

Tricky maths pdf by Sunil kumar kharub and Rakhi Ahlawat



Rakhi Ahlawat

Sunil Kumar

Whatsapp No 9728435915

WWW.COMPETITIONKING.IN

FRACTION TO PERCENTAGE CONVERSION Table

\leftarrow \rightarrow

Fraction	Percentage I	Percentage II	Fraction	Percentage I	Percentage II
$\frac{1}{1}$	100%	100%	$\frac{1}{14}$	7.14%	$7\frac{1}{7}\%$
$\frac{1}{2}$	50%	50%	$\frac{1}{15}$	6.67%	$6\frac{2}{3}\%$
$\frac{1}{3}$	33.33%	$33\frac{1}{3}\%$	$\frac{1}{16}$	6.25%	$6\frac{1}{4}\%$
$\frac{1}{4}$	25%	25%	$\frac{1}{17}$	5.88%	$5\frac{15}{17}\%$
$\frac{1}{5}$	20%	20%	$\frac{1}{18}$	5.56%	$5\frac{5}{9}\%$
$\frac{1}{6}$	16.67%	$16\frac{2}{3}\%$	$\frac{1}{19}$	5.26%	$5\frac{5}{19}\%$
$\frac{1}{7}$	14.28%	$14\frac{2}{7}\%$	$\frac{1}{20}$	5%	5%
$\frac{1}{8}$	12.5%	$12\frac{1}{2}\%$	$\frac{1}{24}$	4.16%	$4\frac{1}{6}\%$
$\frac{1}{9}$	11.11%	$11\frac{1}{9}\%$	$\frac{1}{25}$	4%	4%
$\frac{1}{10}$	10%	10%	$\frac{3}{4}$	25%	25%
$\frac{1}{11}$	9.09%	$9\frac{1}{11}\%$	$\frac{2}{5}$	40%	40%
$\frac{1}{12}$	8.33%	$8\frac{1}{3}\%$			
$\frac{1}{13}$	7.69%	$7\frac{9}{13}\%$			



DERIVED FRACTION TO CONVERSION Table

Fraction	Percentage		Fraction	Percentage	
I	II		I	II	
$\frac{1}{8}$	12.5%		$\frac{2}{3}$	66.67%	
$\frac{3}{8}$	37.5%		$\frac{1}{12}$	8.33%	
$\frac{5}{8}$	62.5%		$\frac{7}{12}$	58.33%	
$\frac{7}{8}$	87.5%		$\frac{11}{12}$	91.67%	
$\frac{1}{6}$	16.67%		$\frac{5}{6}$	83.33%	



Larger FRACTION/PERCENTAGES

$$108.33\% \text{ or } 108\frac{1}{3}\% = 100\% + 8.33\% = 1 + \frac{1}{12} = \frac{13}{12}$$

$$362.5\% \text{ or } 362\frac{1}{2}\% = 300\% + 62.5\% = 3 + \frac{5}{8} = \frac{29}{8}$$

$$191.67\% \text{ or } 191\frac{2}{3}\% = 200\% - 8\frac{1}{3}\% = 2 - \frac{1}{12} = \frac{23}{12}$$

$$393.33\% \text{ or } 393\frac{1}{3}\% = 400\% - 6\frac{2}{3}\% = 4 - \frac{1}{15} = \frac{59}{15}$$

$$283.33\% \text{ or } 283\frac{1}{3}\% = 200\% + 83\frac{1}{3}\% = 2 + \frac{5}{6} = \frac{17}{6}$$

$$\text{OR } = 300 - 16\frac{2}{3}\% = 3 - \frac{1}{6} = \frac{17}{6}$$



$62\frac{1}{2}\%$ of 512 + $83\frac{1}{3}\%$ of 216 = ?

$$= \frac{5}{8} \times 512 + \frac{5}{6} \times 216 \quad \left[\because 62\frac{1}{2}\% = \frac{5}{8} \right]$$

$$= 5 \times 64 + 5 \times 36 = 5(100) \quad \left[83\frac{1}{3}\% = \frac{5}{6} \right]$$

= 500 Ans.

$193\frac{1}{3}\%$ of 225 + $91\frac{2}{3}\%$ of 144 = ?

$$\left(200\% - 6\frac{2}{3}\%\right) 225 + \left(100\% - 8\frac{1}{3}\%\right) \text{ of } 144$$

$$= 450 - \frac{1}{15} \times 225 + 144 - \frac{1}{12} \times 144$$

$$= 435 + 132 = 567 \quad \left[\because 6\frac{2}{3}\% = \frac{1}{15}, 8\frac{1}{3}\% = \frac{1}{12} \right]$$

Population of city beautiful Chandigarh is 490000 in 2016. If growth rate is $14\frac{2}{7}\%$. What will be population in 2017?

Solution :- $P_{2016} = 490000$

$$14\frac{2}{7}\% \text{ of } 490000 = \frac{1}{7} \times 490000 = 70000$$

$$P_{2017} = 490000 + 70000 = 560000$$

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PERCENTAGE IS INTERCHANGABLE

$$A\% \text{ of } B = B\% \text{ of } A = \frac{A \times B}{100}$$



e.g. $64\% \text{ of } 62.5 = ?$

$$\begin{aligned} &= 62.5\% \text{ of } 64 \quad [\because \% \text{ is interchangeable}] \\ &= \frac{5}{8} \times 64 = 40 \quad [\because 62.5\% = \frac{5}{8}] \end{aligned}$$

e.g. $72\% \text{ of } 91\frac{2}{3} = ?$

$$\begin{aligned} &= 91\frac{2}{3}\% \text{ of } 72 \\ &= \frac{11}{12} \times 72 = 66 \text{ ANS.} \quad [\because 91\frac{2}{3}\% = \frac{11}{12}] \end{aligned}$$

$17\frac{1}{2}\% \text{ of } 84 = ?$

$$\begin{aligned} &= 35\% \text{ of } 42 \quad [\because a\% \text{ of } b = 2a\% \text{ of } \frac{b}{2}] \\ &= 70\% \text{ of } 21 \\ &= 14.7 \text{ ANS.} \end{aligned}$$

$32\% \text{ of } 250 + 12.5\% \text{ of } 640 = ?$

$$12.5\% \text{ of } 640 = 25\% \text{ of } 320 \quad [\because a\% \text{ of } b = 2a\% \text{ of } \frac{b}{2}]$$

$$\therefore 32\% \text{ of } 250 + 25\% \text{ of } 320$$

$$= 25\% \text{ of } 320 + 25\% \text{ of } 320$$

$$= (25\% + 25\%) \text{ of } 320 = 50\% \text{ of } 320 = 160 \text{ ANS.}$$

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TRICKY CONCEPTS

1. Convert % in to fraction $\pm \frac{N}{D}$

where + means increase

& - means decrease.

2. Initial value = Denominator = D

3. Final value = D $\pm N$ or I $\pm N$

+ for Increase

- for Decrease

e.g. 20% Increase = $+ \frac{1}{5} \rightarrow$ Increase
 \rightarrow Initial

$$\text{Final} = 5+1 = 6$$

20% decrease = $- \frac{1}{5} \rightarrow$ decrease
 \rightarrow Initial

$$\text{Final} = 5-1 = 4$$

If $16\frac{2}{3}\%$ of a number is added with itself, resultant number becomes 3430. Find the original number?

Solution :- $16\frac{2}{3}\% \uparrow = + \frac{1}{6} \rightarrow I$

$$\Rightarrow F = 6+1 = 7$$

$$7 \rightarrow 3430$$

$$\Rightarrow 6 \rightarrow \frac{3430}{7} \times 6 = 2940 \quad \underline{\text{Ans.}}$$

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If $16\frac{2}{3}\%$ of a Number is subtracted from itself then the resultant Number becomes 225. Find the original Number?

$$\underline{801.} \quad 16\frac{2}{3}\% = -\frac{1}{6} \xrightarrow{\text{Dec.}} \text{INITIAL} \Rightarrow \text{Final} = 6 - 1 = 5$$

$5 \rightarrow 45$

$1 \rightarrow 45 \Rightarrow 6 \rightarrow 45 \times 6 = 270 \text{ ANS.}$

If 20 is added in a no. Then the no. becomes 137.5% of itself. Find the original Number?

Solution :- $13\frac{1}{2}\% = 100\% + 3\frac{1}{2}\% = 1 + \frac{3}{8} = \frac{11}{8} \rightarrow F$

Initial $\leftarrow \frac{11}{8} \rightarrow 3 \rightarrow 210$ $1 \rightarrow 70$ \rightarrow original = 8 $\rightarrow 8 \times 70 = 560$ A.N.8.

Population of a city is 72900 in 2010. If population growth rate is $12\frac{1}{2}\%$. Find population in 2009.

$$\text{Solution :-- } 12\frac{1}{2}\% = \frac{+1}{8} \rightarrow \text{Increase} \\ \rightarrow 2009 \Rightarrow P_{2009} = 8+1=9$$

$$9 \rightarrow 72900$$

$$P_{2009} = 8 \rightarrow 8 \times 8100 = 64800$$



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Product Constancy Method

Let $P = A \times B$

If one increases by some %, in order to keep P as constant, he should decrease B or vice-versa.

OR in simple way If $P = \text{constant}$

$$\Rightarrow A \propto \frac{1}{B} \quad [A \text{ & } B \text{ are inversely proportional}]$$

e.g. If $A = 2:3$, if $P = \text{constant}$

$$\Rightarrow B = 3:2$$

Application



(i) Area of Rectangle $A = l \times b$

(ii) Expenditure = Price \times Consumption
 $E = P \times C$

(iii) Revenue = Price \times Sales, $R = P \times S$

(iv) Distance = Speed \times Time, $D = S \times T$

(v) WORK = Time \times Efficiency etc.



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If the price of sugar is increased by 20%, then by how much % the consumption should be decreased so that expenditure will remain same?

Solution :- $20\% \uparrow = +\frac{1}{5} \rightarrow \text{Increase}$
 $\rightarrow \text{old Price}$

$$\text{New Price} = 5+1 = 6$$

Also $E = P \times C$ as $E = \text{constant} \Rightarrow P \propto \frac{1}{C}$
 original New

$$\text{Price} \rightarrow 5 : 6$$

\Rightarrow Consumption $\rightarrow 6 : 5$ [$\because P \propto \frac{1}{C}$]
 $\% \downarrow = -\frac{1}{6} = 16\frac{2}{3}\%$ ANS.

If the length of rectangle is decreased by 12.5%. By how much percentage breadth must be decreased in order to keep Area same?

Solution :- $12.5\% \downarrow = -\frac{1}{8} \rightarrow \text{old length}$

$$\text{New length} = 8-1 = 7$$

$A = l \times b$, as $A = \text{constant} \Rightarrow l \propto \frac{1}{b}$

old New
 length 8 : 7

Breadth 7 : 8 [$\because l \propto \frac{1}{b}$]

$$\% \uparrow = +\frac{1}{7} = 14\frac{2}{7}\%$$
 ANS.



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If a man goes at a speed of 8 km/hr from his home to office he reaches 20 minutes late. but if he goes at a speed of 12 km/hr he reaches office 20 minute early. Find the distance b/w his home & office?

Solution: #1. $D = S \times T$, D = constant $\Rightarrow S \propto \frac{1}{T}$

	old	New	
speed	8	: 12	$9.20 > 40 \text{ min}$
Time	2	: 3	8.40

Time diff
↓
40

$$\Rightarrow \text{old time} = 40 \times 3 = 120 \text{ min} = 2 \text{ hr.}$$

$$D = S \times T = 8 \times 2 = 16 \text{ Km Ans.}$$

#2 Let distance D = 24 km (Lcm of 8 & 12)

$$\Rightarrow T_1 = \frac{24}{8} = 3 \text{ hr}$$

$$\text{Time diff} = 1 \text{ hr} = 60 \text{ min}$$

$$T_2 = \frac{24}{12} = 2 \text{ hr}$$

$$\Rightarrow \text{If time diff} = 60 \rightarrow D = 24$$

$$\text{but actual } " " = 40 \rightarrow D = \frac{24}{\frac{60}{40}} = 16 \text{ km}$$

#3 TRICK $D = \frac{\text{Product of speeds}}{\text{Difference of speeds}} \times \text{Time diff}$

$$D = \frac{12 \times 8}{12 - 8} \times \frac{40}{60} = 16 \text{ km Ans.}$$



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If the length of rectangle is increased by $12\frac{1}{2}\%$ and breadth decreased by 20% . Find the % change in Area?

Solution :-	$L \times B = A$	$12\frac{1}{2}\% = +\frac{1}{8}$
original	$8 \times 5 = 40$	$20\% \downarrow = -\frac{1}{5}$
New	$9 \times 4 = 36$	

$$\% \text{ change} = -\frac{4}{40} \times 100 = -10\%. \text{ Ans}$$

- Now Area is ↓

If radius of circle is decreased by 10% . Find the % change in Area of circle. ($A = \pi R^2$)

<u>Solution</u> :-	Radius	Area	
original	10	$100, -19$	$10\% \downarrow = -\frac{1}{10}$
New	9	81	$\text{New} = 10 - 1 = 9$

$$\% \text{ change} = -\frac{19}{100} \times 100 = 19\% \downarrow$$

If the price of the sugar is increased by $16\frac{2}{3}\%$ and consumption is decreased by 25% . find the % change in Expenditure?

<u>Solution</u>	Price \times Consu. = Exp.	
original	$6 \times 4 = 24$	$16\frac{2}{3}\% \uparrow = +\frac{1}{6}$
New	$7 \times 3 = 21$	$25\% \downarrow = -\frac{1}{4}$

$$\% \text{ change} = -\frac{3}{24} \times 100 = 12.5\% \downarrow \text{ Ans.}$$

The single discount which is equivalent to successive discounts of 50% & 40% ?

Solution :- 50%, 40%.

$$\begin{array}{l} \text{Original 2} \\ \text{New 1} \end{array} \quad \begin{array}{rcl} 5 & = 10 \\ 3 & = 3 \end{array}) -7$$

$$\text{equivalent } \% = -7/10 \times 100 = 70\% \text{ ANS.}$$

discount is always decrease

$$50\% \downarrow = -\frac{1}{2}$$

$$40\% \downarrow = -\frac{2}{5}$$

A single discount which is equivalent to successive discounts of 30%, 20% & 10% ?

Solution 30%, 20%, 10%.

$$\begin{array}{l} \text{Original 10} \\ \text{New 7} \end{array} \quad \begin{array}{rcl} 5 & = 500 \\ 4 & = 250 \end{array}) -248$$



$$\text{equivalent discount } \% = \frac{248}{500} \times 100 = 49.6\%$$

If the price of cinema ticket is increased by $16\frac{2}{3}\%$, then the sale will be decreased by 20%. Find the % change in revenue?

Solution :-

$$\begin{array}{l} \text{Price} \times \text{Sale} = \text{Revenue} \\ \text{Original 6} \quad 5 = 30 \\ \text{New 7} \quad 4 = 28 \end{array}) -2$$

$$16\frac{2}{3}\% \uparrow = +\frac{1}{6}$$

$$20\% \downarrow = -\frac{1}{5}$$

$$\% \text{ Change} = -\frac{2}{30} \times 100 = 6\frac{2}{3}\% \downarrow$$

ANS.



A reduction ~~in~~ of 25% in the price of sugar enables a housewife to purchase 4 kg more for ₹ 800. Find original and current price per kg?

Solution :- Here Expenditure = Constant = 800

$$\Rightarrow \text{Price} \propto \frac{1}{\text{Consumption}}$$

$$25\% \downarrow = -\frac{1}{4} \rightarrow \text{old} \quad \Rightarrow \text{New} = 4 - 1 = 3$$

Price	old	New
	4	: 3

Consump	3	: 4		\Rightarrow	$\text{old Consumption} = 3 \times 4 = 12 \text{ kg}$
		$+1 \rightarrow 4$			$\text{New Consumption} = 4 \times 4 = 16 \text{ kg}$

(i) old Price = $\frac{800}{12} = 66\frac{2}{3} \text{ ₹/kg}$ (ii) New/Current Price = $\frac{800}{16} = 50 \text{ ₹}$

Due to 30% increase in price of apples, 6 apples are less available for ₹ 520. Find the old and new price of an apple?

Solution :- $30\% \uparrow = +\frac{3}{10}$

Price	old	New
	10	: 13

13	: 10
	$-3 \rightarrow 6$
	$1 \rightarrow 2$

$$\text{Old Cons.} = 13 \times 2 = 26$$

$$\text{Old Price} = \frac{520}{26} = 20 \text{ ₹}$$

$$\text{New Cons.} = 10 \times 2 = 20$$

$$\text{New Price} = \frac{520}{20} = 26 \text{ ₹}$$

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A reduction of 20% in the price of sugar enables a man to buy 10 kg more for ₹ 54. Find the original as well as reduced price per kg?

Solution :→ Here Expenditure = 54 = constant
 $\Rightarrow \text{price} \propto \frac{1}{\text{consumption}}$

$$20\% \downarrow = -\frac{1}{5}$$

old New

$$\text{price} = 5 : 4$$

$$\text{Consumption} = 4 : \underbrace{5}_{+1 \rightarrow 10 \text{ kg}}$$

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$$\Rightarrow \text{old consumption} = 10 \times 4 = 40$$

$$\text{New } " = 10 \times 5 = 50$$

$$\text{Old Price} = \frac{54}{40} = 1.35 \text{ ₹/kg}$$

$$\text{New or Reduced} = \frac{54}{50} = 1.08 \text{ ₹/kg}$$

Due to an increase of 20% in the price of eggs, 2 eggs less available for ₹ 24. The present rate of egg per dozen?

Solution :→ $E = \text{constant}$

$$20\% \uparrow = +\frac{1}{5}$$

old New

$$\text{Price} = 5 : 6$$

$$\text{Consump.} = 6 : \underbrace{5}_{-1 \rightarrow 2}$$

New Consumption

$$\Rightarrow 5 \rightarrow 5 \times 2 = 10 \text{ eggs}$$

$$\text{Price per egg} = \frac{24}{10} = 2.4$$

$$\text{Price of dozen} = 2.4 \times 12 = 28.80 \text{ ₹} \quad \underline{\text{Ans.}}$$

The value of a machine depreciates at the rate of 10% per annum. If its present worth is 3645000. find its worth after 3 years

Solution $10\% \downarrow = -\frac{1}{10}$

$$\begin{array}{r} 10 \\ 10 \\ 10 \\ \hline 1000 \end{array} \quad \begin{array}{r} 9 \\ 9 \\ 9 \\ \hline 729 \end{array}$$

$$1000 \rightarrow 3645000 \Rightarrow 729 \rightarrow 2657205 \text{ ANS.}$$



The present population of a town is 108000. During the 1st yr. population increases by $66\frac{2}{3}\%$, while decreases by $16\frac{2}{3}\%$ during second year. During 3rd year increases by $33\frac{1}{3}\%$. Find the population of town 3 yrs hence?

Sol $66\frac{2}{3}\% \uparrow = +\frac{2}{3}$, $16\frac{2}{3}\% \downarrow = -\frac{1}{6}$, $33\frac{1}{3}\% = +\frac{1}{3}$

$$\begin{array}{r} 3 & 5 \\ 6 & 5 \\ \hline 3 & 4 \\ \hline 54 & 100 \end{array}$$

$$54 \rightarrow 108000 \\ \Rightarrow 100 \rightarrow \boxed{200000} \text{ ANS.}$$

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If the price of sugar is decreased by 40%. By how much % consumption should be increased so that expenditure will decrease by 10%?

Solution :- METHOD 1

$$E = P \times C$$

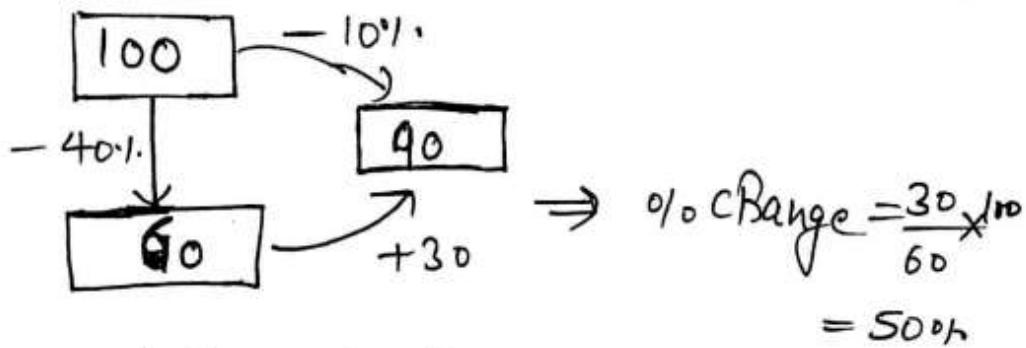
Exp. = Price \times Consumption

$$\begin{array}{l} \text{Old} \\ -10\% \\ \text{New} \end{array} \begin{array}{l} 100 \\ = 10 \times 10 \\ 90 \\ = 6 \times \text{New Consumption} \end{array}$$

$$\Rightarrow \text{New Consumption} = \frac{90}{6} = 15$$

$$\% \uparrow \text{ in Consumption} = \frac{15 - 10}{10} \times 100 = 50\% \quad \underline{\text{Ans.}}$$

METHOD 2:-



If the price of rice is decreased by 40%. By how much % consumption should be increased so that expenditure also increased by 20%?

Solution :- 1st Method

$$E = P \times C$$

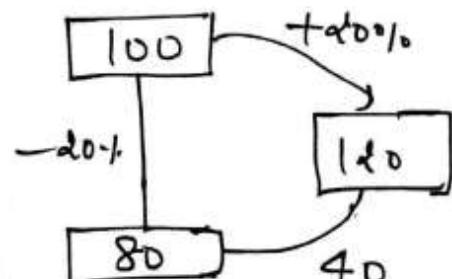
$$\text{let old } 100 = 10 \times 10$$

$$\text{New } 120 = 8 \times N_C$$

$$\Rightarrow N_C = 15$$

$$\% \uparrow = \frac{5}{10} \times 100 = 50\%$$

2nd Method



Focus on Fix: → The quantity that does not change in initial and final mixture make that equal.

e.g. If there is mixture of water and salt & water get evaporated. That means salt will not change in initial and final mixture. make salt equal. You will better understand by questions.

A vessel has 60 litres of solution of acid & water having 80% acid. How much water must be added to make it a solution in which acid is 60%?

solution:- water is added \Rightarrow acid qty is same

1st METHOD

let final mixture (after add water) is = x ltr

equate Acid

$$\frac{80 \times 60}{100} = \frac{60 \times x}{100}$$

$$\Rightarrow x = 80 \text{ ltr}$$

$$\text{water added} = 80 - 60 = 20$$

2nd METHOD

by Ratio

old	Acid	water
	4×3	1×3

New	3×4	2×4
-----	--------------	--------------

make Acid equal

12 : 3	water
12 : 8	added

$$15 \rightarrow 60 \Rightarrow 5 \rightarrow \boxed{20 \text{ ltr}}$$

75 gm of a solution has 30% sugar in it. Then the qty of sugar that should be added to the solution to make 70% sugar solution. Ans. 100 gm

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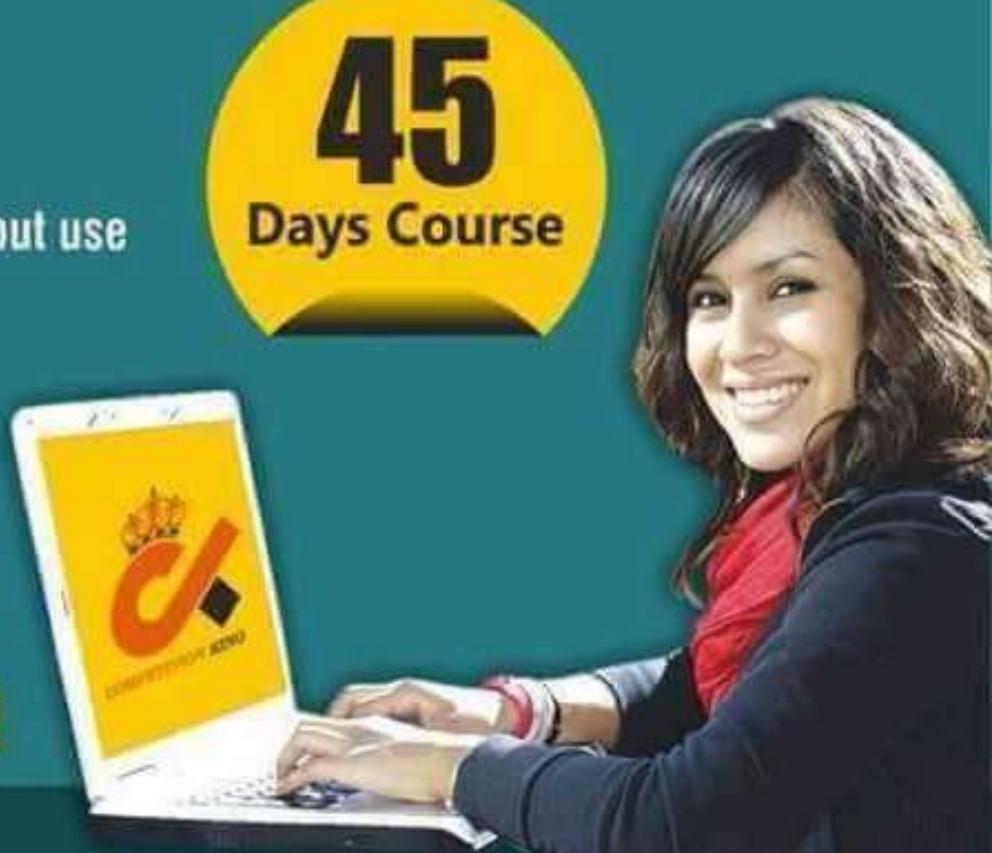
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FRESH grapes contains 90% water while dry grapes contains 20% water. what is the weight of dry grapes obtained from 90 kg FRESH GRAPES?

Solution 1st Method

The weight of non-water part called Pulp will remain same equate

$$\frac{20 \times 10}{100} = \frac{80 \times x}{100} \Rightarrow x = 2.5 \text{ kg}$$

$x \rightarrow$ dry grapes weight.

2nd METHOD Ratio

old	PULP	WATER
	1×8	9×8
New	1	1

MAKE PULP SAME

$$\begin{array}{rcl} \cancel{5 : 45} & 4 : 36 \rightarrow 40 \\ \cancel{5 :} & 4 : 1 \rightarrow 5 \\ 40 \rightarrow 20 \text{ kg} & \Rightarrow 5 \rightarrow \boxed{2.5 \text{ kg}} \end{array}$$

FRESH GRAPES contains 80% water, while dry grapes contains 10% water. If the weight of dry grapes is 500 kg. what is total wt. when it is FRESH?

Solution :- equate Non water Part (Pulp)

1st method

$$\text{let total wt. of fresh grapes} = x \text{ kg.}$$

$$\text{Pulp}_1 = \text{Pulp}_2$$

$$\frac{20 \times x}{100} = \frac{90 \times 500}{100}$$

$$\Rightarrow x = 250 \text{ kg.}$$

2nd METHOD (Ratio)

old	PULP	WATER
	1×9	4×9
New	9	1

$$\text{Dry 10 (9+1)} = 500$$

$$1 \rightarrow 50 \text{ kg}$$

$$\text{Fresh} = 9 + 36 = 45$$

$$\text{wt} = 45 \times 50 = 2250 \text{ kg}$$

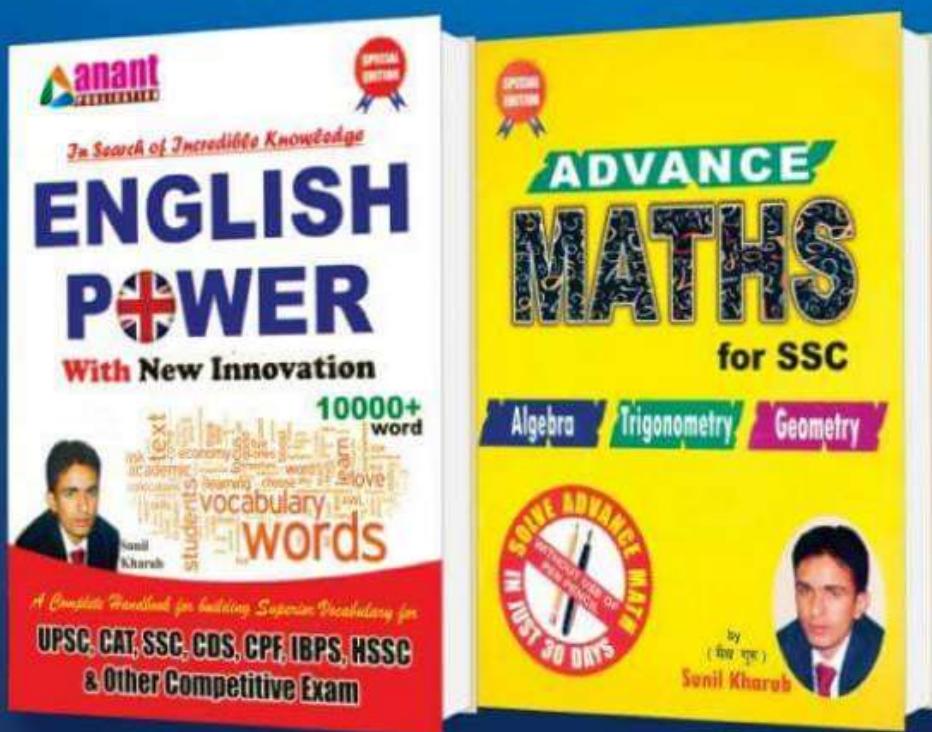
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COMPOUND INTEREST

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

COMPOUND Interest (CI) = $A - P$

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

IN Compound Interest principle keep on changing / compounding / updating after specific period of time according to term specified like yearly / half yearly / quarterly etc.

IN simple words we can say that compound Interest is Interest on Interest OR principle Keep on compounding (updating)

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FIRST year Simple Interest and compound INTEREST are equal.

$$[SI_{\text{first yr}} = CI_{\text{first year}}]$$

After One year $CI > SI$

If Rate of INTEREST ARE Different

$$A = P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right) \left(1 + \frac{R_3}{100} \right) \dots \dots$$

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# INTEREST COMPOUNDED	NEW RATE	NEW TIME	AMOUNT
Half yearly	$R/2$	$2T$	$P \left[1 + \frac{R}{2 \times 100}\right]^{2T}$
Quarterly	$R/4$	$4T$	$P \left[1 + \frac{R}{4 \times 100}\right]^{4T}$
monthly	$R/12$	$12T$	$P \left[1 + \frac{R}{12 \times 100}\right]^{12T}$

When Interest is compounded annually but time is in fraction. e.g. $T = 2\frac{2}{5}$ yrs, then

$$\text{Amount (A)} = P \left[1 + \frac{R}{100}\right]^2 \left[1 + \frac{\frac{2}{5}R}{100}\right]$$

Difference b/w Simple and Compound Interest

e.g. $P = 1000$, $R = 10\%$, $T = 3$ yrs

	SIMPLE INTEREST	COMPOUND INTEREST
1st yr.	P 1000	I 100
2nd yr.	1000	100
3rd yr.	1000	100

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So we can see that In Simple Interest P as well as I is same for all years but in case of CI both P & I keep on updating coz in CI Interest also become principle for next year

Different Techniques For Calculating CI

If $P = 20000$, $R = 10\%$ Per Annum, $T = 3$ yrs
find the compound interest $CI = ?$

Technique 1 (FORMULA METHOD)

$$CI = P \left[\left(1 + \frac{R}{100} \right)^T - 1 \right] = 20000 \left[\left(1 + \frac{10}{100} \right)^3 - 1 \right] = 6620$$

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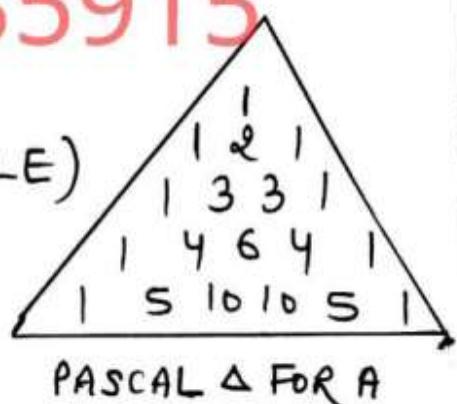
Technique 2 (PASCAL'S TRIANGLE)

$$CI \text{ FOR } 2 \text{ yrs} = 2A + B$$

$$CI \text{ FOR } 3 \text{ yrs} = 3A + 3B + C$$

$$CI \text{ FOR } 4 \text{ yrs} = 4A + 6B + 4C + D$$

$$CI \text{ FOR } 5 \text{ yrs} = 5A + 10B + 10C + 5D + E$$



where $A = R\% \text{ of Principle}$ [$R\%$ is Rate]

$B = R\% \text{ of } A$

$C = R\% \text{ of } B$, $D = R\% \text{ of } C$, $E = R\% \text{ of } D$

FOR Amount $A_2 = P + 2A + B$

$A_3 = P + 3A + 3B + C$

$A_4 = P + 4A + 6B + 4C + D$

Here $CI_3 = 3 \left[\underset{A=2000}{\downarrow} 10\% \text{ of } 20000 \right] + 3 \left[\underset{B=200}{\downarrow} 10\% \text{ of } 2000 \right] + \left[\underset{C=20}{\downarrow} 10\% \text{ of } 200 \right]$

$$= 3 \times 2000 + 3 \times 200 + 20 = 6620 \text{ ANS.}$$

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EXAMPLE SOLVED BY PASCAL TRIANGLE

$P = 5000, R = 5\%, T = 3 \text{ yrs}, CI = ?$

$$CI_3 = 3A + 3B + C$$

$$A = 5\% \text{ of } 5000 = 250$$

$$B = 5\% \text{ of } A = 5\% \text{ of } 250 = 12.5$$

$$C = 5\% \text{ of } B = 5\% \text{ of } 12.5 = .625$$

$$\Rightarrow CI_3 = 3 \times 250 + 3 \times 12.5 + .625 = 788.125 \text{ ANS.}$$

$P = 25000, R = 12\%, T = 3 \text{ yrs}, CI = ?$

$$CI = 3(A) + 3(B) + 1(C)$$

$$A = 12\% \text{ of } 25000 = 3000$$

$$B = 12\% \text{ of } A = 12\% \text{ of } 3000 = 360$$

$$C = 12\% \text{ of } B = 12\% \text{ of } 360 = 43.2$$

$$\Rightarrow CI = 3 \times 3000 + 3 \times 360 + 43.2 = 10123.2$$

$P = 25000, R = 10\%, T = 4 \text{ yrs}, CI = ?$

$$CI_4 = 4(A) + 6(B) + 4(C) + 1(D)$$

$$A = 10\% \text{ of } 25000 = 2500$$

$$B = 10\% \text{ of } A = 10\% \text{ of } 2500 = 250$$

$$C = 10\% \text{ of } B = 10\% \text{ of } 250 = 25$$

$$D = 10\% \text{ of } C = 10\% \text{ of } 25 = 2.5$$

$$CI_4 = 4 \times 2500 + 6 \times 250 + 4 \times 25 + 2.5 = 11602.5 \text{ ANS.}$$

TRICKY MATHS

By Sunil Kumar

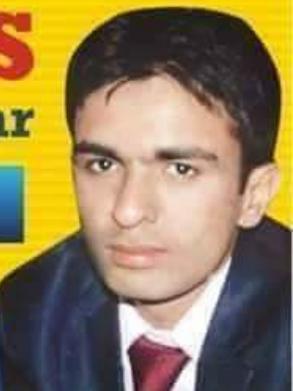
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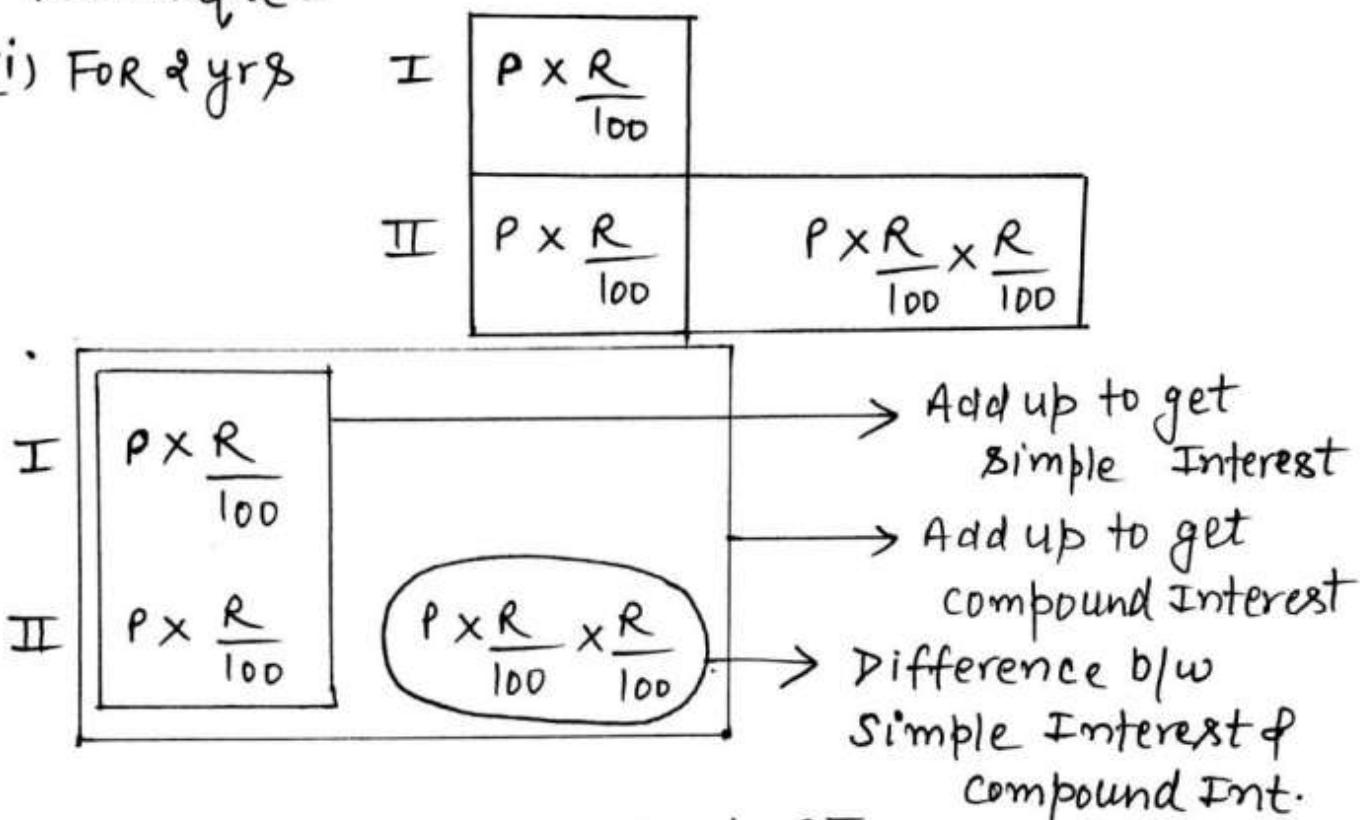
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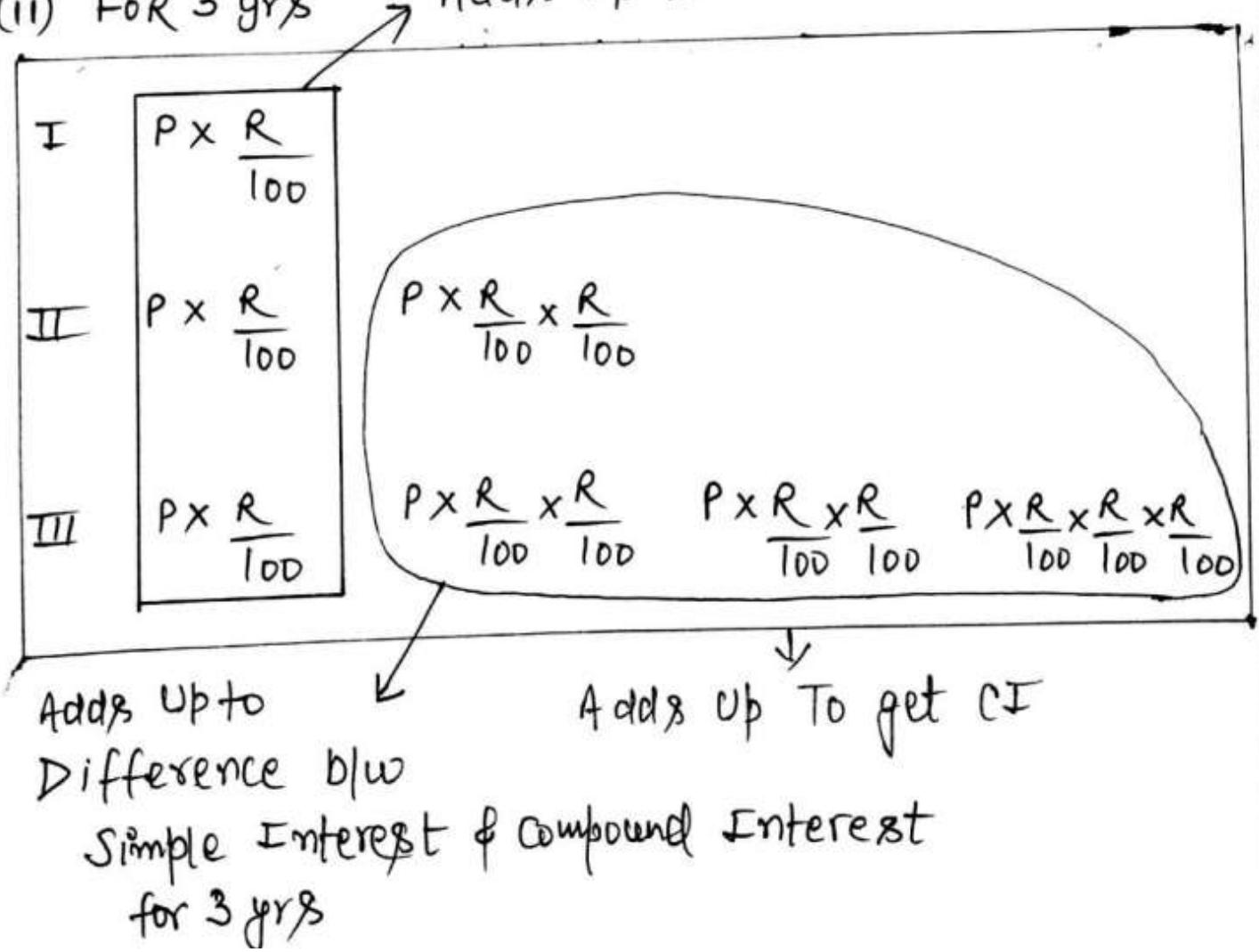


Technique 3

(i) FOR 2 yrs



(ii) FOR 3 yrs



$P = 20000$, $R = 10\%$ p.a., $T = 3$ yrs, $CI = ?$

I 2000

Add all together CI

II 2000 200

III 2000 200 200 20

$$CI_3 = 2000 + 2000 + 2000 + \\ 200 + 200 + 200 + 20$$

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Technique 4 (Ratio/FRACTION METHOD)

$$R = 10\% = \frac{1}{10} \rightarrow I \Rightarrow A = P + I = 11$$

Try to assume Principle according to denominator of fraction and no. of years.

