac{3}{5} \text{ years}$$

$$\boxed{60 \text{ years} = T}$$

example Rupees 800 becomes 956 in 3 years at certain rate of SI. If rate of interest increased by 4% what amount 800 £ become in 3 years?

answer :-

$$956 - 800 = (800)(R)(3)$$

100

$$156 = 24(R)$$

$$956 = 800(1+R)^3$$

$$956 = 800(1+R)^3$$

$$956 = 800(1+R)^3$$

$$R = 6.5\%$$

$$R' = 6.5 + 4 = 10.5\%$$

$$R' = 10.5\%$$

$$I = (800)(10.5)(3)$$

100

$$I = 252$$

$$A = 800 + 252$$

$$= 1052 \text{ £}$$

example Rate of Interest for 1^{st} 2 years = 3% per annum,
 for next 3 years = 8% per annum,
 for period beyond 5 years = 10% per annum,
 a man gets ₹ 1520 as SI for 6 years. How
 much did he deposited.

answer

$$T = 6 \text{ years}$$

$$1520 = \frac{(P)(3)(2)}{100} + \frac{(P)(8)(3)}{100} + \frac{(P)(1)(10)}{100}$$

$$152000 = 6P + 24P + 10P$$

$$152000 = 40P$$

$$\therefore 15200 = 4P$$

$$P = 3800 \text{ ₹}$$

example A sum of ₹ 2600 is lent out in 2 parts such that, interest on 1^{st} part is 10% for 5 years = that on another part at 9% for 6 years. find the 2 sum.

$$\text{answer :- } P_1 + P_2 = 2600$$

$$P_1 + 50P_1 = 2600$$

$$54P_1 = (2600)(54)$$

$$\therefore 104P_1 = 140400$$

$$P_1 = 1350 \text{ ₹}$$

$$\therefore \frac{(P_1)(50)}{100} = \frac{(P_2)(54)}{100}$$

$$\frac{50P_1}{54} = P_2$$

$$P_2 = 1250 \text{ ₹}$$

→ Both sum is,
 1350 and 1250 ₹.

example: A sum of money at compounded interest amounts to thrice itself in 3 years. In how many years will it become 9 times itself?

answer: method 1 : Let the sum be R . Then $R(1 + \frac{1}{T})^T = 3R$

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

$$100 \left(\left(1 + \frac{1}{T}\right)^T - 1 \right) = 300 \left(\left(1 + \frac{1}{T}\right)^T - 1 \right)$$

$$\left(1 + \frac{1}{T}\right)^T = 9$$

$$\frac{1}{3} = \frac{2}{T}$$

$$T = 6 \text{ years}$$

method 2

$$x \xrightarrow[3 \text{ years}]{\text{multiplied by } 3} 3x$$

$$3x \xrightarrow[3 \text{ years}]{\text{multiplied by } 3} 3(3x) = 9x$$

To get 9 times the sum, it is required to multiply by 3 twice.

$$T = 6 \text{ years}$$

$$(P)(1 + \frac{1}{T})^T + (S)(1 + \frac{1}{T})^{T-1} = 9R$$

$$100 + 100 = 900$$

example A Sum of 2250 ₹ was lent out partly at 7% and 10% per annum SI. The total interest received after three years was 540. The ratio of money lent at 7% to that lent at 10% is? How much?

answr :-

$$540 = \frac{(P_1)(21)}{100} + \frac{P_2(30)}{100} \quad , P_1 + P_2 = 2250$$

$$\therefore 54000 = 21P_1 + 30P_2 \quad , \frac{P_1}{P_2} + 1 = \frac{2250}{P_2}$$

$$\therefore \frac{54000}{P_2} = 21 \frac{P_1}{P_2} + 30 \quad \left(\frac{P_1}{P_2} = x \right)$$

$$\therefore \frac{54000}{2250} (x+1) = 21x + 30 \quad , x+1 = \frac{2250}{P_2}$$

$$\therefore 24x + 24 = 21x + 30$$

$$\therefore 3x = 6$$

$$\therefore x = 2$$

Ration :- $2 : 1$

example A Lent 4500 to B for 2 years and 7500 ₹ to C for 4 years at same rate of interest, and receive together 2340 from both as interest. find SI rate of interest.

answr

$$2340 = \frac{(4500)(R)(2)}{100} + \frac{(7500)(R)(4)}{100}$$

$$\therefore 2340 = 90R + 300R$$

$$\therefore 2340 = 390R \quad , R = 6\% \quad [R = 6\%]$$

Chapter Races & games

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example : $A:B = 4:5$, $B:C = 8:7$, find $A:B:C$

$$A:B:C = ?$$

answer :

$$\frac{A}{B} = \frac{4}{5} = K, \quad B:C = \frac{8}{7} = m$$

$$A = 4K, \quad B = 5K$$

$$B = 8m, \quad C = 7m$$

$$5K = 8m$$

$$K = \left(\frac{8}{5}\right)m$$

$$A = 4\left(\frac{8}{5}\right)m, \quad B = 5\left(\frac{8}{5}\right)m, \quad C = 7m$$

$$A = \frac{32}{5}m, \quad B = \frac{40}{5}m, \quad C = 7m$$

$$A:B:C = 32:40:35$$

example : $A:B = 1:2$, $B:C = 3:4$, $C:D = 5:6$
find $A:D = ?$

answer :

$$\frac{A}{B} \times \frac{B}{C} \times \frac{C}{D} = \frac{1}{2} \times \frac{3}{4} \times \frac{5}{6}$$

$$\frac{A}{D} = \frac{15}{48} \rightarrow \boxed{\frac{A}{D} = \frac{5}{16}}$$

example

$$A:B = 3:4, B:C = 3:1, C:D = 3:4$$

$$A:B:C:D = ?$$

answer

$$\therefore \frac{A}{B} = \frac{3}{4}, \frac{B}{C} = \frac{3}{1}, \frac{C}{D} = \frac{3}{4}$$

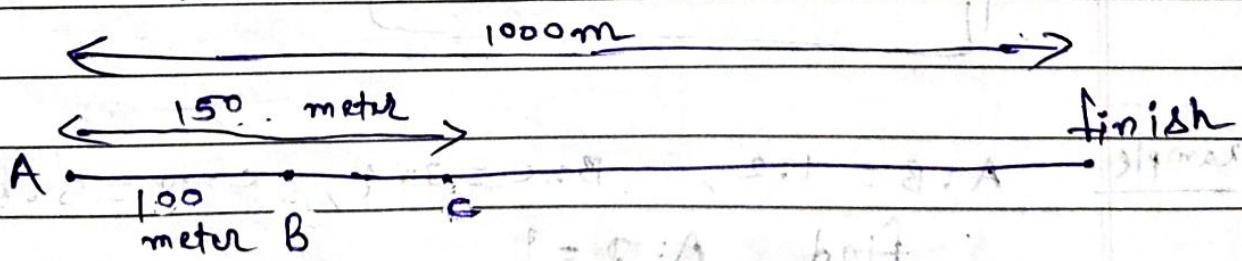
$$\therefore \frac{A}{B} = \frac{3}{4}, \frac{B}{C} = \frac{9}{3}, \frac{C}{D} = \frac{3}{4}$$

$$\therefore \frac{A}{B} = \frac{3}{4} \times 9, \frac{B}{C} = \frac{9}{3}, \frac{C}{D} = \frac{3}{4}$$

$$\therefore A:B:C:D = 27:9:3:4$$

$$\boxed{A:B:C:D = 27:36:12:16}$$

example In a thousand Metre Race, A gave start of 100 meter to B and 150 meter to C. How much start can B give to C for 1000 meter race?

answer

$$A:B:C = 1000:900:850$$

$$\boxed{A:B:C = 20:18:17}$$

$$\begin{aligned} & \angle 900 \rightarrow 50 \\ & \angle 1500 \rightarrow (?) \end{aligned} = \frac{1000 \times 50}{900} = \boxed{55.55}$$

\rightarrow B gave start of 55.55 meter

question

In a 600-meter race, A defeats B by 60m. In 500m race B defeats C by 50m. So in 400m race A defeats C by how much?

answer

(A runs 600m, B runs 540m.) (B runs 500, C runs 450m)

$$\frac{A}{B} = \frac{600}{540}$$

$$\frac{A}{B} = \frac{10}{9}$$

$$\frac{B}{C} = \frac{500}{450}$$

$$\frac{B}{C} = \frac{10}{9}$$

1 (multiply both)

$$\frac{A}{C} = \frac{100}{81} \quad (\text{In 100m race, A runs 100m, B runs 81m})$$

$\frac{A}{C} = \frac{100}{81}$ A runs 100 then C runs 81 only

A runs 400 then C runs (?)

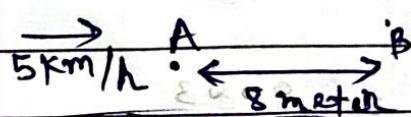
A runs 100 then C defeats by 19.

A runs 400 then C defeats by (?)

2 In 400m race A defeats C by 76 meter.

question

A and B takes part in 100m race. A runs at 5 km/h and A gives start to B of 8 meter and still beats him by 8 second. find speed of B.

drawn

→ speed of A :-

$$5 \text{ km/h} = \frac{25}{18} \text{ m/s}$$

→ Time taken by A = 72 sec

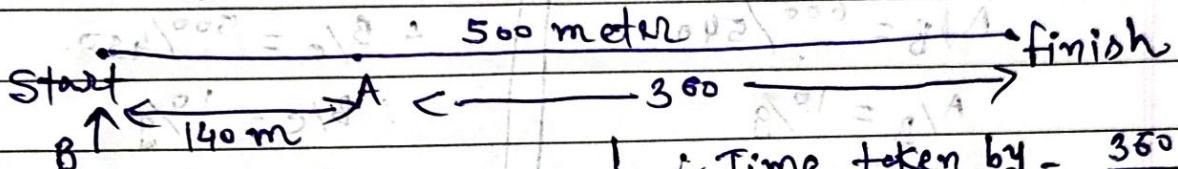
$$\rightarrow \text{Time taken by B} = (72 + 8) \text{ sec} \\ = 80 \text{ sec}$$

$$\rightarrow \text{speed of B} = \frac{92 \times 18}{(80) \times 5} \text{ km/h} = [4.14 \text{ km/h}]$$

example In a 500 meter race, the ratio of speed of A and B is $3/4$. If A has a start of 140 meter then

A wins by _____

and why



$$\frac{S_A}{S_B} = \frac{3}{4} = k$$

$$\therefore S_B = 4k$$

$$S_A = 3k, S_B = 4k$$

$$\therefore \text{Time taken by } A = \frac{500}{3k}$$

$$= 120/k$$

In $\frac{120}{k}$ time distance

$$\text{Cover by } B = (4k) (120/k)$$

$$\rightarrow \text{So, A wins by } 500 - 480 = 20 \text{ m} \quad = 480 \text{ meter}$$

example At a game of billiards, A can give B 15 points in 60. A can give C 20 points in 60. How many points can give B to C in 90 points?

and why

$$\therefore \frac{B}{A} = \frac{45}{60}, \quad \frac{C}{A} = \frac{40}{60}$$

(15 points give to B by A, so B wins 45 points)

(20 points give to C by A)
C wins 40 points

$$\therefore \frac{B/A}{C/A} = \frac{45/60}{40/60} = \frac{9}{8}$$

definition

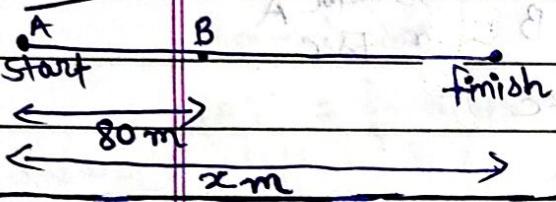
$$\therefore B/C = \frac{9}{8}$$

$$\therefore B/C = \frac{90}{80}$$

(In 90 points game, B can give start point
 $90 - 80 = 10$ points to C)

If
example A runs $\frac{5}{3}$ times as fast as B, A gives B start of 80 metre. How much distance will the winning post from starting point so that A and B might reach at same time.

answer :- $A = \frac{5V}{3}, B = V$



$$\frac{2/3}{5V} = \frac{(x-80)}{V}$$

$$2x = 5x - 400$$

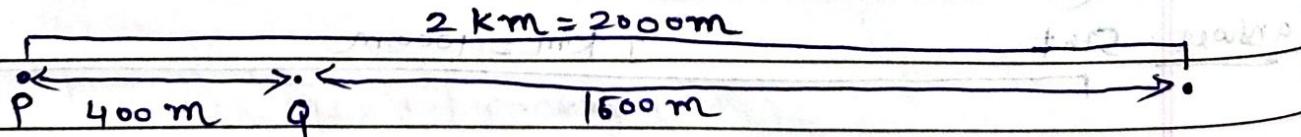
$$400 = 3x$$

$$x = 200 \text{ meter}$$

$V \rightarrow \text{velocity (speed)}$
 $x \rightarrow \text{distance of race}$

example In a 2 km race, P gave 400 meter Head start to Q. If they finished the race on same time and speed ratio of Q is 18 km/h then what is speed of P.