Here Assumed Principle = $(D)^n$, where

$$D = 10 \quad \{ R = \frac{1}{10} \}$$

D = Denominator

$$\text{Principle}_{\text{new/Assumed}} = (10)^3 = 1000 \quad n = \text{No of years}$$

$$P = 1000, R = 10\%, T = 3 \text{ yrs}$$

I 100

$$\Rightarrow CI_3 = 331$$

II 100 + 10

III 100 + 10 + 10 + 1

By Unitary Method

$$\text{if } P = 1000 \Rightarrow CI = 331$$

$$\text{but } P = 20000 \Rightarrow CI_3 = \frac{331}{1000} \times 20000 \\ = 6620$$

$P = 12000$, $R = 10\%$, $T = 2 \text{ yrs}$, $\text{CI} = ?$

I YR	1200	$\xrightarrow{10\%}$
II YR	1200	120

$$\text{CI}_2 = 1200 + 1200 + 120 = 2520 \text{ Ans.}$$

Explanation :-

$$1^{\text{st}} \text{ yr CI} = 1^{\text{st}} \text{ yr SI} = 10\% \text{ of } 12000 = 1200$$

$$\begin{aligned}2^{\text{nd}} \text{ yr CI} &= 10\% \text{ of } 12000 + 10\% \text{ of } 1^{\text{st}} \text{ yr CI} (1200) \\&= 1200 + 120 = 1320\end{aligned}$$

$$\text{CI}_2 = \text{CI } 1^{\text{st}} \text{ YR} + \text{CI } 2^{\text{nd}} \text{ YR} = 1200 + 1320 = 2520$$

$P = 25000$, $R = 10\%$, $T = 3 \text{ yrs}$, $\text{CI} = ?$

$$1^{\text{st}} \text{ yr CI} \quad 2500$$

$$2^{\text{nd}} \text{ yr CI} \quad 2500 \quad 250$$

$$3^{\text{rd}} \text{ yr CI} \quad 2500 \quad 250 \quad 250 \quad 25$$

$$\begin{aligned}\text{CI for 3 year} &= \text{Add All} = 2500 + 2500 + 1500 + \\&\quad 250 + 250 + 250 + 25 \\&= 8275 \text{ Ans.}\end{aligned}$$

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$P = 108000$, $R = 16 \frac{2}{3}\%$, $T = 2$ yrs, CI = ?

$$R = 16 \frac{2}{3}\% = \frac{1}{6} \rightarrow I$$

$$\text{let } P = (6)^3 \{ (D)^n, \text{ Here } D = 6 \}$$

$$CI_1 = \frac{1}{6} \text{ of } 36 = 6$$

$$= 36$$

$$I \quad 6 \swarrow 6$$

$$II \quad 6 \quad | \quad \Rightarrow \quad CI_2 = 6 + 6 + 1 = 13$$

$$\text{if } P = 36 \Rightarrow CI_2 = 13$$

$$\text{but } P = 10800 \Rightarrow CI_2 = \frac{13}{36} \times 10800 = 3900 \text{ ANS.}$$

$P = 1024000$, $R = 12.5\%$, $T = 3$ yrs, CI = ?

$$R = 12.5\% = \frac{1}{8} \rightarrow I$$

$$\text{let } P = (8)^3 = 512 \{ : T = 3 \text{ yr} \}$$

$$CI_1 = \frac{1}{8} \times 512 = 64$$

$$I \quad 64 \swarrow 8 \quad CI_3 = 64 + 64 + 64 + 8 + 8 + 8 + 1$$

$$II \quad 64 \quad 8 \quad 8 \swarrow 1 \quad = 217$$

$$III \quad 64 \quad 8 \quad 8 \quad 1 \quad \Rightarrow \text{If } P = 512 \Rightarrow CI = 217$$

$$\text{but } P = 1024000 \Rightarrow CI = \frac{217}{512} \times 1024000$$

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Explanation \rightarrow Always assume $P = (D)^n$
 where $D = \text{denominator of fraction, } n = \text{no of yrs}$
 e.g If $R = 30\% = \frac{3}{10}$, $T = 3$ yrs
 Assume $P = (10)^3 = 1000$

Technique 5 (SUCCESSIVE PERCENTAGE)

$$R = 10\% = \frac{1}{10} \rightarrow I \rightarrow P \Rightarrow A = 11$$

P	A
I $\frac{1}{10}$	11
II $\frac{1}{10}$	11
III $\frac{1}{10}$	11
<hr/> 1000	<hr/> 1331
<hr/> $\frac{331}{331}$	<hr/> $\downarrow CI$

IF $P = 1000$

$$\Rightarrow CI = 331$$

but $P = 100000$

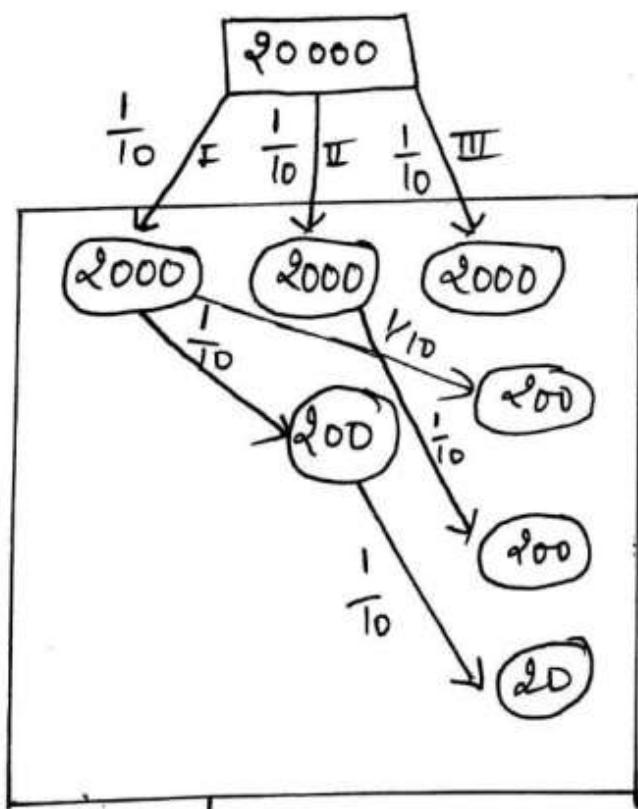
$$\Rightarrow CI = \frac{331}{1000} \times 100000$$

$$\left| \begin{array}{l} \frac{P}{A} = \frac{10}{11} \times \frac{10}{11} \times \frac{10}{11} \\ P : A = 1000 : 1331 \end{array} \right.$$

$$= 66\text{ to Ans.}$$

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Technique 6 (TREE METHOD)

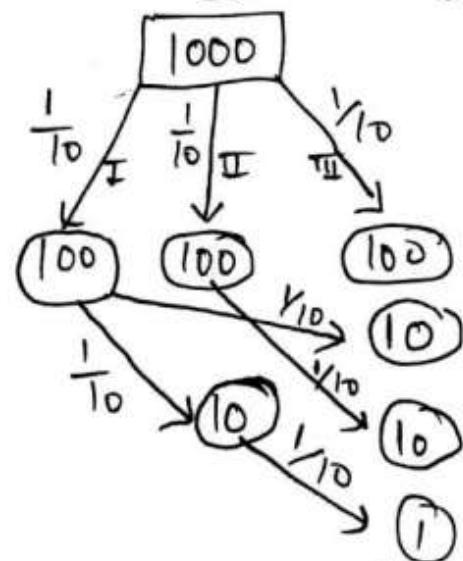


Add all these to get CI

$$\begin{aligned} CI &= 2000 + 2000 + 2000 + 200 \\ &\quad + 200 + 200 + 20 \\ &= 66 \text{ to Ans.} \end{aligned}$$

OR $R = 10\% = \frac{1}{10} \rightarrow I \rightarrow P \Rightarrow A = 11$

$$\text{let } P = (10)^3 = 1000 \quad \{T=3 \text{ yrs}\}$$



Add all present in circle

$$\begin{aligned} CI &= 100 + 100 + 100 + 10 + 10 + 10 + 1 \\ &= 331 \end{aligned}$$

$$\text{If } P = 1000 \Rightarrow CI = 331$$

$$\begin{aligned} \text{but } P &= 100000 \Rightarrow CI = \frac{331}{1000} \times 100000 \\ &= 66 \text{ to Ans.} \end{aligned}$$

$$\# P = 4000, R = 5\%, T = 3 \text{ yrs}, CI = ?$$

I 200

II 200 10

III 200 10 10 .5

$$CI = 200 + 200 + 200 + 10 \\ + 10 + 10 + .5 \\ = 630.5 \text{ Ans}$$

OR

$$R = 5\% = \frac{1}{20} = \frac{21}{20} \rightarrow A$$

$$P \quad A \quad \frac{21}{20} \rightarrow P$$

I	20	21
II	20	21
III	20	21

$$(P) \frac{8000 - 1261}{1261} (A)$$

$$1261 \rightarrow CI$$

$$\text{If } P = 8000 \Rightarrow CI = 1261$$

$$\text{but } P = 4000 \Rightarrow CI = \frac{1261}{8} = 630.5$$

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$$\# P = 3600, R = 16\frac{2}{3}\%, T = 3 \text{ yrs} CI = ?$$

$$R = 16\frac{2}{3}\% = \frac{1}{6} \rightarrow I \quad \Rightarrow A = 7 \quad \text{OR} \quad \frac{A}{P} = \frac{7}{6}$$

	P	A
I	6	7
II	6	7
III	6	7

$$(P) \frac{216}{127} \underbrace{343}_{343} (A)$$

$$\text{If } P = 216 \Rightarrow CI = 127$$

$$\text{but } P = 3600 \Rightarrow CI = \frac{127 \times 3600}{216}$$

$$= 2116.67 \text{ Ans}$$

$$\# A = 4096, R = 14\frac{2}{7}\%, T = 2 \text{ yrs}, P = ?$$

$$R = 14\frac{2}{7}\% = \frac{1}{7} \rightarrow I \quad \Rightarrow A = 8 \quad \text{OR} \quad \frac{A}{P} = \frac{8}{7}$$

	P	A
I	7	8
II	7	8

$$\text{If } A = 64 \Rightarrow P = 49$$

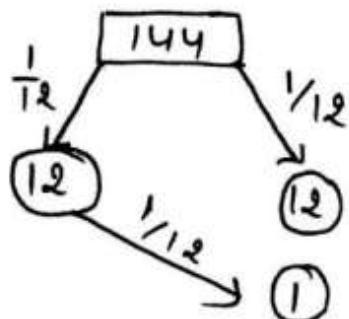
$$(P) \frac{49}{15} \underbrace{64}_{64} (A)$$

$$\text{but } A = 4096 \Rightarrow P = \frac{49}{64} \times 4096$$

$$= 3136 \text{ Ans}$$

$$\# P = 28800, R = 8\frac{1}{3}\%, T = 2 \text{ YR}, CI = ?$$

$$R = 8\frac{1}{3}\% = \frac{1}{12} \rightarrow I \quad \text{let } P = (12)^2 = 144 \quad \{ \text{coz } t=2 \}$$



$$\begin{array}{r} 0 \\ | \\ \begin{array}{r} R & I & 12 \\ II & 12 & 1 \\ \hline CI_2 = 12 + 12 + 1 = 25 \end{array} \end{array}$$

Add all in circle to get $CI = 12 + 12 + 1 = 25$

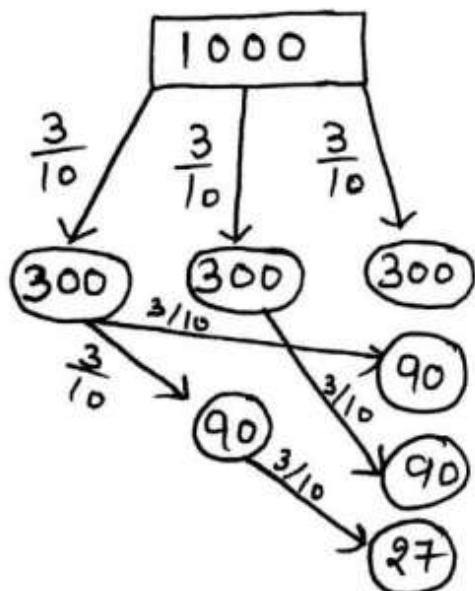
$$\text{If } P = 144 \Rightarrow CI = 25$$

$$\text{but } P = 28800 \Rightarrow CI_2 = \frac{25}{144} \times 28800$$

WhatsApp no 97284-35915 $\in 5000$ ANS.

$$\# P = 25000, R = 30\%, T = 3 \text{ YRS}, CI = ?$$

$$R = 30\% = \frac{3}{10} \rightarrow I \Rightarrow \text{let } P = (10)^3 = 1000 \quad \{ t=3 \}$$



$$\begin{array}{r} 0 \\ | \\ \begin{array}{r} R \\ I & 300 \\ II & 300 & 90 \\ III & 300 & 90 & 90 & 27 \\ \hline CI = 1197 \end{array} \end{array}$$

$$\begin{array}{r} 0 \\ | \\ \begin{array}{r} R & R = \frac{3}{10} \rightarrow I \Rightarrow A = 13 \\ I & P & A \\ II & 10 & 13 \\ III & 10 & 13 \\ \hline (P) & 1000 & 1197(A) \\ & & 1197 \rightarrow CI \end{array} \end{array}$$

add all in circle
 $CI = 1197$

$$\text{Now If } P = 1000 \Rightarrow CI_3 = 1197$$

$$\text{but } P = 25000 \Rightarrow CI_3 = \frac{1197}{1000} \times 25000 = 29925$$

ANS.

Technique 7 (Linear Method)

$$20000 \xrightarrow[2000]{10\% \uparrow} 22000 \xrightarrow[2000]{10\% \uparrow} 24200 \xrightarrow[2000]{10\% \uparrow} 26620$$

P

A₃

$$CI_3 = A_3 - P = 26620 - 20000 = 6620 \text{ Ans}$$

Technique 8 (Net Percentage Change)

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

Here $a = b = 10\% \Rightarrow 10 + 10 + \frac{10 \times 10}{100} = 21\%$.

again $a = 21, b = 10 \Rightarrow 21 + 10 + \frac{21 \times 10}{100} = 33.1\%$.

33.1% is equivalent Rate of 3 yrs

$$\Rightarrow CI_3 = 33.1\% \text{ of } 20000 = 6620 \text{ Ans.}$$

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Competition Success Point

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TRICKY MATH

By Sunil Kumar



Behind HDFC Bank, Red Square Market, Hisar +91- 9728 435915

The digital root (also called repeated digital sum) is the value obtained by adding all the digits of a no. until you get single digit.

→ जब तक तक single digit नहीं पाये जाए तब तक जानकर रखें।

Find the digital root of 24567

$$= 2+4+5+6+7 = 24$$

again $2+4 = 6$

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↓ is digital sum/root of
this no.

D.R. (digital root/sum) of 65536

$$= 6+5+5+3+6 = 25 = 2+5 = \boxed{7}$$

D.R. of 432654

$$= 4+3+2+6+5+4 = 24$$

$$2+4 = \boxed{6}$$

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Digital Root \Rightarrow it is also defined as the remainder when a no. is divided by 9.

e.g. DR of $625 = 6+2+5 = 13 = 1+3 = 4$

or when 625 divided by 9 rem = 4
 $\Rightarrow \text{DR} = 4$

we can use this to find digital root of a No. quickly by cancelling 9
 coz (casting out 9) ■■■

\Rightarrow So if a No has 9 this will not have any impact on the digital sum. So you can safely ignore 9 in No.

e.g. 59991 find digital Root

$$= 5+9+9+9+1 = 33 = 3+3 = 6$$

OR you may cancel out 9

$$\cancel{5}\cancel{9}\cancel{9}\cancel{9}\cancel{1} = 5+1 = 6$$

e.g. 49219

$$\text{DR} = \cancel{4}\cancel{9}\cancel{2}\cancel{1}\cancel{9} = 4+2+1 = 7$$

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651	9	3	H
4	5	1	S
4	5	1	R
1	5	1	T
1	5	1	me
3	5	1	→
3	5	1	9+7+8+4
3	5	1	CLAS
3	5	1	5
3	5	1	4
3	5	1	1

TRICK TO find digital Root quickly

we can cancel out 9 when finding D.R. and also cancels out digits that add up to 9. This is called cutting out 9.

e.g. (i) $\cancel{5} \cancel{3} \cancel{4} = 3$ as $\underline{5+4=9}$

(ii) $\cancel{5} \cancel{2} \cancel{1} \cancel{3} \cancel{4} \cancel{9} = 2+1+3=6$ [$\because 5+4=9$]

(iii) $1495 = \cancel{1} \cancel{4} \cancel{9} \cancel{8}$ [$\underline{5+4=9}$]
 $= 1$

(iv) $7486352 = 7+4+8+6+3+5+2$
 $= 35 = 3+5=8$

or $= \cancel{7} \cancel{4} \cancel{8} \cancel{6} \cancel{3} \cancel{5} \cancel{2} = 8$

लुनील सर } } [$\because 7+2=9$ $4+5=9$]
की + लाल } } $6+3=9$
97+84-35915 } } we can cancel them

e.g. (v) 43712

$$\begin{aligned} &= 43\cancel{7}\cancel{1}\cancel{2} = 4+3+1 \\ &= 8 \quad [\because 7+2=9] \end{aligned}$$

\Rightarrow So to find digital Root quickly you can cancel 9 and digit adding to 9.

Digital Root / sum of all multiples of 9 is also 9.

e.g. $18 = 1+8=9$, $27 = 2+7=9$

$$729 = 7+2+9 = 18 = \underline{1+8}$$

$DR(a+b) = DR[DR[a] + DR[b]]$

$$DR \text{ of } 786 + 152$$

$$= DR[DR[786] + DR[152]]$$

$$= DR[3+8] = DR[1] = 2$$

$DR[a-b] = DR[DR(a) - DR(b)]$

e.g. $DR[962 - 151]$

$$= DR[DR[962] - DR[151]]$$

$$= DR[8-7] = 1$$

$DR[a * b] = DR[DR[a] * DR[b]]$

e.g. $DR(35 * 16)$

ONLINE } $= DR[DR(35) * DR(16)]$

COACHING ALSO } $= DR[8 * 7] = DR[56]$

AVAILABLE } $= 2$

where DR is digital Root / digital sum

In Any mathematical calculation
digital Root on both sides of (=)
is always equal.

$$\text{dR of LHS} = \text{dR of RHS.}$$

e.g.

$$\begin{array}{rcl}
 12 \times 16 & = & 192 \\
 \downarrow & & \downarrow \\
 3 \times 7 & & 1+9+2 \\
 \swarrow \searrow & & \downarrow \\
 21 & & 12 \\
 \downarrow & & \downarrow \\
 3 & = & 3
 \end{array}$$

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e.g.

$$1440 + 120 + 210 = 1770$$

$$\begin{array}{ccc}
 9 + 3 + 3 & & 1+7+7+0 \\
 \downarrow & & \downarrow \\
 15 & & 15 \\
 \downarrow & & \downarrow \\
 6 & \xleftarrow{\text{equal}} & 6
 \end{array}$$

e.g

$$12570 - 4328 = 8248$$

$$\begin{array}{ccc}
 \downarrow & & 8+2+4+8 \\
 6 - 2 & & \downarrow \\
 \downarrow & & 2 \\
 4 & \xleftarrow{\text{equal}} & 4
 \end{array}$$

Important points Regarding digital sum

- It is not valid in Approximation and division.
- If we get digital sum = 0, we have to consider it as 9.
- If we get digital sum in minus it becomes.

-1 means +8
-2 ————— +7
-3 ————— +6
so on

If we get
-a
 $DR = 9 - a$
e.g. -4
 $DR = 9 - 4 = +5$

e.g. $4372 - 4328$
↓ ↘
7 - 8

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⑦ $\Rightarrow +8$

ans have Digital Root +8

- Decimal and % do not have any impact on Digital Sum/Root

$\Rightarrow 7.28, 728, 72.8$ all have same digital Root

$\Rightarrow \%$ mean $\frac{1}{100}$ $100 = 1 + 0 + 0 = 1$
so it does not effect the digital sum

Application of digital sum

Note → Both sides of (=) Digital sum must be equal

Note → OR we can say that Digital sum in question and option must match.

$$\# 1 \equiv (73)^2$$

{ what's App No.
97284-35915
a. 5129 b. 5229 c. 5329 d. 5239}

Solution :→

$$\begin{array}{r} 73 \times 73 \\ \downarrow \quad \downarrow \\ 10 \quad 10 \\ \downarrow \quad \downarrow \\ 1 \quad x \end{array}$$

so Ans. option must have digital sum ①

a.) $5129 = 8 \times$ b.) $5229 = 9 \times$

c.) $5329 = 5+3+2 = 10$ ✓

c is right choice

2. $637.28 - 781.47 + 257.39 = ?$

- a) 113.20 b) 104.30 c) 121.40 d) 133.50

✓ ↓ ↓ ↓ ↓
7 8 9 3

Sol. As point (decimal) does not have any impact on DR

$63\cancel{7}.28 - 781.47 + 257.39$ option A has
OR $\cancel{8} - 9 + 8 = 7$ digital sum 7 (A) ANS

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#3 44% of 125 + 75% of 840 = ?

- a). 600 b). 666 c). 685 d). 765

Solution

44% of 125 + 75% of 840

$$\begin{array}{r} \downarrow \\ 8 \times 8 + 3 \times 3 \\ \downarrow \quad \downarrow \\ 1 \quad + \quad 9 \end{array}$$

$$\begin{array}{r} \swarrow \\ 10 \\ \downarrow \\ 1 \end{array}$$

Now let check OR of

option

- a). 6 × ① ✓
b). 9 × ⑨ 9 ×

so C is Ans.

40 22% of 250 + 35% of 460 = ?

- Solution a). 216 b). 226 c). 232 d). 242

22% of 250 + 35% of 460



$$4 \times 7 + 8 \times 1$$



$$1 + 8$$

$$\begin{array}{r} \swarrow \\ 9 \end{array}$$

→ Now see which option
digital sum is 9

its ① ✓

216 → ⑨

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{ SPECIAL
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5 $333.33 + 33.33 + 3.33 + 30.003 = ?$

- a). 399.999
- b). 399.333
- c). 399.993
- d). 399.339

Solution

$$\begin{array}{r}
 333.33 + 33.33 + 3.33 + 30.003 \\
 \downarrow \quad \downarrow \\
 6 \quad + 3 + 9 + 6 \\
 \downarrow \\
 24 \\
 \downarrow \\
 6
 \end{array}$$

Check option which give digital sum 6

option c \rightarrow 6 c is Ans.

6. 56% of 958 + 67% of 1008 = ?% of 2000

- a). 47.622
- b). 42.86
- c). 60.592
- d). 91.455

Solution

$$56\% \text{ of } 958 + 67\% \text{ of } 1008$$

$$\begin{array}{r}
 2 \times 4 + 4 \times 9 \\
 \diagdown \quad \diagup \\
 8 + 9 \\
 \downarrow \\
 8
 \end{array}$$

$\left. \begin{array}{l} \text{www.competition} \\ \text{King.com} \end{array} \right\}$

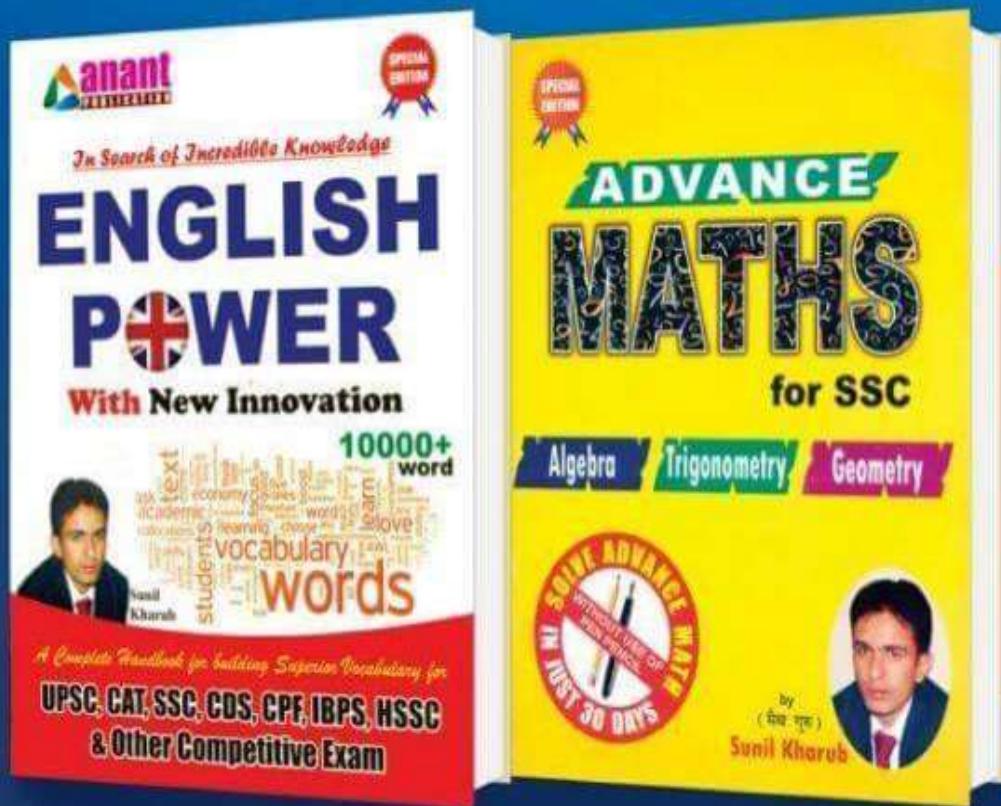
Digital sum of Right side must be ⑧

$$\begin{array}{r}
 x \% \text{ of } 2000 \\
 \downarrow \\
 x
 \end{array}$$

so x be such that $xx2 = 8$

option c $60.592 \rightarrow 4 \Rightarrow \underline{4x2} = 8$
 \Rightarrow c is Ans.

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TRIGONOMETRY TRICKY
 by Sunil Sir 97284-35915

1. If $x = a(\sin\theta + b\cos\theta)$,
 $y = b(\sin\theta - \cos\theta)$, then find
 the value of $\frac{x^2}{a^2} + \frac{y^2}{b^2}$ is

- (a) 0 (b) 1 (c) 2 (d) -2

Solution Put $\theta = 90^\circ$ सुनिल सर

$\Rightarrow x = a(0+0) = a$
 9728435915 $y = b(1-0) = b$

$$\Rightarrow \frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{a^2}{a^2} + \frac{b^2}{b^2} = 1$$

(b)

2. If $a\sin\theta + b\cos\theta = c$, then

$a\cos\theta - b\sin\theta$ is

(a) $\pm \sqrt{a^2 + b^2 + c^2}$ (b) $\pm \sqrt{c^2 + a^2 - b^2}$

(c) $\pm \sqrt{a+b-c}$ (d) $\pm \sqrt{a^2 + b^2 - c^2}$

Sol. Assume $\theta = 90^\circ$

then $a*1 + b*0 = c \Rightarrow c = c$

also $a\cos\theta - b\sin\theta = a.0 - b.1 = -b$

Put $c = c$ in all the options

option (d) gives (b) so (d)

18 Ans

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TRICKY MATHS BY SUNIL SR

If $\tan A = n \tan B$ and $\sin A = m \sin B$
then the value of $\cos^2 A$

- (a) $\frac{m^2+1}{n^2+1}$ (b) $\frac{n^2-1}{m^2-1}$ (c) $\frac{m^2+1}{m^2-1}$ (d) $\frac{m^2-1}{m^2+1}$

Solution let $A = 60^\circ, B = 30^\circ$

then $n = 3, m = \sqrt{3}$

also $\cos^2 A = \cos^2 60^\circ = \frac{1}{4}$

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Now put $n=3, m = \sqrt{3}$ in all the options

only option (b) will give $\frac{1}{4}$
(b) is Ans.

value of $\frac{\sin A}{1+\cos A} + \frac{\sin A}{1-\cos A}$ is ($0 < A < 90^\circ$)

- (a) $\alpha \operatorname{cosec} A$ (b) $\alpha \sec A$ (c) $\alpha \sin A$ (d) $\alpha \cos A$

Solution Put $A = 30^\circ$

the value of given expression is

$$\frac{\frac{1}{2}}{1+\sqrt{3}/2} + \frac{\frac{1}{2}}{1-\sqrt{3}/2} = \frac{1-\sqrt{3}}{2} + \frac{1+\sqrt{3}}{2} = 1$$

Now put $A = 30^\circ$ in options

only 4 option will give $1 = \alpha \operatorname{cosec} 30^\circ$

(A) → ans {
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= 1}

Note → Dont put $A = 45^\circ$ in TPS question

= option (A) and (B) will give same value

TRICKY MATHS BY SUNIL SIR 97284-35915

If $\frac{\cos\alpha}{\cos\beta} = a$ and $\frac{\sin\alpha}{\sin\beta} = b$ then

the value of a and b $\sin^2\beta$

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

Solution : let $\alpha = 30^\circ$, $\beta = 60^\circ$

then $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$ {VIDEOS + HARD COPY}

also $\sin^2\beta = \sin^2 60^\circ = \frac{3}{4}$ {97284-35915}

Now put $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$ in options

check option (c) will give $\frac{3}{4}$

so c is Ans.

If θ is +ve acute angle and

$3(\sec^2\theta + \tan^2\theta) = 5$, then the value
of $\cos 2\theta$ is

- a). $\frac{1}{\sqrt{2}}$ b). 1 c). $\frac{1}{2}$ d). $\frac{\sqrt{3}}{2}$

Solution $\sec^2\theta + \tan^2\theta = \frac{5}{3}$

we know $\sec^2\theta - \tan^2\theta = 1$

adding both $2\sec^2\theta = \frac{8}{3} \Rightarrow \sec^2\theta = \frac{4}{3}$

$$\sec\theta = \frac{2}{\sqrt{3}} \Rightarrow \theta = 30^\circ$$

$$\cos 2\theta = \cos 60^\circ = \frac{1}{2}$$

If $2Y \cos\theta - x \sin\theta = 0$ &
 $2x \sec\theta - y \csc\theta = 3$, then the value
of $x^2 + 4y^2$ is

- (A) 0 (B) 2 (C) 4 (D) 8

Sol. put $\theta = 45^\circ$

$$\frac{2Y}{\sqrt{2}} - \frac{x}{\sqrt{2}} = 0 \Rightarrow 2Y - x = 0 \\ \Rightarrow 2Y = x$$

also $2x \cdot \sqrt{2} - y \sqrt{2} = 3 \Rightarrow 2x - y = 3/\sqrt{2}$

OR $4Y - Y = 3/\sqrt{2} \quad [\because xY = x]$

OR $3Y = 3/\sqrt{2} \Rightarrow Y = \frac{1}{\sqrt{2}} \Rightarrow x = 1Y = \sqrt{2}$

$\therefore x^2 + 4y^2 = 2 + 4 \times \frac{1}{2} = 4 \quad (\text{C})$

Find the value of

$$\frac{\cot x}{\cot x - \cot 3x} + \frac{\tan x}{\tan x - \tan 3x}$$

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- (A) 0 (B) 1 (C) -1 (D) 2

solution Put $\theta = 15^\circ$

$$\frac{\cot 15^\circ}{\cot 15^\circ - \cot 45^\circ} + \frac{\tan 15^\circ}{\tan 15^\circ - \tan 45^\circ} \\ \frac{2+\sqrt{3}}{1+\sqrt{3}} + \frac{2-\sqrt{3}}{1-\sqrt{3}} = 1$$

(B) is Ans.

$\cot 15^\circ$
$= 2 + \sqrt{3}$
$\tan 15^\circ$
$= 2 - \sqrt{3}$

If $2Y \cos\theta - x \sin\theta = 0$ &
 $2x \sec\theta - y \cosec\theta = 3$, then the value
of $x^2 + 4y^2$ is

- (A) 0 (B) 2 (C) 4 (D) 8

Sol. put $\theta = 45^\circ$

$$\frac{2Y}{\sqrt{2}} - \frac{x}{\sqrt{2}} = 0 \Rightarrow 2Y - x = 0 \\ \Rightarrow 2Y = x$$

also $2x \cdot \sqrt{2} - y \sqrt{2} = 3 \Rightarrow 2x - y = 3/\sqrt{2}$

OR $4Y - Y = 3/\sqrt{2}$ [$\because xY = x$]

OR $3Y = 3/\sqrt{2} \Rightarrow Y = \frac{1}{\sqrt{2}} \Rightarrow x = 1Y = \sqrt{2}$

$\therefore x^2 + 4y^2 = 2 + 4 \times \frac{1}{2} = 4$ (C)

Find the value of

$$\frac{\cot x}{\cot x - \cot 3x} + \frac{\tan x}{\tan x - \tan 3x}$$

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- (A) 0 (B) 1 (C) -1 (D) 2

solution Put $\theta = 15^\circ$

$$\frac{\cot 15^\circ}{\cot 15^\circ - \cot 45^\circ} + \frac{\tan 15^\circ}{\tan 15^\circ - \tan 45^\circ}$$

$$\frac{2+\sqrt{3}}{1+\sqrt{3}} + \frac{2-\sqrt{3}}{1-\sqrt{3}} = 1$$

(B) is Ans.

$$\cot 15^\circ = 2 + \sqrt{3}$$

$$\tan 15^\circ$$

$$= 2 - \sqrt{3}$$

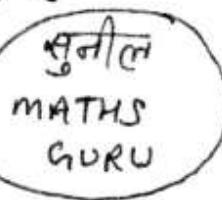
If $x \cos \theta - \sin \theta = 1$, then $x^2 + (1+x^2) \sin \theta$
equals ① 1 b). -1 ③ 0 d) 2

Solution : let $\theta = 0^\circ$

$$\Rightarrow x \cdot 1 - 0 = 1 \Rightarrow x = 1$$

$$\therefore x^2 + (1+x^2) \sin 0^\circ = 1 + (1+1) \cdot 0 = 1 \quad ①$$

② is correct.



IF $\tan^2 \alpha = 1 + 2 \tan^2 \beta$ (α, β are acute)

then $\sqrt{2} \cos \alpha - \cos \beta$ is equal to

- a). 0 b). $\sqrt{2}$ c) 1 d) -1

Solution put $\beta = 45^\circ$ and $\alpha = 60^\circ$

This will satisfy the given condition

$$\tan^2 60^\circ = 1 + 2 \tan^2 45^\circ$$

$$(\sqrt{3})^2 = 1 + 2$$

$$3 = 3$$

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$$\therefore \sqrt{2} \cos \alpha - \cos \beta = \sqrt{2} \cos 60^\circ - \cos 45^\circ$$

$$= \sqrt{2} \times \frac{1}{2} - \frac{1}{\sqrt{2}} = 0.$$

③ is ANS.

* ————— * ————— *

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Data Interpretation

TRICKY MATHS BY SUNIL

If

$$\# \sec \theta = x + \frac{1}{4x} \quad [0^\circ < \theta < 90^\circ], \text{ then}$$

$\sec \theta + \tan \theta$ equal to.

- a). $\frac{x}{2}$ b). $2x$ c). x d). $\frac{1}{2x}$

Solution

Put $x=1$

$$\sec \theta = 1 + \frac{1}{4} = \frac{5}{4} = \frac{H}{B}$$

$$\Rightarrow \tan \theta = \frac{P}{B} = \frac{3}{4}$$

$$\Rightarrow \sec \theta + \tan \theta = \frac{5}{4} + \frac{3}{4} = 2 = ex$$

[www.competitionking.com]

[$\because x=1$]

the simplified value of

$$(\sec x \sec y + \tan x \tan y)^2 - (\sec x \tan y + \tan x \sec y)^2$$

- a) -1 b). 0 c) $\sec^2 x$ d) 1

Solution : Put $x=y=45^\circ$

$$(\sec 45^\circ \sec 45^\circ + \tan 45^\circ \tan 45^\circ)^2$$

$$- (\sec 45^\circ \tan 45^\circ + \tan 45^\circ \sec 45^\circ)^2$$

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

$$= 9 - (2\sqrt{2})^2 = 1 \quad \text{Ans. is } 1$$

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↓

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TRICKY TRIGONOMETRY BY SUNIL SIR

If $(\mu \cos \theta - \sqrt{3})^2 + (\mu \sin \theta - 1)^2 = 0$

then the value of $\frac{\mu \tan \theta + \sec \theta}{\mu \sec \theta + \tan \theta}$ is

- a). $\frac{4}{5}$
- b). $\frac{3}{5}$
- c). $\frac{\sqrt{3}}{4}$
- d). $\frac{\sqrt{5}}{4}$

Solution $(\mu \cos \theta - \sqrt{3})^2 + (\mu \sin \theta - 1)^2 = 0$

$$\Rightarrow \mu \cos \theta = \sqrt{3} \quad \& \quad \mu \sin \theta = 1 \quad \left[\because a^2 + b^2 = 0 \Rightarrow a = 0, b = 0 \right]$$

dividing $\cot \theta = \sqrt{3} \Rightarrow \theta = 30^\circ$

also $\mu \cos \theta = \sqrt{3} \Rightarrow \mu \cos 30^\circ = \sqrt{3}$

$$\Rightarrow \mu \cdot \frac{\sqrt{3}}{\sqrt{3}} = \sqrt{3} \Rightarrow \mu = 1$$

$$\therefore \frac{\mu \tan \theta + \sec \theta}{\mu \sec \theta + \tan \theta} = \frac{\mu \tan 30^\circ + \sec 30^\circ}{\mu \sec 30^\circ + \tan 30^\circ}$$

$$= \frac{\frac{1}{\sqrt{3}} + \frac{2}{\sqrt{3}}}{\frac{4}{\sqrt{3}} + \frac{1}{\sqrt{3}}} = \frac{1}{5} \quad \text{(A) is correct}$$

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the simplified value of

$(1 + \cot \theta - \cosec \theta)(1 + \tan \theta + \sec \theta)$ equal to

Solution put $\theta = 45^\circ$

$$(1 + 1 - \sqrt{2})(1 + 1 + \sqrt{2}) = (\cancel{1} - \sqrt{2})(\cancel{1} + \sqrt{2}) \\ = \cancel{1}$$

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Question $2\sin\alpha + 15\cos\alpha = 7$ find $\cot\alpha$

(a) $4/3$ (c) $5/4$
(b) $3/4$ (d) $1/2$

Question If $\frac{\cos^4\alpha}{\cos^2\beta} + \frac{\sin^4\alpha}{\sin^2\beta} = 1$ find $\sin^4\alpha + \sin^4\beta$

- (a) $\sin^2\alpha \sin^2\beta$ (d) $\frac{\sin^2\alpha + \sin^2\beta}{\sin^2(\alpha + \beta)}$
(b) $\sin^2\alpha \sin^2\beta$
(c) $\sin\alpha \sin\beta$
- Hint $\alpha = \beta$

Question $\sin\theta + \sin^2\theta + \sin^3\theta = 1$

find $\cos^6\theta - 4\cos^4\theta + 8\cos^2\theta = ?$

Ans. 4

\Rightarrow If $\sin\theta + \sin^2\theta = 1$, then $\cos^2\theta + \cos^4\theta = ?$

- a) 1. b). α c). 3 d) -1

Solution $\sin\theta + \sin^2\theta = 1 \Rightarrow \sin\theta = 1 - \sin^2\theta$

$$\Rightarrow \sin\theta = \cos^2\theta$$

$$\begin{aligned} \text{Now } \cos^2\theta + \cos^4\theta &= \cos^2\theta + (\cos^2\theta)^2 \\ &= \cos^2\theta + \sin^2\theta = 1. \end{aligned}$$

\Rightarrow If $\sin\theta + \sin^2\theta = 1$, then find the value
of

$$\cos^4\theta + 3\cos^6\theta + 3\cos^8\theta + \cos^{10}\theta + 2\cos^4\theta + 2\cos^2\theta - 2$$

Solution $\sin\theta = \cos^2\theta$

$$\text{Now } \cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta + 4\cos^4\theta + 2\cos^2\theta - 2$$

$$= [\cos^{12}\theta + 3\cos^{10}\theta + 3\cos^8\theta + \cos^6\theta] + 2[\cos^4\theta + \cos^2\theta - 2]$$

$$= [\cos^4\theta + \cos^2\theta]^3 + 2[\cos^4\theta + \cos^2\theta - 1]$$

$$= [\sin^2\theta + \cos^2\theta]^3 + 2[\sin^2\theta + \cos^2\theta - 1]$$

$$= 1 + 2[1-1] = 0 \quad [\because \sin\theta = \cos^2\theta]$$

If $\sin\theta + \sin^2\theta + \sin^3\theta = 1$
then

$$\cos^6\theta - 4\cos^4\theta + 8\cos^2\theta = ?$$

- a) 1 b) 2 c) 3 d) 4

Solution: $\sin\theta + \sin^2\theta + \sin^3\theta = 1$

$$\Rightarrow \sin\theta + \sin^3\theta = 1 - \sin^2\theta = \cos^2\theta$$

$$\Rightarrow \sin\theta(1 + \sin^2\theta) = \cos^2\theta$$

Squaring Both Sides.

$$\sin^2\theta (1 + \sin^2\theta)^2 = \cos^4\theta$$

$$\Rightarrow (1 - \cos^2\theta)(1 + 1 - \cos^2\theta)^2 = \cos^4\theta$$

$$\Rightarrow (1 - \cos^2\theta)(2 - \cos^2\theta)^2 = \cos^4\theta$$

$$\Rightarrow (1 - \cos^2\theta)(4 + \cos^4\theta - 4\cos^2\theta) = \cos^4\theta$$

$$\Rightarrow 4 - 4\cos^2\theta + \cos^4\theta - 4\cos^2\theta - \cos^6\theta + 4\cos^4\theta = \cos^4\theta$$

$$\Rightarrow -\cos^6\theta + 4\cos^4\theta - 8\cos^2\theta + 4 = 0$$

$$\Rightarrow \cos^6\theta - 4\cos^4\theta + 8\cos^2\theta = 4$$

Very Important Concept

If $A+B=C$ then

$$\tan(A+B) = \tan C \Rightarrow \frac{\tan A + \tan B}{1 - \tan A \tan B} = \tan C$$

$$\Rightarrow \tan A + \tan B = \tan C - \tan A \tan B \tan C$$

$$\Rightarrow \tan A \tan B \tan C = \tan C - \tan A - \tan B$$

e.g Find the value of

$$\tan 5x - \tan 2x - \tan 3x$$

Solution as $5x = 2x + 3x$ so, we can apply
above theorem

So $\tan 5x - \tan 2x - \tan 3x = \frac{\tan 5x \tan 2x}{\tan 3x}$

Simple Interest

(साधारण ब्याज)

This topic is an Extension of Percentages. So you ^{must} have good command on percentage calculations.

Terminology of INTEREST

"Credit the giver, Debit the receiver"

1. Principal (धनराशी) $\Rightarrow (P)$

The original sum of money which was borrowed, lent out or deposited in bank.

2. INTEREST (ब्याज) (I)

The Extra / Additional amount paid over principal over certain time period (T)

3. Rate of Interest (रेट) (r) \Rightarrow

Percent rate at which interest is paid over certain period of time. R.10 per annum

4. Amount (धनराशी)

$$\text{Amount} = \text{Principal} + \text{Interest}$$

UNDERSTANDING INTEREST

Some money → say P (called Principle)



$$A = P + I$$

Amount

$I = P + I$

Have to pay some Extra money
for use of P called
 r (percent) (per annum)

SI (if interest is
calculated on same P
for entire time period)

Interest

How it is calculated

means

R is interest.

on 100 for 1 year

$$\frac{R\%}{100} \cdot P \cdot a$$

(Rate)

SI if Interest
is calculated
on diff. Principle

(P is not same for entire Period)

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SIMPLE INTEREST



Interest on principal over certain time period is uniform.

OR

Simple Interest remains same for same period of time.

Interest for 1 year for every ₹ 100 is called interest rate per annum (R% p.a.)

so if we say rate of interest per annum is $R\%$, we mean that ₹ x is the interest on a principal of ₹ 100 for 1 year.

thus if we have total interest as ₹ 500, the interest per year is ₹ 50, then we can say that the no. of years is $500/50 = 10$.

$$SI = \frac{P \times R \times T}{100}$$

$$A = P + SI$$

↓
amount

SIMPLE INTEREST

Principal is always 100%.

$$P = 100\%$$

Interest for 1 year is Rs r
for 2 yrs is 2r, for 10 yr for ...
and so on

generally $SI = (r \times t) \%$.

$$r \times t \% = SI$$

$$\Rightarrow 1\% = \frac{SI}{r \times t} \Rightarrow 100\% = \frac{100 \times SI}{r \times t}$$

$$\Rightarrow P = \frac{100 \times SI}{r \times t} \Rightarrow \boxed{SI = \frac{P \times r \times t}{100}}$$

$$A = P + SI$$

$$= P + \frac{P \times R \times T}{100} = P \left[1 + \frac{R \times T}{100} \right]$$

$$\boxed{A = P \left[1 + \frac{R \times T}{100} \right]}$$

#

If $R = 5\%$ p.a. $T = 6$ years

let us understand

$P = 15625$ $SI = ?$ solution $P = 100$ $Rt =$ $SI = 10\%$ $100\% \longrightarrow$ $10\% \longrightarrow$ # $R = 4\%$ $T = 5$ $P =$ solution $SI = R \times$ 100% $\Rightarrow 100\%$

$$\begin{aligned} \# \quad \text{Amount} &= P + SI \\ &= 100\% + rt\% \\ &= (100 + rt)\% \end{aligned}$$

$$\# \quad R = 5\% \quad T = 4 \text{ yr} \quad P = 2000 \\ \text{Amount} = ?$$

Solution :-

$$\begin{aligned} P &= 100\% \\ RT\% &= 5\% \times 4 = 20\% \\ \Rightarrow A &= 120\% \\ 100\% &\rightarrow 2000 \\ 120\% &\rightarrow \frac{2000}{100} \times 120 = 2400 \text{ ₹ Ans.} \end{aligned}$$

$$\# \quad R = 5\% \quad T = 4 \text{ yr} \quad A = 480 \\ P = ?$$

Solution

$$\begin{aligned} P &= 100\% \\ RT &= 5 \times 4 = 20\% \end{aligned}$$

$$\begin{aligned} \Rightarrow A &= 120\% \\ 120\% &= 480 \\ \Rightarrow 100\% &= \frac{480}{120} \times 100 = 400 \text{ ₹} \end{aligned}$$

Ans.

In how many years ₹ 500 will amount to ₹ 625 at 5% p.a.

500 रु की राशि 5% की दर से 625 रु ले जाएगी

Sol.

$$A = P + SI$$

↓
100%.

$$500 = 100\%$$

$$\Rightarrow 625 = \frac{100}{500} \times 625 = 125\%$$

$$A = 125\%. \Rightarrow SI = 25\% = R + \underline{\%}$$

$$\text{but } R = 5\%. \Rightarrow T = \underline{5 \text{ yrs}} \text{ Ans.}$$

₹ 425 amounts to ₹ 476 in 3 yrs
at certain rate of interest. find rate.

Solution :- $A = P + SI$

↓
100%

$$425 \rightarrow 100\%$$

$$\downarrow \quad 476 \rightarrow \frac{100\%}{425} \times 476 \rightarrow 112\%$$

$$A = 112\%. \Rightarrow SI = 12\% = R + \underline{\%}$$

$$\text{but } t = 3 \text{ yrs} \Rightarrow R = 4\% \text{ Ans.}$$

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A certain principle in four years will become 3 times. find the Rate

किसी राशि 4 वर्षों में 3 गुणी हो जाए। राशि की दूर से 4 गुणी,

solution

$$A = P + SI$$

$$P = 100\% \quad A = 300\%$$

$$\Rightarrow SI = 200\% = R \times t\%$$

but $t = 4 \Rightarrow R = 50\%. \text{ Ans.}$

A certain sum doubles at 5%. find the time period.

किसी 5% की दर से 4 वर्षों में राशि की दूर से दो गुणी हो जाती है।

solution :- $A = P + SI$

$$P = 100\% \quad A = 200\%$$

$$SI = 100\% = R \times t\%$$

but $R = 5\% \Rightarrow t = \underline{20 \text{ years.}}$

Note :- whenever it is not mentioned whether we have to assume CI or SI we should assume SI.

A sum of money triples in 4 yrs. The same sum will be seven times in how many years?

solution

$$A_1 = P_1 + S\bar{I}$$

$$P_1 = 100\% \quad A_1 = 300\%$$

$$S\bar{I}_1 = \frac{200\%}{\text{in } 4 \text{ yrs.}}$$

Note \rightarrow $S\bar{I}$ is uniform. it will increase by same amount in same time period

$$A_2 = 700\% \quad P_2 = 100\% \Rightarrow S\bar{I}_2 = 600\%$$

$$200\% \text{ in } 4 \text{ yrs}$$

$$600\% \text{ in } 4 \times 3 = 12 \text{ yrs} \quad \underline{\text{Ans.}}$$

$\frac{9}{10}$ राशि से लाल में खाली पानी की गति $\frac{9}{10}$ से दुग्धी के जली $\frac{9}{10}$, भरी राशि की गति $\frac{9}{10}$ में $\frac{9}{10}$ के जली,

solution

$$A = P + S\bar{I}$$

$$A_1 = 500\% \quad P_1 = 100\% \quad S\bar{I}_1 = 400\%$$

$$S\bar{I}_1 = 400\% \text{ in } 5 \text{ yrs}$$



$$A_2 = 700\% \quad P_2 = 100\%$$

$$S\bar{I}_2 = 600\%$$

$$600\% \text{ in } 5$$

$$600\% \text{ in } - \frac{5}{400} \times 600 = \underline{\underline{-\frac{75}{2}}}$$

A sum of money was invested at SI at a certain rate for 3 years. Had it been invested at 4% higher rate, it would have fetched ₹ 480 more. find the principal.

Solution → Additional money obtained
= 4% for 3yr = 12% of P.

$$12\% \rightarrow 480$$

$$100\% \rightarrow 480 / \frac{1}{12} \times 100 = \underline{\underline{4000}} \text{ ₹}$$

A certain sum of money amounts to ₹ 704 in 2 yrs. and ₹ 800 in 5 yrs. find the principal. and rate

Solution $A_5 - A_2 = 800 - 704 = 96 \text{ ₹}$

Interest for 3 years = 96
————— 1 year = 32

————— ₹ ————— = 64

$$P = 704 - 64 = \underline{\underline{640}}$$

$$\text{Rate} = \frac{32 \times 100}{640} = 5\%$$

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Note: Call
③ Purchase full

The rate of interest for first 3 years is 6% p.a., for next 4 years 7% p.a. and for the period beyond 7 years 7.5% p.a.
 If a man lent out ₹ 1200 for 11 years
 find the total interest earned by him.

Solution Interest for first 3 years

$$= 6\% \times 3 = 18\%$$

Interest for next 4 yrs = $7\% \times 4 = 28\%$

$$4 \text{ (till 11 yrs)} = 7.5\% \times 4$$

$$= 30\%$$

Total interest = 76% of ₹

$$= \frac{76 \times 1200}{100} \quad \text{OR} \quad (75\% + 1\%) \text{ of } 1200$$

$$= \frac{3}{4} \times 1200 + 12 = 900 + 12 = \boxed{912}$$

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$A:B = 2:3$ & $B:C = 4:5$
find $A:B:C$

Solution → Focus on No. which B is same
here B is same make B same by
taking LCM of 3 and 4 (12)

$$\begin{array}{ll}
 A:B & B:C \\
 (2:3) \times 4 & (4:5) \times 3 \\
 8:12 & 12:15 \\
 \Rightarrow A:B:C = \underline{\underline{8:12:15}}
 \end{array}$$

If $2a = 3b = 4c$ find $a:b:c$

solution let $2a = 3b = 4c = 12$

$$\Rightarrow a = 6, b = 4, c = 3$$

$$\Rightarrow a:b:c = \underline{\underline{6:4:3}}$$

OR $2a = 3b = 4c = k$

$$\Rightarrow a = \frac{k}{2}, b = \frac{k}{3}, c = \frac{k}{4}$$

$$\begin{aligned}
 a:b:c &= \frac{1}{2} : \frac{1}{3} : \frac{1}{4} \times 12 \\
 &= \underline{\underline{6:4:3}}
 \end{aligned}$$

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A sum of ₹ 14400 is divided into 3 parts such that 1st part is invested at 2% p.a. for 3 years, 2nd part @ 3% p.a. for 4 years & 3rd part at 4% p.a. for 5 years. If simple interest is equal for all parts find the sum of each part.

Solution Let 3 parts are P_1, P_2 & P_3

1st part SI 2nd part SI 3rd SI

$$6\% \text{ of } P_1 = 12\% \text{ of } P_2 = 20\% \text{ of } P_3$$

$$\text{OR} \quad 6P_1 = 12P_2 = 20P_3$$

$$\text{OR} \quad 3P_1 = 6P_2 = 10P_3$$

$$\text{let } 3P_1 = 6P_2 = 10P_3 = 30$$

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$$\Rightarrow P_1 = 10, P_2 = 5, P_3 = 3$$

$$P_1 : P_2 : P_3 = 10 : 5 : 3$$

$$\text{So } P_1 = \frac{14400}{18} \times 10 = \underline{\hspace{2cm}} \quad P_2 = \frac{14400}{18} \times 5 = \underline{\hspace{2cm}}$$

$$\text{of } P_3 = \frac{14400}{18} \times 3 = \underline{\hspace{2cm}} = 4000$$

A sum of ₹ 18750 is left by will by a father to be divided b/w two sons of 12 and 14 years of age so that when they attain maturity at 18, the amount received by each at 5% p.a. S.I. will be same. Find the sum allotted at present

Solution :-

A₁

$$100 + 5\% \times 6 = 130\% \text{ of } P_1$$

A₂

$$100 + 4 \times 5\% \\ 140\% \text{ of } P_2$$

$$130\% \text{ of } P_1 = 120\% \text{ of } P_2$$

$$\Rightarrow 13P_1 = 12P_2 \Rightarrow P_1 : P_2 = 12 : 13$$

$$P_1 = \frac{18750}{25} \times 12 = 9000$$

$$P_2 = \frac{18750}{25} \times \frac{13}{12} = \frac{9750}{12}$$

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With a given rate of interest, the ratio of the principal and amount for a certain period of time is 4:5. After 3 years with the same rate of interest the ratio of principal and amount becomes 5:7. The Rate of Interest is
 (A) 4% (B) 5% (C) 6% (D) 7%

Solution [In simple interest Principal is always same]

Principal	Amount	t	
4	5	1	1 yr
5	7	2	<u>$t+3$</u>

we will make t equal by taking LCM (20)

$$\begin{array}{lll} 5 \times 4 = 20 & 5 \times 5 = 25 & 5 \\ 4 \times 5 = 20 & 7 \times 4 = 28 & 8 \\ \text{I on } \overline{x} \text{ for } 3 \text{ yrs} & & t+3 \end{array}$$

\rightarrow I on \overline{x} for 3 yrs is $18 - 5 = 3$.

$$\therefore x = \frac{3 \times 100}{20 \times 3} = 5\% \text{ p.a.}$$

A person invested some amount at the rate of 12% SI and remaining at 10%. He received yearly interest of ₹ 130.

Had he interchanged the amount invested he would have received ₹ 134. How much money did he invest at diff rates.

- Solution :→ a.) 500 @ 10%, ₹ 800 @ 12%.
 b.) ₹ 700 @ 10%, ₹ 600 @ 12%. c.) ₹ 800 @ 10%, ₹ 400 @ 12%.
 d.) ₹ 700 @ 10%, ₹ 500 @ 12%.

Solution → method!

$$12\% \text{ of } x + 10\% \text{ of } y = 130$$

$$10\% \text{ of } x + 12\% \text{ of } y = 134$$

$$\Rightarrow x = 500, y = 700 \quad \text{(d) is correct}$$

Short cut :→ Diff in two rates = 2%

Diff in interest = ₹ 4

Diff in amount $\Rightarrow \frac{4}{2} \times 100 = 200$

Diff in amount is ₹ 200 only in option D

- # A man lent ₹ 2000 partly at 5% and balance at 4%. If he receives ₹ 92 as annual interest. Find the amount lent at 5%?
- a). ₹ 800 b). ₹ 900 c). ₹ 1000 d) ₹ 1200

Solution method 1

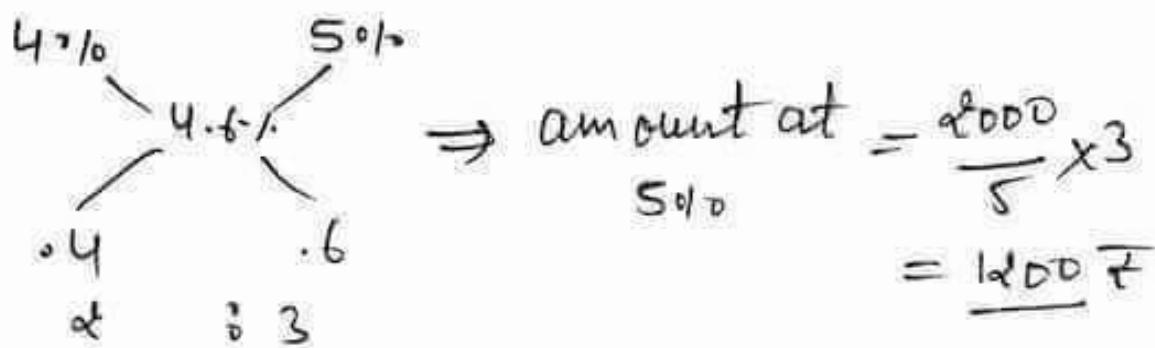
Let x be amount invested at 5%

$$\Rightarrow 5\% \text{ of } x + (2000 - x) \times 4\% = 92$$

$$\Rightarrow x = 1200$$

method 2: By alligation

$$\text{rate for full yr} = \frac{92}{2000} \times 100 = 4.6\%$$



Short cut by sunil. Let the whole amount be invested at 4%

$$\Rightarrow SI = \frac{2000 \times 4 \times 1}{100} = 80 \quad \text{which is 12 less than original (92)}$$

Diff is due to diff of 2 rates $5\% - 4\% = 1$

$$\begin{array}{rcl} 1\% & - & 12 \\ 100\% & - & \underline{\underline{1200}} \end{array} \quad 80 \quad \text{ans is } \underline{\underline{1200}}$$

- # A man lent ₹ 2000 partly at 5% and balance at 4%. If he receives ₹ 92 as annual interest. Find the amount lent at 5%?
- a). ₹ 800 b). ₹ 900 c). ₹ 1000 d) ₹ 1200

Solution method 1

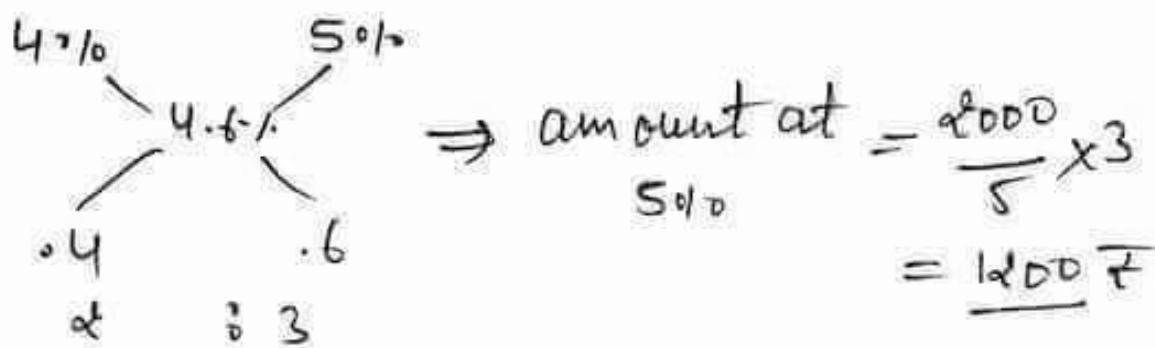
Let x be amount invested at 5%

$$\Rightarrow 5\% \text{ of } x + (2000 - x) \times 4\% = 92$$

$$\Rightarrow x = 1200$$

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$$\Rightarrow SI = \frac{2000 \times 4 \times 1}{100} = 80 \quad \text{which is 12 less than original (92)}$$

Diff is due to diff of 2 rates $5\% - 4\% = 1$

$$\begin{array}{rcl} 1\% & - & 12 \\ 100\% & - & \underline{1200} \end{array} \quad 80 \quad \text{ans is } \underline{1200}$$

A man lent ₹ 16000 part of which he lent at 4% and rest at 5% p.a. SI. If the total interest received was ₹ 700 in one year, the money lent at 4% was

- a) 12000 b) 8000 c) 10,000 d) 6000

Solution: → Let the whole money was invested at 4%

$$\Rightarrow \text{Annual interest} = 16000 \times 4\% = \underline{640}$$

Interest is short from actual interest (700)
by = $700 - 640 = 60$

This diff is due of 5% rate

$$1\% - 60$$

$100\% - \underline{6000}$ This was invested at $\underline{5\%}$

$$\text{So amt invested at } 4\% = 16000 - 6000 = \underline{10,000}$$

OR. Let the whole

money invested at 5%

$$\Rightarrow \text{SI} = \frac{16000 \times 5}{100} = 800$$

This is 100 more due 4% is less

$$1\% - 100$$

$$100\% - \underline{10,000}$$

Sunil borrowed a sum of 30,000. He took a part of it at 12% and remaining at 10% . At the end of $\frac{1}{2}$ years he returned 36480. What was sum borrowed at 12% ?

a) 16000 b) 18000 c) 17500 d) 14000

Solution Interest for $\frac{1}{2}$ yrs = 640

Interest for 1 yr = 3240

Let the whole sum be borrowed at 10% .

Then total interest = $30,000 \times 10\% = 3000$

This is short from actual interest by $\frac{1}{2}40$

and Pg equal to $\frac{1}{2}\%$ of sum borrowed at 12%

$$\begin{array}{rcl} 20\% & - & 240 \\ 100\% & - & \underline{12000} \end{array} \quad \text{(d) is Ans.}$$

OR Let whole sum is borrowed at 12%

$$\Rightarrow I = 30,000 \times 12\% = 3600$$

360 more which Pg $\frac{1}{2}\%$ of sum at 10% .

$$\begin{array}{rcl} 20\% & - & 360 \\ 100\% & - & \end{array}$$

$$\frac{360}{2} \times 100 = 18000 \quad (\text{sum at } 10\%)$$

$$\Rightarrow \text{sum at } \underline{12\%} = \underline{12000}$$

Population of town is 15000. If the No. of male increases by 8% and that of female by 10%. Then the population would increase to 16300 after 1yr. find the no. of females.

- a) 3000 b) 5000 c) 4000 d) 6000

Sol. let the population consists of ~~male~~ male only

\Rightarrow population after 1yr = $15000 \times 8\% = 1200$
which is 100 less than actual (16300)

100 is 20% of female (as it extra)
 $100\% - \underline{5000}$ females

OR let the population consist of female only

\rightarrow population after 1yr = $15000 \times 10\%$
 $= \underline{1500}$

which is 200 extra

20% of male is 200

$100\% - \frac{200}{at} \times 100 = 10,000$ (males)

$\Rightarrow \underline{\text{females}} = \underline{5000}$

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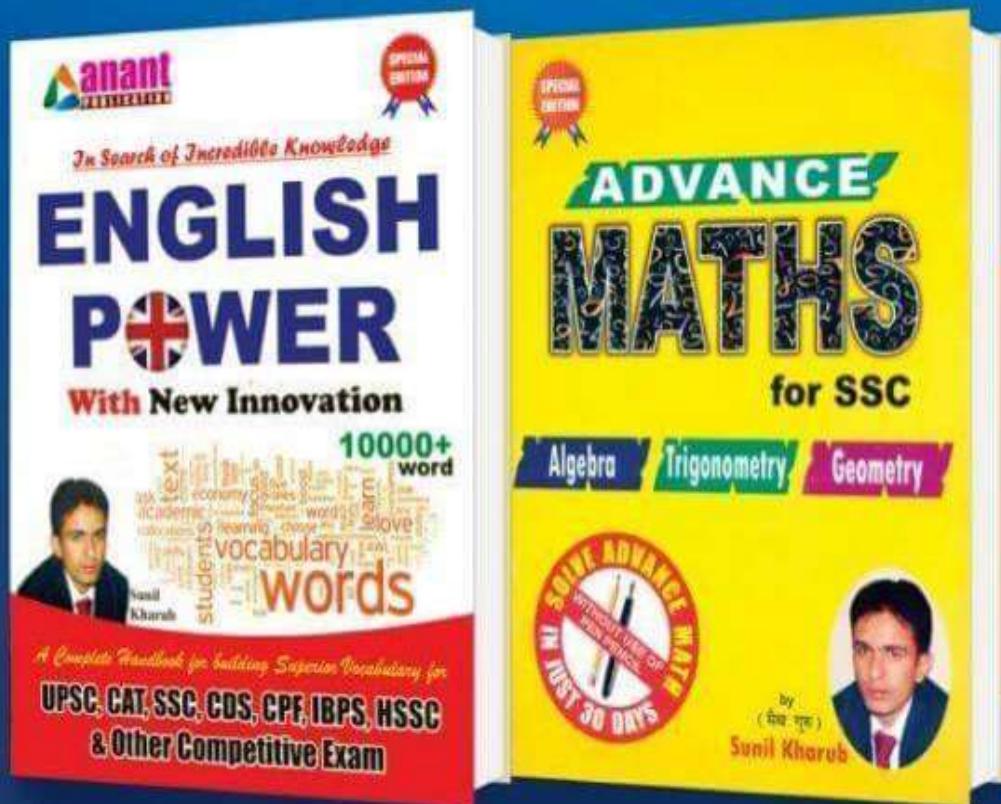
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TRICKY MATHS by Sunil Sir

$\sqrt{7\sqrt{7\sqrt{7\sqrt{7}}}} = ?$

TRICK →

$$\boxed{7^{\frac{2^{n-1}-1}{2^n}}}$$

where n is no.
of square roots.

Here $n = 3$

$$x = 7^{\frac{2^3-1}{2^3}} = 7^{7/18}$$

$\sqrt{7\sqrt{7\sqrt{7\sqrt{7}}}} = 7^{\frac{2^4-1}{2^4}} \quad [n=4]$
 $= 7^{15/16}$

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$\sqrt{7\sqrt{7\sqrt{7\cdots\cdots\infty}}} = ?$

Trick: In these type of questions the No itself is Answer.

So → Ans. is 7

Explanation :

$$\text{let } \sqrt{7\sqrt{7\sqrt{7\cdots\cdots\infty}}} = x$$

squaring both sides

$$\text{we get } x^2 = 7\sqrt{7\sqrt{7\sqrt{7\cdots\cdots\infty}}}$$

$$\Rightarrow x^2 = 7x$$

$$\Rightarrow x^2 - 7x = 0 \Rightarrow x = 7$$

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$\sqrt{12 + \sqrt{12 + \sqrt{12 + \dots}}} = \infty$

Explanation : \rightarrow let $\sqrt{12 + \sqrt{12 + \sqrt{12 + \dots}}} = x$
sq. both sides, we get

$$x^2 = 12 + \sqrt{12 + \sqrt{12 + \dots}} \Rightarrow x^2 = 12 + x \Rightarrow x^2 - x - 12 = 0 \Rightarrow x = 4$$

TRICK : \rightarrow make the factor of No in form

No. के लिए Factor $\frac{N}{(N+1)}$ जिसमें diff. $\neq \frac{9}{8}$

- 1. If + sign is present Ans. is $\rightarrow N+1$ (उपरी)
- 2. If - sign is present Ans. is $\rightarrow N$ (चौड़ा)

Here $12 = 3 \times 4$
+ is present Ans. is 4

$\sqrt{12 - \sqrt{12 - \sqrt{12 - \dots}}} = \infty$
 $12 = 4 \times 3$ but - sign is present

{ सूत्रालं सर की अलाइ } so Ans. is 3

$\sqrt{72 + \sqrt{72 + \sqrt{72 + \dots}}} = \infty$ $72 = 8 \times 9$
Ans. = 9 [+]

$\sqrt{132 - \sqrt{132 - \sqrt{132 - \dots}}} = \infty$
 $132 = 12 \times 11$ - is Pres. so Ans. (11)

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- # But it is not necessary we are always able to make factor of for $N \cdot N+1$
 So what we do. Here is solution
- # Universal Trick \Rightarrow

$$\left\{ \frac{\sqrt{4a+1} \pm 1}{2} \quad \text{where } \begin{array}{l} a = \text{No.} \\ + \text{ for +} \\ - \text{ for -} \end{array} \right\}$$

e.g. $\sqrt{20 + \sqrt{20 + \sqrt{20 + \dots}}}$ $= \frac{\sqrt{4 \times 20 + 1} + 1}{2}$

$\underbrace{\hspace{10em}}$

सुनीजा सर की

$\frac{\sqrt{81} + 1}{2} = 5$

$\sqrt{19 + \sqrt{19 + \sqrt{19 + \dots}}}$

$$a = 19 \Rightarrow \frac{\sqrt{4 \times 19 + 1} + 1}{2} = \frac{\sqrt{77} + 1}{2}$$

$\sqrt{19 - \sqrt{19 - \sqrt{19 - \dots}}}$

$$= \frac{\sqrt{4 \times 19 + 1} - 1}{2} = \frac{\sqrt{77} - 1}{2}$$

- * * * * *
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आधिक जानकारी के लिए संपर्क करें

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$\frac{1}{2} + \frac{1}{6} + \frac{1}{12} + \frac{1}{20} + \frac{1}{30} + \frac{1}{42} = ?$

Solu. By taking Lcm it is very tedious task

1. make Factors

$$\frac{1}{1 \times 2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \frac{1}{4 \times 5} + \frac{1}{5 \times 6} + \frac{1}{6 \times 7}$$

TRICK $\Rightarrow \frac{1}{\text{gap}} [T_1 - T_2]$

where gap \rightarrow constant diff.

$$\frac{T_1}{\frac{1}{1 \times 2}} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \frac{1}{4 \times 5} + \frac{1}{5 \times 6} + \frac{1}{6 \times 7} T_2$$

gap = 1 [diff of 2 and 3 and 3-4]
 $T_1 = \frac{1}{1}, T_2 = \frac{1}{7}$ $= \frac{1}{1} \left[1 - \frac{1}{7} \right] = \frac{6}{7}$

$\frac{1}{15} + \frac{1}{35} + \frac{1}{63} + \frac{1}{99} = ?$

$$= \frac{1}{\cancel{3 \times 5}} + \frac{1}{\cancel{5 \times 7}} + \frac{1}{\cancel{7 \times 9}} + \frac{1}{\cancel{9 \times 11}}$$

gap² gap²

Gap = 2 $T_1 = \frac{1}{3}, T_2 = \frac{1}{11}$

$$= \frac{1}{2} \left[\frac{1}{3} - \frac{1}{11} \right] = \frac{1}{2} \left[\frac{8}{33} \right] = \frac{4}{33}$$

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If $x \cos \theta - \sin \theta = 1$, then $x^2 + (1+x^2) \sin \theta$
equally ① 1 b). -1 ③ 0 d). 2

Solution :> Let $\theta = 0^\circ$

$$\Rightarrow x \cdot 1 - 0 = 1 \Rightarrow x = 1$$

$$\therefore x^2 + (1+x^2) \sin 0^\circ = 1 + (1+1) \cdot 0 = 1$$

②. is correct.



IF $\tan^2 \alpha = 1 + 2 \tan^2 \beta$ (α, β are acute)

then $\sqrt{2} \cos \alpha - \cos \beta$ is equal to

- a). 0 b). $\sqrt{2}$ c). 1 d). -1

Solution put $\beta = 45^\circ$ and $\alpha = 60^\circ$

This will satisfy the given condition

$$\tan^2 60^\circ = 1 + 2 \tan^2 45^\circ$$

$$(\sqrt{3})^2 = 1 + 2$$

$$3 = 3$$

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$$\therefore \sqrt{2} \cos 60^\circ - \cos 45^\circ = \sqrt{2} \cos 60^\circ - \cos 45^\circ$$

$$= \sqrt{2} \times \frac{1}{2} - \frac{1}{\sqrt{2}} = 0.$$

④ is $\frac{1}{\sqrt{2}}$

* ————— * ————— *

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Data Interpretation

TRICKY MATHS BY SUNIL

If

$$\# \sec \theta = x + \frac{1}{4x} \quad [0^\circ < \theta < 90^\circ], \text{ then}$$

$\sec \theta + \tan \theta$ equal to.

- a). $\frac{x}{2}$ b). $2x$ c). x d). $\frac{1}{2x}$

Solution

Put $x = 1$

$$\sec \theta = 1 + \frac{1}{4} = \frac{5}{4} = \frac{H}{B}$$

$$\Rightarrow \tan \theta = \frac{P}{B} = \frac{3}{4}$$

$$\Rightarrow \sec \theta + \tan \theta = \frac{5}{4} + \frac{3}{4} = 2 = ex$$

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[$\because x=1$]

the simplified value of

$$(\sec x \sec y + \tan x \tan y)^2 - (\sec x \tan y + \tan x \sec y)^2$$

- a). -1 b). 0 c). $\sec^2 x$ d). 1

Solution : Put $x = y = 45^\circ$

$$(\sec 45^\circ \sec 45^\circ + \tan 45^\circ \tan 45^\circ)^2$$

$$- (\sec 45^\circ \tan 45^\circ + \tan 45^\circ \sec 45^\circ)^2$$

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

$$= 9 - (2\sqrt{2})^2 = 1 \quad \text{Ans. is } 1$$

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$$\underline{\mu \sec \theta + \tan \theta}$$

$$= \frac{\frac{4}{\sqrt{3}} + \frac{1}{2\sqrt{3}}}{\frac{4}{\sqrt{3}} + \frac{1}{\sqrt{3}}} = \frac{9}{5}$$

The simplified value of
 $(1 + \cot \theta - \operatorname{cosec} \theta) (1 +$

If $2Y \cos\theta - x \sin\theta = 0$ &
 $2x \sec\theta - y \csc\sec\theta = 3$, then the value
of $x^2 + 4y^2$ is

- (A) 0 (B) 2 (C) 4 (D) 8

Sol. put $\theta = 45^\circ$

$$\frac{2Y}{\sqrt{2}} - \frac{x}{\sqrt{2}} = 0 \Rightarrow 2Y - x = 0 \\ \Rightarrow 2Y = x$$

also $2x \cdot \sqrt{2} - y \cdot \sqrt{2} = 3 \Rightarrow 2x - y = \frac{3}{\sqrt{2}}$

OR $4Y - Y = \frac{3}{\sqrt{2}} \quad [\because xY = x]$

OR $3Y = \frac{3}{\sqrt{2}} \Rightarrow Y = \frac{1}{\sqrt{2}} \Rightarrow x = 1Y = \sqrt{2}$

$\therefore x^2 + 4y^2 = 2 + 4 \times \frac{1}{2} = 4 \quad (\text{C})$

Find the value of

$$\frac{\cot x}{\cot x - \cot 3x} + \frac{\tan x}{\tan x - \tan 3x}$$

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- (A) 0 (B) 1 (C) -1 (D) 2

solution Put $\theta = 15^\circ$

$$\frac{\cot 15^\circ}{\cot 15^\circ - \cot 45^\circ} + \frac{\tan 15^\circ}{\tan 15^\circ - \tan 45^\circ}$$

$$\frac{2+\sqrt{3}}{1+\sqrt{3}} + \frac{2-\sqrt{3}}{1-\sqrt{3}} = 1$$

(B) is Ans.

$$\cot 15^\circ = 2 + \sqrt{3}$$

$$\tan 15^\circ = 2 - \sqrt{3}$$

If $2Y \cos\theta - x \sin\theta = 0$ &
 $2x \sec\theta - y \csc\theta = 3$, then the value
of $x^2 + 4y^2$ is

- (A) 0 (B) 2 (C) 4 (D) 8

Sol. put $\theta = 45^\circ$

$$\frac{2Y}{\sqrt{2}} - \frac{x}{\sqrt{2}} = 0 \Rightarrow 2Y - x = 0 \\ \Rightarrow 2Y = x$$

also $2x \cdot \sqrt{2} - y \sqrt{2} = 3 \Rightarrow 2x - y = 3/\sqrt{2}$

OR $4Y - Y = 3/\sqrt{2} \quad [\because xY = x]$

OR $3Y = 3/\sqrt{2} \Rightarrow Y = \frac{1}{\sqrt{2}} \Rightarrow x = 1Y = \sqrt{2}$

$\therefore x^2 + 4y^2 = 2 + 4 \times \frac{1}{2} = 4 \quad (\text{C})$

Find the value of

$$\frac{\cot x}{\cot x - \cot 3x} + \frac{\tan x}{\tan x - \tan 3x}$$

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- (A) 0 (B) 1 (C) -1 (D) 2

solution Put $\theta = 15^\circ$

$$\frac{\cot 15^\circ}{\cot 15^\circ - \cot 45^\circ} + \frac{\tan 15^\circ}{\tan 15^\circ - \tan 45^\circ} \\ \frac{2+\sqrt{3}}{1+\sqrt{3}} + \frac{2-\sqrt{3}}{1-\sqrt{3}} = 1$$

(B) is Ans.

$\cot 15^\circ$
$= 2 + \sqrt{3}$
$\tan 15^\circ$
$= 2 - \sqrt{3}$

TRICKY MATHS BY SUNIL SIR 97284-35915

If $\frac{\cos \alpha}{\cos \beta} = a$ and $\frac{\sin \alpha}{\sin \beta} = b$ then

the value of a and b $\sin^2 \beta$

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

Solution : Let $\alpha = 30^\circ$, $\beta = 60^\circ$

then $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$ {VIDEOS + HARD COPY}

also $\sin^2 \beta = \sin^2 60^\circ = \frac{3}{4}$ {97284-35915}

Now put $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$ in options

check option (c) will give $\frac{3}{4}$

so C is Ans.

If θ is +ve acute angle and

$3(\sec^2 \theta + \tan^2 \theta) = 5$, then the value
of $\cos 2\theta$ is

- a). $\frac{1}{\sqrt{2}}$ b). 1 c). $\frac{1}{2}$ d). $\frac{\sqrt{3}}{2}$

Solution $\sec^2 \theta + \tan^2 \theta = \frac{5}{3}$

we know $\sec^2 \theta - \tan^2 \theta = 1$

adding both $2\sec^2 \theta = \frac{8}{3} \Rightarrow \sec^2 \theta = \frac{4}{3}$

$$\sec \theta = \frac{2}{\sqrt{3}} \Rightarrow \theta = 30^\circ$$

$$\cos 2\theta = \cos 60^\circ = \frac{1}{2}$$

TRICKY MATHS BY SUNIL SR

If $\tan A = n \tan B$ and $\sin A = m \sin B$
then the value of $\cos^2 A$

- (a) $\frac{m^2+1}{n^2+1}$ (b) $\frac{n^2-1}{m^2-1}$ (c) $\frac{m^2+1}{m^2-1}$ (d) $\frac{m^2-1}{m^2+1}$

Solution let $A = 60^\circ$, $B = 30^\circ$

then $n = 3$, $m = \sqrt{3}$

also $\cos^2 A = \cos^2 60^\circ = \frac{1}{4}$

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Now put $n=3$, $m = \sqrt{3}$ in all the options

only option (b) will give $\frac{1}{4}$
(b) is Ans.

value of $\frac{\sin A}{1+\cos A} + \frac{\sin A}{1-\cos A}$ is ($0 < A < 90^\circ$)

- (a) $2 \operatorname{cosec} A$ (b) $2 \sec A$ (c) $2 \sin A$ (d) $2 \cos A$

Solution Put $A = 30^\circ$

the value of given expression is

$$\frac{\frac{1}{2}}{1+\sqrt{3}/2} + \frac{\frac{1}{2}}{1-\sqrt{3}/2} = 2 - \sqrt{3} + 2 + \sqrt{3} = 4$$

Now put $A = 30^\circ$ in options

only 4 option will give $4 = \text{aコレク30} = 4$

④ → ans ~~コレク30~~ = 4

Note → Don't put $A = 45^\circ$ in this question
= option (a) and (b) will give same value

$$\# \text{ If } ax + by = m$$

$$bx - ay = n$$

$$\text{Then } (a^2 + b^2)(x^2 + y^2) = m^2 + n^2$$

e.g. If $\sin x + \cos x = \frac{17}{13}$

$$\text{Then find } \sin x - \cos x$$

Sol. $\sin x + \cos x = \frac{17}{13}$

Let $\sin x - \cos x = m$

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by applying above theorem

$$a=1, b=1$$

$$(1^2 + 1^2)(\sin^2 x + \cos^2 x) = \frac{289}{169} + m^2$$

$$\Rightarrow 2(\cancel{\sin x - \cos x}) = \frac{289}{169} + m^2$$

$$\Rightarrow m^2 = \cancel{2} - \frac{289}{169} = \frac{49}{169}$$

$$\Rightarrow m = \pm \frac{7}{13}$$

Q. Find the max^m and min^m value of
 $8\sin x + 2\cos x$

$$\begin{aligned} & \stackrel{\text{Soln}}{=} 8\sin x + 2\cos x = 3^4\sin x + 3^2\cos x \\ & = 3^{4\sin x + 2\cos x} \end{aligned}$$

$$\text{Max}^m = 3^5$$

$$\text{Min}^m = 3^{-5}$$

$$[-5 \leq 4\sin x + 2\cos x \leq 5]$$

Q.1. If $\csc \theta + \cot \theta = 3$, find $\tan \theta$?

Sol. $\csc \theta + \cot \theta = 3 \quad \text{--- (1)}$

$\Rightarrow \csc \theta - \cot \theta = \frac{1}{3} \quad \text{--- (2)}$

Sub. (1) From (2), we get

[From NCERT Class 11]

$$2\cot \theta = 3 - \frac{1}{3} = \frac{8}{3}$$

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$$\Rightarrow \cot \theta = \frac{8}{6} = \frac{4}{3} \Rightarrow \tan \theta = \frac{3}{4}$$

Q.2. If $\sec \theta - \tan \theta = \sqrt{5} - 2$, find $\cos \theta$?

Sol. $\sec \theta - \tan \theta = \sqrt{5} - 2 \quad \text{--- (1)}$

$\Rightarrow \sec \theta + \tan \theta = \frac{1}{\sqrt{5}-2} = \sqrt{5} + 2 \quad \text{--- (2)}$

Adding (1) & (2), we get

$$2\sec \theta = 2\sqrt{5} \Rightarrow \sec \theta = \sqrt{5}$$

$$\therefore \cos \theta = \frac{1}{\sqrt{5}}$$

Q.3. If $\sec \theta + \tan \theta = \phi$, find $\cos \theta$?

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by Shail The maths Guru

TRIGONOMETRY TRICK

$$\underline{1.} \quad \sin \theta \sin 2\theta \sin 4\theta = \frac{1}{4} \sin 3\theta$$

$$\cos \theta \cos 2\theta \cos 4\theta = \frac{1}{4} \cos 3\theta$$

$$\tan \theta \tan 2\theta \tan 4\theta = \tan 3\theta$$

$$\underline{2.} \quad \sin \theta \sin (60 - \theta) \sin (60 + \theta) = \frac{1}{4} \sin 3\theta$$

$$\cos \theta \cos (60 - \theta) \cos (60 + \theta) = \frac{1}{4} \cos 3\theta$$

$$\tan \theta \tan (60 - \theta) \tan (60 + \theta) = \tan 3\theta$$

$$\underline{Q.} \quad \sin 10^\circ \sin 30^\circ \sin 20^\circ \sin 40^\circ$$

$$= \frac{1}{4} \sin 10^\circ \sin 20^\circ \sin 40^\circ = \frac{1}{4} \times \frac{1}{4} \times \sin 30^\circ$$

$$\left[\frac{\sin 10^\circ \sin 30^\circ \sin 20^\circ \sin 40^\circ}{9728435915} \right] = \frac{1}{4} \times \frac{1}{2} = \frac{1}{76}$$

$$\underline{Q.} \quad \cos 12^\circ \cos 48^\circ \cos 72^\circ$$

$$= \cos 12^\circ \cos (60 - 12^\circ) \cos (60 + 12^\circ)$$

$$= \frac{1}{4} \cos 36^\circ = \frac{1}{4} \times \frac{\sqrt{5}+1}{4} = \frac{\sqrt{5}+1}{16}$$

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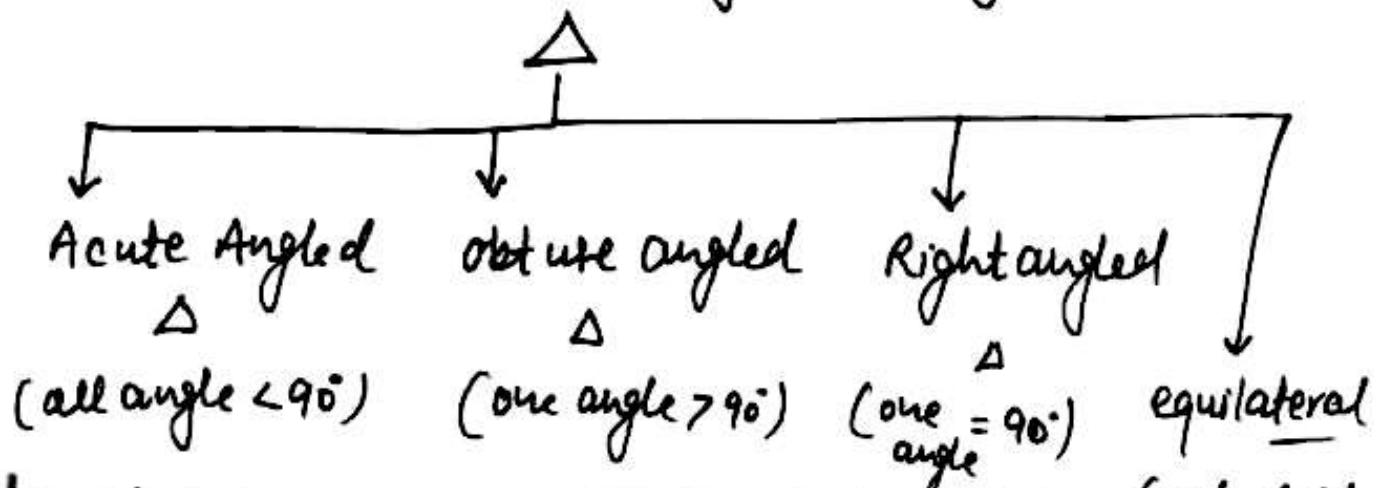
TRIANGLES



- A \triangle is a polygon having three sides.