- (A) 20 km/h (B) 25 km/h (C) 22.5 km/h
(D) 25.5 km/h (E) 28 km/h (F) 30 km/h (G) 32 km/h (H) 35 km/h

answer

$$\therefore T_p = T_q$$

$$\therefore \frac{2 \text{ km}}{V_p} = \frac{1600/1000 \text{ km}}{18 \text{ km/h}}$$

$$\frac{36}{1.6} \text{ km/h} = V_p \Rightarrow V_p = 22.5 \text{ km/h}$$

Speed of P.

example In a 200m race, A beats B by 35 meter or 7 sec.
what is A's time over the course.

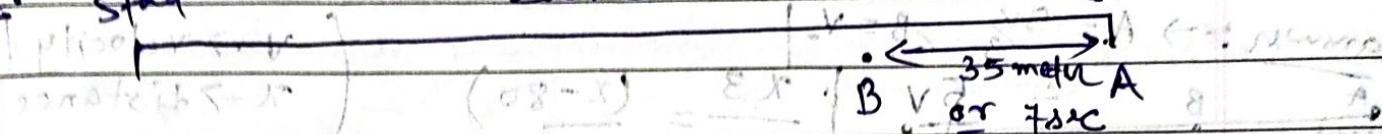
- (A) 30 sec (B) 35 sec (C) 33 sec (D) 48 sec.

answer :-

start

200m

finish



∴ speed of B = $\frac{35}{7} = 5 \text{ m/sec}$

total time for B = $\frac{200}{5}$

$= 40 \text{ sec.}$

∴ total time for A = $(40 - 7) \text{ sec}$

$= 33 \text{ sec}$

→ A's time over the course.

example In a kilometer race, A beats B by 30 sec, B beats C by 15 sec, If A beats C by 180 meter then
time taken by A to run 1 km is — (A)

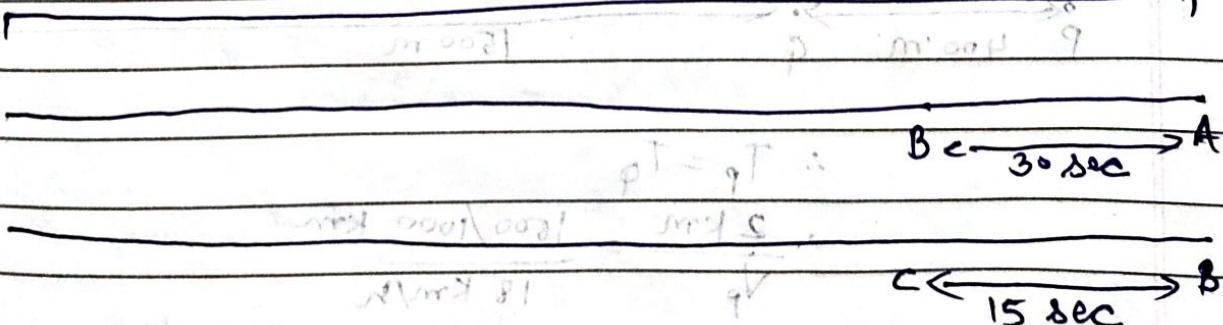
- (A) 250 sec (B) 215 sec (C) 205 sec (D) 200 sec.

answer :-

start

1 km = 1000m

finish



then we can say A beats C by 45 sec.

Speed of C = $\frac{180}{45} = 4 \text{ m/s}$ (A beats C by 180 meter)

→ time taken by C = $1000/4 = 250 \text{ sec}$

→ time taken by A = $250 - 45 = 205 \text{ sec}$

Time & Work

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example A can do a piece of work in 15 days,

B can complete the same work in 12 days,

C can complete work in 20 days.

A and B works together for 4 days and then B left
and C joins A. In How many days the work will
completed.

- (A) $7\frac{3}{7}$ days (B) $8\frac{3}{8}$ days (C) 10 days (D) 11 days

answer:

(efficiency \uparrow , Time \downarrow) (Efficiency $\propto \frac{1}{T}$)

(Number of People $\times \frac{1}{T}$) ($P \propto \frac{1}{T}$)

A ~~1 job / per day~~
~~15 days~~
~~4 Job / per day~~

B ~~5 Job / day~~
~~12 days~~
~~60 Job~~

C ~~3 Job / day~~
~~20 days~~
~~60 Job~~

LCM (15, 12, 20) = 60

Means they do 60 Job.

60 Job

4 day (A+B)

1 day (A+C)

$$4(4+5) + x(7) = 60$$

$$x = \frac{24}{7} = 3\frac{3}{7} \text{ days}$$

$$\boxed{\text{Total days} = x + 4 = 7\frac{3}{7} \text{ days}}$$

example A and B together complete work in 18 days.
 B and C together in 24 days,
 C and A together in 36 days.
 In How many days A, B, C together complete the work?
 and Also find A, B, C individually complete the work.

Answer

$$\begin{array}{rcl} 18 & , & 24 & , & 36 \\ \hline A+B & & & & 72 \\ B+C & & & & 3 \\ C+A & & & & 2 \end{array}$$

\rightarrow Add All three = $2(A+B+C) = 9$

$$A+B+C = 4.5 \text{ Job/day}$$

\therefore for A, B, C,

$$4.5 \text{ Job} = 1 \text{ day}$$

$$72 \text{ Job} = ?$$

$$\frac{72}{4.5} = 16 \text{ days}$$

If A, B, C work together then It will take 16 days.

\rightarrow for A, B, C Individually.

$$A+B+C = 4.5, A+B=4, C=0.5 \text{ Job/day}, C = \frac{72}{0.5}, C = 144 \text{ day}$$

$$A+B+C = 4.5, B+C=3, A=1.5 \text{ Job/day}, A = \frac{72}{1.5}, A = 48 \text{ days}$$

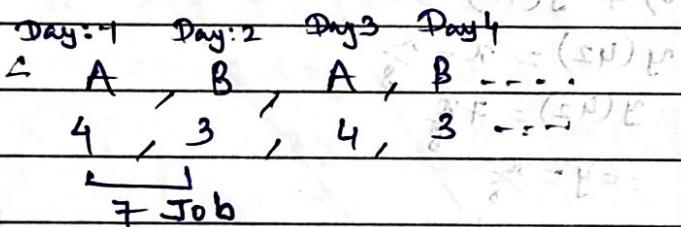
$$A+B+C = 4.5, A+C=2, B=2.5 \text{ Job/day}, B = \frac{72}{2.5}, B = 28.8 \text{ days}$$

example A can do work in 9 days, B can do in 12 days.

They agreed to do on alternate days. In how many days it work gets completed if A comes first, and then B.

answer:

$$\begin{array}{c} \text{A} \quad \frac{3 \times 3}{9} \quad \text{B} \quad \frac{3 \times 4}{12} \\ \text{LCM}(9, 12) = 36 \text{ Job} \end{array}$$



$$36 = 7(5) + 1$$

Means In 5×2 days 35 Job is done by A, B on alternate days. One Job is left and next turn.

Time required to complete 1 lefted work

of 1 job is $\frac{1}{4}$ day.

$$\rightarrow \text{Total Days} = 10 + \frac{1}{4}$$

$$= \frac{41}{4} \text{ days}$$

$$\text{OR } 10\left(\frac{1}{4}\right) \text{ days}$$

Example A can finish Job in 80 days. He works for 10 days and remaining work done by B alone for next 42 days. Then In How many days A and B together finish the work.

Answer :- → Let Total Job is x .

→ A. can do work in 80 days. means efficiency $\frac{x}{80}$

→ Efficiency of B is y .

$$\therefore \left(\frac{x}{80} \right) (10) + y(42) = x$$

$$y(42) = x - \frac{x}{8}$$

$$\therefore y(42) = \frac{7x}{8}$$

$$\therefore 6y = \frac{x}{8}$$

$$\boxed{\frac{x}{48} = y}$$

$$\rightarrow \frac{x}{48} + \frac{x}{80} = 1 \text{ Day} \Rightarrow \frac{x}{48} + \frac{x}{80} = \frac{(80)(48)}{80+48} = \boxed{= 30 \text{ Days}}$$

Example A and B can finish work individually in 32 days and 20 days respectively. They started working together but B leaves the job 4 days before its completion then In how many days work will complete.

Answer :-

A	$\frac{32}{5} \text{ Job/day}$	$\frac{20}{8} \text{ Job/day}$	$\frac{160}{160} \text{ Job}$
B			

$$\text{LCM}(32, 20) \rightarrow 32 = 2^3 \times 2^2$$

$$\rightarrow 20 = 2^2 \times 5$$

$$\text{LCM} = 2^3 \times 2^2 \times 5$$

$$= 160$$

$$\therefore 5x + 8x = 160 - 20$$

$$\therefore 13x = 140$$

$$\therefore x = 10 \frac{10}{13} \text{ days.}$$

$$\therefore \text{Total days} = x + 4$$

$$= 14 \frac{10}{13} \text{ days}$$

example: B is 40% more efficient than A. work together they can finish Job in 120 days then in how many they can finish work Individually.

answer:- $\rightarrow A = x \text{ Job/day}$

$$\rightarrow B = 1.4x \text{ Job/day}$$

$$\rightarrow \text{Total Job} = y$$

~~$$\therefore xy + 1.4xy = 120$$~~

~~$$\therefore 2.4xy = 120$$~~

~~$$\therefore xy = \frac{120}{2.4}$$~~

~~$$\therefore xy = 50$$~~

$$120x + 1.4x(120) = y$$

$$\therefore 120x(2.4) = y$$

$$\therefore 12 \times 24 = \frac{y}{x}$$

for A \rightarrow x Job \rightarrow 1 day

y Job \rightarrow (?)

$$= \frac{y}{x} = 12 \times 24 \quad [= 288 \text{ days}]$$

for B \rightarrow $1.4x$ Job \rightarrow 1 day

y Job \rightarrow

$$= \left(\frac{y}{x}\right) \left(\frac{1}{1.4}\right)$$

$$= \frac{12 \times 24}{1.4} = [205.71 \text{ days}]$$

example

A is as efficient as B and C working together.

A and B working together finish Job in 10 days while

C alone 50 days to finish that Job. Then In How many days B alone can finish?

answer

$$1. B = x \text{ Job/day}$$

$$\therefore C = y \text{ Job/day}$$

$$\therefore A = (x+y) \text{ Job/day}$$

$$10(x+y) = 2 \quad (\text{work done})$$

$$C = (y) \text{ work}$$

$$10(x+y) + 10y = 2 \quad (\text{work done})$$

$$\therefore 10x + 10y + 10y = 2$$

$$\therefore \frac{20x}{y} + 20y = 2$$

$$50y = 2$$

$$\therefore 50 = \frac{2}{y}$$

$$\therefore 20\left(\frac{x}{y}\right) + 10 = 50$$

$$\therefore 20\left(\frac{x}{y}\right) = 40$$

$$\therefore \frac{x}{y} = 2$$

$$\frac{x}{2} = \frac{2}{50}$$

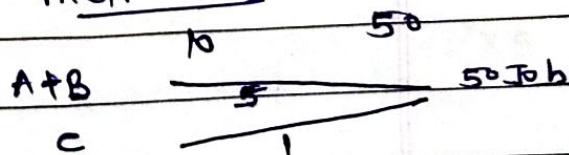
$$\therefore \frac{2}{x} = 25$$

\rightarrow 1 Job \rightarrow $\frac{1}{25}$ day
2 Job (?)

$$\therefore \frac{2}{x} = \frac{2}{25} \text{ days}$$

$$\therefore = 25 \text{ days}$$

method 1.2



$$A+B+C = 6$$

$$A=B+C, 2A=6 \quad A=3, B=2$$

$$B \rightarrow \frac{50}{2} = 25 \text{ days.}$$

example A is three times as good work man as B. and therefore.