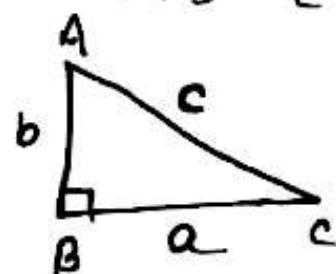
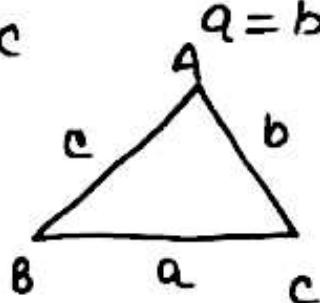
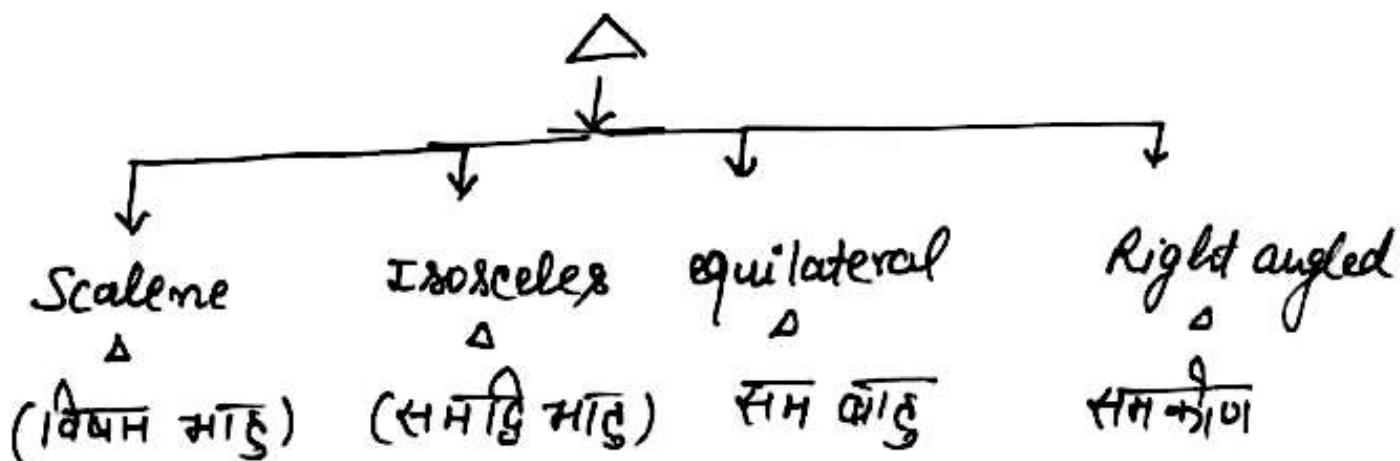
Sum of all the angles of a $\triangle = 180^\circ$

Types:→ ① According to angle



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② According to length of sides



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Sum of any two sides of a triangle
is always greater than 3rd side.

$$a+b > c$$

OR difference of any two sides of a \triangle
is always less than 3rd side.

$$a-b < c$$

$$8, 5, 4 \Rightarrow 8+5 > 4 \quad 8-5 < 4$$

$$a \triangle \quad 8+4 > 5 \quad \text{OR} \quad 8-4 < 5$$

$$4+5 > 8 \quad 5-4 < 8$$

$$a+b > c \quad a-b < c$$

but if $a = 8 \quad b = 3 \quad c = 4$

it will not make a triangle

$\therefore 3+4 < 8$ which is not possible

$a+b < c$ but it ~~we have to be~~

$$\underline{a+b > c}$$

Q. 2 sides of a triangle is 6, 8. Find the
Range of third.

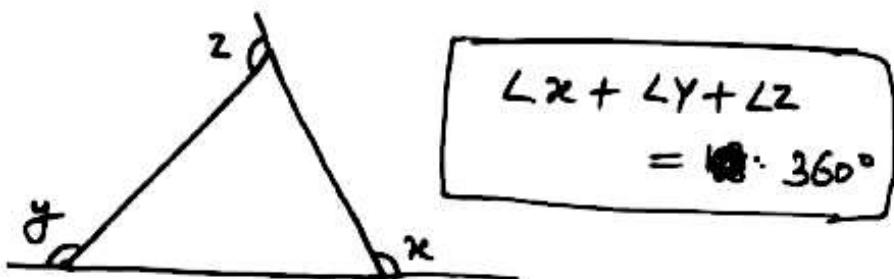
we know $a+b > c$ & $a-b < c$

$$6+8 > c \quad 8-6 < c$$

$$2 < c < 14$$

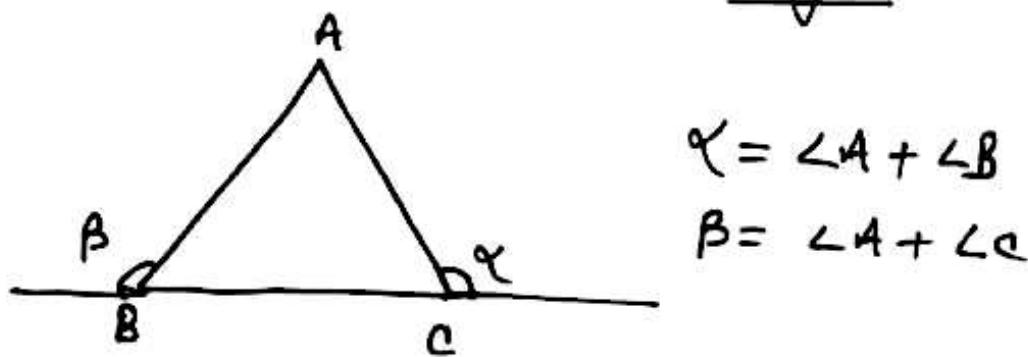
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Sum of all the Exterior angles of a \triangle is always equal to 360°



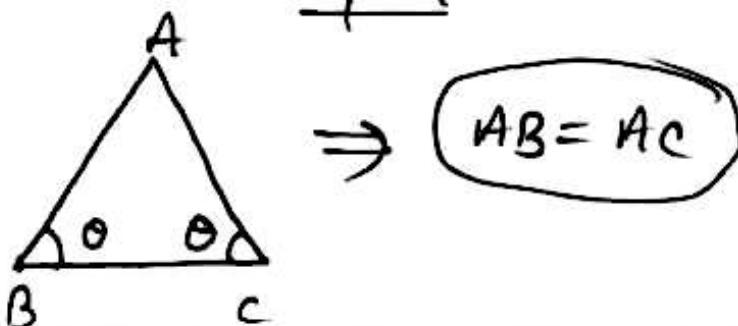
Exterior Angle Theorem

The Exterior angle is equal to sum of two interior opposite angles.



Side opposite to the greatest angle will be greatest and the side opposite the smallest angle will be smallest.

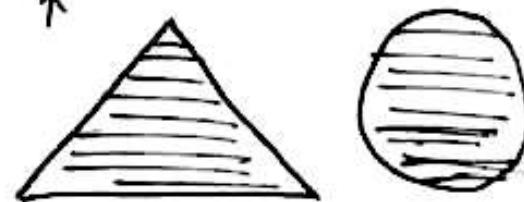
Corollary: \rightarrow Side opposite to equal angle will be equal



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AREA OF A TRIANGLE

AREA (राशि) : Area is ^{whole} the Space Covered by any figure.

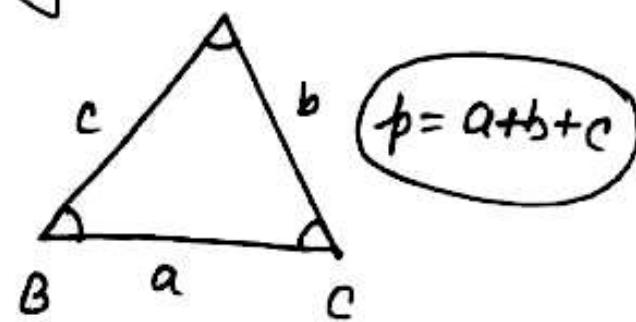


Perimeter (परिमाप) :

total length of sides of any 2-D figure

Shaded portion is

Area



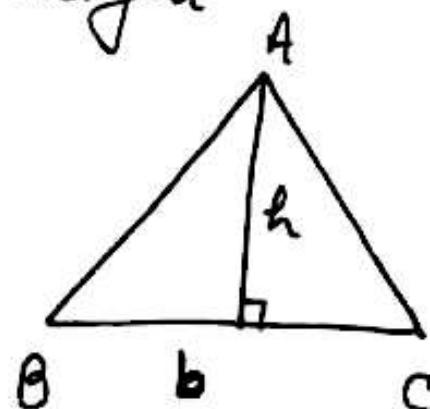
Note

Area of triangle may be find in many different ways depending on what is given in question and type of triangle

① Area of a Triangle

$$\Delta = \frac{1}{2} \times \text{base} \times \text{height}$$

$$\Delta = \frac{1}{2} \times b \times h$$



#2. Hero's FORMULA \Rightarrow when all the sides are given.

$$\Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

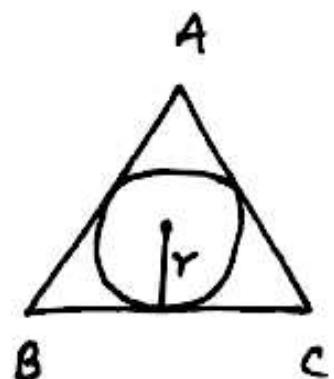
where s is semiperimeter

$$s = \frac{a+b+c}{2}$$

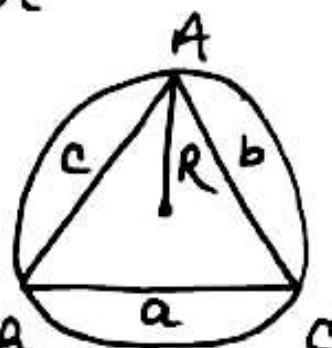
#3. $\Delta = r \times s$

where r is inradius

s is semiperimeter



#4. $\Delta = \frac{abc}{4R}$



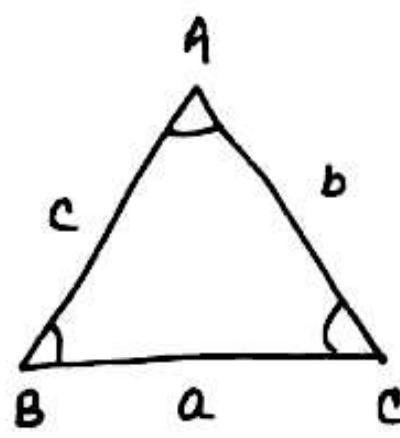
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#5. when two sides and angle between them is given.

$$\Delta = \frac{1}{2} ac \sin B$$

$$\Delta = \frac{1}{2} ab \sin C$$

$$\Delta = \frac{1}{2} bc \sin A$$



#6. When length of medians are given.

trick :→ Assume medians as sides of triangle. and find the area.

IN last multiply the Area by $\frac{4}{3}$.

$$\Delta = \frac{4}{3} \sqrt{s(s-m_1)(s-m_2)(s-m_3)}$$

where m_1, m_2 and m_3 are medians

$$\text{and } s = \frac{m_1 + m_2 + m_3}{2}$$

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Note → Medians of Right angled Triangle also makes Triplet ($a^2 + b^2 = c^2$)

e.g. Find the Area of triangle length of whose medians are 6, 8, 10.

Solution :→ As 6, 8 & 10 are triplet so 6, 8, 10 are median of right angle triangle.

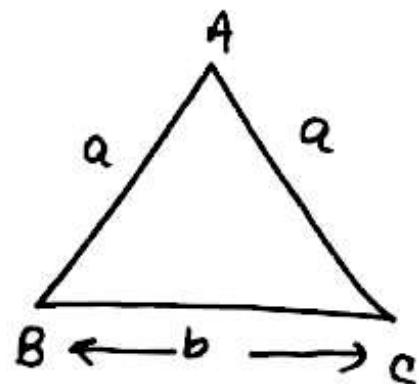
→ Now assume 6, 8 & 10 as side of calculate Area

$$\Delta = \frac{1}{2} \times 6 \times 8 = 24$$

→ multiply this by $\frac{4}{3}$ so Ans $\frac{4}{3} \times 24 = \underline{\underline{32}}$

#7 Isosceles Triangle \rightarrow

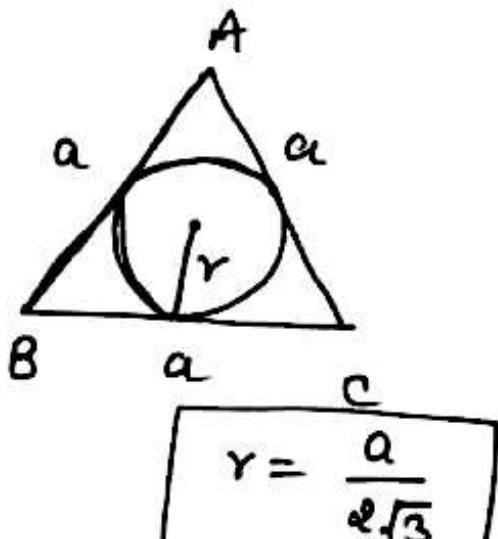
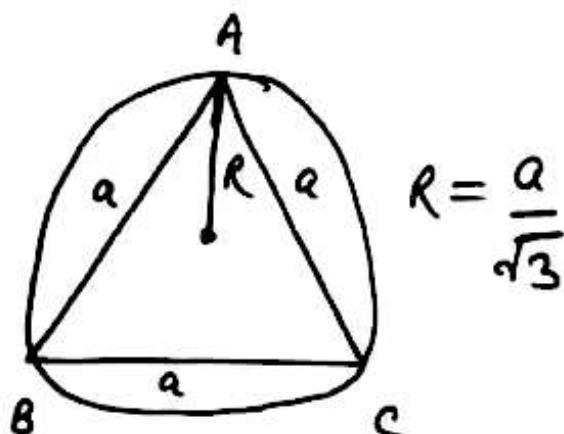
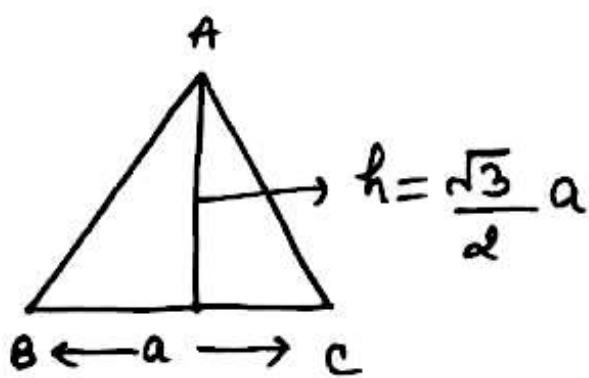
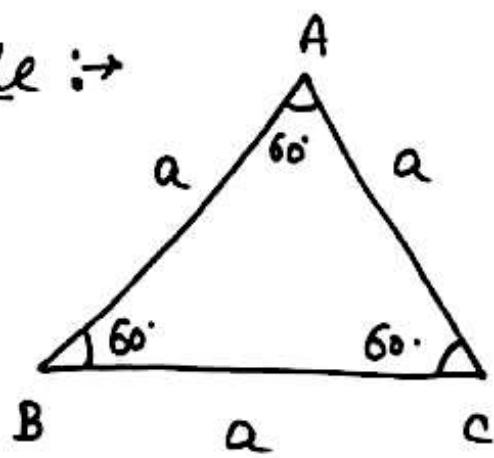
$$\Delta = \frac{b}{4} \sqrt{4a^2 - b^2}$$



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#8. Equilateral Triangle \rightarrow

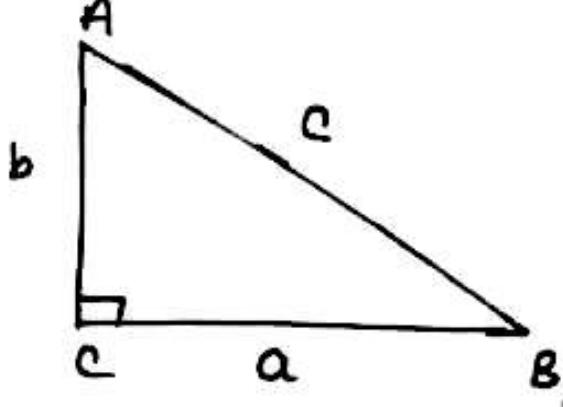
$$\Delta = \frac{\sqrt{3}}{4} a^2$$



Circum Radius

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Right angle Triangle :



→ Sides of Right angled triangle is called triplet

e.g. 3, 4, 5

$$c^2 = a^2 + b^2$$

→ Basic Pythagorean Triplet

3, 4, 5

11, 60, 61

5, 12, 13

12, 35, 37

7, 24, 25

20, 21, 29

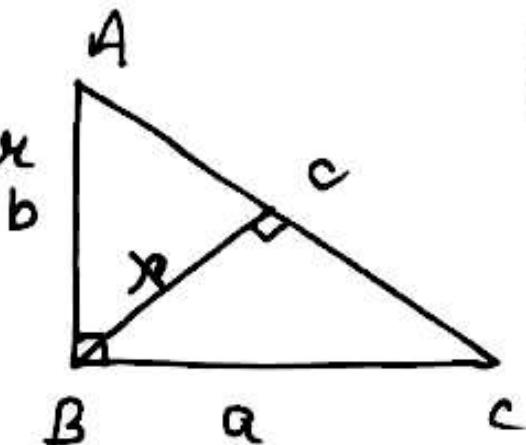
8, 15, 17

28, 45, 53

9, 40, 41

6, 8, 10

\rightarrow length of perpendicular from B to hypotenuse.



$$p = \frac{ab}{c}$$

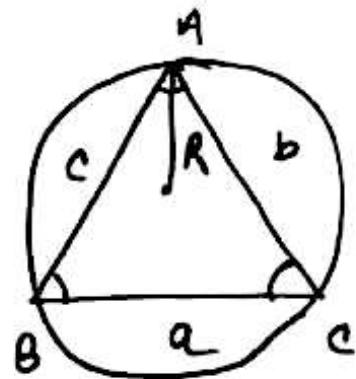
also

$$\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$$

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Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$$



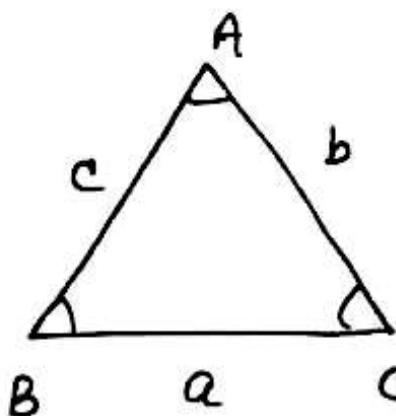
where R = Circum Radius.

Cosine Rule

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

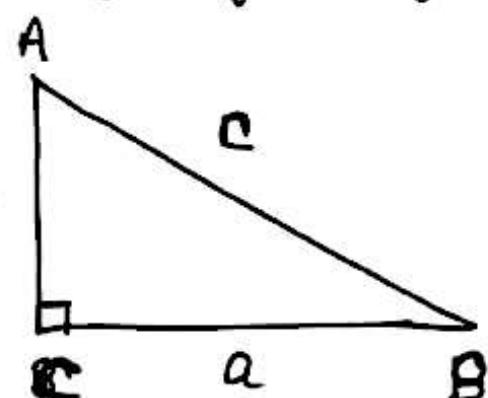
$$\cos B = \frac{c^2 + a^2 - b^2}{2ac}$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$



Special Case \rightarrow In case of Right angled triangle

$$\cos C = 0 \quad \because \cos 90^\circ = 0 \quad C = 90^\circ$$



$$\Rightarrow 0 = \frac{a^2 + b^2 - c^2}{2ab}$$

$$\Rightarrow \boxed{a^2 + b^2 = c^2}$$

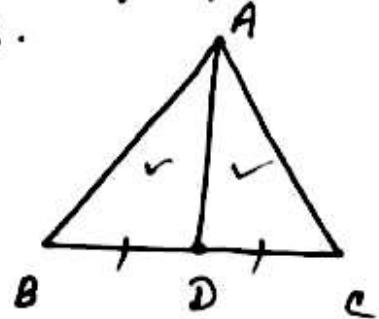
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centres of A Triangle

median :- the line joining the vertex to the mid point of opposite side is called median.

- AD is median

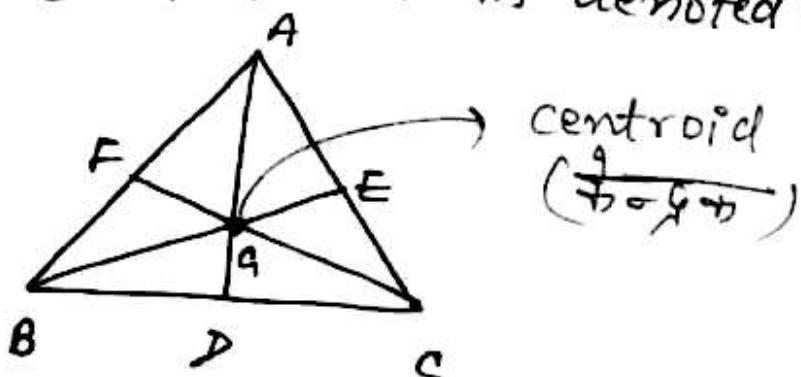
$$\Rightarrow \underline{BD = DC}$$



Note :- A median divides triangle in equal areas. $\triangle ABD = \triangle ADC$

centroid ($\frac{9}{4} - 5 - 4$)

The point of intersection of all the three medians of a triangle is called centroid ($\frac{9}{4} - 5 - 4$). It is denoted by G.

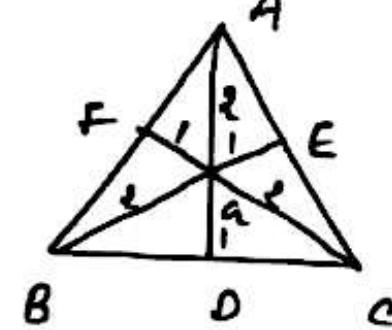


Note :- In the above figure there are 6 s's. The area of all the 6 s's are equal.

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Centroid divides the median in ratio 2:1.

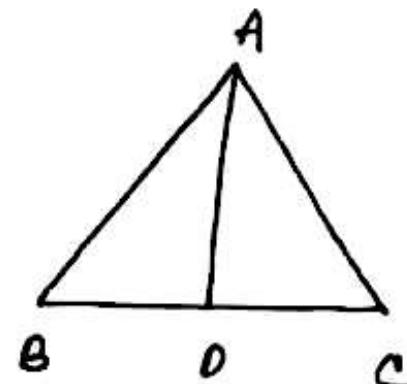
$$\frac{AG}{GD} = \frac{BG}{GE} = \frac{CG}{GF} = \frac{2}{1}$$



e.g. → if $AD = 30 \Rightarrow AG = 20, GD = 10$

Apollonius Theorem:

AD is median



then.

$$AB^2 + AC^2 = 2(AD^2 + BD^2)$$

$$\text{OR } 2(AD^2 + DC^2)$$

$$\text{OR } 2(AD^2 + BD \cdot DC)$$

$$\text{OR } 2\left(AD^2 + \frac{BC^2}{4}\right)$$

$$\left[\begin{array}{l} \because BD = DC \\ = \frac{1}{2}BC \end{array} \right]$$

Similarly for median BE , we have

$$BC^2 + AB^2 = 2(BE^2 + EC^2)$$

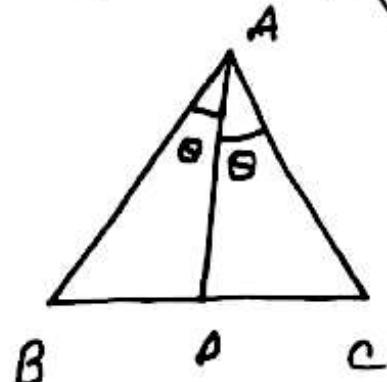
Note :→ Centroid of a triangle always lies inside the Δ.

Angle bisector

A st. line that bisects an angle is called angle bisector of that angle

If AO is angle
bisector then

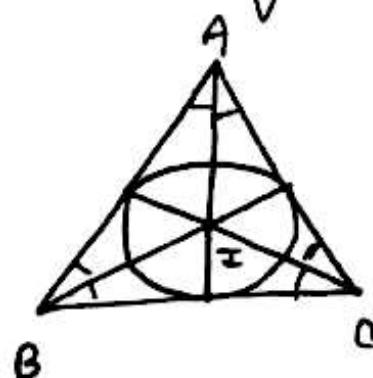
$$\underline{\angle BAO = \angle OAC = \theta}$$



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Incentre

The point of intersection of interior angle bisectors of a triangle is called Incentre. It is denoted by I .



Note:- Circle that touches all the sides is called incircle and its radius is called inradius (r) and its centre is Incentre (I)

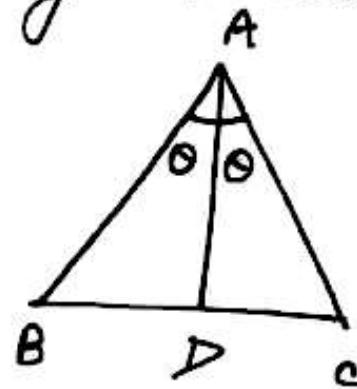
Angle bisector Theorem

It states that angle bisector of an angle of a triangle divides the opposite side in the ratio of remaining 2 sides.

If AD is angle bisector

then

$$\boxed{\frac{BD}{DC} = \frac{AB}{AC}}$$

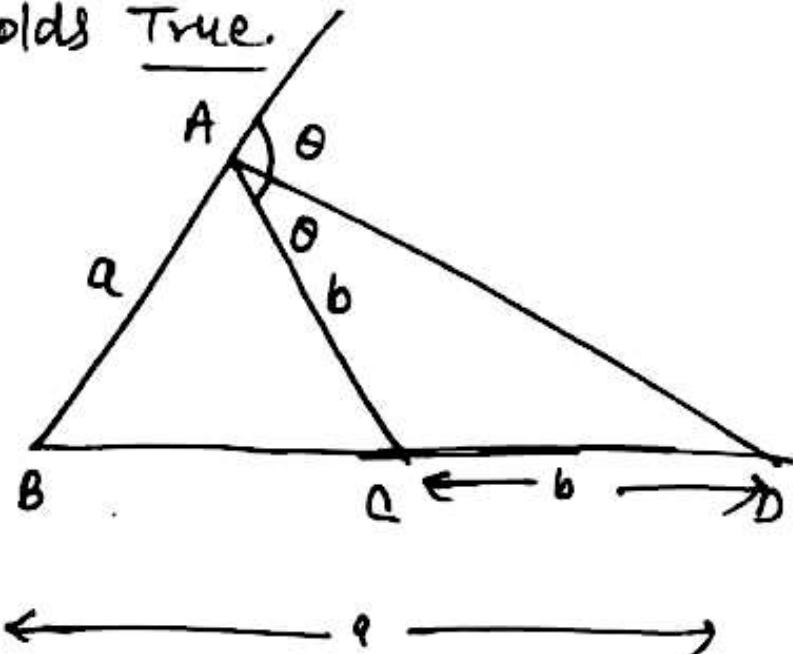


e.g. If $AB = 10$, $BC = 20$,

then $\frac{BD}{DC} = \frac{10}{20} = \frac{1}{2}$

Note. → If AD is exterior bisector of A ,
then also this holds True.

$$\frac{BD}{DC} = \frac{AB}{AC} = \frac{a}{b}$$



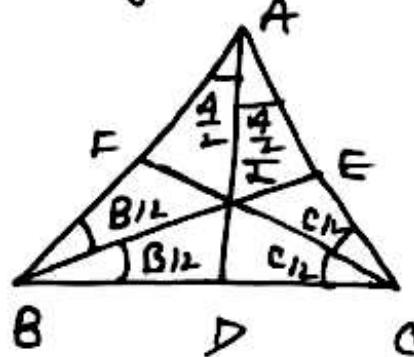
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Relation of Angles in angle bisector

IN $\triangle BIC$

$$\angle BIC + \frac{B}{2} + \frac{C}{2} = 180^\circ$$



$$\Rightarrow \angle BIC = 180^\circ - \frac{B+C}{2}$$

but $B+C = 180^\circ - A$ [sum of angles of $\triangle = 180^\circ$]

$$\Rightarrow \angle BIC = 180^\circ - \frac{(180 - A)}{2} = 90^\circ + \frac{A}{2}$$

$$\boxed{\angle BIC = 90^\circ + \frac{A}{2}}$$

Similarly $\angle BIA = 90^\circ + \frac{C}{2}$

& $\angle AIC = 90^\circ + \frac{B}{2}$

e.g. if $\angle A = 30^\circ$

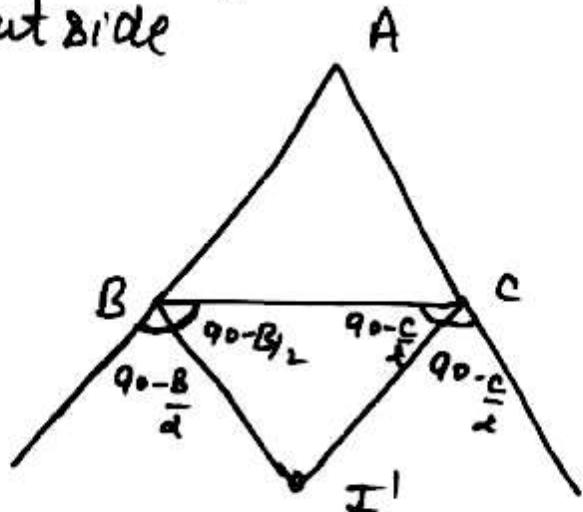
$$\Rightarrow \angle BIC = 90^\circ + \frac{30}{2} = 105^\circ$$

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If exterior bisector of B and C
meet at I outside

then.

IN $\triangle BIC$



$$\angle BIC + 90 - \frac{B}{2} + 90 - \frac{C}{2} = 180^\circ$$

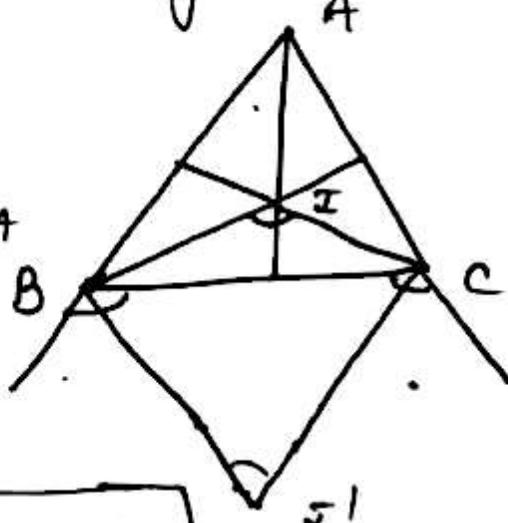
$$\angle BIC = \frac{B+C}{2} = 180^\circ - A = 90 - \frac{A}{2}$$

$$\boxed{\angle BIC = 90^\circ - \frac{A}{2}}$$

Now see the diagram below

$$\angle BIC = 90 + \frac{A}{2}$$

$$\angle BIC' = 90 - \frac{A}{2}$$



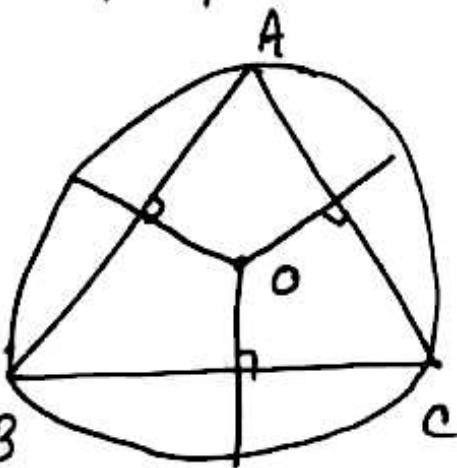
$$\Rightarrow \boxed{\angle BIC + \angle BIC' = 180^\circ}$$

we can say that these are supplementary
to each other

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Perpendicular Bisector:

A line that is perpendicular to a side and bisects it is a perpendicular bisector of the side



Circumcentre

The point at which the perpendicular bisectors of the sides meet is called circumcentre of the \triangle .

→ Circumcentre is the centre of the circle that circumscribes (passes through all the vertices)

Note $\angle BOC = 2 \angle A$

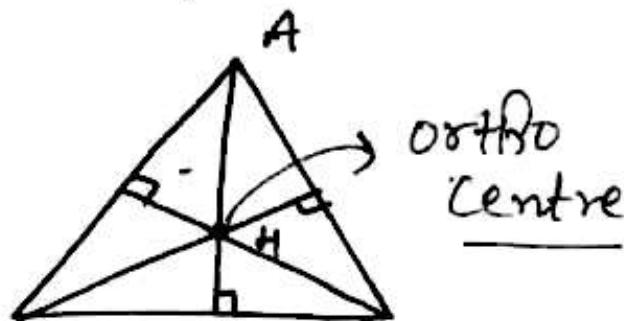
$$\angle AOC = 2 \angle B$$

$$\angle AOB = 2 \angle C$$

angle made by the chord at the centre is always double the angle made by the same chord on circumference

Altitude / Height

A perpendicular drawn from any vertex to the opposite side is called the altitude. In the figure AD, BE & CF are altitude



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ORTHOCENTRE :-

All the altitude of a triangle meet at a point called the orthocentre of the triangle. Denoted by H.

The angle made by any side at the orthocentre and angle at opposite vertex make a supplementary pair

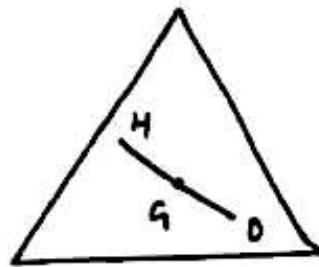
$$\begin{aligned}\angle A + \angle BHC &= 180^\circ = \angle C + \angle AHB \\ &= \angle B + \angle AHC\end{aligned}$$

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Relationship b/w Centroid, Orthocentre and Circumcentre

1. Centroid, orthocentre and circumcentre of any triangle are collinear (fall on a straight line)
2. centroid is always b/w orthocentre and circumcentre.
3. Distance between centroid (G) and orthocentre (H) is always twice the distance b/w centroid and circumcentre (O)

$$GH = 2 GO$$



Note : \rightarrow Centroid (G) and Incentre (I) of a triangle always lies within (inside) the triangle whatever the type of triangle

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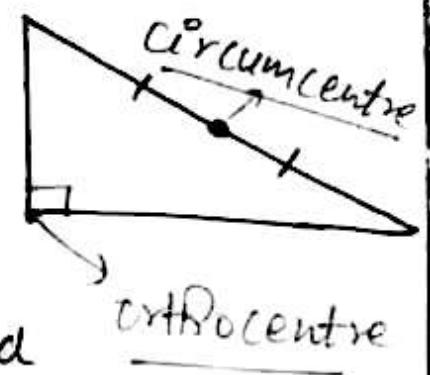
Position of centres in diff. Triangles

Equilateral Triangle

all the centres (G, H, I, O) lies on the same point or we can say that in equilateral triangle median, angle bisector and altitude are same.

Right angled Triangle:

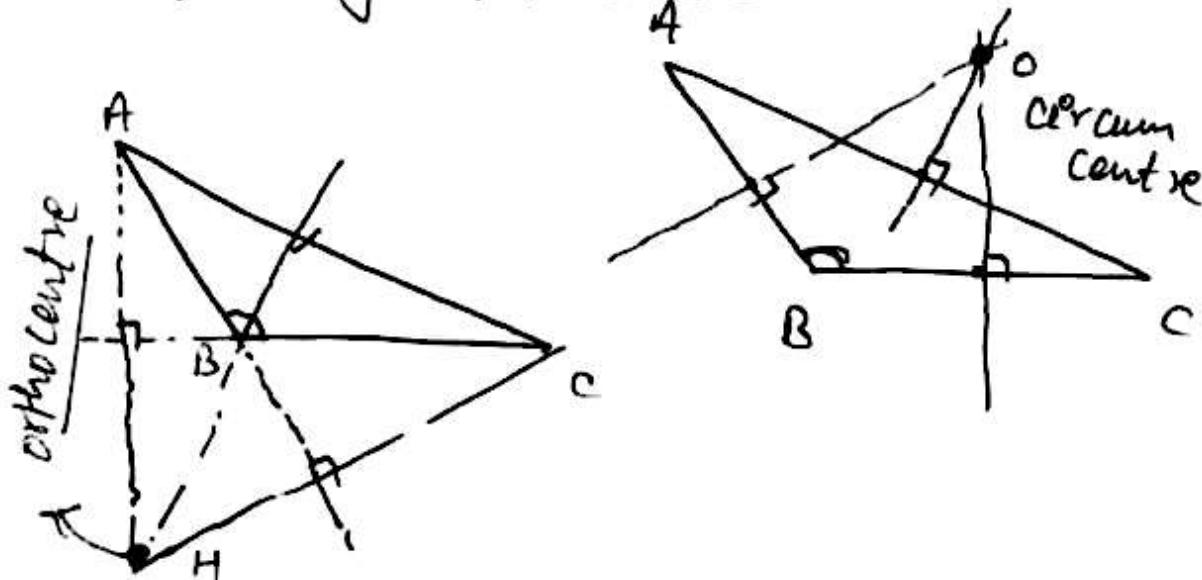
orthocentre at right angle and circumcentre at the mid point of hypotenuse.



Obtuse Angled Triangle

orthocentre lies outside and back of obtuse angle.

Circumcentre also lies outside & but in front of obtuse angle.



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by
(मैथ गुरु)
Sunil Kharub



TIME AND WORK (काम और समय) ①

SUNIL SIR #28435915

$$\text{WORK} = \text{TIME} \times \text{EFFICIENCY}$$

काम = समय × काम करने की दक्षता (दक्षिण)

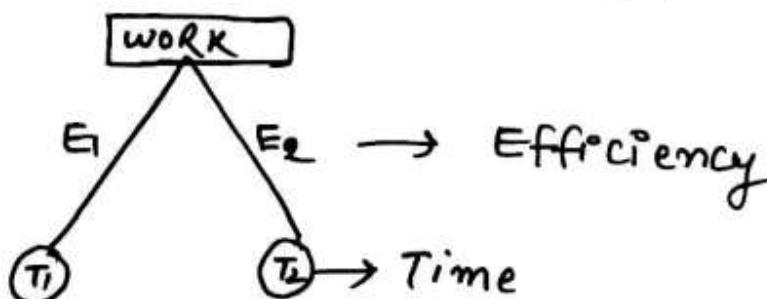
$$W = T \times E$$

Time may be in days / Hours / minutes / seconds

Efficiency \Rightarrow (दक्षिण) is per Unit's Time WORK

(दक्षिण किसी भी काम करने वाले की, दिन/घण्टा मिनट/संकड़ का काम होती है।)

Triangle method or LCM method



Ex. A अकेला किसी काम को 10 दिन में और B अकेला उसी काम को 15 दिन में पूरा कर सकता है, दोनों मिलकर उस काम को कितने दिन में पूरा कर लेंगे

Solution A का 1 दिन का काम $\rightarrow \frac{1}{10}$

B का 1 दिन का काम $\rightarrow \frac{1}{15}$

दोनों का 1 दिन का काम $= \frac{1}{10} + \frac{1}{15} = \frac{1}{6}$

पूरा काम का 6 दिन में

SUNIL SIR 9728435915

OR by LCM method

let WORK = LCM OF (10, 15) Time = 30 units

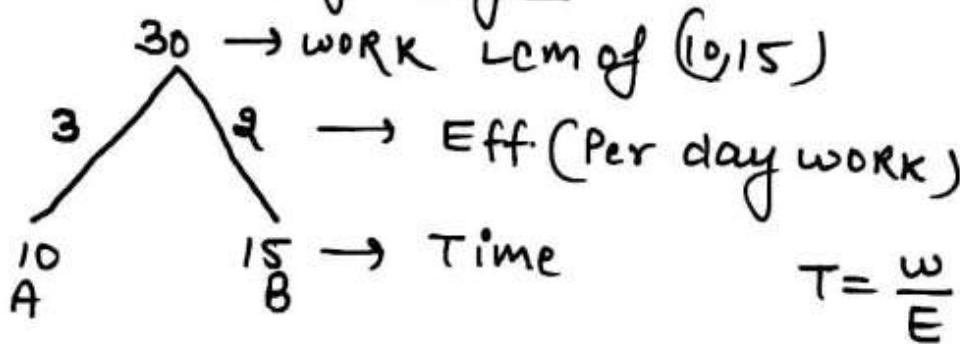
A's 1 day work = A's Eff. = $\frac{30}{10} = 3$ units per day

B's 1 day work = B's Eff. = $\frac{30}{15} = 2$ units per day

(A+B)'s 1 day work = (A+B)'s Efficiency = 5

(A+B) can do Total work in $T = \frac{\omega}{E} = \frac{30}{5} = 6$ days

OR IN SHORT by Diagram



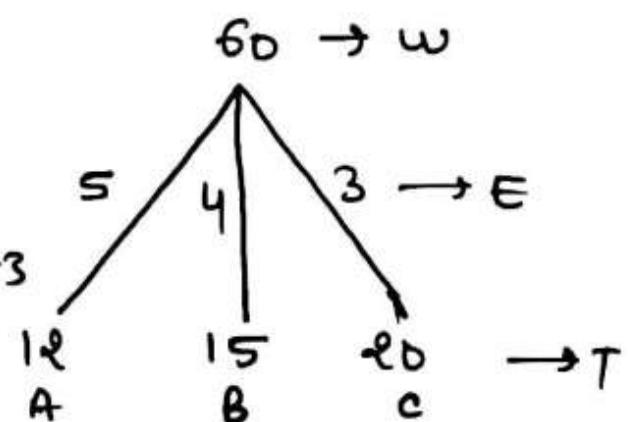
$$\Rightarrow (A+B)_T = \frac{\omega}{(A+B)_E} = \frac{30}{5} = 6$$

A, B, C तीनों अलग-2 रुप काम को समाप्त:
10, 15, और 20 दिन में समाप्त कर सकते हैं।
तीनों मिलकर इस काम को कितने दिनों में
समाप्त करेंगे?

Solution :-

$$T_{A+B+C} = \frac{\omega}{E_{A+B+C}} = \frac{60}{5+4+3}$$

$$= \frac{60}{12} = 5 \text{ दिन}$$



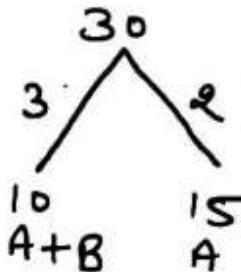
A और B दोनों मिलकर 1 काम को 10 दिन में कर सकते हैं। अगर A अकेला इस काम को 15 दिन में कर सकता है तो B अकेला उस काम को कितने दिनों में पूरा करेगा?

Solution

$$E_B = E_{A+B} - E_A$$

$$= 3 - 2 = 1$$

$$T_B = \frac{\omega}{E_B} = \frac{30}{1} = \frac{30 \text{ दिन}}{3 \text{ दिन}}$$



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A और B मिलकर एक काम को 12 दिन में, B और C मिलकर उसी काम को 15 दिन में, C और A मिलकर उसी काम को 20 दिन में समाप्त करते हैं। तीनों मिलकर उसी काम को कितने दिन में समाप्त करते हैं? और A, B, C अलग-2 कितने दिन में करते हैं?

Solution

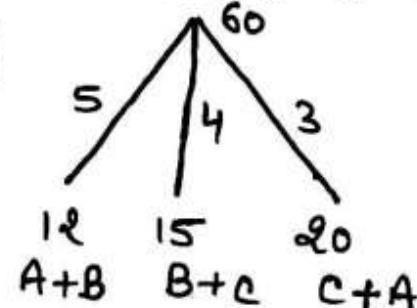
TO PURCHASE

1 दिन का काम NOTES CALL AT
90505-22254

$$A+B+C+C+A = 12$$

$$2(A+B+C) = 12$$

$$\Rightarrow A+B+C \text{ का } 1 \text{ दिन का काम} = (A+B+C) \text{ का Eff} = 6$$



+ ONLINE COACHING

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$$E(A+B+C) = 6$$

$$\text{but } E(A+B) = 5$$

$$\Rightarrow E_C = 1$$

$$T_C = \frac{60}{1} = 60$$

$$= (A+B+C) = 6$$

$$\text{but } E(B+C) = 4$$

$$\Rightarrow E_A = 2$$

$$T_A = \frac{60}{2} = 30$$

$$E(A+B+C) = 6$$

$$\text{but } E(A+C) = 3$$

$$\Rightarrow E_B = 3$$

$$T_B = \frac{60}{3} = 20$$

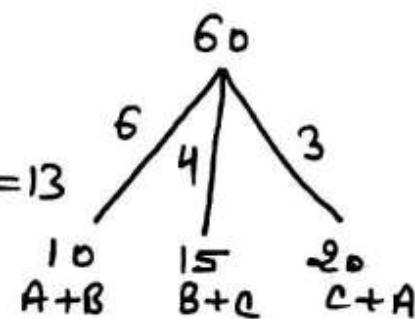
3 दिन → 30, 20, 60

A और B दोनों मिलकर एक काम को 10 दिन में,
 B और C 15 दिन में, C और A 20 दिन में
 समाप्त कर सकते हैं। C अकेला उसी काम को
 कितने दिन में पूरा करेगा?

Solution

$$E(A+B+B+C+C+A) = 6+4+3=13$$

$$\Rightarrow E(A+B+C) = \frac{13}{2}$$

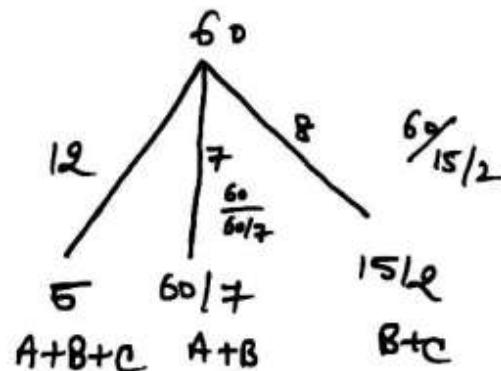


$$\text{but } E_{A+B} = 6 \Rightarrow E_C = E_{A+B+C} - E_{A+B} = \frac{13}{2} - 6 = \frac{1}{2}$$

$$T_C = \frac{\frac{60}{1}}{\frac{1}{2}} = 60 \times 2 = \underline{120 \text{ दिन उत्तर}}$$

A, B और C दोनों मिलकर एक काम को 5 दिन
 में, A और दोनों मिलकर उसी काम को $8\frac{1}{2}$ दिन में,
 B और C उसी काम को $7\frac{1}{2}$ दिन में समाप्त कर
 सकते हैं। C अकेला इस काम को कितने दिन में
 करेगा?

$$\begin{aligned} \text{Solution : } & w = \text{LCM of } 5, \frac{60}{7} + \frac{15}{2} \\ & = \frac{\text{LCM of } (5, 60, 15)}{\text{HCF of } (1, 7, 2)} \\ & = \frac{60}{1} = 60 \end{aligned}$$



$$E_{A+B+C} = 12 \Rightarrow E_C = 5 \text{ units}$$

$$E_{A+B} = 7$$

$$T_C = \frac{w}{E_C} = \frac{60}{5} = 12 \text{ दिन}$$

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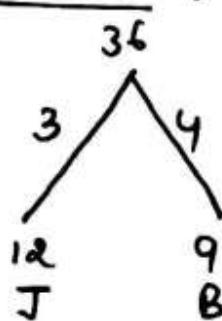
मुनील सर की
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{ ALTERNATE DAYS }

#

जैब लाल और निः एक काम को त्रुम्भा: 12 और 9 दिन में अलग-2 समाप्त कर सकते हैं। अगर वे जारी-2 (Alternate days) पर काम करे तो उन्हें पहले दिन जैविः दूसरे दिन जैवलाल और लीला दिन भी निः और निः काम शुरू करे तो काम कितने दिन में समाप्त होगा?