He is able to finish Job in 60 days less than B working less than B. Working together they can do it in How many days?

$$\text{answer} \rightarrow B = y \text{ Job/day}$$

$$\rightarrow A = 3y \text{ Job/day}$$

$$\rightarrow B \text{ worked for } x \text{ days.}$$

$$\rightarrow A \text{ worked for } (x - 60) \text{ days.}$$

$$\therefore yx = 3y(x - 60)$$

$$\therefore xy = 3xy - 180y$$

$$180y = 2xy$$

$$\therefore x = 90$$

$$\rightarrow B \text{ worked for } 90 \text{ days}$$

$$\rightarrow A \text{ worked for } 30 \text{ days.} \rightarrow \text{Total Job} = \text{LCM}(90, 30) = 90$$

$$\rightarrow B = 1 \text{ Job/day}$$

$$\rightarrow A = 3 \text{ Job/day.}$$

$$\rightarrow \text{Total days} = z$$

$$\therefore z = 22.5 \text{ days}$$

$$\boxed{z = 22\left(\frac{1}{2}\right) \text{ days}}$$

example

Sakshi can do a piece of work in 20 days, Tanya is 25% more efficient than Sakshi. Number of days taken by Tanya to do same piece of work is —

(A) 12 days (B) 14 days (C) 16 days (D) 18 days.

answer

$$\begin{aligned} \rightarrow \text{Sakshi} &= x \text{ Job/day} \\ \rightarrow \text{Tanya} &= 1.25x \text{ Job/day} \\ \rightarrow \text{Total Job} &= 20x \quad \text{not } (x \text{ Job/day} \times 20 \text{ day} = 20x) \end{aligned}$$

$$\begin{aligned} \rightarrow 1.25x \text{ Job} &\rightarrow 1 \text{ day} \\ 20x \text{ Job} &\rightarrow ? \end{aligned}$$

$$\left(\frac{20 \text{ days}}{1.25x} \right)$$

$$\rightarrow \frac{20 \times 100}{125}$$

$$= 16 \text{ days}$$

example A and B together completed in 12 days, B and C together completes in 15 days, after A has been working for 5 days, B for 7 days, C finishes in 13 days. Then In How many days C alone can complete

answer:

$$1. \text{ Total work} = a$$

$$2. A = x \text{ Job/day}$$

$$B = y \text{ Job/day}$$

$$C = z \text{ Job/day.}$$

\therefore for C alone:

$$z \text{ Job} = 1 \text{ day}$$

$$a \text{ Job} = ?$$

$$= \left(\frac{a}{z} \right) \text{ day} - (i)$$

$$\rightarrow 12x + 12y = a, \quad 16y + 16z = a$$

$$\rightarrow 5x + 7y + 13z = a$$

$$\rightarrow x + y = \frac{a}{12}, \quad y + z = \frac{a}{16}, \quad 5x + 7y + 13z = a$$

$$x - z = \frac{a}{12} - \frac{a}{16}$$

$$x - z = \frac{a}{48}$$

$$x = \frac{a}{48} + z$$

$$y = \frac{a}{16} - z$$

$$\therefore 5\left(\frac{a}{48} + z\right) + 7\left(\frac{a}{16} - z\right) + 13z = a$$

Method:- 2

$$\begin{array}{c} 12 \quad 16 \\ A+B \quad 4 \text{ Job/day} \\ \hline B+C \quad 3 \text{ Job/day} \end{array} \quad \text{LCM}(12, 16) = 48$$

$$\therefore 5 \cdot \frac{a}{48} + 5z + 7 \cdot \frac{a}{16} - 7z + 13z = a$$

$$\therefore \frac{26a}{48} - 2z + 13z = a$$

$$11z = a - 26a$$

$$11z = \frac{48a - 26a}{48}$$

$$11z = \frac{22a}{48}$$

$$z = \frac{a}{24}$$

$$24 = \frac{a}{z}$$

$$\therefore 5A + 7B + 13C = 48$$

$$\therefore 5A + 5B + 2B + 2C + 11C = 48$$

$$\therefore 5(4) + 2(3) + 11c = 48$$

$$\therefore C = 2 \text{ Job/person}$$

$\rightarrow C$ alone can do work

in 24 day.

$$\rightarrow 2 \text{ Job} = 1 \text{ Day}$$

$$\therefore 48 \text{ Job} = (?)$$

$$= \frac{48}{2} \text{ Day}$$

$$= [24 \text{ Day}]$$

Example A, B, C completes work separately in 24, 36, 48 days respectively. They can work together, C left Job 4 day before completion and A left Job before 3 days completion. In How many days completes the work.

Answer :-

$$\rightarrow \text{LCM}(24, 36, 48)$$

$$\rightarrow 24 = \underline{3} \times \underline{2} \times \underline{2} \times \underline{2}$$

$$36 = \underline{3} \times \underline{2} \times \underline{3} \times \underline{2}$$

$$(48) = \underline{2} \times \underline{2} \times \underline{2} \times \underline{2} \times \underline{3}$$

$$D = 8 \text{ days} + \text{Job} = \text{LCM} = 3 \times 2 \times 2 \times 2 \times 2 \times 3$$

$$D = 84 + \frac{8}{24} + \frac{8}{36} + \frac{8}{48} = 9 \times 16 = 144$$

$$\rightarrow A = 6 \text{ Job/day}$$

$$\rightarrow B = 4 \text{ Job/day}$$

$$\rightarrow C = 3 \text{ Job/day}$$

$$84 = (x(A+B+C)) + (A+B) + 3B$$

$$144 \text{ Job}$$

$$6x + 4x + 3x = 144 - 10 - 12 + 82 + 48$$

$$13x = 122$$

$$x = \frac{122}{13}$$

$$\text{Total days} = \left(\frac{122}{13} + 4 \right)$$

$$= 13 \frac{5}{13} \text{ days}$$

example 50 men can do piece of work in 40 days. They start work and after some days 10 men left, remaining work will be completed in 40 days. Then after how many days 10 men left the work?

answer :-

$$50 \text{ men} \rightarrow 40 \text{ days} \rightarrow \text{Total Job} = 2000 \text{ Job}$$

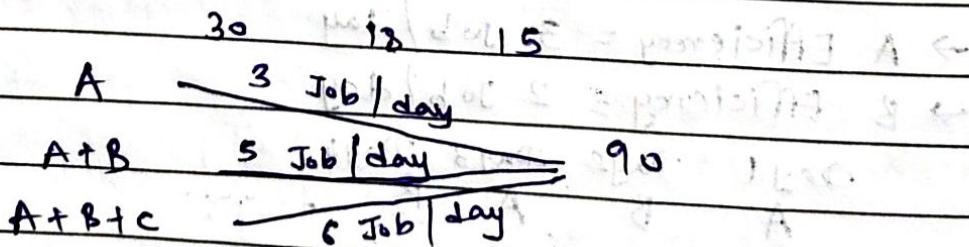
$$50 \text{ men} \times \text{days} \quad 40 \text{ men} \rightarrow 40 \text{ days}$$

$$50x + 1600 = 2000 \\ 50x = 400 \\ x = 8 \text{ days}$$

example A can do piece of work in 30 days. A and B together do in 18 days. A, B, C can do together in 15 days. Now they get total wages 1380 Rupees. Then what is share of B?

- (A) 520 Rupees (B) 480 ₹ (C) 500 ₹ (D) 460 ₹

answer :-



$$30 = 3 \times 5 \times 2$$

$$18 = 3 \times 2 \times 3$$

$$15 = 5 \times 3$$

$$\text{Job} = \text{LCM} = 3 \times 5 \times 2 \times 3$$

$$= 90 \text{ Job}$$

$$B = 2 \text{ Job/day}$$

$$A = 3 \text{ Job/day}$$

$$C = 1 \text{ Job/day}$$

total work = 90 Job \Rightarrow 30 Job because $3 \text{ Job/day} \times 30 \text{ days} = 90 \text{ Job}$
 B efficiency = 2 Job/day
 and working together for 15 days

$$= 450 \text{ Rupees}$$

example A can complete 75% work in 15 days and B alone can complete 60% work in 18 days. If A and B works alternatively starting from A and then B. In How many days Half of Total work can completed?

- (a) 5 days (b) 6 days (c) 12 days (d) 8 days.

answ

$\rightarrow 75\% \text{ work} = 15 \text{ days for A}$

$\rightarrow 100\% \text{ work} = (?)$

\rightarrow for A, 20 days

\rightarrow for B, 30 days

$\rightarrow \text{Total Job} = \text{LCM}(20, 30)$

$\rightarrow A \text{ Efficiency} = 3 \text{ Job/day}$

$\rightarrow B \text{ Efficiency} = 2 \text{ Job/day}$

Day 1	Day 2	Day 3	Day 4
A	B	A	B
3	2	3	2
1	1		

$\therefore 5 \text{ Job in 2 days}$

$$\therefore 5 \text{ Job} = 2 \text{ days} \quad = \frac{60 \times 2}{5} = 24 \text{ Days}$$

$$60 \text{ Job} = (?)$$

\rightarrow All work done in 24 Days

so, Half of total work done in $24/2 = 12 \text{ Days}$

example

Pipes & cister (eis) (Tank)

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Date:

example

A can fill tank in 20 mins,

B can fill tank in 30 mins,

C can empty in 60 mins.

Now A and B are opened together and were operated for first three minutes and then C is also opened. find

In How many minutes tank will be filled.

(A) $14\left(\frac{1}{4}\right)$ mins (B) $13\left(\frac{1}{4}\right)$ mins (C) $15\left(\frac{3}{4}\right)$ mins

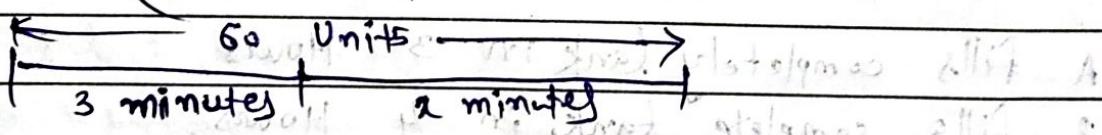
(D) 15 mins.

answer :

A	20	30	60	3 units/mins
B	20	30	60	2 units/mins
C	20	30	60	-1 units/mins

LCM = 60 Units

$$\text{Net Efficiency after C opened} = 3 + 2 - 1 = 4 \text{ per units}$$



$$15 \text{ units} + 45 \text{ units left}$$

$$45 \text{ units} \rightarrow (\text{after 3 minutes, } A+B+C \text{ efficiency})$$

$$x = 45 \frac{1}{4}$$

$$\therefore \text{Total minutes} = \left(45 \frac{1}{4} + 3\right) \text{ minutes}$$

$$= 14\left(\frac{1}{4}\right) \text{ minutes}$$

example A can fill tank in 24 minutes, B can fill tank in 32 minutes. after How much time B should be closed so tank fill in 18 minutes.

answer: ~~LCM of 24 & 32 = 96~~

~~A = 4 units/min~~ ~~LCM = 24 = 8 × 3~~
~~B = 3 units/min~~ ~~32 = 8 × 4~~
~~(i) 24 × 8 = 96~~ ~~(ii) 32 × 8 = 96~~
~~(iii) 3 × 8 = 24~~ ~~(iv) 4 × 8 = 32~~
~~(v) 96 = 96~~ ~~(vi) LCM = 8 × 12~~
~~(vii) 96 = 96~~ ~~= 96~~

$$18(4) + (18-x)3 = 96$$

$$72 + 54 - 3x = 96$$

$$x = 10 \text{ Minutes}$$

do after $18 - 10 = 8$ minutes B should closed.

example

A fills completely tank in 3 hours,

B fills complete tank in 4 hours,

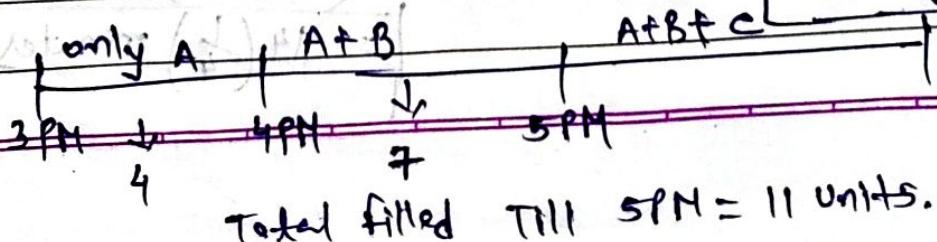
D drains complete tank in 1 hours,

A opened at 3 PM, B opened at 4 PM,
C opened at 5 PM then How much time
required to empty full tank.

answer: $\rightarrow \text{LCM} = (3, 4, 1) = 12 \text{ units}$

$$\rightarrow \text{Total Fill} = 12 \text{ units}$$

$$A = (4 \text{ per H}) \quad C = (-12 \text{ per H}) \\ B = (3 \text{ per H}) \\ \text{Efficiency} = -5 \text{ per H}$$



→ after 5 PM, -5 unit/Hour efficiency.

from $50 \text{ unit} / 5 \text{ Unit} = 1 \text{ Hour}$ (what ever is filled, we have to empty the tank)

$$10 \text{ hour} \times 5 \text{ unit} = (?)$$

(we have to drain them.)

$$= 11 \text{ Hour}$$

return of shift A (5) return of shift F (5)

$$2 \text{ Hour } 12 \text{ Mins}$$

example A fill tank complete in 20 minutes,
B empty full tank in 30 minutes,
both are operated alternate in every minutes.

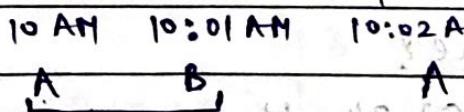
If this proceeds started at 10 AM. At what time
Tank will completely filled?

answer :- → Total fill = LCM (20, 30)

$$20 = 2 \times 10$$

$$30 = 3 \times 10$$

$$\therefore \text{Total} = \text{LCM}(20, 30) = 60$$



(At some time last A is filled then we don't have to open B because tank is fully filled by last opened A)

for every two minutes efficiency is 1 unit / 2 mins.

$$1 \text{ Unit} = 2 \text{ minutes}$$

$$57 \text{ Unit} = (?)$$

(why 57?)

because last A will take 3 units so $57 + 3 = 60$

$$\therefore 114 \text{ minutes for 57 unit}$$

and for last 3 units required is one minute.

$$\rightarrow \text{Total time} = 114 + 1 = 115 \text{ minutes}, \text{ Time} = 11:55 \text{ AM}$$

Example 3 pipes, A, B, C can fill cistern in 10, 15, 18 hours respectively. If pipe A kept open all the time and pipe B and C open alternatively for an hour. Find in how many hours tank will be filled?

- (a) 7 hours 25 minutes (c) 6 hours 12 minutes
 (b) 5 hours 40 minutes (d) 7 hours 48 minutes.

Answer

$$\begin{array}{c} \text{A} \quad 10 \quad 15 \quad 18 \\ \text{B} \quad \cancel{5 \text{ units / hour}} \quad 90 \text{ units} \quad 10 = 5 \times 2 \\ \text{C} \quad \cancel{6 \text{ units / hour}} \quad 90 \text{ units} \quad 15 = 5 \times 3 \\ \text{C} \quad \cancel{5 \text{ units / hour}} \quad 90 \text{ units} \quad 18 = 3 \times 3 \times 2 \\ \text{LCM} = 5 \times 3 \times 2 \times 3 = 90 \end{array}$$

$$\begin{array}{ccccccc} & 1 \text{ Hour} & 1 \text{ Hour} & 1 \text{ Hour} & 1 \text{ Hour} & & \\ \text{A+B} & \text{A+C} & \text{A+B} & \text{A+C} & & & \\ (15 \text{ unit}) & (14 \text{ unit}) & (15 \text{ unit}) & (14 \text{ unit}) & & & \text{How much} \end{array}$$

→ 29 units in 2 hours so 87 units in 6 hours. now turn is of A+B so remaining 3 units done in $\frac{1}{5}$ hour
 → so total time is [6 hours 12 minutes]

Example 3 pipes A, B, C can fill tank in 10 hours. After working at it together for three hours C is closed. A and B remaining part in 14 hours. How much time does C take to fill alone?

- (a) 18 hours
 (b) 20 hours

(c) 24 hours

(d) 22 hours

Answer: → Total fill is y .

$$10A + 10B + 10C = y$$

$$A + B + C = \frac{y}{10}$$

$$\rightarrow \text{so } C = \frac{y}{20}$$

$$\rightarrow \frac{y}{20} = 1 \text{ hour}$$

$$y = (?)$$

$$3(A+B+C) + 14(A+B) = y$$

$$3\left(\frac{y}{10}\right) + 14(A+B) = y$$

$$A+B = \frac{y}{20}$$

$$= 20 \text{ hours}$$

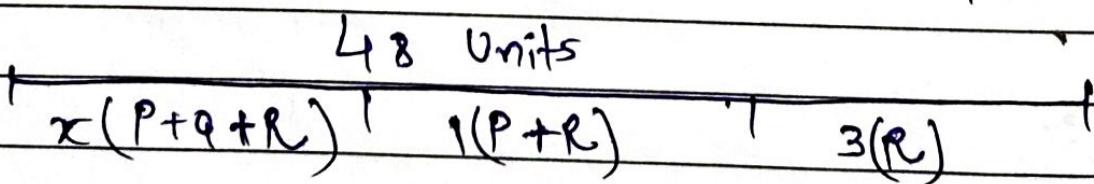
example P, Q, R can fill tank in 12, 16, 24 Minutes.

All three begin to fill together but P and Q left 3 & 4 minutes before filled tank respectively. find Total Time taken by All of three.

- (A) 12 (B) 16 (C) 8 (D) 10

answer :

$$\begin{array}{c}
 \begin{matrix} 12 & 16 & 24 \end{matrix} \\
 \begin{matrix} P & \cancel{4 \text{ units/mins}} \\ Q & \cancel{3 \text{ units/mins}} \\ R & \cancel{2 \text{ units/mins}} \end{matrix} \rightarrow \text{LCM } (12, 16, 24) \\
 \begin{matrix} 48 \text{ Units} \\ \rightarrow 12 = 4 \times 3 \\ \rightarrow 16 = 4 \times 2 \times 2 \\ \rightarrow 24 = 4 \times 3 \times 2 \end{matrix} \\
 \text{LCM} = 4 \times 3 \times 2 \times 2 \\
 = 48 \text{ units}
 \end{array}$$



$$\therefore x(P+Q+R) + 1(P+R) + 3R = 48$$

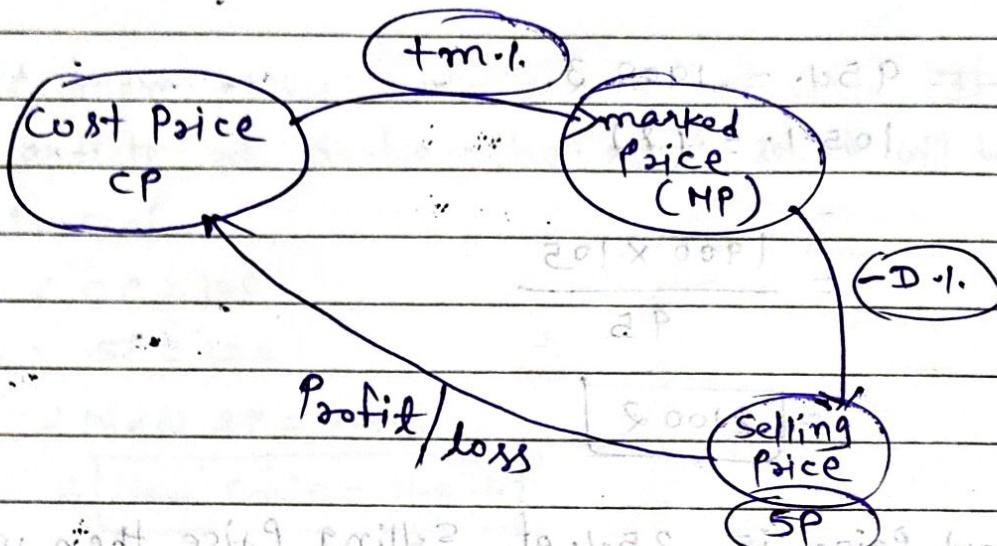
$$\therefore x(4+3+2) + 1(6) + 3(2) = 48$$

$$9x = 36$$

$$\therefore x = 4$$

$$\text{Total time} = 4 + 4$$

$$= 8 \text{ minutes}$$



$$SP = \frac{[100 + \pm \% P/L]}{100} \times CP$$

(+ for profit, - for loss)

example Name buys cycle at 1400, and sells it at 15.1% loss
what selling price?

answer

$$SP = \frac{100 - 15}{100} (1400)$$

$$SP = 1190$$

example A Person incures a loss of 5.1% by selling a watch for Rupees 1900. At what price the watch be sold to earn 5.1% profit.

answer: $SP \rightarrow$ let assume 100% cost price.

$$95\% = 1900 \text{ Rs.}$$

$$105\% = (?)$$

$$= \frac{1900 \times 105}{95}$$

$$= \boxed{2100 \text{ Rs}}$$

example If cost price is 25% of selling price then what is profit %?

answer :- → Let assume selling price = 100

→ cost price = 25

$$\rightarrow \text{profit} = \frac{SP - CP}{CP} \times 100 = \frac{75}{25} \times 100$$

$$= \boxed{300 \%}$$

example A mobile was sold at a loss of 8%. It was observed if SP was 540 more then profit would have been 10%. What is actual SP of mobile?

answer :-

→ CP → 100%

→ SP → 92% New SP → 110%

diff. In SP = 18%

$$18\% \rightarrow 540 \rightarrow \frac{540 \times 92}{18}$$

$$92\% \rightarrow (?)$$

$$= \boxed{2760 \text{ Rupees}}$$

example A man gains 20%. selling by article. If he sells the article at double the price what will be its profit percent.

answer

$$\therefore CP = 100$$

$$\therefore SP = 120$$

$$\therefore \text{New SP} = 240$$

$$\therefore \text{New gain} = \underline{140\%}$$

example If Ravi purchases 10 oranges for 25 ₹ and sells 9 oranges for same price then find % gain?

answer :-

25 Rupees $\xrightarrow{\text{Purchase}}$ 10 oranges.

25 Rupees $\xrightarrow{\text{Sell}}$ 9 oranges.

$$225 = 25 \times 9 \quad \xrightarrow{\text{Purchase}} 90.$$

$$250 = 25 \times 10 \quad \xrightarrow{\text{Sell}} 90$$

$$\%P = \frac{25}{225} \times 100$$

$$\%P = 11\frac{1}{9}\%$$

example Ravi sells 16 pens at cost of 20 pens. what is Profit/Loss?
 Percent Made by him? all about the ratios

answer

$$\rightarrow \left(\frac{20 - 16}{16} \right) \times 100$$

$$\rightarrow \frac{4}{16} \times 100$$

$$\rightarrow 25\% \text{ Profit}$$

example A shopkeeper expects gain of 22.5% on his cost price.
 If his SP was Rupees 392 then find his profit?

answer :-

~~$$\therefore 392 = \left(\frac{100 + 22.5}{100} \right) CP$$~~

$$\therefore 39200 =$$

~~$$122.5 \cdot 10 \rightarrow 392$$~~

~~$$22.5 \cdot 1 \rightarrow (?)$$~~

$$= \frac{392 \times 22.5}{122.5}$$

$$= 72 \text{ Rupees.}$$

example A shopkeeper offers a discount of 10%. on his article. Marked price is 450 then what is selling price?

answer:

$$\therefore 100 \% \rightarrow 450$$

$$\therefore 90 \% \rightarrow (?)$$

$$= \frac{90 \times 450}{100}$$

$$= \boxed{405 \text{ Rupees}}$$

example A Merchant Marked Price his goods 20% more than its cost price and allows a discount of 15%. then what is profit?

answer:

$$\rightarrow CP = 100$$

$$\rightarrow MP = 120$$

$$\rightarrow SP = 120 - \frac{120 \times 15}{100}$$

$$\rightarrow SP = 102$$

$$\rightarrow \boxed{\text{Profit} = 2\%}$$

Method 12

$$\%P = a + b + \frac{ab}{100}$$

$$\%P = 20 - 15 - \frac{15 \times 20}{100}$$

$$\boxed{\%P = 2\%}$$

example After allowing discount of 15%, there was still gain of 5%. then what is percentage of Marked Price over cost price?

answer

$$\therefore \%P = a + b + \frac{ab}{100}$$

$$\therefore 5 = a - 15 - \frac{15a}{100}$$

$$21 = \frac{84a}{100}$$

$$\therefore \boxed{a = 25\%}$$

example A discount of 10% was given on marked price and was observed that gain is 20%, if discount is increased to 15%, then what will be gain percentage?

answer :-

$$\therefore \text{S.P} = m - d - \frac{md}{100}$$

$$\therefore \text{S.P} + d = m \left(1 - \frac{d}{100}\right)$$

$$\therefore \begin{cases} \text{S.P} + d = m \\ 1 - \frac{d}{100} \end{cases}$$

$$\frac{\text{S.P} + d_1}{1 - \frac{d_1}{100}} = \frac{\text{S.P} + d_2}{1 - \frac{d_2}{100}}$$

(marked price is same for both cases)

$$\frac{20 + 10}{1 - \frac{10}{100}} = \frac{P_2 + 15}{1 - \frac{15}{100}}$$

$$\frac{30}{90} = \frac{P_2 + 15}{85}$$

$$\frac{85}{3} = P_2 + 15$$

$$\therefore P_2 = \frac{85 - 45}{3}$$

$$\therefore P_2 = 40\%$$

$$\therefore P_2 = 13.33\%$$

example A dishonest dealer professes sells his goods at cost price, but uses a weight of 960 gram for a kg. Find his gain %.

answer

$$\text{Profit} = \frac{1000 - 960}{960} \times 100 = 4.16\%$$

$$\therefore \text{P} = \frac{4000}{960} \times \frac{95}{96} = 4.16\%$$

$$\boxed{\text{P} = 4.16\%}$$

example a dealer sells goods at 6% discount but uses 14 gram instead of 16 g. what is his % profit or loss?