Solution :-



$$\begin{aligned} & 7 \text{ काम } 2 \text{ दिन का} \\ & \Rightarrow 7 \times 5 \text{ काम } 2 \times 5 \text{ दिन} \\ & \Rightarrow 35 \text{ काम } 10 \text{ दिन का} \\ & \text{अन्य काम } \textcircled{1} \end{aligned}$$

$$\begin{array}{l} \text{पहले दिन } \mathbf{B} \text{ की} \\ 4 \text{ काम} \\ \text{दूसरे दिन } \mathbf{J} \text{ की} \\ 3 \text{ काम} \end{array}$$

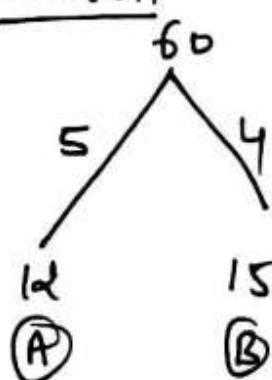
अब 11वें दिन उभide की जारी

$$\text{ले निः } 1 \text{ काम के कर देगा} = \frac{1}{4} \text{ दिन}$$

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

A और B अलग-2 एक काम को त्रुम्भा: 12 और 15 दिन में समाप्त कर सकते हैं। वे जारी-2 (Alternate) पर काम करे और अगर वे काम को शुरू days करे तो काम कितने दिनों में पूर्य हो जाएगा?

Solution



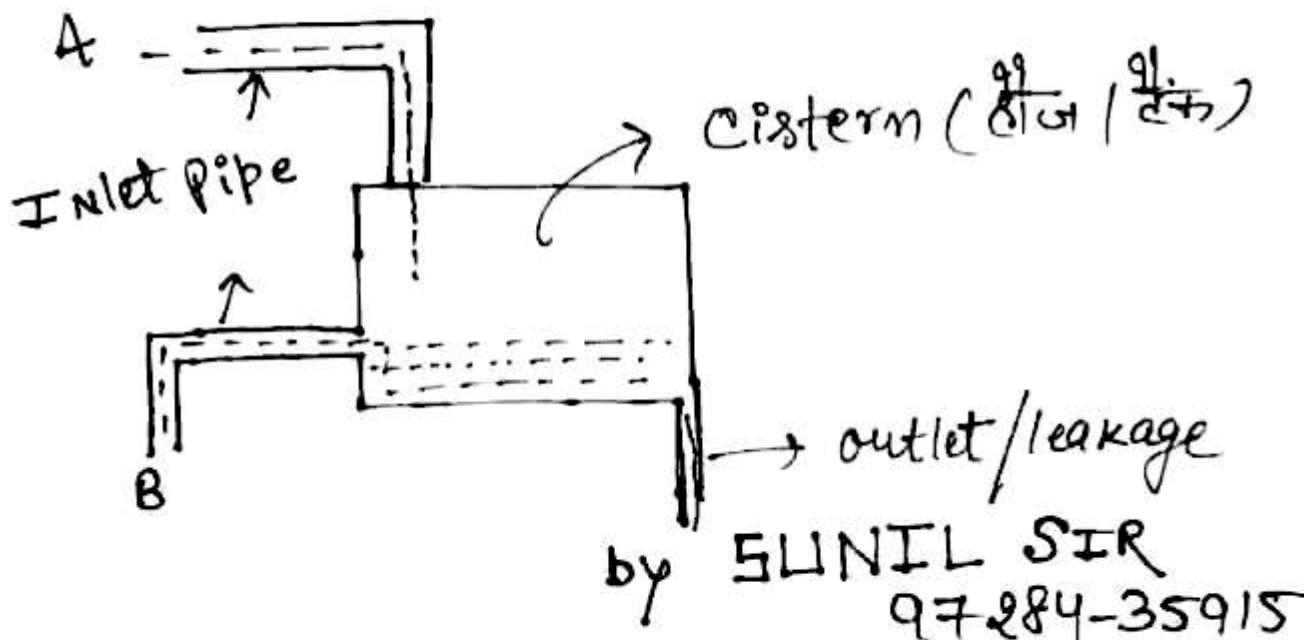
$$\begin{aligned} & 9 \text{ काम } 2 \text{ दिन} \\ & 9 \times 6 \text{ काम } 2 \times 6 \\ & 54 \text{ काम } 12 \text{ दिन} \\ & \text{अन्य} \rightarrow 60 - 54 = 6 \\ & \text{इसमें से } 5 \text{ काम } 4 \text{ दिन } \text{ तेरी } \end{aligned}$$

$$\begin{array}{l} 1 \text{ काम } B \text{ के} \\ \frac{1}{4} \text{ दिन में} \\ \text{कर देगा} \\ T = 12 + 1 + \frac{1}{4} \\ \text{13}\frac{1}{4} \end{array}$$

पाइप और टंकी

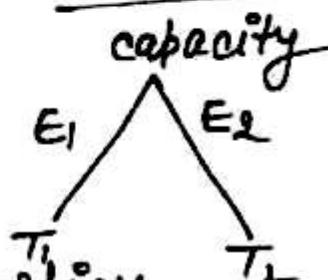
PIPES & CISTERNS

(जल और हाज)



CONTENT

1. Basic Concept
2. Alternate hours
3. Capacity based question
4. Miscellaneous



"TRICKS may ditch you IN
EXAM But BASICS
will NOT"

SSC
CGL/LDC

BANK
PO/CLERK

concept

Capacity = Time × Efficiency → efficiency is
the amt of water flowing through pipe in 1 min/hour.
of tank

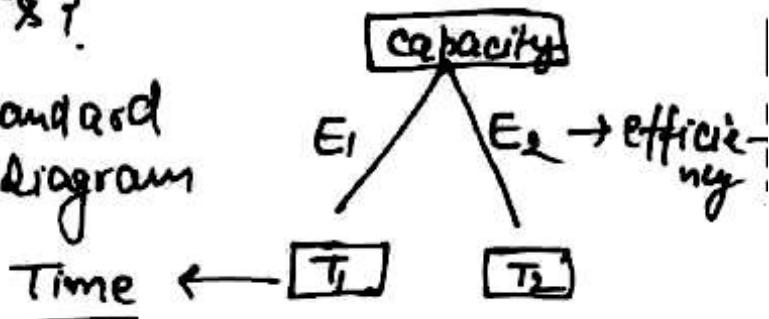
$$C = T \times E$$

Note → Always Assume capacity Lcm of time to make question Easy.

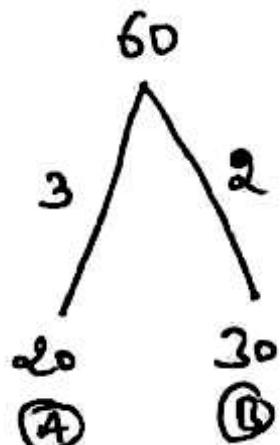
- # Two pipes A and B can fill a tank in 20 min and 30 min respectively. If both pipes are opened together time taken to fill the tank is?

Solution

standard diagram



Let assume capacity Lcm of time (20, 30)
 $= 60 \text{ ltr}$



A+B can fill 5 ltr in 1 min
($E_1 + E_2$)

A+B can fill 60 ltr in

$$T = \frac{C}{E_1 + E_2} = \frac{60}{5} = 12 \text{ min}$$

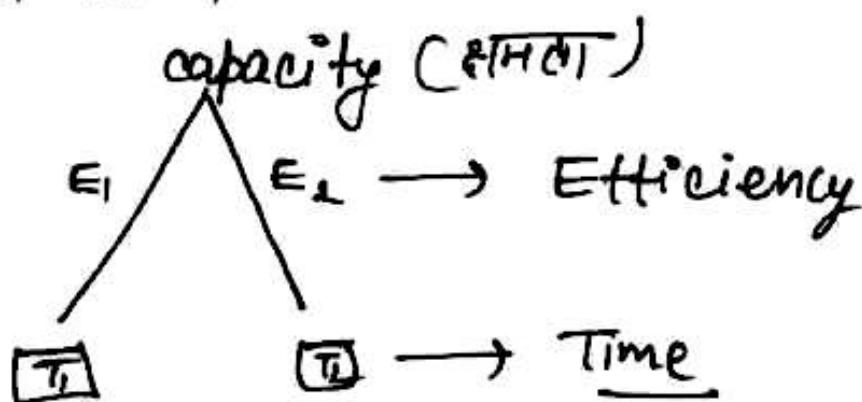
Capacity = Time × Efficiency

Efficiency → नल सक धंडा / मिनट / सेकंड में
जितना पानी भरता है या निकालता है।

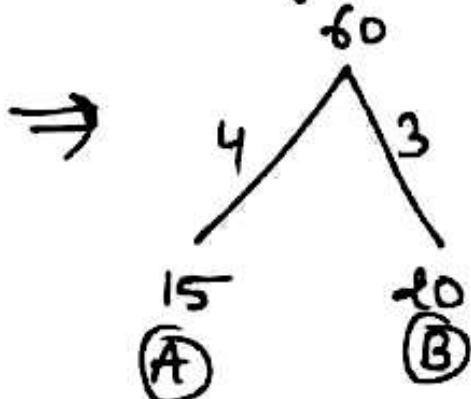
दो नल सक तंकी की क्षमता : 15 और
20 मिनट में भर सकते हैं, अदि दोनों नल
सक साथ एकील द्वारा जल ले तंकी की
भरने में कितना समय लगेगा ?

Solution : → हमेशा समय का LCM ही
tank की क्षमता मान।

concept



let capacity
LCM of 15 & 20 = 60



$$A+B \text{ 1 min में } (E_1+E_2) \text{ करते}$$

$$\frac{60}{7} = 7 \text{ litr}$$

60 litr भरने में समय

$$T = \frac{C}{E_1+E_2} = \frac{60}{7} = 8\frac{4}{7} \text{ min}$$

Note → जो नल TANK खाली करता है उसकी Efficiency Negative लेनी है,

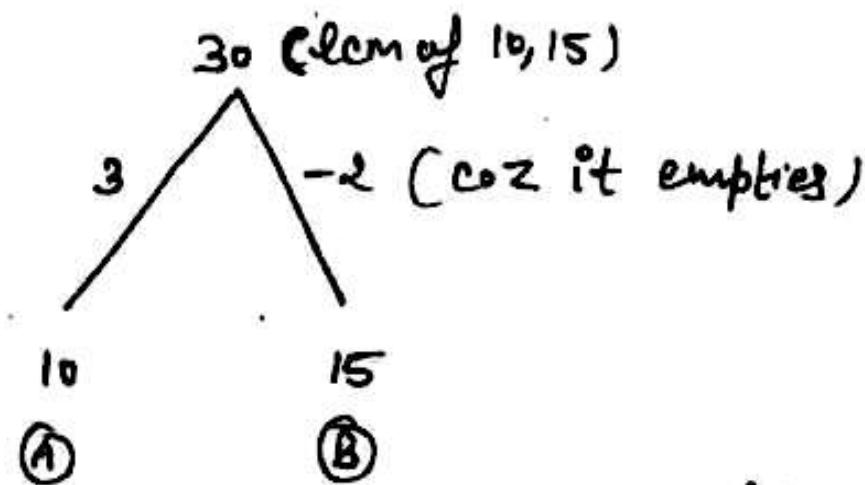
Pipe leakage which empties tank has
Negative Efficiency.

Pipe A can fill the tank in 10 min, while pipe B can empty the tank in 15 min. If both are opened together Tank will be filled in what time?

नल A किसी तंकी को 10 min. में भरता है,
और B इसी तंकी को 15 min में खाली करता है,
तो तंकी कितने मिनट में भरेगी?

Solution

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1 min. में तंकी $3-2 = 1$ भर रही है

धूरी तंकी भरेगी

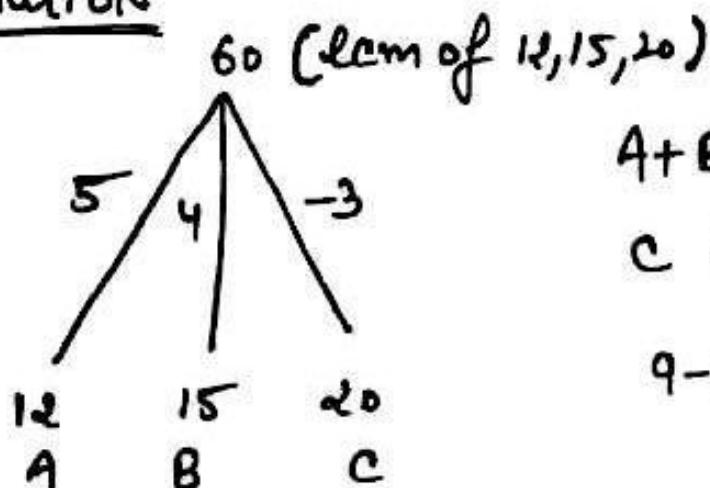
$$T = \frac{C}{E_1 - E_2} = \frac{30}{3-2} = \frac{30}{1} = 30 \text{ min.}$$

सुनील सर की TRICKY फ्रेम्वर्क

Pipe A and B can fill a tank in 12 min & 15 min. respectively, while 3rd pipe C can empty the tank in 20 min. In what time tank will be filled if all the 3 pipes are opened together

दो नल A और B किसी हॉज की गुमरा: 12 और 15 min. में भर सकते हैं। तिसरा नल भरी हुई हंडी की 20 min. में खाली कर सकता है, यदि दोनों नलों की एक साथ खोल दिया जाए तो हॉज कितनी देर में भर जाएगा?

Solution



एकल सर की
त्रिकोण

$$\begin{aligned} A+B \text{ मरते हैं } & 5+4=9 \text{ min. } \\ C \text{ खाली करता है } & -3 \\ 9-3=6 \text{ litr } \text{ मरती } & 1 \text{ min. } \end{aligned}$$

Time taken to fill full tank

$$T = \frac{C}{E_A+E_B-E_C} = \frac{60}{5+4-3} = \frac{60}{6} = 10 \text{ min.}$$

MATHS SPECIAL COACHING

SSC

BANK

HISAR HARYANA → 9784-35915

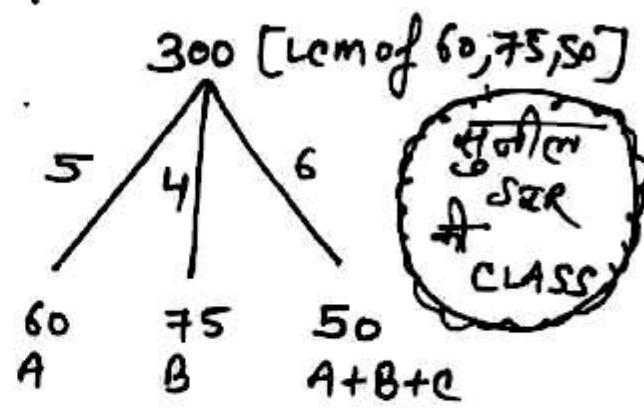
Two pipes A and B can fill a cistern in 1 hour and 75 min. respectively. There is also an outlet C. If all the 3 pipes are opened together, the tank is full in 50 min. How much time will be taken by C to empty the full tank?

Solution :

$$(A+B+C) \text{ s eff} = 6$$

$$\Rightarrow 5 + 4 + C = 6$$

$$\Rightarrow C = -3 \text{ lit/min}$$



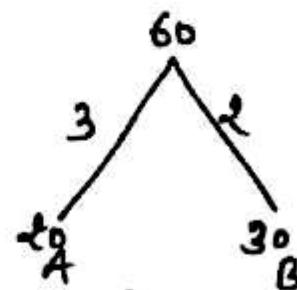
$$C \text{ can empty the tank in} = \frac{300}{3} = 100 \text{ min}$$

दो नल एक टंकी को भरता है 20 और 30 मिनट में भर सकते हैं। हीना नल को एक साथ बंद कर दिया जाता है। 8 मिनट बाद नल A को बंद कर दिया जाता है। तो पूरी टंकी कितने समय में भर जाएगी?

Solution A+B 1 मिनट में

$$\text{भरते हैं} = 5 \text{ litr}$$

$$8 \text{ मिनट में} 5 \times 8 = 40 \text{ litr}$$



$$\text{वाकी } 60 - 40 = 20 \text{ लिटर } B \text{ भरता}$$

$$20 \text{ litr की } B \text{ भरता} = \frac{20}{2} = 10 \text{ मिनट}$$

$$\text{Total } 8 + 10 = 18 \text{ मिनट}$$

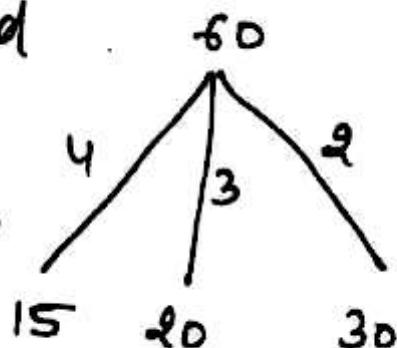
MATHS
4
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BANK

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3 pipes A, B & C can fill a tank in 15, 20 & 30 min. respectively. All 3 are opened together. After 4 min. pipe A is closed. after 4 min more pipe B is also closed. Rem. tank is filled by C alone. In how much time tank is filled

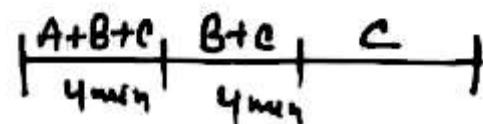
Solution

$$\begin{array}{l} \text{1 min } A+B+C \text{ fills} = 4+3+2=9 \\ \text{4 min } \frac{9}{15} = 9 \times 4 = \underline{36} \end{array}$$



$$B+C \text{ in } 4 \text{ min} = 5 \times 4 = 20$$

$$\text{Total in } 8 \text{ min} = 56$$



$$\text{Remaining } 60 - 56 = 4 \text{ filled by } C \text{ in } \frac{4}{2} = 2 \text{ min}$$

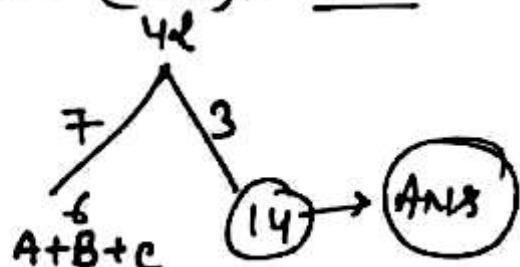
$$\text{Total } 4 + 4 + 2 = \boxed{10 \text{ min}}$$

3 pipes A, B & C can fill a cistern in 6 hrs after working at it together for 2 hours C is closed and A+B can fill the remaining part in 7. The time taken by C alone to fill the cistern?

Solution After 2 hrs of work of A+B+C 4 hrs work remaining but A+B takes 7 hrs to complete
 $\Rightarrow C's \text{ 4 hours} = (A+B)'s \frac{3}{7} \text{ hrs}$

C.E: A+B

$$3 : 4$$



Tricky Maths by Sagar (97284-35915)

- # Two pipes A and B can fill a tank in 24 minutes and 32 min. respectively. If both the pipes are opened simultaneously after how much time pipe B is closed so that tank is full in 18 minutes?

Solution

Pipe B is closed after some time

& tank is filled in 18 min.

\Rightarrow A has worked for 18 min

A can fill in 18 min = $18 \times 4 = 72$

Rem. $96 - 72 = 24$ (this must be filled by B)

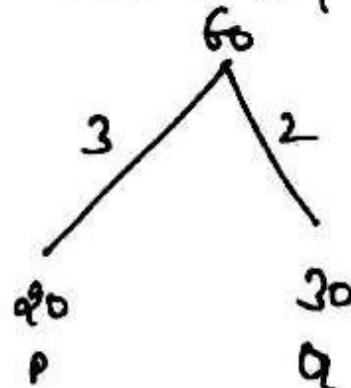
B can fill 24 in = $24/3 = 8$ min Ans

- # Two pipes P and Q would fill a cistern in 20 hours and 30 hours respectively. After some time pipe P is closed, and tank was filled in 18 min. After how much time pipe P is stopped

so P has worked for 18 min

$$= 18 \times 2 = 36$$

$$\text{Rem} = 60 - 36 = 24$$



This must be filled by P = $\frac{24}{3} = 8$ min

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EXTRA TIME Question

गोला त्रिक
+ ३१५

Pipe A takes 4 hours more than (A+B) together to fill a tank. B takes 9 hrs more than (A+B) together to fill the same tank. In how much time tank is filled if both pipes (A+B) works together?

Solution

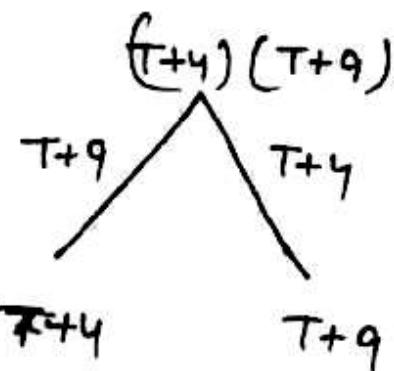
let A+B takes T hrs to fill tank
 \Rightarrow A will takes T+4 hrs
 B ————— T+9 hrs

Trick A+B will takes $\sqrt{4 \times 9} = \sqrt{36} = \underline{\underline{6 \text{ hrs}}}$

Basic Approach

A+B can fill

$$\frac{(T+4)(T+9)}{T+4 + T+9} = T$$



$$\Rightarrow \frac{1}{T} = \frac{1}{T+4} + \frac{1}{T+9} = \frac{(T+4)(T+9)}{(T+4)(T+9)}$$

$$\Rightarrow T = \sqrt{4 \times 9} = \underline{\underline{6 \text{ And.}}}$$

MATHS BY SONAL SIR

SSC

BANK

HISAR (CHRY)

For Demo $\rightarrow 97284 - 35915$

If 2 pipes function simultaneously the reservoir will be filled in 6 hours. One pipe fills the reservoir 5 hours faster than the other. How many hours the faster pipe take to fill the reservoir?

- Ⓐ 8 hrs Ⓛ 10 hrs Ⓜ 12 hrs Ⓞ CND

Solution

सुनील और की टॉप्स

Let the faster pipe take T hrs

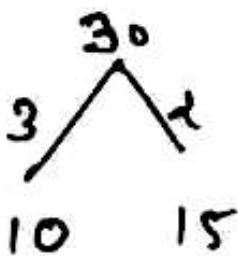
\Rightarrow slower pipe will take $T+5$ hrs

$$\text{both pipe fill tank in} = \frac{T(T+5)}{T+(T+5)} = 6$$

$$\Rightarrow T^2 + 5T = 12T + 30 \Rightarrow T^2 - 7T - 30 = 0$$

$T=10$

OR By options and option



$$\frac{30}{5} = 6$$

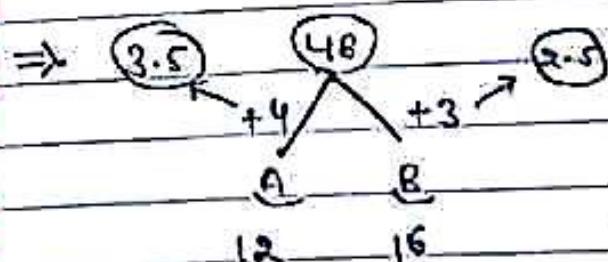
so 8 is Ans.

BANK
SSC
MATHS
TRICKS

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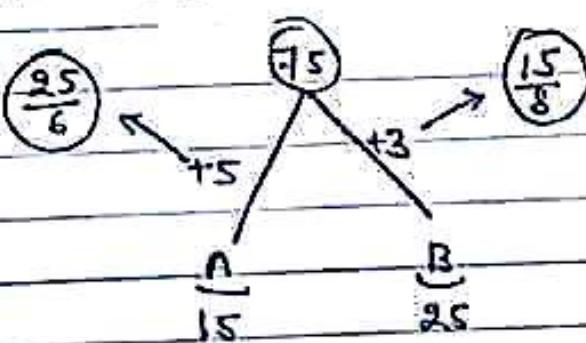
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प्र० - एक हौंड को दी पाइप अलग-2 फुट में 15 तथा 16 मिनट में भर सकते हैं। दोनों पाइपों की सुध साथ खोला जाता है, कुछ कमी होने के कारण पहले पाइप से पूरी छागता का $\frac{5}{8}$ आग पानी बहता है तथा दूसरे पाइप से $\frac{5}{16}$ आग पानी बहता है। तथा कभी दूर बरब के 3 मिनट वाले हौंड भर जाता है तो जात कीजिए कि कितने समय वाले वर्गी पूरी की गई।



$$\begin{aligned} 3 \times 7 &= 21 \\ \frac{21}{6} &= 4 \frac{1}{2} \text{ मिनट} \end{aligned} \quad \left\{ \begin{aligned} 4 \times \frac{5}{8} &= \frac{5}{2} (3.5) \\ \frac{5}{2} &= 2.5 \end{aligned} \right.$$

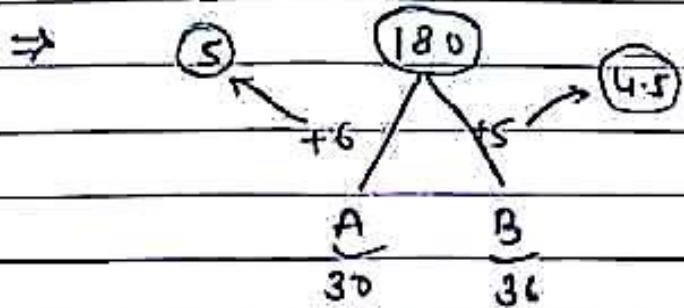
प्र० - एक हौंड को दी पाइप अलग-2 फुट में 15 तथा 16 मिनट में भर सकते हैं। दोनों पाइपों को एक साथ खोला जाता है। कुछ कमी होने के कारण पहले अपनी छागता का $\frac{5}{6}$ आग तथा दूसरा अपनी छागता का $\frac{5}{8}$ आग पानी बहर निकालता है। कभी दूर होने के 5 मिनट वाले हौंड भर जाता है। तो जात कीजिए कितने समय वाले वर्गी दूर की गई।



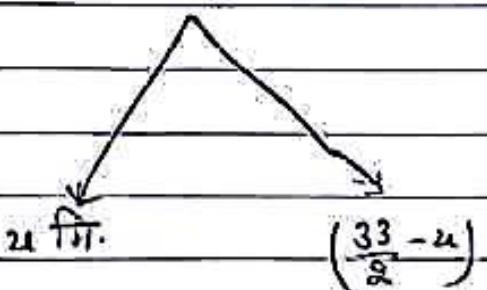
$$\begin{aligned} \frac{25}{6} + \frac{15}{8} &= \frac{45}{24} \\ 8 \times 5 &= 40 \\ \frac{45}{24} &= \frac{168}{29} \text{ मिनट} \end{aligned}$$

प्र० - दी जल A तथा B किसी टैक्स को अलग-2 फुट में 30 तथा 36 मि. में भर सकते हैं। दोनों को एक साथ खोल दिया जाता है। तथा कुछ समरूप के कारण वे अपनी छागता का फूट-पूट $\frac{5}{10}$ तथा $\frac{9}{10}$ के टैक्स को भरते हैं। कुछ समरूप वाले समरूप खता हो जाता है। तथा इसके $16\frac{1}{2}$ मिनट वाले टैक्स भर जाता है तो उसका समरूप

कितनी देर रही?



$16\frac{1}{2}$ मिनट



$$9.5u + 11\left(\frac{33-u}{2}\right) = 180$$

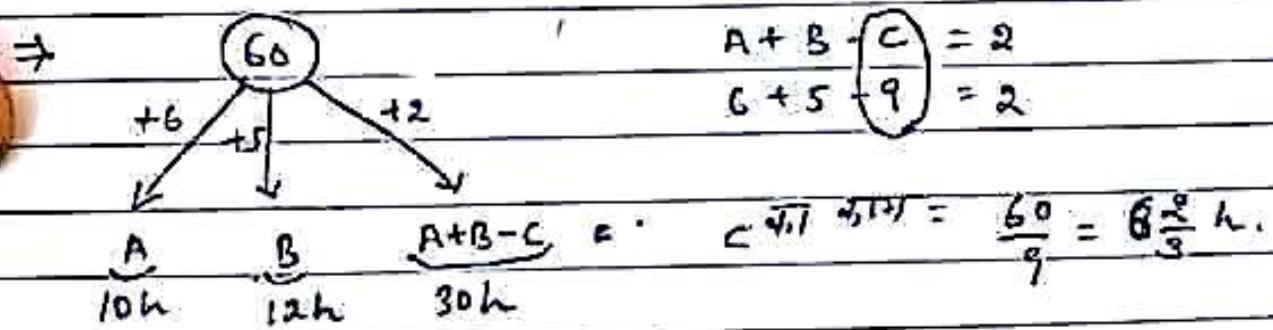
$$9.5u + 181.5 - 11u = 180$$

$$1.5u = 1.5$$

$$u = 1 \text{ मिनट}$$

Ques:- दो नल A तथा B किसी टैंक की अचाहा-2 भूमियाँ 10 तथा 15 मिनट में भर सकते हैं। टैंक में एक निकासी नल C है।

यदि सभी नलों को एक साथ खोल दिया जाता है तो टैंक 30 मिनट में भर जाता है। तो कितने औरेला C टैंक की कितने समय में खाली कर देगा।



Ques:- दो नल A तथा B अचाहा-2 किसी हौज को भूमियाँ? धन्ता तथा 15 मिनट में भर सकते हैं तथा C हौज की खाली करता है। यदि सभी नलों को एक साथ खोला जाए तो हौज उ 30 मिनट में भर जाता है तो बताएं कि C भरे हौज की कितनी देर में खाली कर देगा।

$$\Rightarrow \begin{array}{c} 300 \\ +5 \quad +4 \quad +6 \\ \hline A \quad B \quad C \\ 60 \quad 75 \quad 50 \\ \hline A+B-C \end{array} \quad \begin{array}{l} A+B-C = 6 \\ 5+4-3 = 6 \\ \hline C \Rightarrow \frac{300}{3} = 100 \text{ मि.} \end{array}$$

Ques:- दो पाइप एक होज की अलग-2 क्रमशः 15 तथा 16 घन्टे में भर सकते हैं। दोनों पाइपों की एक साथ खोला जाता है तथा होज के तल में एक छिन्न होने के कारण होज अरब में वृद्धि अधिक हो जाता है कि छिन्न और होज की बित्ती घन्टों में बराली कर देगा।

$$\Rightarrow \begin{array}{c} 112 \\ +8 \quad +7 \\ \hline A \quad B \\ 14 \quad 16 \\ \hline A+B-C = \frac{112}{9} \end{array} \quad \begin{array}{l} A+B = \frac{112 \times 60}{45} = 448 \\ \quad \quad \quad +92 \\ \hline 540 \text{ मि.} / \frac{540}{60} \rightarrow 9 \text{ घ.} \\ -C = \frac{112}{9} \times 15 \rightarrow \frac{23}{9} \Rightarrow \frac{2}{\frac{5}{9}} \end{array}$$

Ques:- दो पाइप एक साथ मिलकर द्वितीय टंक की क्रमशः 5 व 20 घन्टे में भर सकते हैं। द्वितीय तीसरा पाइप रखाली बरता है जिसके बारे में ओपरेटर की जान ना होने के कारण टंक की अरब में एक घन्टा का अधिक समय लगा। तो तीसरा पाइप टंक की बित्ती दर में बराली कर देगा।

$$\Rightarrow \begin{array}{c} 20 \\ +4 \quad +1 \\ \hline A \quad B \\ 5 \text{ घ.} \quad 20 \text{ घ.} \\ \hline A+B-C = \frac{20}{5} = 4 \end{array} \quad \begin{array}{l} A+B = \frac{20}{5} \Rightarrow 4 \text{ घ.} \\ C \Rightarrow \frac{20}{7} = 2.86 \end{array}$$

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Ques:- एक होज में को नल लगे हैं जो उसे ब्रुगड़ा 30 व 20 घन्टे में भर सकते हैं। तीसरा नल होज से पुति जिन्हें 45 ली.

(4)

पानी बाहर निकलता है। यदि तीनों को एक साथ खोल दिया जाए तो पूरा होज 15 मिनट में भर जाएगा। उस होज की क्षमता क्या होगी?

$$\Rightarrow \begin{array}{c} 60 \\ +2 \\ +3 \\ \hline 63 \end{array} \quad \begin{array}{c} 2+3=1 \\ A+B-C=4 \\ \hline C=1 \end{array}$$

$\frac{60}{30h} \quad \frac{60}{30h} \quad \frac{A+B-C}{15h} \quad C = 1 = \frac{60}{1} = 60h$

$$\text{ज्ञाता} = (60 \times 45) \times 60 = 162000 \text{ litr}$$

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Ques:- दो नल एक होज की क्षमता 12 लीटर मिनट में भर सकती है। तीसरा नल एक घन्टे में 162 लीटर पानी बाहर निकलता है। जब होज पूरी तरह भरी हुई होती है, तो C तीसों एक साथ खोल दिए जाते हैं। तथा होज 5 मिनट में खाली हो जाता है तो उसे होज की क्षमता क्या होगी?

$$\Rightarrow \begin{array}{c} 100 \\ +12 \\ +8 \\ \hline 120 \end{array} \quad \begin{array}{c} A+B-C \\ \downarrow \quad \downarrow \quad \downarrow \\ 12+8-45=25 \end{array}$$

$\frac{12}{3} \text{ मि.} \quad \frac{8}{2} \text{ मि.} \quad -4 \text{ मि.}$

$$C = 45 = \frac{100}{45} = \frac{20}{9} \text{ मि.}$$

$$\text{Capacity} \Rightarrow 162 \times \frac{20}{9} = 360 \text{ litr.}$$

Ques:- एक टैक्ट के तेज गति एक विद्रु तक 6 मिनट में पहाड़ी चढ़ सकता है। एक अन्य नल टैक्ट की 5 गिरावट/मिनट से भरता है। यदि दोनों नलों द्वारा एक साथ खोल दिया जाए, तो टैक्ट 8 घण्टे में पहाड़ी हो जाता है। टैक्ट की क्षमता क्या होगी?

(5)

नल - 4 ल/मि.

$$\Rightarrow 24$$

-4 -3

$$-A + \frac{B}{1} = -3$$

$$\begin{array}{c} A \\ -6h \end{array} \quad \begin{array}{c} -A + B \\ -8h \end{array}$$

$$B \Rightarrow 1 = \frac{24}{1} = 24h$$

$$\text{समता} = 4 \text{ ल/मि} \times 60 \times 24 = 5760 \text{ ली}$$

Ques:- एक ट्रैक में 8 नल लगे हुए हैं, जिसमें से कुछ ट्रैक का भरने हैं तथा कुछ खाली रहते हैं। प्रत्येक भरने वाला नल 12 घण्टे में भरता है तथा प्रत्येक खाली करने वाला नल 36 घण्टे में खाली कर सकता है। यदि ट्रैक 3 घण्टे में भर जाता है तो भरने वाले नलों की संख्या बताओ।

 $\Rightarrow (I)$

$$\begin{array}{c} 8-\text{nल} \\ + \quad - \\ \text{पनल} \quad (8-u) \text{-nल} \end{array}$$

$$\begin{array}{c} 36 \\ +3 \quad -1 \\ 12h \quad 36h \end{array}$$

$$[3u - 1(8-u)] \times 3 = 36 \cdot 12$$

$$3u - 8 + u = 12 \Rightarrow 4u = 20 \Rightarrow u = 5$$

(II)

$$\begin{array}{c} + \quad - \\ +24 \quad -8 \\ 12 \end{array}$$

$\frac{36}{3}$

20 +8

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$$5 : 3$$

6

प्रैद:- एक टैक को मरने में तथा खाली करने वाले नलों की तुला
 संख्या 12 है। प्रत्येक भरने वाला नल 6 घंटे में शुरू सकता
 है तथा प्रत्येक खाली करने वाला 12 घंटे में खाली कर सकता
 है। पहिं सभी को एक साथ रोल दिया जाए तो टैक 5 घंटे
 में मर जाती है। पानी मरने वाले नलों की संख्या बताओ।

$$\Rightarrow +24 \quad -12$$

$\therefore 24 : 21$

$5 : 7$

प्रैद:- एक टैक में 8 गश्प लगे हुए हैं जिनमें से तुला पानी मरता है।
 तथा तुला निकालते हैं। प्रत्येक भरने वाला 8 घंटे में तथा खाली
 करने वाला 6 घंटे में खाली कर सकता है। पहिं सभी को एक
 साथ रोल दिया जाए तो टैक खाली होने में 6 घंटे लगते हैं।
 तो पानी मरने वाले नलों की संख्या बताओ।

$$\Rightarrow ① +24 \quad -32$$

$28 : 28$

$1 : 1$

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(ii) 8 नल

$3u - 32 + 4u = -4$

$7u = 28$

$u = 4$

$[3u - 4(8-u)] \times 6 = -24 - 4$

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Boat AND STREAM (नाव और धारा) ①

Let X km/hr is the speed of Boat in still water

Y km/hr is the speed of River/CURRENT/STREAM

Downstream Speed (धारा के अनुकूल/अनुप्रवाह)

Let Speed of Boat downstream is u km/hr

$$\Rightarrow u = (X+Y) \text{ km/hr} \quad \text{--- (1)}$$

Upstream Speed (धारा के प्रतिकूल/उद्गम प्रवाह)

Let speed of boat upstream is v km/hr

$$\Rightarrow v = (X-Y) \text{ km/hr} \quad \text{--- (2)} \quad (X > Y)$$

Solving ① and ②, we get

$$X = \frac{u+v}{2} = \frac{\text{downstream speed}}{\text{upstream speed}}$$

$$Y = \frac{u-v}{2} = \frac{\text{downstream speed}}{\text{upstream speed}}$$

Note : Down stream speed is always greater than up stream speed.

A boat speed in still water is 7 km/hr. If the river is flowing at 3 km/hr, it takes him 14 hours to row to a place and come back. Find the distance between two places?

Solution :→ METHOD 1

Let distance is 0 Km ~~is~~

$$\Rightarrow \frac{D}{7+3} + \frac{D}{7-3} = 14 \Rightarrow D = 40 \text{ km}$$

METHOD 2 → $u = 7+3 = 10 \text{ km/hr}$
 $v = 7-3 = 4 \text{ km/hr}$

Let $D = 20$ (LCM of 10 & 4)



If Time is 7 hr (5+2) Distance = 20 km
 But time is 14 hr $\Rightarrow D = 2 \times 20 = 40 \text{ km}$

METHOD 3 → $D = \frac{T(x^2 - y^2)}{2x}$ $T \rightarrow \frac{\text{Total Time}}{2}$

$T = 14 \text{ hrs}$, $x = 7 \text{ km/hr}$, $y = 3 \text{ km/hr}$

$$\Rightarrow D = \frac{14(7^2 - 3^2)}{2 \times 7} = 40 \text{ km Ans.}$$

A boat takes twice as much as time going upstream than downstream. If river is flowing at the rate of 4 Km/hr. Find the speed of boat in still water?

Solution downstream : upstream

Time	1	:	3	
\Rightarrow Speed	3	:	1	($D = \text{const}$)

$$u = 3 \quad v = 1 \quad \Rightarrow \quad x = \frac{3+1}{2} : y = \frac{3-1}{2}$$

Boat speed	$\leftarrow 2$:	$1 \downarrow$
			River speed

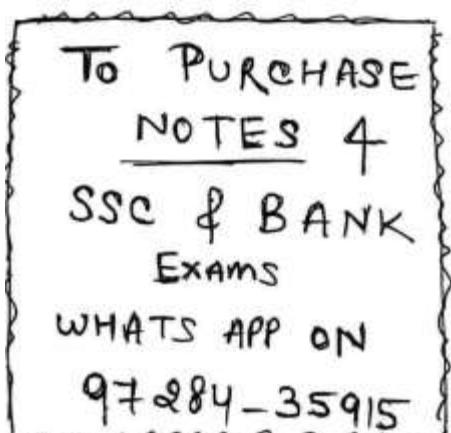
but $1 \rightarrow 4 \text{ km/hr}$

$$\Rightarrow 2 \rightarrow 4 \times 2 = 8 \text{ km/hr} \quad \underline{\text{Ans}}$$

Note: Average speed if distance is constant

$$\text{Avg speed} = \frac{2 \times u \times v}{u+v}$$

where $u \rightarrow$ downstream speed
 $v \rightarrow$ upstream speed



A man can row 40 km upstream and 55 km downstream in 13 hours. Also he can row 30 km upstream and 44 km downstream in 10 hrs. Find the speed of boat in still water and speed of river?