- (A) $7\left(\frac{3}{7}\right)$ (B) $11\left(\frac{6}{7}\right)$ (C) 8.5 (D) 9

answer \rightarrow Discount = 6 = d

$$\rightarrow \text{profit due to less weight} = P_1 = \frac{16 - 14}{14} \times 100$$

$$\boxed{P_1 = 100\%}$$

$$\therefore P_1 L = P_1 - d - \frac{P_1 d}{100}$$

$$\therefore P_1 L = \frac{100}{7} - 6 - \frac{100 \times 6}{7 \times 100}$$

$$\therefore P_1 L = \frac{100}{7} - 6 - \frac{6}{7}$$

$$\boxed{\therefore P_1 L = 7\left(\frac{3}{7}\right)}$$

example A Dealer sells his goods at 20% discount but uses 40% less weights. What is % profit/loss?

answer :- $\rightarrow CP = 100$

$\rightarrow SP_d = 80$ (selling Price after discount)

$\rightarrow SP_w = 60$ (selling Price after less weights)

$$\rightarrow \text{profit/loss} = \frac{20}{60} \times 100 = 33.33\%$$

$= 33.33\%$ \rightarrow Profit

example Dealer uses 920 gram instead of 1000 gram weights to sell his goods. He sells at 15% gain on Cost Price, find % profit.

answer

$$\rightarrow CP = 1000 \text{ (let assume)}$$

$$\rightarrow MP = 1150 \quad (MP = CP + (15\% \text{ of } CP))$$

$$\rightarrow SP = 920$$

$$\% \text{ profit} = \left(\frac{1150 - 920}{920} \right) \times 100$$

$$\% \text{ profit} = \frac{230}{920} \times 100$$

$$\% \text{ profit} = 25\%$$

$$\boxed{\% \text{ profit} = 25\%}$$

example A dishonest seller marks his item at 20% above the CP. Also allows discount 15% but uses 900 gram of 1000 gram. find i. Profit/Loss

answer:

$$\rightarrow CP = 1000 \text{ (assume)}$$

$$\rightarrow MP = 1200$$

$$\rightarrow SP_d = 1200 - \frac{1200 \times 15}{100}$$

$$\rightarrow SP_d = 1020$$

$$\therefore \% = \frac{1020 - 900}{900} \times 100$$

$$\therefore \% = \frac{120}{900} \times 100$$

$$\therefore \% = \frac{120}{9} = 13.33\% \rightarrow \text{Profit}$$

example Shopkeeper cheats to a extends of 20% while buying as well as selling by false weights. Find His gains %.

answer:

~~Actual Price = 100~~

~~CP = 80~~

~~SP = 120~~

~~\therefore \% = \frac{40}{80} \times 100~~

$$\therefore \% = p_1 + p_2 + \frac{p_1 p_2}{100}$$

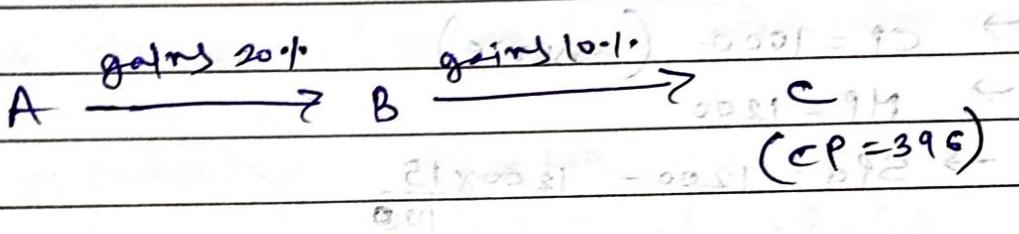
$$\therefore \% = 20 + 20 + \frac{(20)(20)}{100}$$

$$\therefore \% = 44\%$$

example A book is sold from A to C, CP of C is 396,
A gains 20% by selling to B, B gains 10% while selling to C.

CP of A is half of the original cost to start

answer



$$\rightarrow \text{I.P} = P_1 + P_2 + \frac{P_1 P_2}{100} \quad 0.32 = 0.692$$

$$\text{I.P} = 20 + 10 + \frac{200 \times 10}{100}$$

$$\boxed{\text{I.P} = 32\%}$$

$$\rightarrow \text{I.P} = \frac{\text{CP of C} - \text{CP of A}}{\text{CP of A}} \times 100$$

$$32 = \frac{(396 - x)}{x} \times 100$$

$$0.32 = \frac{396 - x}{x}$$

$$396 + 32x + 1.32x = 396$$

$$x = \frac{396 \times 100}{132}$$

$$\boxed{x = 300} \rightarrow \text{cost price of A.}$$

12.1.

example

Shopkeeper marks selling price of book above cost price of book. While selling he gives ~~20~~ discount and booked loss of 20%. Find discount %.

answer

$$\rightarrow CP = 100$$

$$\rightarrow MP = 112$$

$$\rightarrow SP = 98$$

$$\text{discount} = \frac{112 - 98}{112} \times 100$$

$$= \frac{14}{112} \times 100 = 12.5\%$$

example A fruit seller buys some apples at rate of 10 rupees for 4 apples, and equal number for 5 apples. He sells whole lot at 9 for RS. 20. What is the i. profit / loss.

answer:

$$10 \text{ Rupees} \rightarrow 4 \text{ apples}$$

$$10 \text{ Rupees} \rightarrow 5 \text{ apples}$$

$$50 \text{ Rupees} \rightarrow 20 \text{ apples}$$

$$40 \text{ Rupees} \rightarrow 20 \text{ apples}$$

$$90 \text{ Rupees} \rightarrow 40 \text{ apples}$$

$$20 \text{ Rupees} \rightarrow 9 \text{ apples}$$

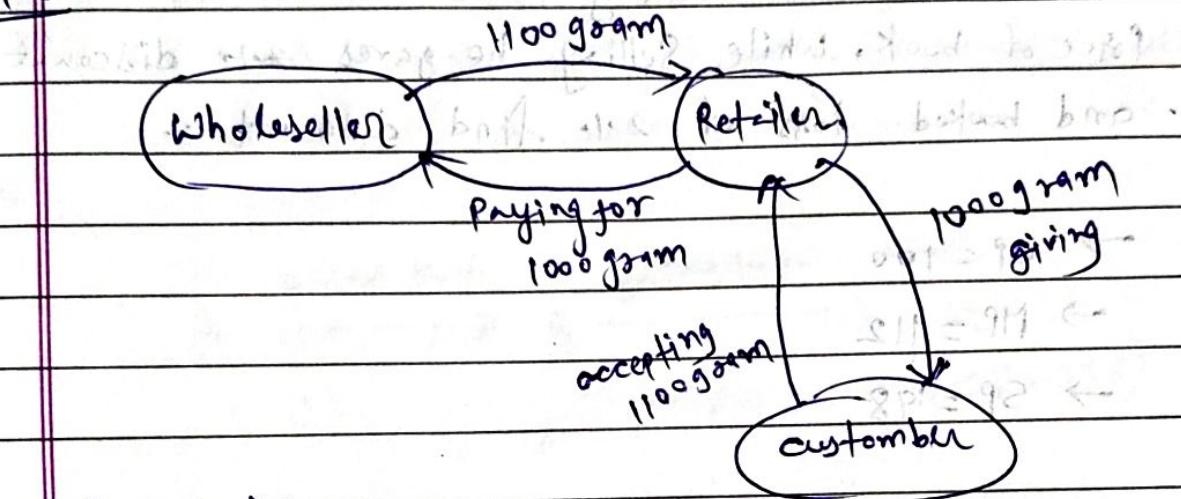
$$90 \times 9 \text{ Rupees} \rightarrow 40 \times 9 \text{ apples}$$

$$20 \times 40 \text{ Rupees} \rightarrow 9 \times 40 \text{ apples}$$

$$\therefore \text{i. Profit / Loss} = \frac{(810 - 800)}{810} \times 100 = \frac{-1000}{810} = -1.23\%$$

Loss of -1.23%.

example



find Profit %

→ both sides profit is 10%.

$$\text{Profit} \% = \frac{P_1 + P_2 + P_1 P_2}{100}$$

$$10\% + 10\% + (10)(10) \quad \frac{100}{100}$$

$$10\% = 21\%$$

example What is the difference between article costing 1000 when discount of 20% is given and when two successive discount of 10% is given on article.

answer

$$\rightarrow 20\%$$

$$\rightarrow 10\%, 10\%$$

$$10\% - \frac{(10)(10)}{100}$$

→ difference on

discount

$$\rightarrow 10\% \text{ of } 1000 = 10 \text{ Rupees}$$

Note: for successive discount

$$10\% = d_1 + d_2 - \frac{d_1 d_2}{100}$$

example The Marked Price on an article is 80% above Cost Price and sold it after giving two successive discount of 25%. and x%. then earned profit of 15%. Find value of x.

answR

$$\therefore CP = 100$$

$$\therefore MP = 180$$

$$\therefore SP = \left(25 + x - \frac{x}{4} \right) \frac{180}{100}$$

$$\therefore SP_d = 180 - \left(25 + \frac{3x}{4} \right) \frac{180}{100}$$

setting
price
after discount

~~$$180 - \left(25 + \frac{3x}{4} \right) \left(\frac{180}{100} \right) = \frac{15}{100} (180) + 180$$~~

~~$$1 - \left(25 + \frac{3x}{4} \right) \frac{180}{100} = \frac{15}{100} + 1$$~~

~~$$10 = 25 + \frac{3x}{4}$$~~

~~$$\frac{40}{3} = x$$~~

~~$$\therefore x = 12.66\ldots$$~~

selling
price
after
profit

$$\therefore SP_p = 115 \quad (\text{cost price} + 15\% \text{ profit})$$

→ comparing both selling price,

$$180 - \left(25 + \frac{3x}{4} \right) \frac{180}{100} = 115$$

$$18000 - (25 + 3x) 180 = 11500$$

$$18000 - 4500 - 135x = 11500$$

$$13500 = 135x, \quad x = 14.82\ldots$$

example If NP of TV is 25 more than CP. If shopkeeper offers two successive discounts of 20% & 15% on NP price. If SP is 13600 then find cost price.

answer :-

$$\rightarrow CP = x$$

$$\rightarrow NP = x + \frac{25}{100}x$$

$$\rightarrow NP = \frac{5x}{4}$$

$$NP + (0.20) \left(\frac{25}{100} \right) = 92.5$$

$$\rightarrow \text{Pd} = 20 + 15 - \frac{(20)(15)}{100}$$

$$\therefore d = 35 - 3$$

$$\therefore d = 32\%$$

$$\rightarrow SP = \frac{5x}{4} - \left(\frac{5x}{4} \right) \left(\frac{32}{100} \right) = 13600$$

$$\therefore \frac{5x}{4} \left(1 - \frac{32}{100} \right) = 13600$$

$$\therefore \frac{5x}{4} \left(\frac{68}{100} \right) = 13600$$

$$\therefore x \left(\frac{17}{20} \right) = 13600$$

$$\therefore x = 16000$$

∴ CP = 16000

$$SP = 16000 \left(1 - \frac{32}{100} \right) = 10880$$

$$NP = 10880 \left(1 + \frac{25}{100} \right) = 13600$$

$$CP = 16000 \left(1 + \frac{25}{100} \right) = 20000$$

$$\therefore CP = 20000 \left(1 - \frac{32}{100} \right) = 13600$$

$$\rightarrow T = \frac{D}{S}$$

Distance = Speed × Time

$$\rightarrow \text{km/hr} \rightarrow \frac{5}{18} \text{ m/s}$$

$$\frac{18}{5} \text{ s} \rightarrow \frac{18}{5} \times \frac{1}{5} \text{ m/s}$$

$$\rightarrow \text{Avg. speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

example if person walks at 14 km/h instead of 10 km/h.

He would have walked 20 km more than actual distance travelled by him is what?

answer :-

Let assume a distance.

$$T_1 = T_2$$

$$\therefore \frac{x}{10} = \frac{x+20}{14}$$

$$14x = 10x + 200$$

$$4x = 200, x = 50 \text{ km}$$

example A man complete a journey in 10 hours. he travels first half of journey 21 km/h and second half at rate of 24 km/h. find Total Distance.

answer :-

$$\frac{D}{2 \times 21} + \frac{D}{2 \times 24} = 10$$

(D → Total distance)

$$\therefore 24D + 21D = 10080$$

$$45D = 10080$$

$$D = 224 \text{ km}$$

example A Man takes 6 hours 30 minutes to a walking to a certain place and riding back. He would have gained 2 hours 10 minutes if he riding for both ways. How long he would take for both ways. if he walking only?

answer

$$\rightarrow T_w + T_r = 6 \text{ hours } 30 \text{ Min.} - 2 \text{ Hours } 10 \text{ Min.}$$

$$\therefore 2T_r = 4 \text{ hours } 20 \text{ Min}$$

$$\therefore T_r = 2 \text{ hours } 10 \text{ Min}$$

$$\rightarrow T_r + T_w = 6 \text{ hours } 30 \text{ Min}$$

$$2 \text{ hours } 10 \text{ Min} + T_w = 6 \text{ hours } 30 \text{ Min}$$

$$\therefore T_w = 4 \text{ hours } 20 \text{ Min}$$

$$\rightarrow 2T_w = 2(4 \text{ hours } 20 \text{ Min}) = 8 \text{ hours } 40 \text{ Min}$$

example B Rohan covers a certain distance between his home and office on bicycle having an avg. speed of 30 km/h. He is late by 10 minutes, However with speed of 40 km/h he reaches office 5 minutes early. find distance between Home and office.

answer $\rightarrow \text{Distance} = D.$

$$\rightarrow \frac{D}{30} - \frac{1}{6} = \frac{D}{40} + \frac{5}{60}$$

$$\frac{D}{30} - \frac{D}{40} = \frac{1}{6} + \frac{1}{12}$$

$$\frac{(40-30)}{(30)(40)} = \frac{12+6}{12 \times 6}$$

$$\frac{D}{120} = \frac{18}{12 \times 6}$$

$$D = 30 \text{ km}$$

Method 2

$$D = \frac{S_1 \times S_2}{|S_1 - S_2|} \times T_G$$

(T_G = Time Gap)

$$D = 40 \times 30 \times \frac{15}{60}$$

$$D = 30 \text{ km}$$

example A walks 20 km at 5 km/h, he will be late by 40 minutes, if he walks 8 km/h. How early from a fixed time he will reach?

answer

$\rightarrow x$ is time reaches early.

$$\therefore \frac{20 - 40}{5} = \frac{20 + x}{8}$$

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

$$\therefore \frac{10}{3} = \frac{5}{2} + x$$

$$\therefore \frac{20 - 15}{6} = x \text{ (in hours)}$$

$$\therefore \frac{5}{6} = x \text{ to meet John.}$$

$$\therefore x = \frac{5}{6} \text{ hours}$$

But between now A is $x = \left(\frac{5}{6} \times 60\right)$ minutes to finish shopping.

So it takes him 50 minutes to finish shopping.

$$\therefore x = 50 \text{ minutes}$$

example

If a train runs 40 km/h, it late by 11 minutes.

If it runs 50 km/h then late by 5 minutes only what is correct time for train to complete its journey.

answer:

$$\therefore \frac{D}{40} - \frac{11}{60} = \frac{D}{50} - \frac{5}{60}$$

$$\therefore \frac{D(10)}{40 \times 50} = \frac{1}{10}$$

$$\therefore D = 20 \text{ km}$$

$\text{Avg. speed} = \frac{\text{Total distance}}{\text{Time}}$

$$50 = \frac{20}{\text{Time}}$$

$$\therefore \text{Time} = \frac{20}{50} (60) \quad (\text{In Minutes})$$

$$\therefore \boxed{\text{Time} = 24 \text{ Minutes}}$$

\rightarrow (50 km/h takes because it late only by 5 Minutes)

(we take those speed which complete its journey in less time)

$$\angle \text{Actual Time of journey} = 24 - 5$$

$$\boxed{= 19 \text{ Minutes}}$$

\rightarrow it's late by 5 Minutes

example Walking at $\frac{3}{4}$ of his usual speed: A man reaches his office 20 min late. find His usual time.

answer \rightarrow Usual time = y ,

\rightarrow Usual speed = x ,

\rightarrow Distance = D .

$$\therefore \frac{x}{y} = \frac{D}{y}$$

$$\therefore \frac{3}{4} \left(\frac{x}{y} \right) = \frac{1}{y + \frac{1}{3}}$$

$$\therefore \frac{3}{4y} = \frac{1}{y + \frac{1}{3}}$$

$$\therefore 3y + 1 = 4y$$

$$\therefore \boxed{y = 1 \text{ Hour} = 60 \text{ Min}}$$

example Walking at $\frac{4}{3}$ of his usual speed. A man improves his timing by 10 minutes. find his usual time.

answer :-

$$\rightarrow \text{usual time} = y$$

$$\rightarrow \text{usual speed} = x$$

$$\rightarrow \text{Distance} = D$$

$$D = x \cdot y$$

$$\therefore \frac{4x}{3} = \frac{D}{y-10}$$

$$\therefore \frac{x}{D} = \frac{1}{y}$$

$$\therefore \frac{4}{3} \left(\frac{x}{D} \right) = \frac{1}{y-10}$$

$$\therefore \frac{4}{3} \cdot \frac{1}{y} = \frac{1}{y-10}$$

$$\therefore 4y - 40 = 3y$$

$$\therefore y = \frac{40}{1} \text{ hours}$$

$$= 40 \text{ minutes}$$

example A train running at $\frac{7}{11}$ of its usual speed, which reaches platform in 22 hours. How much time could be saved?

answer

$$\rightarrow y \text{ is usual time.}$$

$$\rightarrow x \text{ is usual speed.}$$

$$\rightarrow D \text{ is Distance}$$

$$\therefore x = \frac{D}{y}$$

$$\therefore y = 14$$

$$\text{Time Saved} = 22 - 14 = 8 \text{ hours}$$

$$\therefore \frac{7x}{11} = \frac{D}{22}$$

$$\therefore x = \frac{D}{14}$$

$$\therefore 14 = \frac{D}{x}$$

example Speed is $\frac{3}{4}$ of its normal speed. Rate is by 2.5 hours
find usual time.

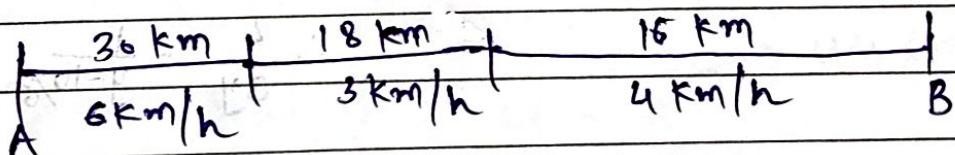
answer

$$\therefore \frac{x}{y} = \frac{1}{\frac{3}{4}} \Rightarrow \frac{3}{4} \left(\frac{1}{y} \right) = \frac{1}{y+2.5}$$

$$\therefore 3y + 3(2.5) = 4y$$

$$\therefore y = 7.5 \text{ hours}$$

example A person covers a distance various speed as follows,



find avg. speed

answer

$$\text{Avg. speed} = \frac{30 + 18 + 15}{5 + 6 + 4}$$

$$\therefore \text{Avg. speed} = \frac{64}{15} \text{ km/h}$$

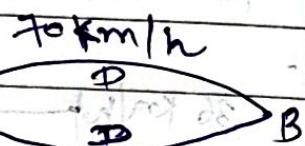
$$= 4 \left(\frac{4}{15} \right) \text{ km/h}$$

example

A man covers certain distance by driving a car at 70 km/h and returns to a starting point riding on bike at 55 km/h find avg. speed and distance between two points, Total time A to B, B to A is 10 hours

answer:-

$$\text{avg speed} = \frac{70 + 55}{2} \text{ km/h}$$



$$\text{avg speed} = 62.5 \text{ km/h}$$

$$\Rightarrow \text{avg speed} = \frac{\varnothing + \varnothing}{\frac{\varnothing}{70} + \frac{\varnothing}{55}}$$

$$= \frac{2\varnothing(70)(55)}{\varnothing(55+70)}$$

$$= 61.6 \text{ km/h}$$

$$\rightarrow \varnothing = (\text{Avg time}) \times (\text{Time}_2)$$

$$\varnothing = (61.6) \left(\frac{10}{2}\right)$$

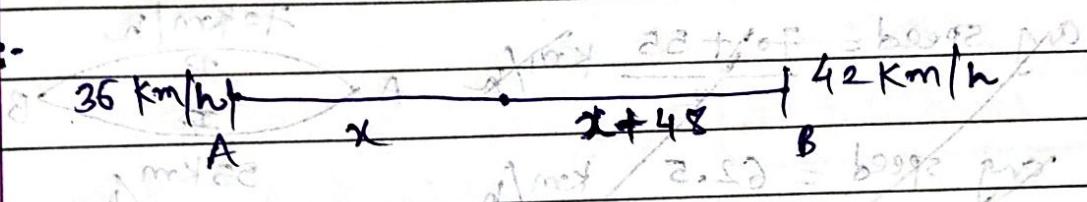
$$\varnothing = 308 \text{ km}$$

$$\text{Time} = \frac{\text{Total distance}}{\text{Relative speed}}$$

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example Two trains start at same time from A and B proceeds towards B and A at 36 km/h and 42 km/h respectively when they meet it is found that one train has moved 48 km more than the other what is distance between A and B.

answer :-



$$\rightarrow \text{Time of meeting} = \frac{\text{distance}}{\text{relative speed or speed of B when A is stop}}$$

$$\frac{x}{36} = \frac{x+48}{42}$$

$$\frac{42x}{36} - \frac{36x}{36} = 48$$

$$6x = 48$$

$$\frac{6x}{6} = \frac{48}{6}$$

$$x = 8 \text{ hours}$$

$$\rightarrow \text{Speed} = \frac{\Phi}{T} = \frac{(x)(\text{op}) + x}{(x+2x)} = \frac{2x}{3x} = \frac{2}{3}$$

$$\therefore 36 \times 8 = 288$$

$$\therefore x = 288$$

$$\Phi = 288 \text{ km}$$

$$\rightarrow \text{distance} = x + x + 48$$

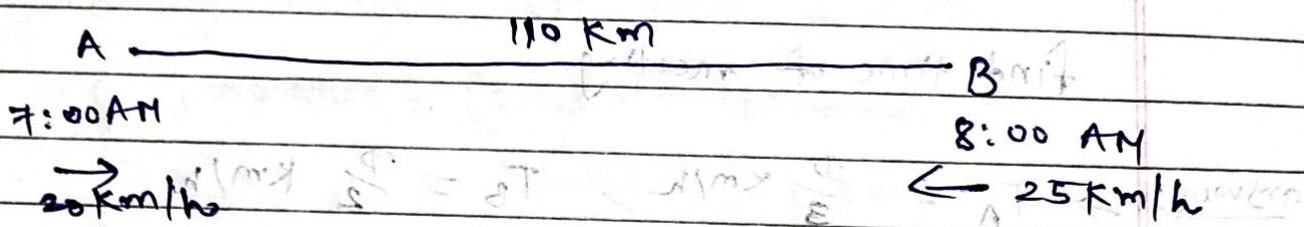
$$= 624 \text{ Km}$$

$$\text{metre} \times \text{second} = \text{kg}$$

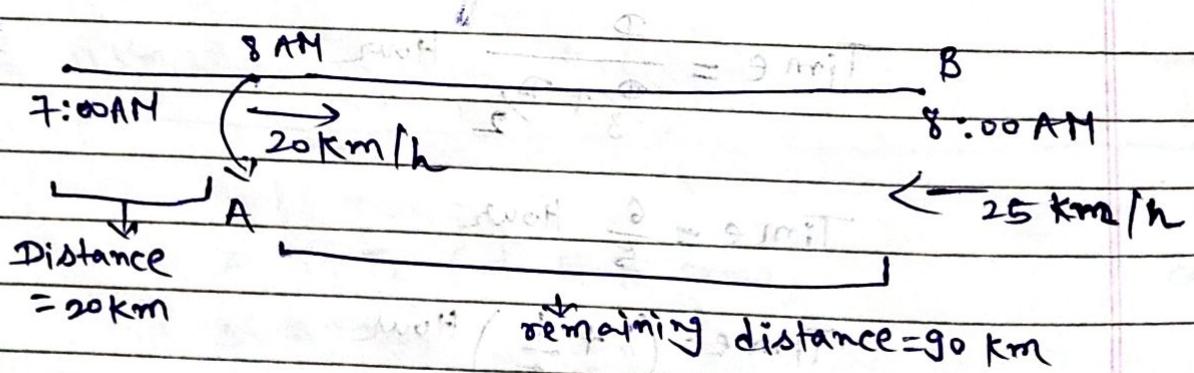
$$1 \text{ kg} \cdot \text{m/s} = \text{N}$$

example Two stations A and B are 110 km apart on a straight line. One train starts from A at 7:00 AM and travel towards B at 20 km/h. Another train starts from B at 8:00 AM and travel towards A at 25 km/h at what time will they meet?

answer



→ after one hour



$$\therefore \text{Time} = \frac{\text{Distance}}{\text{Relative Speed}}$$

$$\therefore \text{Time} = \frac{90 \text{ km}}{(20 + 25) \text{ km/h}}$$

$$\therefore \text{Time} = 2 \text{ Hours}$$

→ At 10:00 AM they will meet.

example

8:00 AM

11:00 AM

A and B start from the same place at the same time and travel in opposite directions. A travels at 3 km/h and B at 2 km/h.