Solution : METHOD 1

$\checkmark \rightarrow$ upstream $\rightarrow x - y$
speed

$\checkmark \rightarrow$ downstream $\rightarrow x + y$
speed

$$\text{so } \frac{40}{v} + \frac{55}{u} = 13 \quad \left\{ \times 3 \right. \rightarrow \frac{120}{v} + \frac{165}{u} = 39 \rightarrow \textcircled{1}$$

$$\frac{30}{v} + \frac{44}{u} = 10 \quad \left\{ \times 4 \right. \rightarrow \frac{120}{v} + \frac{176}{u} = 40 \rightarrow \textcircled{2}$$

$$\textcircled{1} - \textcircled{2}, \text{ we get } -\frac{11}{u} = -1 \Rightarrow u = 11$$

Putting either in $\textcircled{1}$ or $\textcircled{2}$ value of $u = 11$
 $\Rightarrow v = 5 \text{ km/hr}$

$$\therefore \text{speed of boat in still water } x = \frac{u+y}{2} = \frac{11+5}{2} = 8 \text{ km/hr}$$

$$\text{speed of river } y = \frac{u-y}{2} = \frac{11-5}{2} = 3 \text{ km/hr}$$

METHOD 2 HIT AND TRIAL (TRy u & v that satisfies both equations)

$$\frac{40}{v} + \frac{55}{u} = 13 \rightarrow \textcircled{1}$$

$$\frac{30}{v} + \frac{44}{u} = 10 \rightarrow \textcircled{2}$$

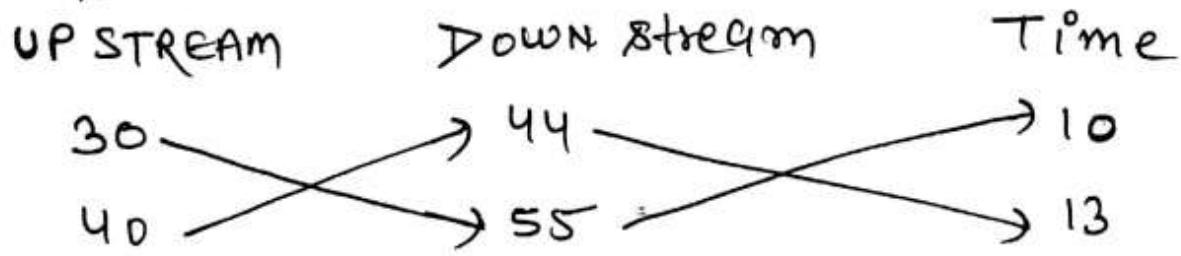
but $u > v$

let $u = 11$ (HCF of 55 & 44)

to make 13 v must be 5 $\Rightarrow x = \frac{11+5}{2} = 8$

$$y = \frac{11-5}{2} = 3$$

METHOD 3 :



down stream $u = \frac{|30 \times 55 - 44 \times 40|}{|30 \times 13 - 40 \times 10|} = \frac{110}{10} = 11$ (1)

up stream speed $v = \frac{|30 \times 55 - 44 \times 40|}{|55 \times 10 - 44 \times 13|} = \frac{110}{22} = 5$ (2)

$$\Rightarrow x = \frac{u+v}{2} = \frac{11+5}{2} = 8, \quad y = \frac{u-v}{2} = \frac{11-5}{2} = 3$$

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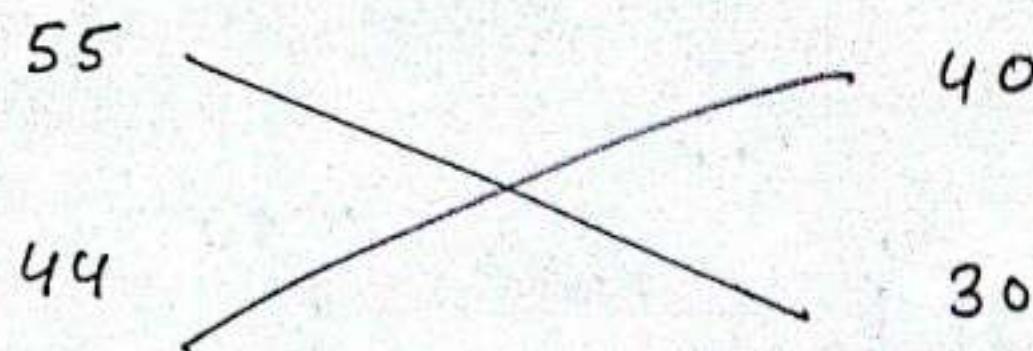
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Ans. 2
Step-1

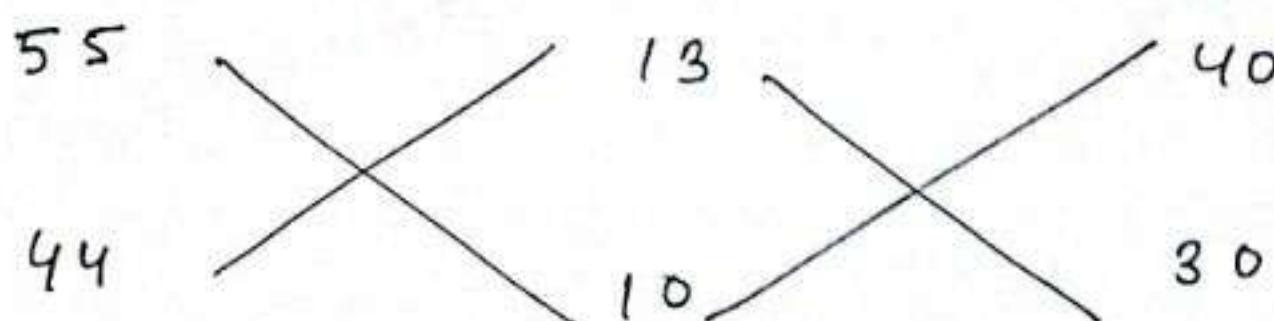
Downstream Distance ~~Upstream Distance~~



$$x = |55 \times 30 - 44 \times 40| = 10 \times 11 (5 \times 3 - 4 \times 4) \\ = |10 \times 11 \times 1| = 110$$

Step-2

Downstream Distance time Upstream Distance



$$|55 \times 10 - 44 \times 13| \\ = |11(5 \times 10 - 4 \times 13)| \\ = 22$$

$$\& |13 \times 30 - 10 \times 40| \\ = 10$$

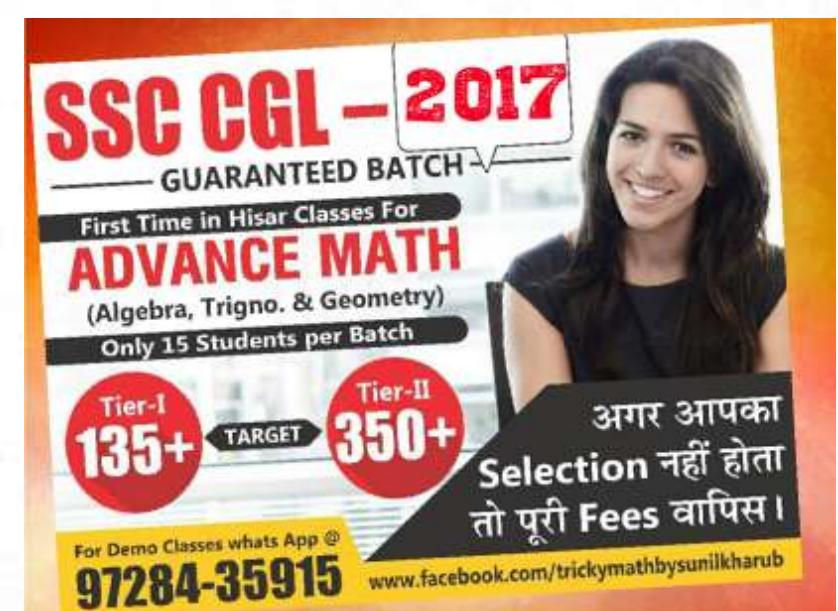
Now, $a = \frac{x}{10}$, $b = \frac{x}{22}$

~~$a = \frac{110}{22} = 5$~~ , $b = \frac{110}{22} = 5$

$a = \frac{110}{10} = 11$

So, Speed of man in still water = $\frac{1}{2}(a+b) = \frac{1}{2}(11+5) = 8 \text{ kmph}$

Speed of current = $\frac{1}{2}(a-b) = \frac{1}{2}(11-5) = 3 \text{ kmph}$.



ALGEBRA PDF

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1. $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
2. $a^3 + b^3 + c^3 - 3abc = [a+b+c][a^2 + b^2 + c^2 - ab - bc - ca]$
 $= \left(\frac{a+b+c}{2}\right)[(a-b)^2 + (b-c)^2 + (c-a)^2]$
3. $a^2 + b^2 + c^2 = 0 \Rightarrow a = 0, b = 0 \text{ & } c = 0$
e.g. If $(a-3)^2 + (b-2)^2 + (c-4)^2 = 0$
then $a-3 = 0 \Rightarrow a = 3, b = 2, c = 4$
4. If $a^2 + b^2 + c^2 + 3 = 2(a+b+c)$, find $a+b+c$
Solution :- $a^2 + b^2 + c^2 + 3 = 2a + 2b + 2c$
 $\Rightarrow a^2 + b^2 + c^2 - 2a - 2b - 2c + 3 = 0$
 $\Rightarrow a^2 - 2a + 1 + b^2 - 2b + 1 + c^2 - 2c + 1 = 0$
 $\Rightarrow (a-1)^2 + (b-1)^2 + (c-1)^2 = 0$
 $a = 1, b = 1, c = 1$
 $a+b+c = 1+1+1 = 3$

ALGEBRA

- If $x + \frac{1}{x} = 2$, then find the value of $x^{99} + \frac{1}{x^{100}}$

Solution :- $x + \frac{1}{x} = 2 \Rightarrow x^2 - 2x + 1$
 $\Rightarrow (x-1)^2 = 0 \Rightarrow x = 1$

So If $x + \frac{1}{x} = 2$ Put $x = 1$

$$x^{99} + \frac{1}{x^{100}} = (1)^{99} + \frac{1}{(1)^{100}} = 2$$

$$\& x^{99} - \frac{1}{x^{100}} = (1)^{99} - \frac{1}{(1)^{100}} = 1 - 1 = 0$$

- Special use in trigonometry
if $\sin \theta + \operatorname{cosec} \theta = 2$, then $\sin^n \theta + \operatorname{cosec}^n \theta = 2$
 - if $\cos \theta + \sec \theta = 2$, then $\cos^n \theta + \sec^n \theta = 2$
if $\tan \theta + \cot \theta = 2$, then $\tan^n \theta + \cot^n \theta = 2$
 - If $x + \frac{1}{x} = -2$, then put ($x = -1$)
 - $x^2 + \frac{1}{x^2} = \left(x + \frac{1}{x}\right)^2 - 2$
 - $x^2 + \frac{1}{x^2} = \left(x - \frac{1}{x}\right)^2 + 2$
 - $x^4 + \frac{1}{x^4} = \left(x^2 + \frac{1}{x^2}\right)^2 - 2$
 - $x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$
 - If $x + \frac{1}{x} = a \Rightarrow x^3 + \frac{1}{x^3} = a^3 - 3a$
e.g. $x + \frac{1}{x} = 5 \Rightarrow x^3 + \frac{1}{x^3} = 125 - 3 \times 5 = 110$
 - $x^3 - \frac{1}{x^3} = \left(x - \frac{1}{x}\right)^3 + 3\left(x - \frac{1}{x}\right)$
e.g. If $x - \frac{1}{x} = a \Rightarrow x^3 - \frac{1}{x^3} = a^3 + 3a$
If $x - \frac{1}{x} = 5 \Rightarrow x^3 - \frac{1}{x^3} = 125 + 3 \times 5 = 140$
 - $x + \frac{1}{x} = 3 \quad x - \frac{1}{x} = 3$
 $x^2 + \frac{1}{x^2} = 9 - 2 = 7 \quad x^2 + \frac{1}{x^2} = 9 + 2 = 11$
 $x^4 + \frac{1}{x^4} = 49 - 2 = 47 \quad x^4 + \frac{1}{x^4} = 11^2 - 2 = 119$
 $x^8 + \frac{1}{x^8} = 2209 - 2 = 2207$

Q. If $x + \frac{1}{x} = 3$ find $\left[x^2 - \frac{1}{x^2} \right]$

$$\text{Solution :- } x + \frac{1}{x} = 3 \rightarrow x^2 + \frac{1}{x^2} = 7$$

$$\text{and } x - \frac{1}{x} = \sqrt{x^2 + \frac{1}{x^2} - 2} = \sqrt{7 - 2} = \sqrt{5}$$

$$\text{and } \left[x^2 - \frac{1}{x^2} \right] = \left[x - \frac{1}{x} \right] \left[x + \frac{1}{x} \right] = \sqrt{5} \times 3 = 3\sqrt{5}$$

Q. If $x^4 + \frac{1}{x^4} = 119$ Find $x + \frac{1}{x}$

$$\text{Sol. } x^2 + \frac{1}{x^2} = \sqrt{x^4 + \frac{1}{x^4} + 2} = \sqrt{119 + 2} = 11$$

$$\Rightarrow x + \frac{1}{x} = \sqrt{x^2 + \frac{1}{x^2} + 2}$$

$$= \sqrt{11 + 2} = \sqrt{13}$$

Q. If $x^2 - 3x + 1 = 0$, Find $x^4 + \frac{1}{x^4}$

Solution -

$$x^2 - 3x + 1 = 0$$

Divide by x

$$x - 3 + \frac{1}{x} = 0 \Rightarrow x + \frac{1}{x} = 3$$

$$\Rightarrow x^2 + \frac{1}{x^2} = 9 - 2 = 7$$

$$\Rightarrow x^4 + \frac{1}{x^4} = 49 - 2 = 47$$

Q. If $x + \frac{1}{x} = 3$, Find $x^5 + \frac{1}{x^5} = ?$

$$\text{Solution - } x + \frac{1}{x} = 3 \Rightarrow x^2 + \frac{1}{x^2} = 7 \Rightarrow x^4 + \frac{1}{x^4} = 49 - 2 = 47$$

$$\left[x^4 + \frac{1}{x^4} \right] \left[x + \frac{1}{x} \right] = 47 \times 3 = 141$$

$$x^5 + x^3 + \frac{1}{x^3} + \frac{1}{x^5} = 141$$

$$x^5 + \frac{1}{x^5} = 141 - \left(x^3 + \frac{1}{x^3} \right) = 141 - 18 = 123$$

MOCK QUESTIONS

1. If $x^2 - 3x + 1 = 0$ then find the value of

- (1) $x^4 + \frac{1}{x^4}$ (2) $x^3 + \frac{1}{x^3}$ (3) $x^6 + \frac{1}{x^6}$ (4) $x^7 + \frac{1}{x^7}$ (5) $x^{3/2} + \frac{1}{x^{3/2}}$ (6) $x^5 + \frac{1}{x^5}$

2. If $2a + \frac{1}{3a} = 5$, then find

- (a) $8a^3 + \frac{1}{27a^3}$ (b) $27a^3 + \frac{1}{8a^3} = ?$

3. If $x^4 + \frac{1}{x^4} = 119$, find $x^3 - \frac{1}{x^3} = ?$

4. If $x + \frac{1}{x} = 5$ Find

- (a) $x^5 + \frac{1}{x^5}$ (b) $x^{3/2} + \frac{1}{x^{3/2}}$

• If $x + \frac{1}{x} = 1$

$$\Rightarrow x^2 + 1 = x \Rightarrow x^2 - x + 1 = 0$$

$$\& (x^3 + 1) = (x + 1)(x^2 - x + 1)$$

$$= 0 \quad [\because x^2 - x + 1 = 0]$$

$$x^3 = -1$$

e.g. If $x + \frac{1}{x} = 1$, then find $x^{54} + x^{48} + x^{12} + x^6$

Solution :- $x + \frac{1}{x} = 1 \Rightarrow x^3 = -1$

$$x^{54} + x^{48} + x^{12} + x^6$$

$$= (x^3)^{18} + (x^3)^{16} + (x^3)^4 + (x^3)^2$$

$$= (-1)^{18} + (-1)^{16} + (-1)^4 + (-1)^2$$

$$= 1 + 1 + 1 + 1 = 4$$

- $x + \frac{1}{x} = -1 \Rightarrow x^3 = +1$

Q. If $x + \frac{1}{x} = \sqrt{3}$

$$\Rightarrow x^3 + \frac{1}{x^3} = 3\sqrt{3} - 3\sqrt{3} = 0$$

$$\Rightarrow x^6 + 1 = 0$$

e.g. If $x + \frac{1}{x} = \sqrt{3}$, find $x^{18} + x^{12} + x^6 + 1$

Solution - $x + \frac{1}{x} = \sqrt{3} \Rightarrow x^6 + 1 = 0$

$$x^{18} + x^{12} + x^6 + 1 = 0$$

$$= x^{12}(x^6 + 1) + (x^6 + 1)$$

$$= x^{12} \times 0 + 0 = 0 \quad [\because x^6 + 1 = 0]$$

Q. If $x + \frac{1}{x} = 1$, Find $x^{17} + \frac{1}{x^{17}}$

Solution - $x + \frac{1}{x} = 1 \Rightarrow x^{17} + \frac{1}{x^{17}} = \frac{x^{18}}{x} + \frac{x}{x^{18}}$

$$= \frac{(x^3)^6}{x} + \frac{x}{(x^3)^6} = \frac{(-1)^6}{x} + \frac{x}{(-1)^6} = x + \frac{1}{x} = 1$$

Q. If $x + \frac{1}{x} = \sqrt{3} \Rightarrow x^3 + \frac{1}{x^3} = 3\sqrt{3} - 3\sqrt{3} = 0 \Rightarrow x^6 + 1 = 0$

e.g. If $x + \frac{1}{x} = \sqrt{3}$, Find $x^{18} + x^{12} + x^6 + 1$

Solution- $x + \frac{1}{x} = \sqrt{3} \Rightarrow x^6 + 1 = 0$

$$x^{18} + x^{12} + x^6 + 1$$

$$= x^{12}(x^6 + 1) + (x^6 + 1)$$

$$= x^{12} \times 0 + 0 = 0 \quad [\because x^6 + 1 = 0]$$

Square Root In Algebra

• $\sqrt{7+4\sqrt{3}} = ?$

Always Try to make $2ab$ from Root

$$2ab = 4\sqrt{3} \Rightarrow ab = 2\sqrt{3}$$

$$a = 2, b = \sqrt{3} \Rightarrow a^2 + b^2 = 4 + 3 = 7$$

$$\text{Solution: } - \sqrt{7+4\sqrt{3}} = \sqrt{(2+\sqrt{3})^2} = 2 + \sqrt{3}$$

Q. $\sqrt{13+4\sqrt{3}} = ?$

$$\sqrt{38+5\sqrt{3}} = \sqrt{\frac{76+10\sqrt{3}}{2}} = \frac{1}{\sqrt{2}} \sqrt{76+10\sqrt{3}} = \frac{1}{\sqrt{2}} (5\sqrt{3}+1)$$

Q. $x = \frac{\sqrt{3}}{2}$, then find $\sqrt{1+x} + \sqrt{1-x}$

$$\text{Solution} - x = \frac{\sqrt{3}}{2} \Rightarrow \sqrt{1+x} = \sqrt{1+\frac{\sqrt{3}}{2}} = \sqrt{\frac{2+\sqrt{3}}{2}}$$

$$= \sqrt{\frac{4+2\sqrt{3}}{4}} = \frac{1}{2} (\sqrt{3}+1) = \frac{\sqrt{3}+1}{2}$$

$$\text{in same way } \sqrt{1-x} = \frac{\sqrt{3}-1}{2}$$

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

Q. If $a = 998$, $b = 998$, & $c = 997$ find $a^3 + b^3 + c^3 - 3abc = ?$

$$\text{Solution :- } a^3 + b^3 + c^3 - 3abc = \frac{a+b+c}{2} [(a-b)^2 + (b-c)^2 + (c-a)^2]$$

$$= \left[\frac{998+998+997}{2} \right] [0+1+1] \\ = 2993$$

Q. If $a + b + c = 8$, then find $(a-4)^3 + (b-3)^3 + (c-1)^3 - 3(a-4)(b-3)(c-1)$

Solutions :- Put $a = 4$, $b = 3$, $c = 1$

$$4 + 3 + 1 = 8$$

we get 0

Q. If $a^2 + b^2 + c^2 = ab + bc + ca$ then $\frac{a+c}{b} = ?$

Solution :- $a^2 + b^2 + c^2 = ab + bc + ca$

$$\Rightarrow a^2 + b^2 + c^2 - ab - bc - ca = 0$$

$$\Rightarrow \frac{1}{2} [(a-b)^2 + (b-c)^2 + (c-a)^2] = 0$$

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

or by hit and trial method

put $a = b = c = 1$

$$\text{Ans. is } \frac{1+1}{1} = 2$$

Q. If $a^2 + b^2 + 2b + 4a + 5 = 0$, find $\frac{a-b}{a+b}$

Solution :- $a^2 + b^2 + 2b + 4a + 5 = 0$

$$\Rightarrow a^2 + 4a + 4 + b^2 + 2b + 1 = 0$$

$$\Rightarrow [a+2]^2 + [b+1]^2 = 0$$

$$a = -2, b = -1$$

$$\text{Put } \frac{a-b}{a+b} = \frac{1}{3}$$

Q. If $a+b+c = 9$ & $ab+bc+ca = 26$, then find $a^3 + b^3 + c^3 - 3abc = ?$

Solution :- $[a+b+c]^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

$$\Rightarrow [9]^2 = a^2 + b^2 + c^2 + 2(26)$$

$$\Rightarrow a^2 + b^2 + c^2 = 29$$

$$\therefore a^3 + b^3 + c^3 - 3abc = (a+b+c) [a^2 + b^2 + c^2 - (ab + bc + ca)]$$

$$= 9 [29 - 26] = 27$$

or by hit and trial method

put $a = 4, b = 3, \text{ and } c = 2$

$$a^3 + b^3 + c^3 - 3abc = \frac{1}{2}(a+b+c) [(a-b)^2 + (b-c)^2 + (c-a)^2]$$

$$= \frac{1}{2} \times 9 [1 + 1 + 4] = 27$$

Q. If $x = \sqrt{3} + \sqrt{2}$, then Find $x^3 + \frac{1}{x^3}$

Solution :- $x = \sqrt{3} + \sqrt{2}$

$$\Rightarrow \frac{1}{x} = \sqrt{3} - \sqrt{2} \Rightarrow x + \frac{1}{x} = 2\sqrt{3}$$

$$\therefore x^3 + \frac{1}{x^3} = 24\sqrt{3} - 6\sqrt{3} = 18\sqrt{3}$$

Q. If $\frac{2p}{p^2 - 2p + 1} = \frac{1}{4}$, then find $p^2 + \frac{1}{p^2}$

Solution :- $\frac{2p}{p^2 - 2p + 1} = \frac{1}{4}$ or $\frac{p^2 - 2p + 1}{2p} = 4$

$$\frac{p^2 - 2p + 1}{p} = 8$$

$$p - 2 + \frac{1}{p} = 8 \Rightarrow p + \frac{1}{p} = 10$$

$$\Rightarrow p^2 + \frac{1}{p^2} = 100 - 2 = 98$$

Q. If $\frac{a}{1-a} + \frac{b}{1-b} + \frac{b}{1-c} = 1$, then find the value of

$$\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$$

- (a) 1 (b) 2 (c) 3 (d) 4

Solution:- Put $a = b = c = \frac{1}{4}$

Ans. is 4

Q. Find the value at $x = 16$ of the following expression

$$x^4 - 17x^3 + 17x^2 - 17x + 14$$

Solution:- $x^4 - 17x^3 + 17x^2 - 17x + 14$

$$= x^4 - 16x^3 - x^3 + 16x^2 + x^2 - 16x - x + 14$$

Now put $x = 16$

$$= 16^4 - 16^4 - 16^3 - 16^3 - 16^2 - 16^2 - 16 + 14 = -2$$

Some Selected Questions

Q. If $x + \frac{1}{x} = \sqrt{3}$, find the value of

- (i) $x^{72} + x^{66} + x^{54} + x^{36} + x^{24} + x^6 + 1$
- (ii) $x^{206} + x^{200} + x^{90} + x^{84} + x^{18} + x^{12} + x^6 + 1$

Solution :- (i) $x + \frac{1}{x} = \sqrt{3} = x^6 + 1 = 0$

$$\begin{aligned} & x^{72} + x^{66} + x^{54} + x^{36} + x^{24} + x^6 + 1 \\ & [x^6]^{12} + [x^6]^{11} + [x^6]^9 + [x^6]^6 + [x^6]^4 + x^6 + 1 \\ & = [-1]^{12} + [-1]^{11} + [-1]^9 + [-1]^6 + [-1]^4 + 0 \\ & = 1 - 1 - 1 + 1 + 1 = 1 \end{aligned}$$

(ii) $x^{206} + x^{200} + x^{90} + x^{84} + x^{18} + x^{12} + x^6 + 1$
 $x^{200}[x^6 + 1] + x^{84}[x^6 + 1] + x^{12}[x^6 + 1] + x^6 + 1$
 $0 + 0 + 0 + 0 = 0 \quad [\because x^6 + 1 = 0]$

Q. If $x = (a + \sqrt{a^2 + b^3})^{\frac{1}{3}} + (a - \sqrt{a^2 + b^3})^{\frac{1}{3}}$ then find the value of $x^3 + 3bx - 2a$

- (a) $2a^3$
- (b) $-2a^3$
- (c) 0
- (d) 1

Solution:- $x = (a + \sqrt{a^2 + b^3})^{\frac{1}{3}} + (a - \sqrt{a^2 + b^3})^{\frac{1}{3}}$

cubing both sides, we get

$$\begin{aligned} x^3 &= (a + \sqrt{a^2 + b^3}) + (a - \sqrt{a^2 + b^3}) \\ &+ 3 (a + \sqrt{a^2 + b^3})^{\frac{1}{3}} (a - \sqrt{a^2 + b^3})^{\frac{1}{3}} (x) \\ \Rightarrow x^3 &= 2a + 3[a^2 - (a^2 + b^3)]^{1/3} [x] \\ &= 2a + 3[-b^3]^{1/3} x \\ &= 2a - 3bx \\ \Rightarrow x^3 + 3bx - 2a &= 0 \end{aligned}$$

Q. If $x = 2 + \frac{1}{2^3} + \frac{2}{2^3}$, then value of $x^3 - 6x^2 + 6x + 1$ is

- (a) 3
- (b) 2
- (c) 1
- (d) 0

Solution:- $x = 2 + \frac{1}{2^3} + \frac{2}{2^3} \Rightarrow x - 2 = \frac{1}{2^3} + \frac{2}{2^3}$

cubing both sides, we get

$$\begin{aligned} x^3 - 8 - 3.2x[x-2] &= 2 + 2^2 + 3 \times 2^{1/3} \times 2^{2/3} (x-2) \\ \Rightarrow x^3 - 8 - 6x^2 + 12x &= 2 + 4 + 6(x-2) \end{aligned}$$

$$\Rightarrow x^3 - 6x^2 + 6x = 2$$

$$\Rightarrow x^3 - 6x^2 + 6x + 1 = 2+1 = 3$$

Q. If $a = 3 + 2\sqrt{2}$, then find the value of $\frac{a^6 + a^4 + a^2 + 1}{a^3}$

Solution:- $a = 3 + 2\sqrt{2} \Rightarrow \frac{1}{a} = 3 - 2\sqrt{2}$

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

$$\text{Now } \frac{a^6 + a^4 + a^2 + 1}{a^3} = a^3 + a + \frac{1}{a} + \frac{1}{a^3} = 6 + 198 = 204$$

Q. If $2x + \frac{1}{3x} = 5$, then find the value of $\frac{5x}{6x^2 + 20x + 1}$

Solution :- $2x + \frac{1}{3x} = 5 \Rightarrow 6x^2 + 1 = 15x$

$$\therefore \frac{5x}{6x^2 + 20x + 1} = \frac{5x}{15x + 20x} = \frac{5x}{35x} = \frac{1}{7}$$

Q. If $x + \frac{1}{x} = 99$, then find of value of $\frac{100x}{2x^2 + 102x + 2}$

Solution:- $x + \frac{1}{x} = 99 \Rightarrow x^2 + 1 = 99x$

$$2x^2 + 2 = 198x$$

$$\therefore \frac{100x}{2x^2 + 102x + 2} = \frac{100x}{198x + 10x} = \frac{100x}{300x} = \frac{1}{3}$$

Q. If $x - \frac{1}{x} = 3$, then find the value of $x^3 + \frac{1}{x^3}$

Solution:- $\left[x + \frac{1}{x} \right]^2 = \left[x - \frac{1}{x} \right]^2 + 4 = 13$

$$\Rightarrow x + \frac{1}{x} = \sqrt{13} \Rightarrow x^3 + \frac{1}{x^3} = 13\sqrt{13} - 3\sqrt{13} = 10\sqrt{13}$$

Q. If $x - \frac{1}{x} = 5$, then find the value of $2 \left[x^2 - \frac{1}{x^2} \right]$

Solution:- $2 \left[x^2 - \frac{1}{x^2} \right] = 2 \left[x - \frac{1}{x} \right] \left[x + \frac{1}{x} \right]$

$$\left[x + \frac{1}{x} \right]^2 = \left[x - \frac{1}{x} \right]^2 + 4 = 25 + 4 = 29$$

$$\Rightarrow x + \frac{1}{x} = \sqrt{29}$$

$$2 \left[x^2 - \frac{1}{x^2} \right] = 2 \times 5 \times \sqrt{29} = 10\sqrt{29}$$

Q. If $x = 3+2\sqrt{2}$, then find the value of $x^3 + \frac{1}{x^3}$

$$\text{Solution:- } x = 3+2\sqrt{2} \Rightarrow \frac{1}{x} = 3-2\sqrt{2}$$

$$x + \frac{1}{x} = 6$$

$$\begin{aligned} \therefore x^3 + \frac{1}{x^3} &= \left[x + \frac{1}{x} \right]^3 - 3 \left[x + \frac{1}{x} \right] \\ &= 216 - 3 [6] = 198 \end{aligned}$$

Q. If $\frac{a}{b} + \frac{b}{a} = 1$, then find the value of $a^3 + b^3$

$$\text{Solution:- } \frac{a}{b} + \frac{b}{a} = 1 \Rightarrow a^2 + b^2 = ab$$

$$\begin{aligned} &\& a^3 + b^3 = (a+b)(a^2 - ab + b^2) \\ &= (a+b)(ab - ab) = 0 \end{aligned}$$

Q. If $p = 101$, then find the value of $\sqrt[3]{p^3 - 3p^2 + 3p - 1}$

$$\begin{aligned} \text{Solution:- } \sqrt[3]{p^3 - 3p^2 + 3p - 1} &= \sqrt[3]{p^3 - 1^3 - 3p(p-1)} = \sqrt[3]{(p-1)^3} = p - 1 \\ &= 101 - 1 = 100 \end{aligned}$$

Q. If $\frac{a}{1-a} + \frac{b}{1-b} + \frac{c}{1-c} = 1$, then find the value of $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$

$$\text{Solution:- } \frac{a}{1-a} + \frac{b}{1-b} + \frac{c}{1-c} = 1$$

$$\frac{a}{1-a} + 1 + \frac{b}{1-b} + 1 + \frac{1}{1-c} + 1 = 1 + 3 = 4$$

$$\frac{a+1-a}{1-a} + \frac{b+1-b}{1-b} + \frac{c+1-c}{1-c} = 4$$

$$\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c} = 4$$

Q. If $x + y = 2z$, then find the value of $\frac{x}{x-z} + \frac{z}{y-z}$

Solution:- $x+y = 2z$

$$\Rightarrow x - z = z - y$$

$$\frac{x}{x-z} + \frac{z}{y-z} = \frac{x}{x-z} - \frac{z}{x-z} = \frac{x-z}{x-z} = 1$$

Q. If $a+b+c = 10$, $a^2+b^2+c^2 = 38$ & $abc = 30$, then find the value of

(i) $\frac{1}{a} + \frac{1}{b} + \frac{1}{c}$

(ii) $a^3 + b^3 + c^3$

Solution:- (i) $\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{bc+ac+ab}{abc}$

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

$$\Rightarrow (10)^2 = 38 + 2(ab+bc+ca)$$

$$\Rightarrow ab + bc + ca = 31 \Rightarrow \frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{31}{30}$$

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

$$a^3+b^3+c^3 - 3 \times 30 = 10 [38-31] = 70$$

$$a^3+b^3+c^3 = 160$$

• $(a+b)^2 = a^2+b^2+2ab$

• $(a-b)^2 = a^2+b^2-2ab$

Q. $\sqrt{13+4\sqrt{3}}$

$$2ab = 4\sqrt{3}$$

$$ab = 2\sqrt{3} \times 1$$

$$a = 2\sqrt{3} \quad b = 1$$

$$a^2 + b^2 = 12 + 1 = 13$$

$$\sqrt{13+2\sqrt{3}} = \sqrt{(2\sqrt{3}+1)^2} = 2\sqrt{3} + 1$$

Q. $\sqrt{38+5\sqrt{3}} = \sqrt{\frac{76+10\sqrt{3}}{2}} = \frac{1}{\sqrt{2}} \sqrt{76+10\sqrt{3}}$

Now $2ab = 10\sqrt{3}$ $ab = 5\sqrt{3}$

$a^2 + b^2 = 75 + 1 = 76$

$$\Rightarrow \frac{1}{\sqrt{2}} \sqrt{76+10\sqrt{3}} = \frac{1}{\sqrt{2}}(5\sqrt{3}+1) \text{ Ans.}$$

Q. If $x = \frac{4\sqrt{6}}{\sqrt{2}+\sqrt{3}}$, then find $\frac{x+\sqrt{8}}{x-\sqrt{8}} + \frac{x+\sqrt{12}}{x-\sqrt{12}}$

Solution:- $x = \frac{4\sqrt{6}}{\sqrt{2}+\sqrt{3}} = \frac{4\sqrt{2} \times \sqrt{3}}{\sqrt{2} \times \sqrt{3}} = \frac{\sqrt{8} \times \sqrt{12}}{\sqrt{2}+\sqrt{3}}$

$$\Rightarrow \frac{x}{\sqrt{8}} = \frac{\sqrt{12}}{\sqrt{2}+\sqrt{3}}$$

applying C & D , we get

$$\frac{x+\sqrt{8}}{x-\sqrt{8}} = \frac{\sqrt{12}+\sqrt{2}+\sqrt{3}}{\sqrt{12}-\sqrt{2}-\sqrt{3}} = \frac{3\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} \quad \text{- i}$$

$$\text{Simillary } \frac{x}{\sqrt{12}} = \frac{\sqrt{8}}{\sqrt{2}+\sqrt{3}}$$

Applying C & D, we get

$$\frac{x+\sqrt{12}}{x-\sqrt{12}} = \frac{\sqrt{8}+(\sqrt{2}+\sqrt{3})}{\sqrt{8}-(\sqrt{2}+\sqrt{3})} = \frac{3\sqrt{2}+\sqrt{3}}{\sqrt{2}-\sqrt{3}} \quad \text{- ii}$$

Adding (i) of (ii), we get

$$\frac{x+\sqrt{8}}{x-\sqrt{8}} + \frac{x+\sqrt{12}}{x-\sqrt{12}} = \frac{3\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} + \frac{3\sqrt{2}+\sqrt{3}}{\sqrt{2}-\sqrt{3}} = 2$$

In these type of Qu. Ans. is always 2

- $\sqrt{a \pm \sqrt{a \pm \sqrt{a \pm \dots}}} = \frac{\sqrt{4a+1} \pm 1}{2}$ [This trick applies to all]

e.g. $\sqrt{12 - \sqrt{12 - \sqrt{12 - \dots}}} \quad [a=2]$

$$= \frac{\sqrt{12 \times 4 + 1} - 1}{2} = 3$$

e.g. $\sqrt{19 + \sqrt{19 + \sqrt{19 + \dots}}} \quad [a=19]$

$$= \frac{\sqrt{4 \times 19 + 1} + 1}{2} = \frac{\sqrt{77} + 1}{2}$$

e.g. $\sqrt{72 + \sqrt{72 + \dots}} \quad [a=72]$

$$= \frac{\sqrt{4 \times 72 + 1} + 1}{2} = \frac{17 + 1}{2} = 9$$

Q. If $\frac{5+2\sqrt{3}}{7+4\sqrt{3}} = a + b\sqrt{3}$, then find the value of $a + b$

Solution:- $\frac{5+2\sqrt{3}}{7+4\sqrt{3}} = a+b\sqrt{3}$

$$\Rightarrow \frac{5+2\sqrt{3}}{7+4\sqrt{3}} \times \frac{7-4\sqrt{3}}{7-4\sqrt{3}} = a + b\sqrt{3}$$

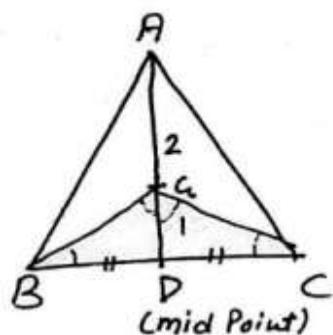
$$\Rightarrow 35 - 6\sqrt{3} - 24 = a + b\sqrt{3}$$

$$\Rightarrow 11 - 6\sqrt{3} = a + b\sqrt{3}$$

Comparing coefficient both sides we get $a = 11$, $b = -6 \therefore a+b = 5$

Q.:- यदि ΔABC का ऐसा केंद्र है, जिसमें $AG=BC$ हो, तो $\angle BGC$ का मान कितना होगा?

Sol.:- (1) 60° (2) 90° (3) 120° (4) 135°



$$AG = 2GD$$

$$\text{and } AG = BC \Rightarrow$$

$$\therefore GD = \frac{1}{2} BC$$

$$\therefore [GD = BD = CD]$$

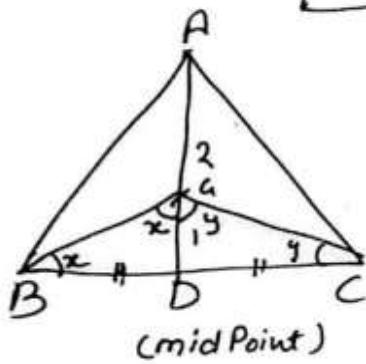
so $\Delta BGD \cong \Delta DGC$ [Isosceles Δ]

$$\therefore \angle BGC = \angle BGD + \angle DGC = \angle DBG + \angle DCB$$

$$\therefore \angle BGC = 90^\circ \quad (\Delta \text{ property})$$

$$\boxed{\angle BGC = 90^\circ}$$

OR



$$AG = 2GD = BC$$

$$\therefore GD = BD = CD$$

$\Delta BGD \cong \Delta DGC \rightarrow$ Isosceles Δ

apply isosceles Δ property.

take $\Delta BGC \Rightarrow$

$$x + y + (x + y) = 180^\circ$$

$$\therefore (x + y) = 180^\circ - 90^\circ$$

$$\therefore$$

$$\boxed{\angle BGC = 90^\circ}$$

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Q:- Brothers A and B had some savings in the ratio 4:5.

They decided to buy a gift for their sister the cost in the ratio 3:4. After they have bought the gift. A spent $\frac{2}{3}$ of his amount while B is left with RS. 145. Then the value of the gift is?

Soln:-

saving

4:5

A : B

4x 5x

Expenditure 3:4 [gift cost]
A : B
3y 4y

$$\frac{(4x) \times \frac{1}{3}}{5x - 145} \times \frac{3}{4} \Rightarrow 16x = 9(5x - 145)$$
$$29x = 145 \times 9$$
$$\boxed{x = 45}$$

$$\text{so } 5 \times 45 - 145 = 4y$$

$$\frac{225 - 145}{4} = y \Rightarrow y = \frac{80}{4} = 20$$

$$\text{Gift cost} = 20 \times 7 = 140 \text{ Rs.}$$

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Q:- एक यात्रा ने कुछ दूरी किसी चाल से तय की, यादि वह 3 km/h अधिक की चाल से वह दूरी तय करता हो तो उसे 40 मिनट कम समय लगता, यदि वह 2 km/h कम की चाल से वह दूरी तय करता, तो उसे 40 मिनट ज्यादा लगती, वह दूरी (km) में है?

- | | |
|---------------------|--------|
| (1) 20 | (3) 35 |
| (2) $36\frac{2}{3}$ | (4) 40 |

Sol:-

$$\begin{aligned}
 & \cancel{s} \quad \cancel{t} \\
 +3 & \cancel{-40} \Rightarrow -40 \cancel{s} + 3t = |-40 \times 3| \quad -\textcircled{1} \\
 -2 & \cancel{+40} \Rightarrow 40 \cancel{s} - 2t = |+40 \times (-2)| \quad -\textcircled{2} \\
 \hline
 t & = 120 + 80 = 200 \text{ minute.}
 \end{aligned}$$

$$S = \frac{80 + 2 \times 200}{40} = \frac{480}{40} = 12 \text{ km/h}$$

$$\text{Distance } D = \frac{2 \times 200}{40} = 40 \text{ km}$$

Q.1- A tradesman gives 4% discount on the marked price and gives 1 article free for buying every 15 articles and thus gains 35%. The marked price is increased above the cost price by.

- (A) 40%. (B) 39%. (C) 50%. (D) 20%.

Soln:-

$$\frac{16 \times 138}{100} = \left(\frac{18 \times x}{100} \right) \times \frac{96}{100}$$

$$x = \frac{144}{96} \times 100 = 150 \text{ (MRP)}$$

So MRP is above the CP is 50%.

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Q.:- A contractor employed 150 workers to complete a project in a certain number partly payment of wages, every day 4 workers start dropping. It results completion late by 8 days. In how many days the project was completed? He imposed on the contractor because of this delay what do you suggest to smooth working so that the project is completed in time.

Soln:-

$$150(n-8) = \frac{n}{2} [2 \times 150 + (n-1)(-4)]$$

$$150(n-8) = n[150 - 2(n-1)]$$

either satisfy by option [This would be easy]

OR solve the quadratic eqⁿ

$$150n - 150 \times 8 = 150n - 2n^2 + 2n$$

$$2n^2 - 2n - 1200 = 0$$

$$n^2 - n - 600 = 0$$

$$\begin{matrix} -25 & \nearrow \\ & 24 \\ \searrow & \Rightarrow & \text{factor} \\ & +25 & \cancel{-24} \end{matrix}$$

So it takes 25 days to complete the work.

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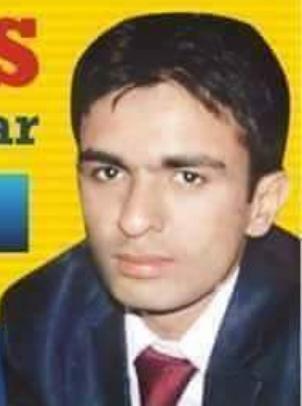
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Q.:- The price of sugar is reduced by 20%. Now a person can buy 500gm sugar for 36 Rs. The original price of the sugar per kg was

- (a) 14.40 Rs. (b) 15.60 Rs. (c) 15.60 Rs. (d) Rs. 16.50 (e) 18 Rs.

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

$$P \rightarrow \begin{matrix} 4 \\ \swarrow \\ 5 \end{matrix}$$

(consumption) C \rightarrow $\begin{matrix} 5 \\ \swarrow \\ \frac{5}{2} \text{ Kg} \end{matrix}$: $\begin{matrix} 4 \\ \curvearrowright \\ 1 \end{matrix} \rightarrow 2 \text{ kg}$ $\rightarrow 500 \text{ gm or } \frac{1}{2} \text{ kg}$

$$\text{original Price} = \frac{36}{2} = 18 \text{ Rs./kg}$$

$$\text{Reduced Price} = \frac{36 \times 2}{5} = \frac{72}{5} = 14.4 \text{ Rs./kg.}$$

Q.:- A Reduction of 10% in the price of sugar enables a housewife to buy 6.2 kg more for ₹1116. The reduced price per kg?

- (A) ₹12 (B) ₹14 (C) ₹16 (D) ₹18.

Soln:-

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

$$P \rightarrow \begin{matrix} 9 \\ \swarrow \\ 10 \end{matrix}$$

$$C \rightarrow \begin{matrix} 10 : 9 \rightarrow 6.2 \times 9 \\ \swarrow \\ 6.2 \times 10 \end{matrix} \rightarrow 6.2 \text{ kg}$$

$$\text{Reduced Price} = \frac{1116}{6.2 \times 10} = ₹18.$$

Ans.

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Q.1:- Due to an increase of 20% in the price of eggs, 2 eggs less are available for Rs. 24. The present rate of eggs per dozen is?

Soln:- (1) 25 Rs. (2) 26.20 Rs. (3) Rs. 27.80 (4) Rs. 28.80

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

$$P \rightarrow 6 \curvearrowleft 5$$

$$C \rightarrow \begin{matrix} \swarrow 5 \\ 10 \text{ eggs} \end{matrix} ; \begin{matrix} \searrow 6 \\ 1 \rightarrow 2 \text{ eggs} \end{matrix} \rightarrow 12 \text{ eggs}$$

$$\text{Present Rate} = \frac{24}{10} = 2.4 \text{ /egg}$$

$$\text{Present rate per dozen} = 2.4 \times 12 = 28.80.$$

Q.1:- A reduction of 25% in the price of rice enables a person to buy 10kg more rice for ₹600. The reduced price per kg of rice is

(1) ₹30 (2) ₹25 (3) ₹20 (4) ₹15

Soln:-

$$25\% \downarrow = \frac{1}{4}$$

$$P \rightarrow 3 \curvearrowleft 4$$

$$C \rightarrow \begin{matrix} \swarrow 4 \\ 40 \text{ kg.} \end{matrix} ; \begin{matrix} \searrow 3 \\ 1 \rightarrow 10 \text{ kg} \end{matrix} \rightarrow 30 \text{ kg}$$

$$\text{Reduced Price per kg} = \frac{600}{45} = 15 \text{ Rs.}$$

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Profit and Loss

Cost Price - The price at which an article is purchased,
(CP) is called its cost price.

Selling Price - The price at which an article is sold,
(SP) is called its selling price.

$$\text{Profit/Loss} = \pm (SP - CP)$$

+ → Profit

- → Loss

Generally, Profit / Loss is calculated on Cost Price,
until, it is mentioned in the question.
And, we will take $\boxed{CP=100}$
Percentage or 100 Method

1) $CP = 100$

Profit → 20%.

$CP \rightarrow 100$

Profit = 100

$SP \rightarrow 100 + 20 = 120$

Fraction Method

$CP = 100$

Profit → 20%.

fraction → $\frac{1}{5}$)

CP	Profit	SP
5	1	6

2) $CP = 100$

Loss → 25%.

CP	Loss	SP
100	25	75

2) $CP = 100$

Loss → 25%. → $\frac{1}{4}$

CP	Loss	SP
4	1	3

$$\text{Profit/Loss \%} = \left(\frac{\text{Profit/Loss}}{CP} \right) \times 100$$

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100 Percentage (100%) Method :-

Example :- A damaged chair that cost Rs. 110 was sold at a loss of 10%. Find the loss and the selling price?

Soln :-

	Loss	SP
$CP \rightarrow 100$	10	$(100 - 10) = 90$
↓	↓	↓
110	11	$\frac{110}{100} \times 90 = 99$

Example :- A toy is sold for Rs. 6.00 at a profit of 25%. Find its SP and Profit amount?