X

 $T_A \rightarrow$

10:00 AM

8:00 AM

 $T_B \leftarrow$

find time of meeting.

answer:

$$\rightarrow T_A = \frac{D}{3} \text{ km/h}, T_B = \frac{D}{2} \text{ km/h}$$

$$\rightarrow \text{Distance} = D \text{ Km}$$

$$\text{Time} = \frac{D}{\frac{D}{3} + \frac{D}{2}} \text{ Hour}$$

$$\text{Time} = \frac{6}{5} \text{ Hour}$$

$$\text{Time} = \left(1 + \frac{1}{5}\right) \text{ Hour}$$

$$\text{Time} = 1 \text{ Hour} + \left(\frac{1}{5} \times 60\right) \text{ minutes}$$

$$\boxed{\text{Time} = 1 \text{ Hour } 12 \text{ minutes}}$$

$$\boxed{\text{Time of meeting} = 9:12 \text{ AM}}$$

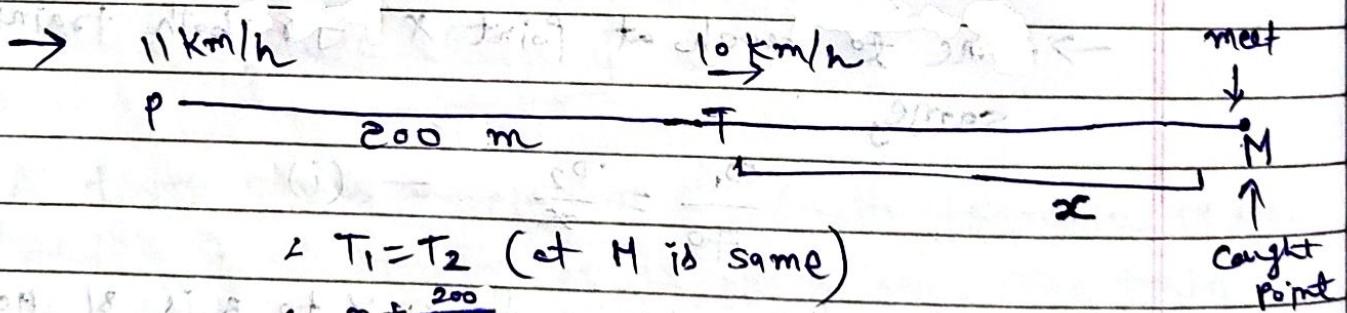
Leave the left HA 20:00

Example: A thief is noticed by policeman from a distance of 200 m. A thief starting running towards policeman. Speed of thief = 10 km/h, policeman = 11 km/h. What is the distance between them after 6 min.? After how many km and when will thief will be caught?

Answer: → Distance between them after 6 min :-

$$\begin{aligned} \text{Distance} &= (\text{Relative speed}) (\text{Time}) \\ &= (11 - 10) \left(\frac{6}{60}\right) \text{ km} \\ &= \frac{1}{10} \text{ km} \end{aligned}$$

Distance = 100 meter



∴ $T_1 = T_2$ (as M is same)

$$\frac{x + \frac{200}{1000}}{11} = \frac{x}{10}$$

$$\therefore \frac{x + 0.2}{11} = \frac{x}{10}$$

$$\therefore 10x + 2 = 11x$$

∴ x = 2 km

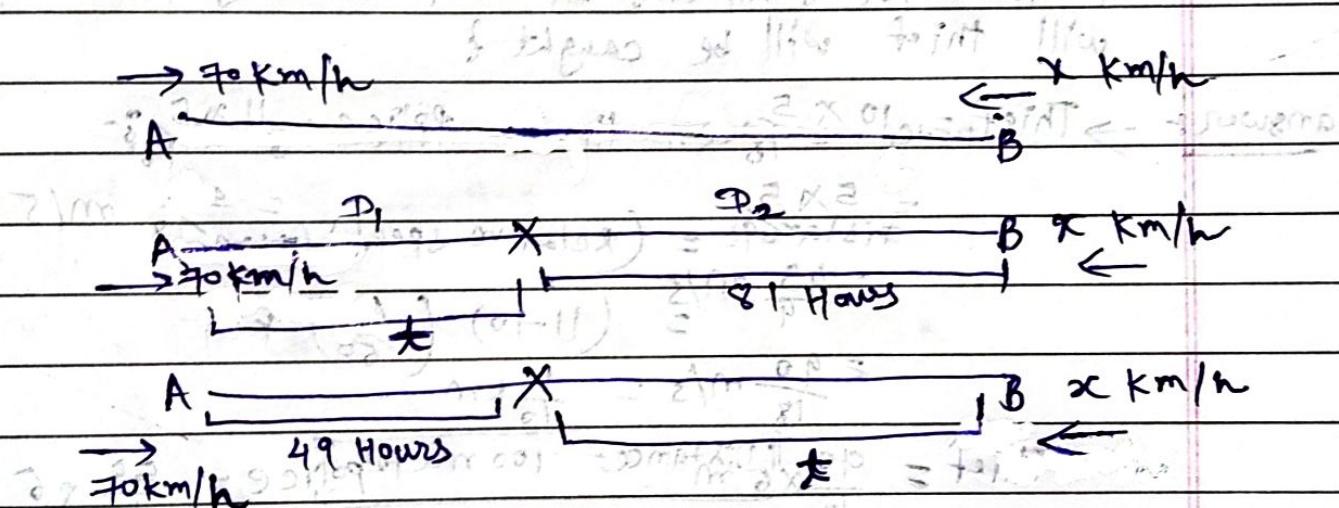
after 2 km they will meet or thief will caught.

$$\rightarrow s = \frac{d}{T} \rightarrow 10 \text{ km/h} = \frac{2 \text{ km}}{\text{Time}}$$

after 12 min.
thief will caught.

$$\begin{aligned} \text{Time} &= \frac{1}{5} \text{ Hour} = \frac{60}{5} \text{ Minutes} \\ &= 12 \text{ Minutes} \end{aligned}$$

Example Two trains start from two stations A and B at same time and proceeds towards each other to reach B and A respectively. After crossing each other they take 81 and 49 hours respectively to reach their destination. Find speed of second train if first train runs at 70 km/h .

Answer

→ time to reach at point X for both trains is same,

$$\frac{D_1}{70} = \frac{D_2}{x} - (i)$$

→ Time taken by A from X to B is 81 Hours.

$$70 = \frac{x}{81} \\ D_2 = 70 \times 81 - (ii)$$

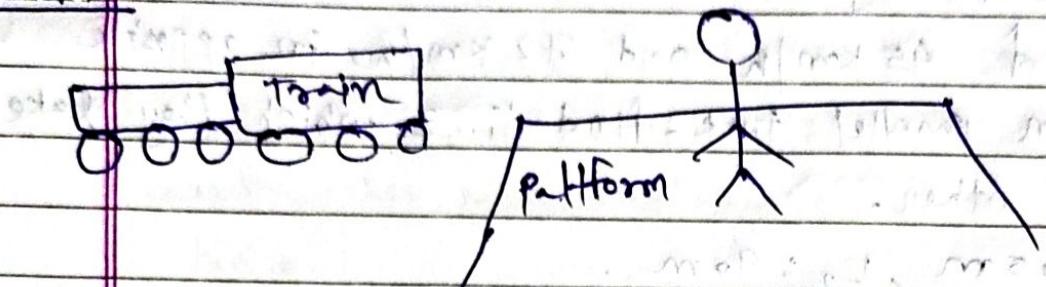
→ Time taken by B from X to A is 49 Hours.

$$x = \frac{D_1}{49} - (iii)$$

→ put D_1, D_2 in equation - (i)

$$x = 90 \text{ km/h}$$

→ Speed of another train.

Concept:-

example How many seconds will a train 100m long at a rate of 72 km/h takes to pass An electric pole.

answer:-

$$\rightarrow \boxed{5 \text{ sec}}$$

$$\rightarrow 72 \text{ km/h} \rightarrow 20 \text{ m/s}$$

$$\therefore \text{Time} = \frac{100}{20} \text{ sec} = 5 \text{ sec}$$

$$\boxed{\text{Time} = 5 \text{ sec}}$$

example A train crosses a platform of length 150m in 15 sec. and a man standing on it in 9 sec. The train is travelling at uniform speed then find length of train.

answer

$$\therefore v = \frac{T_L}{9}$$

$$v = \frac{T_L + 150}{15}$$

$\rightarrow T_L \rightarrow$ length of train

\rightarrow both's time speed is same.

$$\therefore \frac{T_L}{9} = \frac{T_L + 150}{15} \quad (\text{equalling speed})$$

$$\therefore 15T_L = 9T_L + 1350$$

$$\therefore 6T_L = 1350$$

$$\boxed{T_L = 225 \text{ m}}$$

example Two trains of length 105 m and 90 m respectively runs at speed of 45 km/h and 72 km/h in opposite direction on parallel track - find time which they take cross each other.

answer :- $L_1 = 105\text{m}$, $L_2 = 90\text{m}$.

~~total speed = $45 + 72 = 117\text{ km/h}$~~

~~cross distance = $105 + 90 = 195\text{ m}$~~

$$\text{Time} = \frac{L_1 + L_2}{V_1 + V_2}$$

$$\text{Time} = \frac{195 \times 18}{(45+72)5}$$

$$\boxed{\text{Time} = 6 \text{ seconds}}$$

example Two trains running at rate of 45 km/h & 36 km/h on Parallel track in opposite direction are observed to pass each other in 8 sec, when running in same direction as same rate as before a person sitting in faster train he passes the other train in 30 sec. find length of trains.

answer :- $\rightarrow 8 \text{ sec} :-$

$$8 = \frac{(L_1 + L_2) \times 18}{(45+36)5}$$

$$\boxed{L_1 + L_2 = 180}$$

$\rightarrow 30 \text{ sec} :-$

$$30 = \frac{L_2 \times 18}{36 \times 5}$$

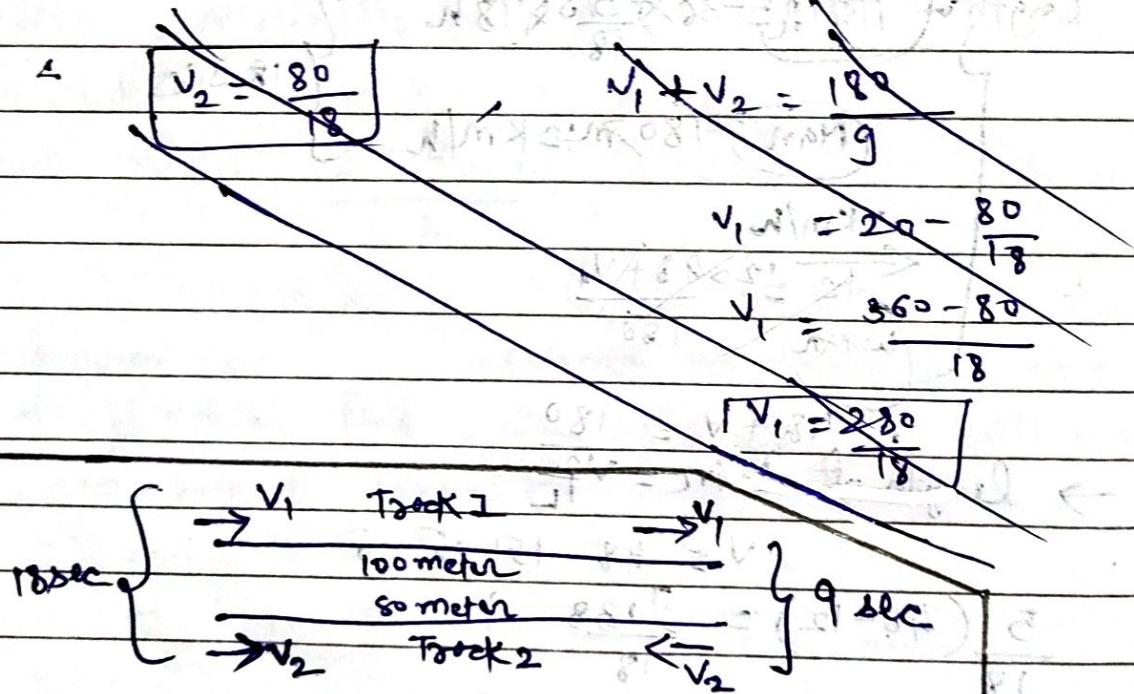
$$\boxed{L_2 = 75\text{m}}$$

$$\boxed{L_1 = 105\text{m}}$$

length of trains.

example Two trains of length 100 meter and 80 meter runs on a parallel line when running in the same direction, faster train passes the slower in 18 sec. but when in opposite direction they passes each other in 9 sec. find speed of each train.

answer :-



$$18 = \frac{100 + 80}{v_1 - v_2}$$

$$\therefore v_1 - v_2 = 10$$

$$9 = \frac{100 + 80}{v_1 + v_2}$$

$$v_1 + v_2 = 20$$

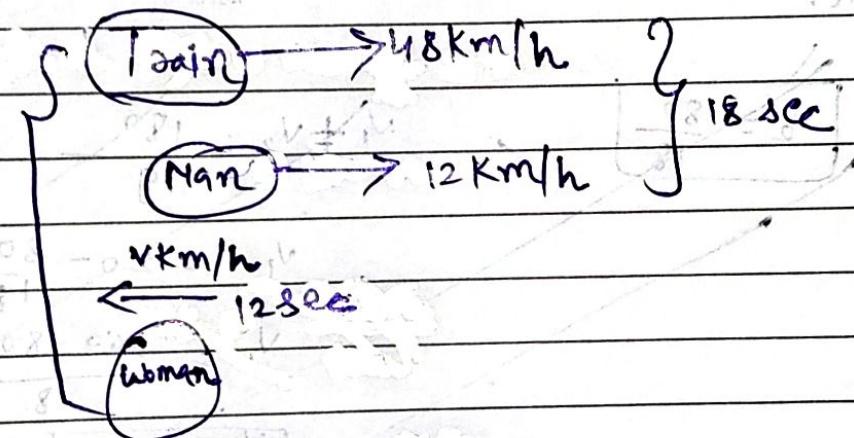
$$\text{Add, } 2v_1 = 30$$

$$v_1 = 15 \text{ m/s}$$

$$v_2 = 5 \text{ m/s}$$

example A train running at 48 km/h. crosses a man going speed of 12 km/h in same direction in 18 sec. it passes a woman coming from opposite direction in 12 sec. find speed of woman.

answer



$$\rightarrow \text{length of train} = T_L$$

$$\frac{5}{18} (48 - 12) = \frac{T_L}{18}$$

$$\therefore T_L = 36 \times 5$$

$$\therefore T_L = 180 \text{ m}$$

$$\rightarrow (48 + v) \frac{5}{18} = \frac{180}{12}$$

$$(48 + v) 5 = \frac{180 \times 9 \times 2}{4 \times 3}$$

$$48 \times 5 + 5v = 270$$

$$240 + 5v = 270$$

$$5v = 30$$

$v = 6 \text{ km/h}$ \rightarrow Speed of woman.