Soln :-

Profit	SP
25	$(100 + 25) = 125$
↓	↓
$\frac{6}{125} \times 100$	6.
$= 4.8$	$\frac{6}{125} \times 25$ $= 1.2$

Example :- A merchant loses 10% by selling an article. If the cost price of the article is ₹ 15. Then the selling price of the article-

Soln :-

CP	Loss	SP
100	10	$(100 - 10) = 90$
↓	↓	↓
15	1.5	13.5

NOTE, Generally, profit/loss calculated on cost price.

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Cost Price		Profit And Loss				
		SP →	Selling Price fraction	P → Profit	L → Loss	
%	Profit	Loss		Profit	Loss	
10%	110	90	# $\frac{1}{10}$	$\frac{11}{10}$	$\frac{9}{10}$	
20%	120	80	# $\frac{1}{5}$	$\frac{6}{5}$	$\frac{4}{5}$	
$33\frac{1}{3}\%$	$133\frac{1}{3}$	66.67	# $\frac{1}{3}$	$\frac{4}{3}$	$\frac{2}{3}$	
$14\frac{2}{7}\%$			# $\frac{1}{7}$	$\frac{8}{7}$	$\frac{6}{7}$	
$57\frac{1}{7}\%$			# $\frac{4}{7}$	$\frac{11}{7}$	$\frac{3}{7}$	

NOTE, For Profit , find $SP = CP + \text{Profit}$ | if Loss $SP = CP - \text{Loss}$

⇒ if Profit 10%

Then simply $\frac{1}{10} \rightarrow \text{Profit}$ and $SP = CP + \text{Profit}$
 $SP = 10 + 1 = 11$

$$\therefore \rightarrow \frac{1}{10} \rightarrow 10+1 \rightarrow SP$$

Loss 10%. → take fraction $\frac{1}{10} \rightarrow \text{Loss}$
 $\frac{9}{10} \rightarrow \text{CP}$

$$\frac{1}{10} \rightarrow \frac{9}{10} \xrightarrow{SP} CP$$

$$SP = CP - LOMS \quad \boxed{\text{or}} \quad LOMS = CP - SP$$

Profit $\rightarrow 14\frac{2}{7}\%$. \Rightarrow fraction $\rightarrow (\frac{1}{7} \xrightarrow{\text{Profit}} CP)$
 $7+1 \rightarrow 8 \rightarrow SP$



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Fraction Method → Example :- if $CP = 555$, Profit = 20%, $SP = ?$

$$20\% = \frac{1}{5} \rightarrow CP \# \frac{6}{5} \rightarrow SP$$

$$5 \rightarrow 555$$

$$SP \ 6 \rightarrow \frac{555}{5} \times 6 = 666$$

Ex :- if $CP = 770$, Profit = $57\frac{1}{7}\%$. $\rightarrow \frac{4}{7}$

$$\begin{array}{c} SP \\ 11 : CP \\ 7 \\ \downarrow \quad \downarrow \\ \frac{770}{7} \times 11 : 770 \\ \downarrow \\ SP \rightarrow 1210 \end{array}$$

Ex :- if $CP = 600$, $10\% \rightarrow 33\frac{1}{3}\%$. $(\frac{1}{3}) \rightarrow CP$

$$\begin{array}{c} SP \leftarrow CP \\ 2 \quad 3 \\ \downarrow \quad \downarrow \\ 600 \\ \frac{600}{3} \times 2 \\ \hookrightarrow 400 \end{array}$$

Ex :- if $SP = 720$, Profit = 20%. i.e. $\rightarrow \frac{1}{5} \rightarrow CP$

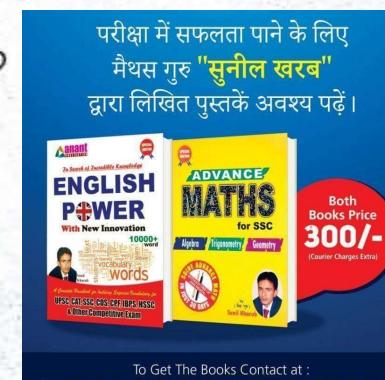
$$\begin{array}{cc} SP & CP \\ (5+1) & \\ 6 & \downarrow \\ \downarrow & 5 \\ 720 & \frac{720}{6} \times 5 = 600 \end{array}$$

Ex :- if $SP = 880$, Profit = $14\frac{2}{7}\%$. i.e. $\rightarrow \frac{1}{7} \rightarrow CP$.

$$\begin{array}{cc} SP & CP \\ (7+1) & \\ 8 & \downarrow \\ \downarrow & 7 \\ 880 & \frac{880}{8} \times 7 = 770 \end{array}$$

Ex :- if $SP = 400$, $10\% \Rightarrow 33\frac{1}{3}\%$. i.e. $\rightarrow \frac{1}{3} \rightarrow CP$

$$\begin{array}{cc} SP & CP \\ (3+1) & \\ 2 & \downarrow \\ \downarrow & 3 \\ 400 & \frac{400}{2} \times 3 = 600 \end{array}$$



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Ex:- if $SP = 650$, Profit $\rightarrow 30\%$.
find Profit=?

$$30\% \rightarrow \frac{3}{10} \rightarrow \text{Profit}$$

$$10 \rightarrow CP$$

$$3+10=13 \rightarrow SP$$

SP	CP	Profit
13	10	3
\downarrow		\downarrow
650		$\frac{650}{13} \times 3 = 150$

Ex:- if Profit $\rightarrow 280$, Profit % $\rightarrow 57\frac{1}{4}$ (i.e. $\frac{4}{7} \rightarrow CP$)
find CP & SP

CP	SP	Profit
7	11	4
\downarrow	\downarrow	\downarrow
$\frac{280}{4} \times 7$	$\frac{280}{4} \times 11$	280
		3770
		$\hookrightarrow 490$

Question1:- A man buy a cycle for Rs. 1400 and sells it at a loss of 15%. what is selling price of the cycle?

Sol1:-

$$\text{Loss} = 15\% \text{ i.e } \frac{15}{100} \times 20 = \frac{3}{20} \rightarrow CP$$

CP	SP	Loss
20	$(20-3=17)$	3
\downarrow	\downarrow	
1400	$\frac{1400}{20} \times 17 = 1190$	

Question2:- A TV is purchased at Rs. 5000 and sold at Rs. 4000. Find Loss Percent?

Sol2:-

$$\text{Loss \%} = \frac{1000}{5000} \times \frac{20}{100} = 20\%$$

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Question 3:- A person incurs a loss of 5%. by selling a watch for Rs. 1140. At what price should the watch be sold to earn 5% profit?

Sol? :-

$$\begin{array}{ccc}
 CP \rightarrow 100 & & \\
 -5\% & \nearrow \text{for} & \downarrow +5\% \text{ Profit} \\
 95 & & 105 \\
 \hookrightarrow 1140 & & \hookrightarrow \frac{1140}{95} \times 105 = 1260 \text{ Rs.} \\
 & & 19
 \end{array}$$

Question 4:- A book was sold for Rs. 27.50 with a profit of 10%. If it were sold for Rs. 25.75 then would have been percentage of profit & loss?

Sol? :-

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

$$\begin{array}{ccc}
 CP & \text{Profit} & SP \\
 \downarrow & \downarrow & \\
 10 & 1 & 11 \\
 \downarrow & & \downarrow \\
 27.50 & & 27.50 \\
 \frac{27.50}{11} \times 10 & & \\
 CP = 25, \text{ now, } SP \rightarrow 25.75 & & \\
 \text{Profit} \rightarrow 0.75 & &
 \end{array}$$

$$P\% = \frac{0.75}{25} \times 100 = 3.00\%$$

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OR

$$110 \rightarrow 27.50$$

$$\therefore 100 \rightarrow 25$$

$$\text{if } SP \rightarrow 25.75$$

$$\text{The } P\% = \frac{0.75}{25} \times 100 = 3\%$$

Profit and Loss Based on selling Price :-

Example :- A toy is sold for 400 Rs. at profit of 25% of selling price. Separate this selling price into cost and profit?

Soln:- $25\% \rightarrow \frac{1}{4} \rightarrow \text{Profit}$ ($CP = SP - \text{Profit}$)

SP	CP	Profit
↓	↓	↓
4	(4-1=3)	1
↓	↓	profit on Cost Price = $\frac{100}{300} \times 100$
400	300	= $33\frac{1}{3}\%$.

Example :- At a sale, necklaces selling at RS. 50 are sold at a loss of 60% of selling price. What is the loss and the original cost?

Soln:- $60\% \rightarrow \frac{6}{10} \rightarrow \frac{3}{5} \rightarrow \text{Loss}$ ($CP = SP + \text{Loss}$)

SP	Loss	CP (SP+Loss)
↓	-3	28
5	↓	↓
↓	-30	80
50		CP = 80

$$\text{Loss} \rightarrow 30$$

$$\text{and Loss at CP} = \frac{30}{80} \times 100 = 37.5\%.$$

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Example :- If the cost price is 25% of selling price. Then what is the profit percent?

Soln:- $CP = \frac{1}{4} SP \Rightarrow \frac{CP}{SP} = \frac{1}{4} \Rightarrow P = SP - CP = 3$

$$P\% = \frac{3}{1} \times 100 = 300\%.$$

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Question 1 :- If the cost price is 95% of the selling price, what is profit percent?

Soln:- $CP = \frac{95}{100} SP \Rightarrow CP : SP$

$$P\% = \frac{1}{19} \times 100 = 5.26\%$$

Question 2 :- If there is a profit of 20% on the cost price of an article, the percentage of profit calculated on its selling price will be-

Soln:- $20\% \rightarrow \frac{1}{5} \rightarrow CP$

$$CP \quad SP \quad P$$

$$5 \quad 6 \quad 1$$

$$\text{Profit on } SP = \frac{1}{6} \times 100 = 16\frac{2}{3}\%$$

Question 3 :- If selling price of an article is $1\frac{1}{3}$ of cost price, find gain%.

Soln:- $SP = \frac{4}{3} CP \Rightarrow SP \quad CP$

$$\underbrace{P \rightarrow 1}$$

$$\text{Gain \%} = \frac{1}{3} = 33\frac{1}{3}\%$$

CGL - 2013 & 2014

Question 4 :- A shopkeeper sold a sewing machine in Rs. 1080 with 10% loss. Find the price so that he would get 10% profit?

Soln:- $90 \rightarrow 1080$

$$110 \rightarrow \frac{1080}{90} \times 110 = 1320 \text{ Rs.}$$

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Question 5:- A mobile was sold at a loss of 8%. It was observed that if the selling price was Rs. 540 more, the profit made would have been 10%. What is the actual selling price of the mobile?

Soln:-

$$\begin{array}{r}
 CP \rightarrow 100 \\
 -8 / +10 \\
 92 \quad 110 \\
 \hline
 18\% \rightarrow 540 \\
 100 \rightarrow 3000
 \end{array}$$

$$\text{actual SP (i.e. } \rightarrow 92) = \frac{3000}{100} \times 92 \\
 = 2760$$

Question 6:- A man sold an item at 7% loss; had he been able to sell it at a gain of 9%, it would have gain Rs. 64 that it did. what was cost price.

Soln:-

$$\begin{array}{r}
 CP \rightarrow 100 \\
 -7 / +9 \\
 93 \quad 109 \\
 \hline
 16\% \rightarrow 64 \\
 100 \rightarrow 400 \\
 \boxed{CP = 400 \text{ Rs.}}
 \end{array}$$

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Question 7. A man gains 20% by selling an article for a certain price. If he sells it at double the price, the % of profit will be?

Soln:-

$$\begin{array}{ccc}
 20\% \rightarrow \frac{1}{5} & CP & P \\
 & 5 & 1 \\
 & & 6 \\
 & & \searrow \\
 & & P = 7
 \end{array}$$

↓ if sell double the price.

$$P\% = \frac{7}{5} \times 100 = 140\%$$

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Question 8:- A plot is sold for Rs. 18,700 with a loss of 15%. At what price it should be sold to get profit of 15%.

Soln:-

$$\begin{array}{r}
 100 \xrightarrow{+15} 115 \\
 -15/ \\
 85 \rightarrow 18,700 \\
 115 \rightarrow \frac{18700}{85} \times 115 = 1100 \times 23 \\
 = 25300
 \end{array}$$

Question 9:- A person sold an item at 20% profit, had it been able to purchase 10% less. Then his profit % becomes?

Soln:-

$$\begin{array}{r}
 CP \quad SP \\
 100 \xrightarrow{+20} 120 \\
 \text{if } -10 \\
 CP \quad SP \\
 90 \xrightarrow{+30} 120 \\
 P.V. = \frac{30}{90} \times 100 = 33\frac{1}{3}\%
 \end{array}$$

Question 10. A man sold an item 10% less, if he had bought it at 20% less then his his profit%.

Soln:-

$$\begin{array}{r}
 CP \quad SP \\
 100 \xrightarrow{-10} 90 \\
 \text{if } -20 \\
 CP \quad SP \\
 80 \xrightarrow{+10} 90 \\
 P.V. \rightarrow \frac{10}{80} \times 100 = 12\frac{1}{2}\%
 \end{array}$$

Question 11- A person sold an item at 10% profit. If he had bought it at 10% less and sold it for Rs. 3 more than it did he would have gained 25%. Find CP=?

Soln:-

$$\begin{array}{r}
 CP \quad SP \\
 100 \xrightarrow{+10} 110 \\
 \text{if } -10 \\
 CP \quad SP \\
 90 \xrightarrow{+25\%} 90 \times \frac{5}{4} = 112.50
 \end{array}
 \left. \begin{array}{l}
 02.5 \rightarrow 3 \\
 100 \rightarrow \frac{3}{12.5} \times 100 = 240
 \end{array} \right\} 240/120$$

Question 12:- A man sold an article at 10% less. If he had bought it for 20% less and sold it for RS. 55 more. He would have profit of 40%. Find CP=?

Soln:-

$$\begin{array}{ccc}
 & \xrightarrow{\text{CP}} & \xrightarrow{\text{SP}} \\
 100 & \xrightarrow{-10} & 90 \\
 \text{if } -20 / & & 22 \rightarrow 55 \\
 \xrightarrow{\text{CP}} 80 & \xrightarrow{40\%} 112 & 100 \rightarrow \frac{55}{22} \times 100 = 250
 \end{array}$$

Question 13:- A man sells an article at a profit of 20%. If he bought it at 20% less and sold it for RS. 75 less. He would have gain 25%. Find CP=?

Soln:-

$$\begin{array}{ccc}
 & \xrightarrow{\text{CP}} & \xrightarrow{\text{SP}} \\
 100 & \xrightarrow{+20} & 120 \\
 \text{if } -20 / & & 20 \rightarrow 75 \\
 \xrightarrow{\text{CP}} 80 & \xrightarrow{25\% \text{ gain}} 100 & 100 \rightarrow \frac{75}{25} \times 100 = 375
 \end{array}$$

Question 14:- A man wanted to sell an article with 20% but he actually sold at 20% less for RS. 480. At what price he wanted to sell it to earn the profit?

Soln:-

$$\begin{array}{c}
 100 \xrightarrow{-20\%} 80 \xrightarrow{+20\%} 120 \rightarrow \frac{480}{80} \times 120 = 720
 \end{array}$$

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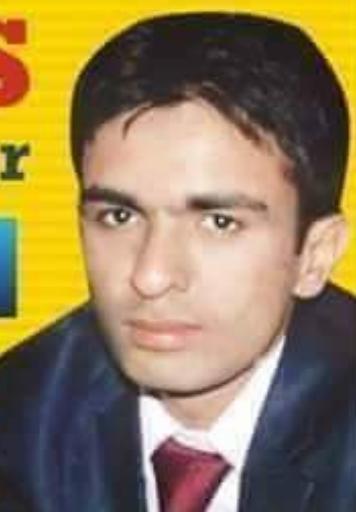
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Chain Related Question -

Question1:- A sold an book to B at a profit of 20% and B sold it the same book to C at a profit of 10%. If C bought it for Rs. 396. How much did A pay for it?

Soln:-

A B C

$$100 \rightarrow 120 \xrightarrow{+10\%} 132$$

$$132 \rightarrow 396$$

$$100 \rightarrow \frac{396}{132} \times 100 = 300$$

Question2:- A sells an article to B at a loss of 20%. B to C at a gain of 15%. to D at a loss of 5% and D to E at a profit of 10%. If E had to pay Rs. 500. How much did A pay for it?

Soln:-

A B C D E

$$100 \rightarrow 80 \xrightarrow{+15\%} 92 \xrightarrow{-5\%} 87.4 \xrightarrow{+10\%} 96.14$$

$$96.14 = 500$$

$$100 = \frac{500}{\frac{96.14}{48.07}} \times 100 = 520.07$$

or A to E $\rightarrow 100 \times \frac{80}{100} \times \frac{115}{100} \times \frac{95}{100} \times \frac{110}{100} \rightarrow 500$

$$100 \rightarrow \frac{\frac{102}{80} \times \frac{25}{115} \times \frac{100}{95} \times \frac{10}{11}}{\frac{4}{23} \times \frac{19}{11}} = 520.07$$

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Question 3:- Ravi bought a book at 25% discount on its original price. He sold it with 50% increase on the price he bought it. The new sale price is by what percent more than the original price?

Sol? :-

Original Ravi

$$100 \xrightarrow{-25\%} 75 \xrightarrow{+50\%} 112.5$$

↓
12.5%

∴ New sale price is 12.5% more than the original price.

Question 4:- Shopkeeper marked the selling price of a book at 12% above the cost price. At the time of selling, he allowed certain discount and suffered a loss of 2%. Find the discount percentage?

Sol? :-

MP	CP	SP
112	$\xleftarrow{+12\%} 100$	$\xrightarrow{\text{loss}} 98$
D		
$\frac{14}{112} \times 100 = 12.5\%$		



$$\text{Discount \%} = 12.5\%.$$

Question 5:- A sells a bicycle to B at a profit of 20%. B sells it to C at a profit of 25%. If C pays Rs. 225/- for it, the CP of the bicycle for A is-

Sol? :-

A	B	C
100	$\xrightarrow{+20\%} 120$	$\xrightarrow{+25\%} 150$
$\frac{3}{2}$		
$150 \rightarrow 225$		
$100 \rightarrow \frac{3}{2} \times 100 = 150$		



⇒ when Quantities at Cost Price and at selling Price are different :-

Question 1:- A man bought toffees at the rate of 15 for a rupee and sold them at the rate of 12 for a rupee. Find gain/loss percentage?

Soln :-

Quantity	Price
$x - 15$	1 ← CP
$y - 12$	1 ← SP

$$\text{Profit} = \frac{15-12}{12} \times 100 = \frac{3}{12} \times 100\% = 25\%$$

$$P\% \rightarrow 25\%$$

NOTE → If CP & SP are same but Quantities are different.

$$\text{Then Profit/Loss \%} = \left(\frac{x-y}{y} \right) \times 100$$

Profit → if +ve

Loss → if -ve

$x \rightarrow$ Quantity bought at CP

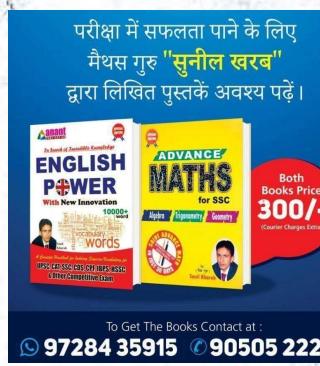
$y \rightarrow$ Quantity sold at SP.

Question 2:- A person buys some pencils at 5 for a rupee and sells them at 3 for a rupee. His gain percent will be -

Quantity	Cost
5	1 ← CP
3	1 ← SP

5	1 ← CP
3	1 ← SP

$$\text{Profit \%} = \frac{5-3}{3} \times 100 = \frac{200}{3} = 66\frac{2}{3}\%$$



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Question 3:- The cost price of 36 books is equal to the selling price of 30 books. The gain % is -

Soln:-

$$\text{gain \%} = \frac{36-30}{30} \times 100 \left(\frac{x-4}{4} \times 100 = \text{P.\%} \right)$$

$$= \frac{6}{30} \times 100 = 20\%$$

(or)

$$36 CP = 30 SP$$

$$\frac{CP}{SP} = \frac{30}{36}$$

$$\begin{array}{c} CP \\ 5 \\ \swarrow \\ 6 \end{array}$$

$$\text{P.\%} = \frac{1}{5} \times 100 = 20\%$$

Question 4:- If I would have purchased 11 articles for Rs. 10 and sold all the articles at the rate of 11 for Rs. 11. The profit percent would have been

Soln:-

Quantity	Cost
11	10 ← CP
10	11 ← SP

$$\text{P.\%} = \frac{11 \times 11 - 10 \times 10}{10 \times 10} \times 100 = \frac{121-100}{100} \times 100$$

$$= 21\%$$

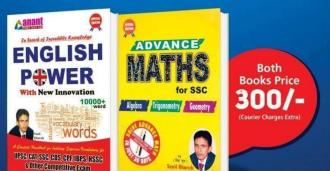
Question 5:- Bananas are bought at the rate of 6 for Rs. 5 and sold at the rate of 5 for Rs. 6 profit percent is -

Soln:-

Quantity	Cost
6	5 ← CP
5	6 ← SP

$$\text{P.\%} = \frac{36-25}{25} \times 100 = 11 \times 4 = 44\%$$

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Question 6:- A retailer bought some apple at the rate of 7 apple for RS. 4 and sold them at the rate of 8 apple for RS. 5. If he gains RS. 30 on that day. Find the quantity of apple sold by him?

Sol:-

$$\left. \begin{array}{l} CP = \frac{4}{7} \\ SP = \frac{5}{8} \end{array} \right\} \text{Profit} = SP - CP = \frac{5}{8} - \frac{4}{7} = \frac{3}{56} \rightarrow \text{Profit RS. } 3 \text{ per article}$$

56 article → Profit 3 RS.

Profit 30 RS. → on 560 article.

Question 7:- A man bought oranges at the rate of 8 for RS. 34 and sold them at the rate of 12 for RS. 57. How many oranges should be sold to earn a net profit of RS. 45.

Sol:-

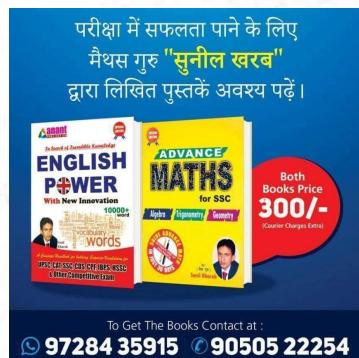
$$CP = \frac{34}{8} = \frac{17}{4}$$

$$SP = \frac{57}{12} = \frac{19}{4}$$

$$\text{Profit} = \frac{19}{4} - \frac{17}{4} = \frac{2}{4} \rightarrow \text{Profit}$$

$\frac{1}{2}$ article → Profit RS. 1

90 Article ← Profit RS. 45



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Dishonest Dealer :-

$$\% \text{ Gain} = \frac{\text{error}}{\text{False weight}} \times 100$$

Question 1. :- A dishonest dealer to sell his goods at cost price, but he uses a weight of 960 grams for the kg weight. Then the percentage of gain is -

Soln :-

$$\text{Gain \%} = \frac{1000 - 960}{960} \times 100 = \frac{40}{960} \times 100 = 4\frac{1}{6}\%$$

Question 2. :- A dealer professes to sell his goods at CP but unfortunately he weighs 1200 gm instead of 1 kg. Find loss %.

Soln :-

$$\text{Loss \%} = \frac{200}{1200} \times 100 = 16\frac{2}{3}\%$$

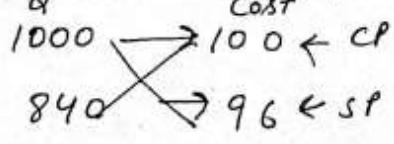
Question 3. :- A dishonest dealer professes to sell his goods at CP but he uses 20% less weight. Find Profit %?

Soln :-

$$\text{Profit \%} = \frac{26}{80} \times 100 = 25\%$$

Question 4. - A merchant professes to loss 4% on a certain tea. But he uses a weight equal to 840 grams instead of 1 kg. Find his real cost / loss / gain?

Soln :- Method-1



$$\frac{960 - 840}{840} \times 100 = \frac{120}{840} \times 100 = 14\frac{2}{7}\%$$

OR

$$\left(\begin{matrix} 96 \\ 100 \\ 84 \end{matrix} \right) \rightarrow 12 \quad \frac{12}{84} \times 100 = 14\frac{2}{7}\%$$

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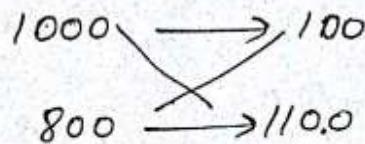
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Question 5:- A grocer sells rice at a profit of 10% and uses a weight which is 20% less. Find his total percentage gain?

Soln:- Method-1



$$\frac{1100 - 800}{800} \times 100 = \frac{300}{800} \times 100 \\ = 37.5\%$$

Method-2, $\therefore \text{Gain} = \frac{1000 - 800}{800} \times 100 = \frac{200}{800} \times 100 = 25\%$.

10% Profit \rightarrow selling Time

$$\text{Net Profit} = x + y + \frac{xy}{100} \\ = 25 + 10 + \frac{25 \times 10}{100} = 37.5\%.$$

Method-3

$$\left(\frac{\text{Profit \%} + \text{less in weight \%}}{100 - \text{less in weight \%}} \right) \times 100$$

$$= \left(\frac{10 + 20}{100 - 20} \right) \times 100 = \frac{30}{80} \times 100 = 37.5\%.$$

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Question 6:- A dishonest dealer sells goods at 10% loss on cost price but uses 15 grams instead of 20 grams. what is his percentage profit or loss?

Sol? :- (Buy time)

20 $\cancel{100}$

(Selling time) 15 $\cancel{90}$

$$\frac{18-15}{15} \times 100 = \frac{3}{15} \times 100 = 20\%$$

Profit = 20%.

Question 7:- A dishonest dealer sells the goods at $6\frac{1}{2}\%$ loss on cost price but uses $12\frac{1}{2}\%$ less weight. what is his percentage profit or loss?

Sol? :-

weight price

1000 $\cancel{10}$

(Buy time)

875 $\cancel{93.75}$

(Selling time)

$$\frac{9375-8750}{8750} \times 100 = \frac{625}{8750} \times 100$$

$$\text{Profit} = \frac{50}{7} = 7\frac{1}{7}\%$$

Question 8:- A dishonest dealer sells goods at 30% profit but uses only 800 grams in the place of a kg weight. what is his real gain percentage?

Sol? :- (Buy time)

Quantity Price

1000 $\cancel{100}$

(Sell time) 800 $\cancel{130}$

$$\frac{1300-800}{800} \times 100 = \frac{500}{8} = 62.5\%$$

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Marked Price (MP) and Discount



Marked Price / Label Price / Tag Price / List Price

→ Discount% is always given on MP. ($SP = MP - D$)

→ Profit/Loss% is always calculated on cost price.
 $CP \rightarrow$ always take 100%.

Example :- An article was sold for RS. 490 after giving discount of 30%, what is the marked price?

Soln:-

$$\begin{array}{c} MP - 100 \\ \text{Discount} - 30 \\ SP = ? \\ SP = 490 \\ \text{so } 100 = 700 \end{array}$$

[Here CP is not given
so simple taken
 $MP = 100$]

Example :- A shopkeeper offers a discount of 10% on his articles. The marked price of the article is RS. 450. The selling price should be?

Soln:-

$$\begin{array}{c} 100 = 450 \\ D = -10 \\ 90 = \frac{450}{100} \times 90 = 40.5 \text{ Rs} \end{array}$$

Example :- A merchant marked the price on his goods 20% more than its cost price and allows a discount of 15%. His profit percentage is

Soln:-

$$\begin{array}{ccc} MP & CP & SP \\ 120 & \xleftarrow[15\%]{\text{Discount}} 100 & \xrightarrow{102} \\ & & \text{so profit \%} = 2\% \end{array}$$

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Question 1:- After allowing a discount of 16%, there was still a gain of 5%. Then the percentage of marked price over the cost?

Soln:-

MP	CP	SP
125	100	105

$\curvearrowright D = 16\%$

so % of MP over the cost = 25%.



Question 2:- If a discount 10% given on the MP of a book, the publisher gains 20%. If the discount is increased to 15%, the gain of publisher is?

Soln:-

MP	CP	SP
$133\frac{1}{3}$	100	120

\curvearrowright

if $D \uparrow \rightarrow 15\%$.

$$\text{Then profit} \rightarrow \frac{400}{3} \times \frac{85}{100} = \frac{340}{3} = 113.33 \text{ (SP)}$$

profit % = 13.33%.

Question 3:- A trader gains 12% after selling a book at 10% discount on the printed price. The ratio of the cost price and printed price of the item is?

Soln:-

MP	CP	SP
1120	100	112

$\curvearrowright D = 10\%$

$$\text{Ratio } \frac{CP}{MP} = \frac{100 \times 9}{1120} = \frac{900}{1120} = \frac{45}{56}$$

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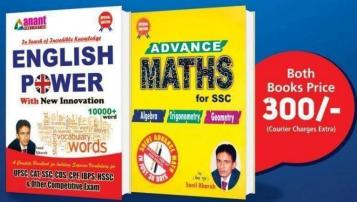
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Question 4:- The marked price of an article is 50% above its cost price. When marked price is increased by 20%, and selling price is increased by 20%, the profit is doubled. If original marked price was Rs. 600. The original selling price was?

Sol? :-

MP	CP	SP
150	$\leftarrow 100 \rightarrow 400$	$SP = 500$
$\downarrow +20\%$		$\downarrow +20\%$
180		$\frac{6}{5} SP$
	$150 \rightarrow 600$	
	$100 \rightarrow 400$	
$\frac{6}{5} SP - 400 = 2(SP - 400)$		
$\frac{6}{5} SP = 400$	$\boxed{SP = 500}$	



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Question 5:- A trader marked the price of a commodity so as to include a profit of 25%. but allowed a discount of 16% on marked price. His actual profit will be-

Sol? :-

MP	CP	SP
125	$\leftarrow 100$	105
		actual Profit = 5%.
	$\xrightarrow[D]{16\%} 125 \times \frac{21}{160} = 105$	

Question 6:- A shopkeeper fixes $\frac{4}{3}$ the MP of an item 35% above its CP. The percentage of discount allowed to gain 8% is-

Sol? :-

MP	CP	SP
135	$\leftarrow 100 \rightarrow 108$	
		$D = \frac{27}{135} \times 100 = 20\%$

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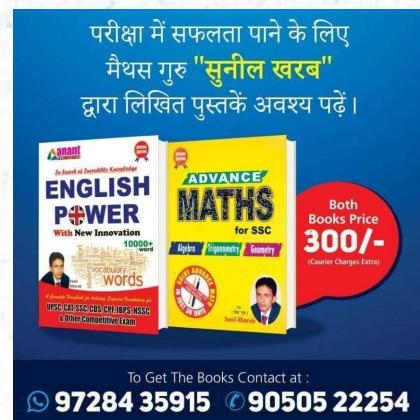


⇒ when same no. of article buy at a different rates and sell whole lot at a different rate
Then profit / loss -

Question 1:- A fruit seller buys some oranges at a rate of 4 for Rs. 10 and equal no. more at 5 for Rs. 10. He sells the whole lot at 9 for Rs. 20. what is loss or gain percent?

Soln:-

Price	Quantity
10	4] × 5
10	5] × 4
<u>Rs. 50</u>	<u>20 (Q)</u>
<u>Rs. 40</u>	<u>20 (Q)</u>
<u>Rs. 90</u>	<u>40] × 9 Total Q</u> → 810
<u>20</u>	<u>9] × 40</u> → 360 (Selling Price)



so → Here clearly loss, CP = 810
SP → 800

$$\text{loss \%} = \frac{10}{810} \times 100 = 1\frac{19}{81}\%.$$

Question 2:- Some article bought at the rate of 11 for Rs. 10 and the same no. of article at the rate of 9 for Rs. 10. If whole lot was sold at 1 RS. per article then gain/loss

Soln:-

P	Q	P	Q
10	11] × 9	→ 90	99
10	9] × 11	→ 110	99
<u>200</u>			<u>198 (Q)</u>
<u>198</u>			198 C. I. RS. Per article
<u>loss → 2</u>			

$$\text{loss \%} = \frac{2}{200} \times 100 = 1\%.$$

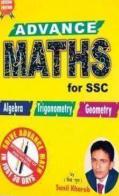
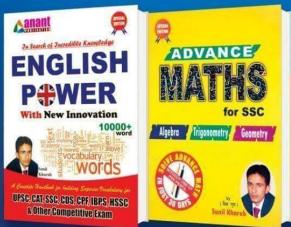


Question 3:- A man bought a certain no. of pen at the rate of 6 for RS. 2 and equal no. of pen at the rate of 8 for RS. 4. At what price per dozen should he sell them to make a profit of 10%.

Soln:-

$$\begin{array}{rcccl}
 P & & Q & & P \\
 2 & 6] \times 2 & \rightarrow & 8 & 24 \\
 4 & 8] \times 6 & & 12 & 24 \\
 & & & \hline & 20 & 48 \\
 & & & & x & 12] \times 4 \\
 & & & & & \hline & & & & 20 & 48 & (CP) \\
 & & & & & 4x & 48 & (SP) \\
 & & & & & \hline & & & & 4x - 20 & 2 \\
 & & & & & \frac{2}{2} & \times 100 = 10 \\
 & & & & & 4x = 22 & \Rightarrow x = \frac{22}{4} = 5.5
 \end{array}$$

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Question 4:- A man purchase some orange at a rate of 1 orange for RS. 2 and same no. of orange at a rate of 2 orange for RS. 1. He sells whole at certain rate to earn a profit of 10%.
find SP of 1 orange.

Soln:-

$$\begin{array}{rcccl}
 P & & Q & & P \\
 2 & 1] \times 2 & \rightarrow & 4 & 2 \\
 1 & 2 & \rightarrow & 1 & 2 \\
 & & & \hline & 5 & 4 & (CP) \\
 & & & & x & 4 & (SP) \\
 & & & & \hline & & & & x - 5 & 2 \\
 & & & & \frac{2}{5} & \times 100 = 10 \\
 & & & & x - 5 = 0.5 & \Rightarrow x = 5.5
 \end{array}$$

$$SP \text{ of } 1 \text{ orange} = \frac{5.5}{4} = 1.375$$

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⇒ when Two quantity sold at same price but at a profit and other one is at a loss, then CP of both quantity?

Question 1:- A sales man sells 2 watches for Rs. 1060 each. On one he gets 20% profit and on the other 20% loss. His profit or loss in the entire transaction was -

Soln:- ^{NOTE} This type of questions always occur → Loss

gmb If a person sells two items at the same price, one at a gain of $\frac{x}{10}$ and another at a loss of $\frac{x}{10}$. Then the seller always incurs a loss.

$$\text{and loss} = \left(\frac{x}{10}\right)^2$$

∴ Ans $\Rightarrow x = 20\%$.

$$\text{loss} = \left(\frac{20}{10}\right)^2 = -4\%$$

Question 2- A person sells two machines at Rs. 396 each. One he gains 10% and on the other he losses 10%. His profit or loss in the whole transaction is -

Soln:- $\text{loss} = \left(\frac{10}{10}\right)^2 = -1\%$

Question 1:- A house and a shop were sold for Rs. 1 lakh each. In this transaction, the house sale resulted into 20% loss whereas the shop sale into 20% profit. The entire transaction resulted in -

Soln:- $\text{loss} = \left(\frac{20}{10}\right)^2 = -4\%$

$$96 \rightarrow 2 \text{ lakh}$$

$$-4\% = \frac{2 \times 4}{96/12} = \frac{1}{12} \text{ lakh.}$$

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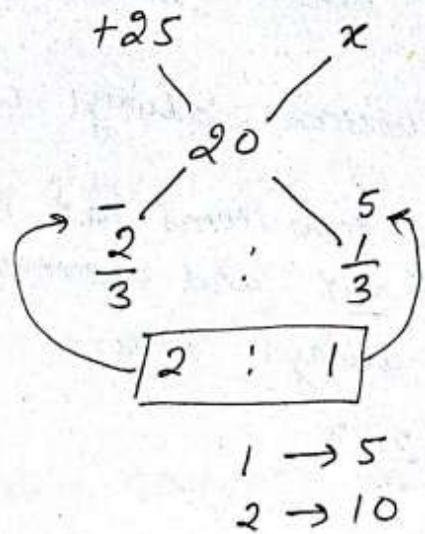
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⇒ Some Profit / Loss question using Allegation Method →

Question 1:- A man buys some books for Rs. 4800. He sells $\frac{2}{3}$ of it at a profit of 25%. At what percent gain should he sell the remaining so as to make an overall profit of 40% on the whole transaction?

Sol:-



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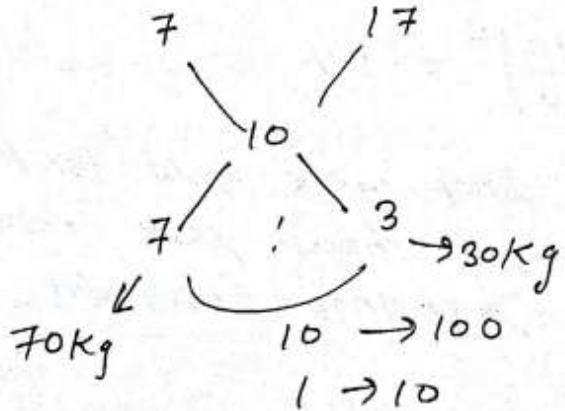
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So $\frac{1}{3}$ of it sold at $\rightarrow 10\%$.

Question 2:- A man had 100 kg of sugar part of which he sold at 7% profit and rest at 17% profit. He gained 10% on the whole. How much did he sell at 7% profit?

Sol?:-



Ans \rightarrow 70kg.

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Some Other Important Questions:-

Question 1:- Two articles are sold at the same price. One at a profit of 75% and another at a loss of 30%. What is the overall profit/loss?

Sol:-

Two Article →
one at a profit → 75%.

$$\begin{array}{ll} \text{CP} & \text{SP} \\ 100 & 175 \text{ (A)} \end{array}$$

$$250 = \frac{175}{70} \times 100 = 175 \text{ (B)} \quad (\text{because SP is same})$$

$$\begin{array}{l} \text{Total CP} = 350 \\ \text{Total SP} = 350 \end{array} \left. \begin{array}{l} \text{so There is no profit NO LOSS.} \\ \text{ } \end{array} \right\}$$

Q4L-2013.

Question 2:- A person bought two bicycles for Rs. 1600 and sold the first at 10% profit and the second at 20% profit. If he sold the first at 20% profit and second at 10% profit, he would get Rs. 5 more. The diff' of the cost price of the two bicycle was-

Sol:-

$$\begin{array}{l} A+B = 1600 \quad \text{---(1)} \\ \text{and } \text{I}^{\text{st}} \text{ (1.1A + 1.2B) Then } 1.2A + 1.1B \end{array}$$

$$\text{So, } 1.2A + 1.1B - 1.1A - 1.2B = 5$$

$$0.1A - 0.1B = 5$$

$$A - B = 50 \quad \text{---(2)}$$

$$\begin{array}{l} A = \frac{1600+50}{2}, \quad B = \frac{1600-50}{2} \\ \boxed{A = 825} \quad \boxed{B = 775} \end{array}$$

Diff' b/w Their Cost Price

$$= 825 - 775 = 50 \text{ RS.}$$



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Question 3:- A shopkeeper bought an article in Rs. 450. He labelled it 20% more than the cost price. If he sold the article in Rs. 496.80, find the discount percentage given by him?

Solⁿ:

MP	CP	SP
120 ← 100		
↓	↓	
540	450	496.80

$$D\% = \frac{43.2}{540} \times 100 = \frac{432}{54} = 8\%$$

Question 4:- A trader gives an additional concession of 35% on an article which is already get discounted by 20% on the marked price. If the buyer pays an amount of Rs. 1300 for the article, then the marked price is -

Solⁿ:

MP		D
100	→ -20%	80 → -35%
		52
		80 → 52 → 1300
		100 → 2500 RS.

Question 5:- I sold two hens for Rs. 105 each. On one I lost 25%. On the other I gained 50%. what is the gain / loss on my total outlay?

Solⁿ:

1 st hen	SP	Total CP = 140 + 70 = 210
CP	105	Total SP = 105 + 105 = 210
$\frac{35}{105} \times 100$		So, There is NO profit & NO loss.
$= 140$		
2 nd	SP	
CP	105	
$\frac{105}{20} \times 100$	105	
$= 150$		
$\frac{35}{105} \times 2$		
$= 70$		



$$\frac{B}{9} + 2 = \frac{B-3}{6} \Rightarrow \frac{B}{9} + 2 = \frac{B}{6} - \frac{1}{2}$$

$$\frac{B}{9} - \frac{B}{6} = -2 - \frac{1}{2}$$

$$\frac{B}{18} = \frac{5}{2} \Rightarrow \boxed{B = 45}$$

Question :- In the Bargaining Bazar everyone purchase with a fair bargaining, so the traders markup the prices too much. A trader marked up an article at Rs. M expected huge profit if it is sold on marked price. But a customer purchased it at $\frac{M}{2}$ with his fine bargaining skills, so the expected profit of the trader diminished by 66.66%. what is the percentage discount fetched by the customer through bargaining?

Soln:-

MP SP

M $\frac{M}{2}$

$$\frac{1}{2} \times 100 = 50\%$$

Question :- A merchant can buy goods at the rate of Rs. 20 per good. The particular good is part of an overall collection and the value is linked to the no. of items that are already on the market. So, the merchant sells the first good for Rs. 2, second one for Rs. 4, third for Rs. 6 ... and so on. If he wants to make an overall profit of atleast 40%, what is the minimum no. of goods he should sell?

Soln:- Assume he buys n goods.

$$\therefore \text{Total CP} = 20n$$

$$\text{SP} = \frac{140}{196} \times 20n = 28n$$

$$\begin{aligned} \text{Total SP} & 2 + 4 + 6 + 8 + \dots n \text{ terms} \geq 28n \\ 2(1+2+3+\dots+n) & \geq 28n \\ \cancel{2} \times \cancel{n}(n+1) & \geq 28n \\ \cancel{n} & \geq 27 \end{aligned}$$

- He should sell a minimum of 27 goods.

Question :- After selling 10 candles a man earn a profit of the SP of 3 Pens; while selling 10 pens a man loss SP of 4 candle. The numerical value of profit % and loss % is equal and cost price of candle is $\frac{1}{2}$ of CP of Pen. Find the ratio of SP of candle to Pen?

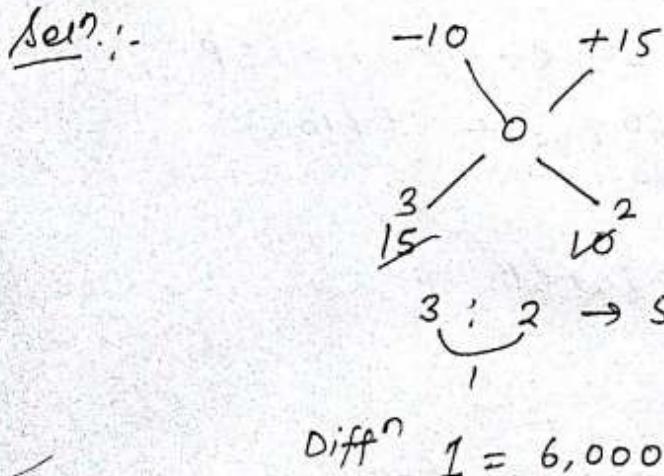
Price	Candle	Pen
CP	x	$2x$
SP	A	B

$$10(A-x) = 3B \Rightarrow \text{Profit \%} = \frac{3B}{10x} \times 100 = \frac{30B}{x}$$

$$10(2x-B) = 4A \Rightarrow \text{Loss \%} = \frac{4A}{20x} \times 100 = \frac{40A}{2x}$$

$$3B = 2A \Rightarrow \boxed{\frac{A}{B} = \frac{3}{2}}$$

Question :- A traders sells two articles, one at a loss of 10% and another at a profit of 15%. but finally there is no loss or gain. If the total sale price of these two articles is Rs. 30,000. Find the difference between their cost prices?



$3 : 2 \rightarrow 5 \rightarrow 30,000$ [because there are NO Profit NO Loss]

SO Total CP = Total SP

$$\text{Diff}^n 1 = 6,000$$

Ans.