Boat

→ $S_u \rightarrow$ upstream (against river)

$$\rightarrow S_b = S_s$$

→ $S_d \rightarrow$ downstream (with river)

$$S_d = S_b + S_s$$

example Gaurav can upstream at 10 km/h and downstream at 18 km/h find, Gaurav's rate in still water and rate of current?

answer:

$$S_b = \frac{10 + 18}{2}$$

$$S_b = 14 \text{ km/h}$$

Gaurav

$$S_s = \frac{18 - 10}{2}$$

$$S_s = 4 \text{ km/h}$$

current

example Ramesh can row 12 km/h in still water, it takes him twice as long to row up as to row down the river find rate of stream.



$$\therefore \frac{S_d}{S_u} = 2, S_b = 12, S_u = v, S_d = 2v$$

$$S_b = \frac{S_u + S_d}{2}$$

$$S_u + S_d = 24$$

$$3v = 24, v = 8$$

$$S_d = 16 \text{ km/h}$$

$$S_u = v = 8$$

$$\therefore S_s = \frac{8}{2} = 4 \text{ km/h}$$

example A man rows 12 km/h in still water, when a river is running at 2.4 km/h it takes 1 hour to row to a place & come back. How far is the place?

answer is

$$S_b = 12 \text{ km/h}$$

$$S_s = 2.4 \text{ km/h}$$

$$T_u + T_d = 1 \text{ hour}$$

$$\therefore \frac{D}{9.6} + \frac{D}{14.4} = 1$$

$$\therefore \frac{D}{9.6} + \frac{D}{14.4} = 1$$

$$\therefore D \left(\frac{14.4 + 9.6}{14.4 \times 9.6} \right) = 1$$

$$\therefore D \left(\frac{24 \times 100}{144 \times 96} \right) = 1$$

$$D = \frac{25}{144} \text{ km}$$

$$\therefore D = 0.1735 \text{ km}$$

example Rahul can sow a certain distance downstream in 6 hours and return same distance in 9 hours. In still water Rahul's speed is 12 km/h. find speed of stream.

answer :-

$$\begin{array}{c} \rightarrow S_s \text{ of stream} \\ 12 \text{ km/h} \rightarrow 6 \text{ hours} \\ \leftarrow 9 \text{ hours} \\ (2.1 - 2.4) (2.1 + 2.4) (S) = \text{baseball} \end{array}$$

$$(T_d = 6 \text{ h}) \quad (T_u = 9 \text{ h})$$

$$S_b = 12 \text{ km/h}, (S_s = ?)$$

$$\therefore \begin{cases} T_d = T_u \\ 6(12 + S_s) = 9(12 - S_s) \end{cases}$$

$$S_s = \frac{12}{5} \text{ km/h}$$

method :- 2

$$\therefore \frac{S_b}{S_s} = \left| \frac{T_u + T_d}{T_u - T_d} \right|$$

$$\therefore S_s = \frac{12}{5} \text{ km/h}$$

example ~~example~~ Avg speed = ?

~~with 18 km upstream speed $s_b = 1.5 \text{ km/h}$~~

$$A \xrightarrow{s_b = 4.5 \text{ km/h}} B$$

→ find Avg. speed for whole distance for two ends
too.

answer :-

$$\begin{aligned} \text{avg speed} &= \frac{(2)(4.5 + 1.5)}{(4.5 + 1.5) + (4.5 - 1.5)} \\ &= \underline{\underline{(2)(6)(3)}} \end{aligned}$$

$$\boxed{\text{avg speed} = 4 \text{ km/h}}$$

example A person takes 9 hours for moving a distance 68 km downstream and 45 km upstream. Now he is supposed to travel 51 km downstream and 72 km upstream, he takes 11 hours. Find speed of person.

$$\frac{68}{s_b + s_s} + \frac{45}{s_b - s_s} = 9 \quad \therefore \frac{51}{s_b + s_s} + \frac{72}{s_b - s_s} = 11$$

$$\therefore s_b - s_s = 9, \quad s_b + s_s = 17$$

$$\therefore 2s_b = 26$$

$$\boxed{s_b = 13 \text{ km/h}}$$

short cut for calculation :-

→ Numerator of

$\frac{1}{s_b + s_s}$ is 68 & 51,

It is common so, as per observation we find $s_b + s_s$ & $s_b - s_s$.

Example 44 km \rightarrow Downstream, 30 km upstream, total 10 hours
 55 km \rightarrow Downstream, 40 km upstream, total 13 hours
 find speed of person and speed of current?

Answer:-

$$\frac{44}{S_b + S_s} + \frac{30}{S_b - S_s} = 10 \quad | \quad \text{and} \quad \frac{55}{S_b + S_s} + \frac{40}{S_b - S_s} = 13$$

$$\therefore S_b + S_s = 11, \quad S_b - S_s = 5$$

$$\therefore 2S_b = 16$$

$$S_b = 8 \text{ km/h}, \quad S_s = 3 \text{ km/h}$$

Example Downstream: 55 km in 66 minutes.

ratio of speed of boat / speed of stream = 4,

How much time will boat take to cover 72 km upstream.

Answer:-

$$\therefore \frac{55}{4v+v} = \frac{66}{60}$$

$$\therefore \frac{72}{4v-v}$$

$$\therefore \frac{5}{5v} = \frac{6}{60}$$

$$= \frac{72}{3(10)} \times 60$$

$$\therefore v = 10.$$

$$\therefore t = 144 \text{ Minutes}$$

2 hours 24 minutes.

for 3 Person:- Ratio of Capital & Ratio of Income

$$\rightarrow I_1 : t_1 : I_2 : t_2 : I_3 : t_3 = P_1 : P_2 : P_3$$

$$\rightarrow t_1 : t_2 : t_3 = \frac{P_1}{I_1} : \frac{P_2}{I_2} : \frac{P_3}{I_3}$$

$$P_1 : I_1 : P_2 : I_2 : P_3 : I_3 = t_1 : t_2 : t_3$$

Example Ram, Shyam, Kamal together starts a business in partnership. All of capital is 3:4:7. If Annual profit is 21 Thousand. What will the Kamal's share in profit.

Answer

$$\text{Kamal} = \frac{7}{14} \times 21$$

$$\text{Kamal} = 10.5 \text{ Thousand}$$

$$\text{Kamal} = 10,500$$

Example A and B investing 3:5 respectively. After six months C enters in business and capital of same as B. what is the profit ratio of A,B,C after one year.

Answer:

$$6:10:5$$

→ Split for 6 Months:

1st six Month

$$A:B = 3:5$$

After six Month

$$A:B=3:5, C=5$$

after one year

$$A:B:C = 6:10:5$$

example A and B together start a business in ratio

4:3. If 9% of total profit goes to charity and
A's share is ₹196 rupees then find total profit

answer → $4x + 3x \rightarrow$ total investment.

$$\therefore \frac{4}{7} \left(\frac{91}{100} \right) (P_1 + P_2) = 1196$$

$$\therefore \text{total Profit} = \frac{1196 \times 7 \times 100}{4 \times 91}$$

$$\therefore \text{Required total profit} = \frac{1196 \times 100}{4 \times 13}$$

$$\therefore \text{Required profit after charity} = \frac{92 \times 100}{4} \\ = 2300 \text{ ₹}$$

example A invested 10% more than B. and B invested 10% less than C. If total investment is ₹5780.

find investment of C.

$$C \rightarrow 100\%$$

$$B \rightarrow 90\%$$

$$A \rightarrow 99\%$$

$$\therefore C = \frac{100}{190+99}$$

$$5780$$

$$\therefore C = 2000 \text{ ₹}$$

example A and B enter into partnership = 18000 and 12000 respectively.
 after 3 months A withdraws 5000 and B invested 5000.
 after 6 months C joins business with 21000.
 The shares of B exceeds that of C out of total profit 25400 after 1 year by How much?

answer

$$\begin{aligned} &= 18000 + 11000 + 11000 : 12000 + 17000 : 17000 + 14000 \\ &\quad (18+22+22) : 21000 + 21000 \\ &\quad : 49 : 63 : 42 \quad 21 : 18+21 \\ &\quad 7 : 9 : 6 \quad 7+9+6 = 22 \end{aligned}$$

$$B-C = \frac{3}{22} (26,400)$$

$$B-C = 3600 \text{ £}$$

example A,B,C enter into Partnership in ratio $\frac{7}{2} : \frac{4}{3} : \frac{6}{5}$
 after 4 months A increases his shares by 50%
 If total profit at the end of 21600. then B share in profit is

answer-

$$\rightarrow \frac{7}{2} + \left(\frac{7}{2} + \frac{7}{4} \right) 2 : \frac{4}{3} \times 3 : \frac{6}{5} \times 3$$

$$\rightarrow \frac{7}{2} + \frac{21}{2} : \frac{12}{3} : \frac{18}{5}$$

$$\rightarrow 14 : 4 : 18$$

$$B \text{ share} = \frac{4}{18+18+18} \times 21600 = \frac{4 \times 5}{18 \times 6} \times 21600 = 2 \times 100 \times 2 =$$

$$B \text{ shares} = 4000 \text{ £}$$

example A and B entered into partnership.

After 3 months A withdrew $\frac{1}{4}$ of his capital, B withdrew $\frac{1}{5}$ of his capital. Their gain at end of 10 months is 10 months = 750. Find A's share.

$$3 \times 4 + 7(4-1) :: 3 \times 5 + 7(5-1)$$

$$12 + 21 :: 15 + 28$$

$$33 :: 43$$

$$\therefore A = \frac{33}{33+43} (750)$$

$$A = 330 \text{ £}$$

example A, B, C entered into partnership. A brought $\frac{3}{5}$ of profit. B and C remaining profit equally. If C got 400 less than A. find total profit.

$$\rightarrow \frac{3x}{5} \rightarrow A \quad (\text{x is total profit})$$

$$\rightarrow B, C \rightarrow \frac{x}{5}$$

$$\frac{3x}{5} - \frac{x}{5} = 400$$

$$2x = 400 \times 5$$

$$x = 1000 \text{ £}$$

example A, B invest ₹ 3000 & 4000 respectively in a business. A receive ₹ 10/- per month from profit as a remuneration for running business. Rest of the profit divided ^{as} ~~Total~~ proportion of their investment. A receives ₹ 390 then what does B receive in year?

answer :- → x is remaining profit.

$$\frac{3}{7}x = 270 \quad (390 - 10 \times 12 = 270)$$

$$x = 90 \times 7$$

$$x = 630$$

$$B = \frac{4}{7} \times 630$$

$$B = 360$$

∴ B receives ₹ 360/-

∴ rest goes to the A i.e. ₹ 270/-

$$A = 90 + 630 = 720$$

$$A = 9 + 6 + 9$$

$$A = 27$$

$$B = 48 \quad C = 9 \quad D = 9$$

$$281 \div 9 = 31$$

$$281 = 9 \times 31 + 2$$

$$281 = 9 \times 31 + 2$$

$$281 = 9 \times 31 + 2$$