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Question :- A company allow 15% discount to his customer and still earn 19% profit. If production cost of product is increased by 12%. therefore company issued a new list price. which is 10% higher than the previous list price; and company still allow 15% discount to his customer. Find new profit %?

Soln:- MP CP SP

$$140 \quad 100 \quad 119$$

$$\downarrow +10\% \quad \downarrow +12\%$$

$$154 \quad 112 \quad 130.9$$

$$D = 15\%$$

$$\Rightarrow P\% = \frac{130.9 - 112}{112} \times 100$$

$$= \frac{18.9}{112} \times 100$$

$$= \frac{135}{8} = 16\frac{7}{8}\%$$

Question :- A man sold a watch and a pen at Rs. 492 and Rs. 168 respectively. earning 10% of the total CP of 2 article. Had he sold the watch at 435/- and pen at CP. He would have lost 5% on total CP. Find CP of watch?

$$SP \rightarrow (492 + 168) = 660 \leftarrow (\text{i.e } 110) \text{ SP}$$

$$600 = \frac{660}{110} \times 100 \leftarrow \text{CP}(100)$$

$$\text{How} \Rightarrow \text{Total SP} = \frac{w}{435} + \frac{P}{135} \leftarrow \text{at CP}$$

$$100 \rightarrow 600 \xrightarrow{-5\%} \begin{array}{c} 570 \\ \diagdown \quad \diagup \\ 435 \quad 135 \end{array} \leftarrow \text{CP of Pen}$$

$$\text{So CP of watch} = 600 - 135 = 465$$

Question : By selling 45 oranges for Rs. 160. A women loses 20%. How many oranges should she sell for Rs. 112 to gain 20% on the whole?

Soln :-

	α	P	
Buying Time	x	160	Price is same so $\frac{x-45}{45} = -\frac{1}{5}$ $x = 36$
Selling Time	45	160	

$$\text{Total amount} \rightarrow 160 + 112 = 272$$

and make profit $\rightarrow 20\%$.

	α	P	
Buying Time	36	160	
Selling Time	x	272	

$$\frac{36 \times 272 - 160 \times x}{160x} = +\frac{1}{5}$$

$$36 \times 272 = 192x \Rightarrow x = \frac{36 \times 272}{192} = 51$$

She should sell 51 oranges to gain 20% on whole.

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Question:- A publisher printed 3,000 copies of future stock at a cost of RS. 2400. He gave 500 copies free to different philanthropic institutions. He allowed a discount of 25% on the published price and gave one copy free for every 25 copies bought at a time. He was able to sell all the copies in this manner. If the published price is RS. 3.25, then what is his overall gain or loss percentage in the whole transaction?

- (a) 113%. (b) 130%. (c) 162%. (d) 144%.

Soln:-

$$3000 \text{ (copies)} \longrightarrow 2400$$

$\downarrow -500 \text{ (philanthropic Institutions)}$

Now $\rightarrow 2500$ (for sell) -

$$\begin{aligned} \text{published price} &\rightarrow 3.25 \xrightarrow{D=25\%} \text{SP} \\ &= \frac{3.25 \times 75}{100} \\ &= \frac{9.75}{4} \end{aligned}$$

$$1 \text{ copy SP} = \frac{9.75}{4}$$

when he sell 25 copies at a time $\rightarrow +1$ free.

So, 2500 copies

$$\begin{array}{ccc} & (25+1) \times 96 = 2496 & 4 \text{ copies at } \frac{9.75}{4} \\ \downarrow & & \end{array}$$

26 copies at 25 copies's price

$$26 \text{ copies SP} = \frac{9.75}{4} \times 25 = \frac{243.75}{4}$$

$$\text{Total SP} = \frac{243.75}{4} \times 96 + \frac{9.75}{4} \times 4 = 5850 + 9.75 = 5859.75$$

$$\text{Total CP} = 2400$$

$$\text{P.V.} = \frac{5859.75 - 2400}{2400} \times 100 = \frac{3459.75}{24} = 144.156\% \approx 144.1\%$$

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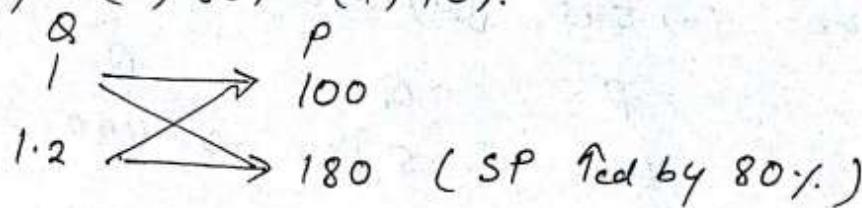
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Question:- As a marketing company campaign a company decides to offer an extra amount of 20% of a toothpaste free with no change in price. If per gm total cost of the toothpaste to the company is same and original profit were 80%. on this particular product, what would be the new profit after the free offer?

- Soln:- (a) 40%. (b) 50%. (c) 60%. (d) 70%.



$$P\% = \frac{180 - 120}{120} \times 100 = \frac{60}{120} \times 100 = 50\%$$

Question:- An article was sold at a profit of 4%, but due to general price rise, the cost of the article to the company rose by 30%. As a temporary measure, to match the market trend, the company decided not to increase the price of the article for three months. what percent of loss the company would suffer on the article during this 3 month period?

- (a) 40%. (b) 20%. (c) 50%. (d) 20%.

Soln:-

CP	SP
100	104
$\downarrow +30$	But
130	104

$$\text{Loss \%} = \frac{26}{130} \times 100 = 20\%$$

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Question :- A trader bought a few pens at the rate of 5 per Rs. 100 and a second time bought the same number of pens at the rate of 4 per Rs. 100. He mixed both the lots and then sold the pens at the rate of 9 per Rs. 200. In this business he suffered a loss of Rs. 300. The total no. of pens he bought was -

- (a) 540 (b) 545 (c) 1080 (d) 1090.

	P	Q	P
80l? :-	100	$5 \times 4 \rightarrow 400$	20
	100	$4 \times 5 \rightarrow 500$	20
(CP)	8100	360 ←	40×9
(SP)	8000	360	9×40 (sold)

loss → 100% at 360 pen

$$300 \text{Rs. loss} = \frac{360}{190} \times 300 = 1080$$

Total no. of pens he bought = 1080

Question :- A manufacturer sells an article to a wholesale dealer at a profit of 10%. The wholesale dealer sells it to a shopkeeper at 20% profit. Ultimately, the shopkeeper sells it to the customer at a price of Rs. 56100, suffering a loss of 15%. The cost price of the article for the manufacturer is then -

- (a) 10,000 (b) 25,000 (c) 50,000 (d) 55,000

80l? :- M → W → S → C
 $100 \rightarrow 110 \rightarrow 132 \rightarrow 112.2 \rightarrow 56100$

$$112.2 \Rightarrow 56100$$

$$100 \rightarrow \frac{56100}{112.2} \times 100 = 50,000$$

Question :- A milkman purchases the milk at Rs. X per litre and sells it at Rs. 2X per litre still he mixes 2 litres water with every 6 litre of pure milk . what is the profit percentage ?

Sol :- (A) 116 %. (B) 166.66 %. (C) 60 %. (D) 100 %.

$$CP \rightarrow 6X$$

$$SP \rightarrow 8(2X) = 16X$$

$$\text{p.y.} = \frac{10X}{6X} \times 100 = \frac{1000}{6} = 166.66\%$$

Question :- Two merchants sell , each an article for RS. 1000. If merchant A computes his profit on cost price , while merchant B computes his profit on selling price, they end up making profit of 25 %. respectively. By how much is the profit made by merchant B greater than that of Merchant A?

Sol :- $25\% = \frac{1}{4}$

CP	<u>A</u>		<u>B</u>	
	P.	SP	P.	SP
4	1	5	3	4
↓		↓	↓	↓
800	200	1000	750	250
	50			

So Merchant B makes 50 more profit than Merchant A

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Question :- A dealer of scientific Instrument to allows 20% discount on the marked price of the instrument and still makes a profit of 25%. If his gain over the sale of an instrument is ₹ 150. Find the marked price of the instrument?

Sol:-

$$\begin{array}{ccc}
 \text{MP} & \text{CP} & \text{SP} \\
 \frac{125 \times 100}{4} & 100 \rightarrow 125 & 25 \rightarrow 150 \\
 & D = 20\% & 1 \rightarrow 6 \\
 & & \frac{125 \times 5}{4} \rightarrow \frac{6 \times 125 \times 5}{4} \\
 & & = \frac{3750}{4} = 937.50
 \end{array}$$

Question :- Pooja wants to sell a watch at a profit of 20%. She bought it at 10% less and sold it at ₹ 30 less, but still she gained 20%. The cost price of watch is

- (1) 240 ₹ (2) 220 ₹ (3) 250 ₹ (4) 225 ₹

Sol:-

$$\begin{array}{ccc}
 \text{CP} & \text{SP} \\
 100 \rightarrow 120 & \\
 \text{but buy } -10\% \swarrow & \downarrow 12 \rightarrow 30 \\
 90 \quad +20\% \nearrow 108 & \\
 & & 100 \rightarrow \frac{5}{12} \times 100 \\
 & & = 250 \text{ ₹}
 \end{array}$$

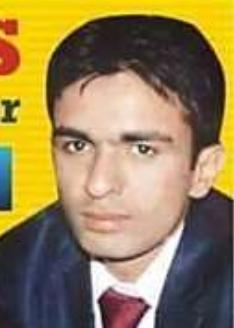
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Question :- One year payment to the servant Rs. 200 plus one shirt. The servant leaves after 9 months and receives Rs. 120 and a shirt. What is the price of the shirt?

- (1) Rs. 80 (2) Rs. 100 ✓ (3) Rs. 120 (4) Can't be determined

Soln:- 1 year \rightarrow 200 RS. + 1 Shirt

$$9 \text{ month} \rightarrow \frac{3}{4} (200 + S)$$

$$\Leftrightarrow 120 + S$$

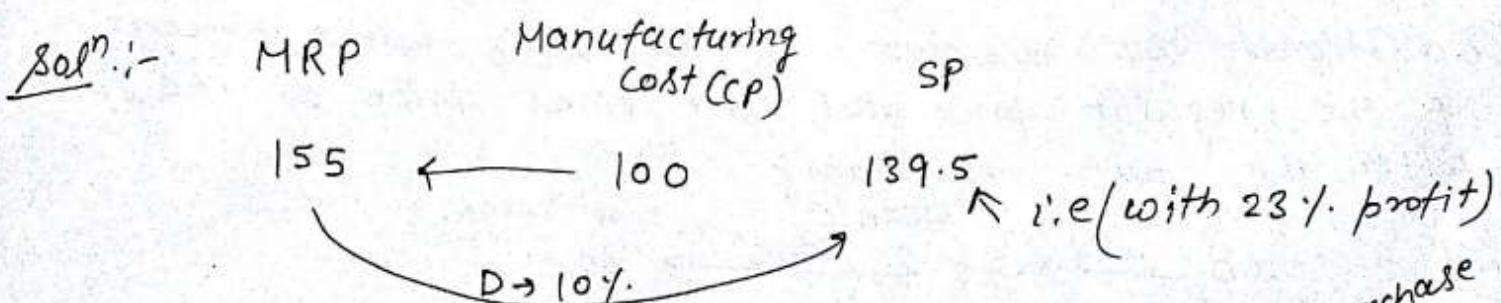
$$\text{So, } \frac{3}{4} \times 200 + \frac{3}{4} S = 120 + S$$

$$30 = \frac{1}{4} S \Rightarrow S = 120$$

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Question :- The Maximum Retail Price (MRP) of a product is 55% above its manufacturing cost. The product is sold through a retailer, who earns 23% profit on his purchase price. What is the profit percentage (expressed in nearest integer) for the manufacturer who sells his product to the retailer? The retailer gives 10% discount on MRP.

- (A) 31%. (B) 22%. (C) 15%. (D) 13%.



So, Retailer sells the product 139.5 = 123% of x purchase price of Retailer

$$x = \frac{139.5}{123} \times 100 = 113.4$$

So profit \rightarrow 13.4% (for the manufacturer)

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Question:- A retailer cheats both while buying and selling goods, while buying goods from the shopkeeper, he uses weighing machine that shows 1000 gm when the actual quantity is 1100 gm. While selling, he uses a machine that shows 1100 gm when the actual quantity is 1000 gm. If he sells goods at cost price only, determine his profit percentage in this whole transaction.

Soln:- He sells 1000 gm as 1100 gm

→ He will sell the whole 1100 gm he got

$$1100 \rightarrow \frac{1100}{100} \times 1100 = 1210 \text{ gm}$$

He buy → 1000 gm } profit % = 21 %.
sell → 1210 gm }

OR He makes 10% profit while buying
and 10% profit while selling

$$\text{Net profit} = 10 + 10 + \frac{10 \times 10}{100} = 21\%$$

Question:- A certain suit's price was reduced by 25% in the first week and 20% in the next week. In the 3rd week, the shop owner decided to offer additional 10% discount on the suit. what percent of the regular price was the final price of the suit after the two reductions?

Soln:-

1st week	2nd week	
100 $\xrightarrow{-25\%}$ 75	$\xrightarrow{-20\%}$ 60.0	
		\downarrow final price after 10% discount 54

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Question:- Titan sells a wrist watch to a wholesaler making a profit of 10%. The wholesaler in turns, sells it to the retailer making a profit of 10%. A customer purchases it by paying Rs. 990. Thus the profit of retailer is $\frac{23}{11}\%$. what is the cost incurred by the titan to produce it?

Soln:-

$$T \quad W \quad R \quad C$$

$$100 \rightarrow 110 \rightarrow 121 \rightarrow 121 \times \left(\frac{100 + 23}{11} \right) = 123.53$$

$$123.53 \rightarrow 990$$

$$100 \rightarrow \frac{990}{123.53} \times 100 = 801.42$$

Question:- A scientific calculator is available at universal shoppe in Hazratganj at 20% discount and the same is available at only 15% discount at universal shoppe bhootnath market. Ms. Agarwal has just sufficient amount of Rs. 800 to purchase it at universal shoppe Hazratganj. what is the amount that Ms. Agarwal has less than the required amount to purchase it at universal shoppe bhootnath?

Soln:-

$$80 \rightarrow 800$$

$$85 \rightarrow \frac{800}{80} \times 85 = 850$$

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$$\text{difference} = 850 - 800 = 50 \text{ Rs.}$$

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Question :- A milkman buys some milk contained in 10 vessels of equal size. If he sells his milk at RS. 5 a litre, he loses RS. 200; while selling it at RS. 6 a litre, he would gain RS. 150 on the whole. Find the no. of litres contained in each vessel.

Soln:- suppose Total milk = x ltr.

$$\text{So, } 5x + 200 = 6x - 150$$

$$x = 350$$

each vessel contains $\frac{350}{10} = 35$ litres.

Question :- A Shopkeeper sold 12 cameras at a profit of 20% and 8 cameras at a profit of 10%. If he had sold all the 20 cameras at a profit of 15%, then his profit would have been reduced by RS. 36. what is the cost price of each camera?

$$\text{Soln:- } (12 \times 120 + 8 \times 110) - 115 \times 20 = 36$$

$$2320 - 2300 = 36$$

$$20 \rightarrow 36$$

$$100 \rightarrow \frac{36}{20} \times 100^5 = 180$$

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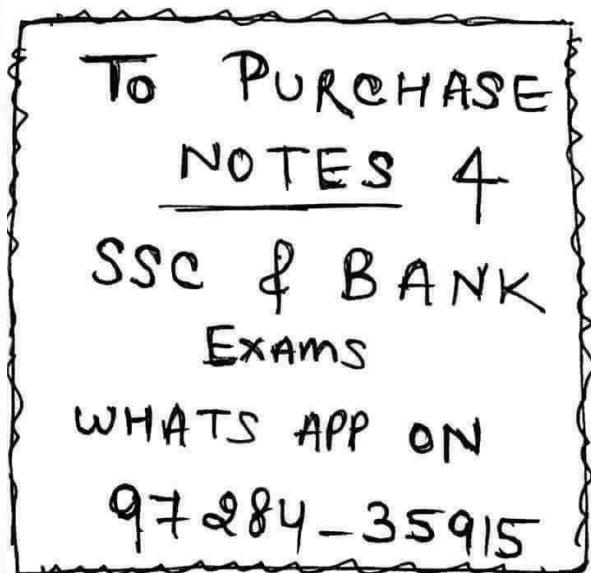
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Question :- Mahesh and Umesh purchased a radio each for the same price and both marked-up their respective radio by the same amount. Mahesh gave a discount of RS. 20 followed by another discount of 20% on the reduced price, while Umesh gave a discount of 20% followed by a discount of RS. 20. If Mahesh's profit% is equal to thrice of Umesh's loss percentage, what is the profit (in RS.) of Mahesh on his Radio?

(a) RS. 2 (b) RS. 3 (c) RS. 4 (d) RS. 5

Sol:-



Compound Interest (CI)



Interest on Interest

P - Principal

CI - Compound Interest

A - Amount ($P+CI$)

r = rate of interest

t → time

$$A = P \left[1 + \frac{r}{100} \right]^n$$

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Example :- $P=1000$, $r=10\%$, $t=2$ years, CI

$$\begin{array}{ccc} 1000 & \xrightarrow{10\%} & 100 \\ \downarrow 10\% & & \downarrow 10\% \\ 100 & & 10 \end{array} \quad \left. \begin{array}{l} SI = \frac{1000 \times 10 \times 2}{100} \\ = 200 \end{array} \right\}$$

$$\text{Total CI} = 200 + 10 = 210$$

NOTE, In first year, No difference between Simple Interest and Compound Interest.

Therefore, To find CI, $P=1000$, $r=10\%$.

when	$1000 \times \frac{10}{100} = 100$	$100 \times \frac{10}{100} = 10$	CI
$t=2$	2	1	$\rightarrow 2 \times 100 + 10 = 210$
$t=3$	100 3	10 3	$10 \times \frac{10}{100} = 1$ $\rightarrow 3 \times 100 + 3 \times 10 + 1 = 331$
$t=4$	100 4	10 6	$1 \times \frac{10}{100} = 0.1$ $\rightarrow 4 \times 100 + 6 \times 10 + 4 \times 1 + 0.1 = 464.1$
$t=5$	100 5	10 10	$0.1 \times \frac{10}{100} = 0.01$ $\rightarrow 5 \times 100 + 10 \times 10 + 5 \times 1 + 0.1 = 610.51$

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Example:- $P = 5000$, $r = 5\%$. find $CI = ?$

when

$t = 2$

$$\frac{5000 \times 5}{100} = 250$$

2

$$\frac{250 \times 5}{100} = 12.5$$

1

$$= 250 \times 2 + 12.5 = 512.5$$

$t = 3$

$$\begin{matrix} 250 \\ 3 \end{matrix}$$

$$\begin{matrix} 12.5 \\ 3 \end{matrix}$$

$$\begin{matrix} 12.5 \times \frac{5}{100} = .625 \\ 1 \end{matrix}$$

$$= 250 \times 3 + 37.5 + .625 = 788.125$$

Table:- To find CI

when

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

1

$$\left(\frac{Pxr}{100} \right) \times \frac{r}{100}$$

$t = 2$

2

1

$$\Rightarrow 2 \times \left(\frac{Pr}{100} \right) + 1 \times \left(\frac{Pr}{100} \right) \frac{r}{100}$$

$t = 3$

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

3

$$\left(\frac{Pr}{100} \right) \times \frac{r}{100}$$

$$\left(\frac{Pr}{100} \right) \times \frac{r}{100} \times \frac{r}{100}$$

$t = 4$

4

6

4

1

$t = 5$

5

10

10

5

1

$t = 6$

6

15

20

15

6

1

Diff' b/w SI & CI.

1st Row \rightarrow SI

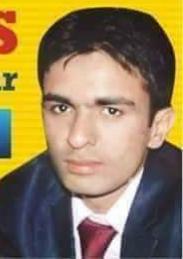
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Case-1 → When $r \rightarrow$ yearly ~~annually~~
Question :- Albert invested an amount of Rs. 8000 in
 a fixed deposit scheme for 2 years at
 compound interest rate 5 p.c.p.a. how much amount
 will Albert get on maturity of the fixed deposit?

Sol? :- $t = 2$ $\frac{8000 \times 5}{100} = 400$ $\frac{400 \times 5}{100} = 20$

$$CI = 400 \times 2 + 20 = 820$$

$$A = P + SI = 8000 + 820 = 8820$$

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Case-2 :- When compound interest is reckoned
 half-yearly / quarterly / monthly.

Half-yearly, $rate(r) = \left(\frac{r}{2}\right)\%$ and $time(t) = 2xt$

Quarterly → $rate(r) = \left(\frac{r}{4}\right)\%$ and $time(t) = 4xt$

Monthly → $rate(r) = \left(\frac{r}{12}\right)\%$ and $time(t) = 12xt$

Example :- Sam investment Rs. 15000 @ 10% per annum
 for one year. If the interest is compounded
 half-yearly, then the amount received by SAM at
 the end of the year will be -

Sol? :- Half yearly, $r = \frac{10}{2} = 5\%$, $t = 2$ half years

$$\begin{array}{l} 15000 \times 5 \\ = 750 \frac{100}{2} \\ 2 \end{array} \quad \begin{array}{l} 750 \times 5 \\ = 37.5 \frac{100}{2} \\ 1 \end{array}$$

$$CI = 750 \times 2 + 37.5 = 1537.5$$

$$\begin{aligned} A = P + SI &= 15000 + 1537.5 \\ &= 16537.5 \end{aligned}$$

Ex.:- Find the compound interest on Rs. 15,625 for 9 months at 16% per annum compounded quarterly?

Sol? :- Compounded Quarterly

$$r = \frac{16}{4} = 4\%, t = \frac{9}{12} \times 4 = 3.$$

$$\underline{t=3} \quad \frac{15625 \times 4}{100} = 625 \quad \frac{625 \times 4}{100} = 25 \quad \frac{25 \times 4}{100} = 1$$

$$CI = 625 \times 3 + 25 \times 3 + 1 = 1951.$$

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Example.:- Find the compound interest on Rs. 5000 for 9 months at 48% per annum compounded monthly?

$$\underline{SOL? :-} \quad P = 5000, \quad \underline{\text{monthly}} \quad t = \frac{4}{12} \times 12 = 4, \quad r = \frac{48}{12} = 4\%.$$

$$\underline{t=4} \quad \frac{5000 \times 4}{100} = 200 \quad \frac{200 \times 4}{100} = 8 \quad \frac{8 \times 4}{100} = 0.32 \quad \frac{0.32 \times 4}{100} = 0.0128$$

$$\begin{aligned} \text{Total } CI &= 200 \times 4 + 8 \times 6 + 4 \times 0.32 + 0.0128 \\ &= 800 + 48 + 1.28 + 0.0128 \end{aligned}$$

$$\boxed{CI = 849.2928}$$

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⇒ Difference between Compound interest and Simple Interest

(1) Diffⁿ (CI - SI) when $t = 2$ years

$$\text{Difference } D = \frac{Pr^2}{(100)^2}$$

(2) $D = (CI - SI)$, when $t = 3$ years

$$D = \frac{Pr^2(300+r)}{(100)^3}$$

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(3) when [Difference $D = CI - SI$] time more than 3 year

$$\begin{array}{c} \frac{Pr}{100} \\ t=4 \end{array} \quad \left| \begin{array}{c} \left(\frac{Pr}{100}\right) \times \frac{r}{100} \\ 4 \\ G \end{array} \right. \quad \left| \begin{array}{c} \left(\frac{Pr}{100}\right) \times \frac{r}{100} \times \frac{r}{100} \\ 4 \\ 1 \end{array} \right. \quad \left| \begin{array}{c} \left(\frac{Pr}{100}\right) \times \frac{r^3}{100} \\ 1 \end{array} \right.$$

Diffⁿ b/w CI & SI

$$\begin{array}{c} \frac{Pr}{100} \\ t=5 \end{array} \quad \left| \begin{array}{c} 10 \\ 10 \\ 5 \\ \hline \end{array} \right. \quad \text{diffⁿ b/w CI & SI}$$

Example:- $P = 10,000, r = 5\%, t = 4$, find $D = CI - SI$

$$\begin{array}{c} \frac{10,000 \times 5}{100} \\ t=4 \end{array} \quad \left| \begin{array}{c} \frac{500 \times 5}{100} \\ 4 \\ 6 \\ \hline \end{array} \right. \quad \begin{array}{c} \frac{25 \times 5}{100} = 1.25 \\ 4 \\ 1 \\ \hline \end{array} \quad \begin{array}{c} \frac{1.25 \times 5}{100} = .0625 \\ 1 \\ \hline \end{array}$$

diffⁿ b/w CI & SI

$$D = 25 \times 6 + 4 \times 1.25 + 0.0625$$

$$= 150 + 5 + .0625$$

$$\boxed{D = 155.0625}$$

Ques.:- The difference between simple and compound interest on a certain sum of money at 5% per annum for 2 years is ₹ 15. Then the sum is -

Solⁿ: $t=2$

$$D = \frac{Pr^2}{(100)^2} \Rightarrow 15 = \frac{P \times 5 \times 8}{100 \times 100}$$

$$\boxed{P = 6000}$$

Question.:- The difference between compound and simple interest on ₹ 2500 for 2 years at 4% per annum is -

Solⁿ: $t=2$

$$D = \frac{Pr^2}{(100)^2} = \frac{2500 \times 4 \times 4}{100 \times 100} = 4.$$

Question .:- If the difference between the CI & SI on a certain sum of money for 3 years at 5% per annum is ₹ 15.25, then the sum is -

Solⁿ:

$$D = \frac{Pr^2 (300 + r)}{(100)^3}$$

$$15.25 = \frac{P \times 5 \times 5 \times \frac{61}{305}}{100 \times 100 \times 100}$$

$$P = 25 \times 80 = 2000$$

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NOTES 4
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Exams
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Question.:- On what sum of money will the diffn b/w CI & SI for 2 years at 5% per annum be equal to 25 ₹.

Solⁿ:

$$25 = \frac{P \times 5 \times 5}{100 \times 100} \Rightarrow \boxed{P = 10,000}$$

\Rightarrow when a principal becomes n_1 times after t_1 years then it will become n_2 times after t_2 years -

$$(n_1)^{1/t_1} = (n_2)^{1/t_2}$$

Principal
rate of
interest } same

$\boxed{\text{or}} \quad (n_1)^{t_2} = (n_2)^{t_1}$

or simply, we can calculate -

Ex.:- A sum of money becomes 8 times in 3 years. If the rate is compounded annually. In how much time will the same amount at the same compound rate become 16 times?

Soln:-

$$n_1 \rightarrow 8, \quad t_1 \rightarrow 3$$

$$n_2 \rightarrow 16, \quad t_2 \rightarrow ?$$

$$(8)^{t_2} = (16)^3$$

$$(2)^{3t_2} = (2)^{4 \times 3} \Rightarrow 3t_2 = 12$$

$$\boxed{t_2 = 4 \text{ years}}$$

Ex.:- A sum of money at compound interest amounts to thrice itself in 3 years. In how many years will it be 9 times itself - times year

Soln:-

$$n_1 \rightarrow 3, \quad t_1 \rightarrow 3$$

$\boxed{\text{or}}$

$$n_2 \rightarrow 9, \quad t_2 \rightarrow ?$$

$$(3)^{t_2} = (9)^3$$

$$(3)^{t_2} = (3)^{2 \times 3}$$

$$3 \textcircled{2} \begin{array}{r} 3 \\ 9 \\ \hline X 2 \\ \hline 6 \text{ years} \end{array}$$

$$\boxed{t_2 = 6}$$

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Question:- A sum of money doubles itself in 4 years at compound interest. It will amount to 8 times itself the same rate of interest-

Soln:-

$$2^3 \left(\frac{2}{8} \right)^2 \rightarrow \frac{4}{\frac{X 3}{12}} \text{ year } \quad \left| \begin{array}{l} \text{or} \\ (2)^{t_2} = (8)^4 \\ (2)^{t_2} = (2)^{3 \times 4} \\ t_2 = 12 \text{ years} \end{array} \right.$$

Question:- A sum borrowed under compound interest doubles itself in 10 years. When will it becomes fourfold of itself at the same rate of interest?

Soln:-

$$2^2 \left(\frac{2}{4} \right)^2 \rightarrow 10 \quad \left| \begin{array}{l} \text{or} \\ (2)^{t_2} = (4)^{10} \\ (2)^{t_2} = (2)^{2 \times 10} \\ t_2 = 20 \text{ years} \end{array} \right.$$

Question:- A sum of ₹ 12,000 deposited at CI becomes double after 5 years. How much will it be after 20 years?

Soln:-

$$2^4 \left(\frac{2}{16} \right)^2 \rightarrow 5 \quad \left| \begin{array}{l} () \times 4 \\ \rightarrow 20 \end{array} \right.$$

If will become 16 times $\rightarrow 12,000 \times 16$
 $= 192,000$

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Installments in Compound Interest :-

$$P = \frac{x}{(1+\frac{R}{100})^1} + \frac{x}{(1+\frac{R}{100})^2} + \frac{x}{(1+\frac{R}{100})^3} + \dots + \frac{x}{(1+\frac{R}{100})^n}$$

$x \rightarrow$ Each Installment value.

$R \rightarrow$ Rate of interest

$n \rightarrow$ no. of installment

$P \rightarrow$ Principal

Question :- A person borrowed a sum of RS. 6000 at 10% p.a., interest compounded annually. If the money is to be repaid in three equal annual installment, each payable at the end of the year, then what is the value of each installment?

Soln:- no. of installment = 3

$$6000 = x \left[\frac{1}{(1+\frac{10}{100})} + \frac{1}{(1+\frac{10}{100})^2} + \frac{1}{(1+\frac{10}{100})^3} \right]$$

$$x \cdot 6000 = x \left[\frac{10}{11} + \frac{100}{121} + \frac{1000}{1331} \right]$$

$$6000 = x \left[\frac{121 \times 10 + 11 \times 100 + 1000}{1331} \right]$$

$$x = \frac{6000 \times 1331}{1331} = 2412.68$$

[OR]

$$6000 \left(1+\frac{10}{100}\right)^3 = x \left[\left(1+\frac{10}{100}\right)^2 + \left(1+\frac{10}{100}\right) + 1 \right]$$

$$6000 \left(\frac{1331}{1000}\right) = x \left[\frac{121}{100} + \frac{11}{10} + 1 \right]$$

$$x = \frac{6000 \times 1.331}{3.31} = 2412.68$$

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NOTES 4
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EXAMS
WHATS APP ON
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Question :- Three equal installment, each of Rs. 200, were paid at the end of year on a sum borrowed at 20%. Compound interest compounded annually. Find the sum. — $n=3$

$$\begin{aligned}
 \text{Soln:- } P &= \frac{x}{\left(1 + \frac{R}{100}\right)^1} + \frac{x}{\left(1 + \frac{R}{100}\right)^2} + \frac{x}{\left(1 + \frac{R}{100}\right)^3} \\
 &= 200 \left[\frac{1}{\left(1 + \frac{20}{100}\right)} + \frac{1}{\left(1 + \frac{20}{100}\right)^2} + \frac{1}{\left(1 + \frac{20}{100}\right)^3} \right] \\
 &= 200 \left[\frac{5}{6} + \frac{25}{36} + \frac{125}{216} \right] \\
 &= 200 \left[\frac{5 \times 36 + 25 \times 6 + 125}{216} \right] = \frac{100 \times 455}{108} \\
 &\boxed{P = 421.29}
 \end{aligned}$$

Question :- A man borrows a certain sum of money and pays it back in 2 years in two equal installments. If CI is reckoned at 5% per annum and he pays back annually Rs. 441. what sum did he borrow —

$$\begin{aligned}
 \text{Soln:- } n &= 2 \\
 P &= 441 \left[\frac{1}{\left(1 + \frac{5}{100}\right)} + \frac{1}{\left(1 + \frac{5}{100}\right)^2} \right] \\
 &= 441 \left[\frac{20}{21} + \frac{400}{441} \right] = 441 \left[\frac{20 \times 21 + 400}{441} \right] \\
 &= 400 + 420 = 820
 \end{aligned}$$

Total money borrowed = 820

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Question :- The difference between simple interest and compound interest on a sum for 2 years at 8% when the interest is compounded annually Rs. 16. If the interest was compounded half-yearly, the difference in two interest would be nearly -

Soln :-

$$D = \frac{Pr^2}{(100)^2} \Rightarrow 16 = \frac{P \times 8 \times 8}{100 \times 100}$$

$$\boxed{P=2500}$$

NOW, CI \rightarrow Half-yearly, $r = \frac{8}{2} = 4\%$, $t = 2 \times 2 = 4$

$$CI \rightarrow \frac{2500 \times 4}{100/100} \quad \frac{100 \times 4}{4/100} \quad \frac{4 \times 4}{100} = 0.16 \quad \frac{0.16 \times 4}{100} = .0064$$

$$CI = 100 \times 4 + 6 \times 4 + 0.64 + .0064 \\ = 400 + 24 + 0.64 + 0.0064 = 424.6464$$

$$SI \text{ of 2 years} = \frac{2500 \times 2 \times 8}{100} = 400$$

$$\text{diffn } D = 424.6464 = 24.64\%$$

OR

$$CI = \frac{2500 \times 4}{100} \left| \begin{array}{l} \frac{100 \times 4}{100} \\ 4 \\ 6 \\ \hline \end{array} \right. \quad \frac{4 \times 4}{100} = 0.16 \quad \frac{0.16 \times 4}{100} = 0.0064$$

$t=4$

SI

Diffn b/w CI & SI

$$D = 4 \times 6 + 4 \times 0.16 + 1 \times 0.0064 \\ = 24 + 0.64 + .0064$$

$$\boxed{D = 24.6464}$$

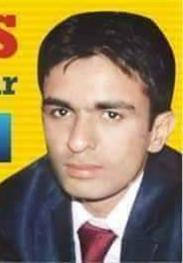
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Question :- A father left a will of Rs. 35 lakh between his two daughters who aged 8.5 and 16 such that they may get equal amounts when each of them reach the age of 21 years. The original amount of Rs. 35 lakhs has been instructed to be invested at 10% p.a simple interest. How much did the elder daughter get at the time of the will?

Soln:-

$$x \left[1 + \frac{8 \times 10}{100} \right] = y \left[1 + \frac{\frac{2.5}{2} \times 10}{100} \right]$$

$$x \times \frac{3}{2} = \frac{4.5y}{2} \Rightarrow \frac{x}{y} = \frac{4.5}{3}$$

$$\begin{array}{c} x:y \\ 3:2 \rightarrow 14 \text{ lakh} \\ \swarrow 5 \rightarrow 35 \text{ lakh} \\ 21 \text{ Lakh } 1 \rightarrow 7 \text{ lakh} \end{array}$$

Question :- If a sum of money grows to $\frac{144}{121}$ times when invested for 2 years in a scheme where interest is compounded annually, how long will the same sum of money take to treble if invested at same rate of interest in a scheme where interest is computed using simple interest method?

Soln:-

$$\frac{144}{121} = \left(1 + \frac{r}{100} \right)^2 \Rightarrow 1 + \frac{r}{100} = \frac{12}{11} \Rightarrow \frac{r}{100} = \frac{12}{11} - 1 = \frac{1}{11}$$

$$r = \frac{100}{11} \text{ %}$$

Now at SI $\rightarrow 2P = \frac{P \times t \times 100}{11 \times 100} \Rightarrow t = 22 \text{ years}$

[Principal trebles]
so SI $\rightarrow 2P$

Question:- The compound interest on Rs. 2000 in 2 years. If the rate of interest is 4% per annum for the 1st year and 3% per annum for the 2nd year will be -

Sol? :- 1st year $\rightarrow 2000 \times \frac{4}{100} = 80$

2nd year, $P = 2000 + 80 = 2080$

$$\text{Interest} = 2080 \times \frac{3}{100} = 62.4$$

Total CI = $80 + 62.4 = 142.4$

Question:- A sum of money on CI amounts to Rs. 10648 in 3 years and 9680 in 2 years.

The rate of interest per annum is -

Sol? :- After 2 years $\rightarrow 9680$ } After 1 year
After 3 years $\rightarrow 10648$

So, we take

$$P = 9680$$

$$\begin{aligned}\text{Interest} &= 10648 - 9680 \\ &= 968\end{aligned}$$

so, simply Interest = $\frac{9680 \times 1 \times r}{100}$ t = 1 year.

$$\begin{aligned}968 &= \frac{9680 \times 1 \times r}{100} \\ r &= 10\%\end{aligned}$$

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NOTES 4
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EXAMS
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Question:- A man invest Rs. 5000 for 3 years at 5% p.a. Compound interest reckoned yearly. Income tax at the rate of 20% on the interest earned is deducted at the end of each year. Find the amount at the end of the third year?

Soln:- 5% → rate of interest

20% → of the interest amount is paid as Tax

↳ i.e., 80% of the interest amount stays back

∴ rate of interest as 80% of 5% = 4% p.a.

$$t=3 \quad \begin{array}{l} 5000 \times \frac{4}{100} \\ = 200 \end{array} \quad \begin{array}{l} 200 \times \frac{4}{100} \\ = 8 \end{array} \quad \begin{array}{l} 8 \times \frac{4}{100} = 0.32 \\ 1 \end{array}$$

$$CI = 200 \times 3 + 8 \times 3 + 0.32 = 624.32$$

$$\text{The amount end of the year} = 5000 + 624.32 \\ = 5624.32$$

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NOTES 4
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EXAMS
WHATS APP ON
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Question:- Rs. 5887 is divided between Shyam and Ram such that Shyam's share at the end of 9 years is equal to Ram's share at the end of 11 years, compounded annually at the rate of 5%. Find the share of Shyam?

$$\text{Soln:- } S \left(1 + \frac{r}{100}\right)^9 = R \left(1 + \frac{r}{100}\right)^{11} \Rightarrow \frac{S}{R} = \left(\frac{1 + \frac{r}{100}}{1 + \frac{r}{100}}\right)^2$$

$$\frac{S}{R} = \frac{441}{400} \quad 841 \rightarrow 5887$$

$$\text{Shyam}(441) \rightarrow \frac{5887 \times 441}{841} = 3087$$

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Question:- Find the difference between the CI and SI on ₹ 32,000 at 10% p.a for 4 years.

Sol? :-

$$t=4 \quad \left| \begin{array}{l} \frac{32000 \times 10}{100} \\ = 3200 \\ 4 \end{array} \right. \quad \left| \begin{array}{l} \frac{3200 \times 10}{100} \\ = 320 \\ 6 \end{array} \right. \quad \left| \begin{array}{l} \frac{320 \times 10}{100} \\ = 32 \\ 4 \end{array} \right. \quad \left| \begin{array}{l} \frac{32 \times 10}{100} \\ = 3.2 \\ 1 \end{array} \right. \\ \text{I}^{st} \text{ Row} \rightarrow \text{SI} \quad \text{Diffn b/w CI & SI}$$

$$D = 6 \times 320 + 4 \times 32 + 3.2 \\ = 1920 + 128 + 3.2 = 2051.2$$

Question:- On a certain sum of money the compound interest for 2 years is Rs. 282.15 and the SI for the same period of time is Rs. 270. The rate of interest per annum is —

Sol? :-

$$\text{2 year CI} \rightarrow 282.15 \\ \text{2 year SI} \rightarrow 270 \rightarrow \text{1 year SI} = \frac{270}{2} = 135 \\ D = CI - SI = 282.15 - 270 = 12.15 \\ \text{and} \\ 135 \times \frac{r}{100} = 12.15 \\ r = \frac{12.15}{135} \times 100 = 9\% \\ \downarrow \\ \text{D} \rightarrow \text{Interest on interest}$$

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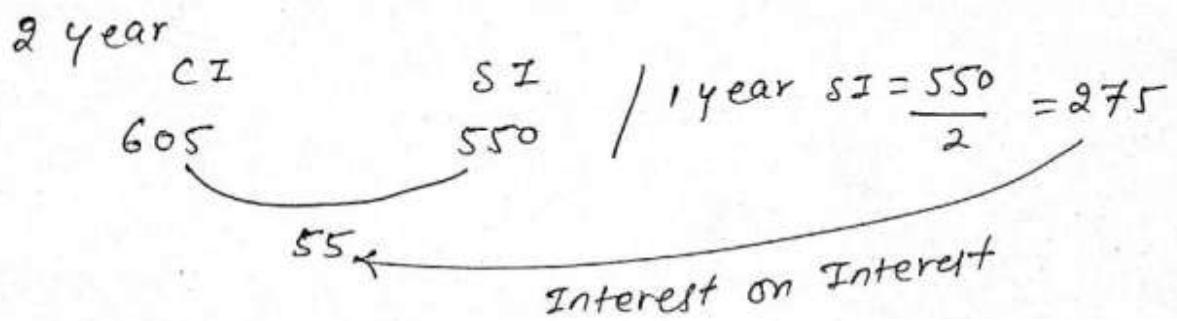
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Question :- Shawn invested one half of his saving in a bond that paid simple interest for 2 years and received Rs. 550 as interest. He invested the remaining in a bond that paid compound interest, interest being compounded only annually, for the same 2 years at the same rate of interest and received Rs. 605 as interest. what was the value of his total saving before investing in these two bonds?

Soln :-



$$\therefore r = \frac{55}{275} \times 100 = 20\%$$

$$275 = \frac{P \times 20}{100} \Rightarrow P = 1375$$

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EXAMS
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97284-35915

$$\text{so, Total saving before Investing} = 1375 \times 2 \\ = 2750 \text{ t}$$

Question :- Rs. 100 doubled in 5 years when compounded annually. How many years will it take to get another Rs. 200 compound interest?

Soln :-

$$2^2 \rightarrow 5 \\ 2^4 \xrightarrow{X 2} 10$$

so, To earn another 200 interest,
It will take another 5 years.

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Compound Interest \Rightarrow

Question 1:- Arun borrowed a certain sum from Manish at a certain rate of simple interest for 2 years. He lent this sum to Sunil at the same rate compounded annually for the same period. At the end of two years, he received Rs. 2400 as compounded interest but paid Rs. 2000 only as SI. Find the rate of interest?

Soln:-

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NOTES 4
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Exams
WHATS APP ON
97284-35915

$$\begin{array}{c}
 \text{2 year CI} - \text{SI} \\
 \left| \begin{array}{l} \text{2400} \\ \text{2000} \end{array} \right. \quad \left| \begin{array}{l} \text{1 year SI} = \frac{2000}{2} \\ = 1000 \end{array} \right. \\
 \qquad\qquad\qquad \text{400} \quad \qquad\qquad\qquad \text{Interest on Interest} \\
 \text{1000} \times r = 400 \\
 \frac{1000 \times r}{100} = 40 \\
 r = 40\%
 \end{array}$$

Question 2. A man borrows Rs. 20,000 at 10% compound interest. At the end of every year he pays Rs. 2000 as part repayment. How much does he still owe after three such installments?

Soln:- for $t=3$

$20,000 \times \frac{10}{100}$	$2000 \times \frac{10}{100}$	$200 \times \frac{10}{100}$
$= 2000$	$= 200$	$= 20$
$\frac{3}{}$	$\frac{3}{}$	$\frac{1}{}$

$$\text{Total CI} = 6000 + 600 + 20 = \underline{\underline{6620}}$$

He pays 2000 as part repayment

$$\begin{aligned}
 & 2000 \left(1 + \frac{10}{100}\right)^2 + 2000 \left(1 + \frac{10}{100}\right) + 2000 \\
 & = 2000 \left[\frac{121}{100} + \frac{11}{10} + 1 \right] = 2000 \times \frac{331}{100} \\
 & = \underline{\underline{6620}}
 \end{aligned}$$

$$\begin{aligned}
 \text{Remaining amount} &= 20,000 + 6620 - 6620 \\
 &= 20,000
 \end{aligned}$$

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Question 3:- A tree increases annually by $\frac{1}{5}$ th of its height. If its height today is 50m, what will be the height after 2 years?

- (A) 64m (B) 72m (C) 66m (d) 84m

Soln:-

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

$$100 \rightarrow 120 \rightarrow 144$$

$$\begin{matrix} \downarrow \\ 50 \end{matrix}$$

$$\frac{50}{100} \times 144 = 72m$$

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WHATS APP ON
97284-35915

Question 4:- An amount of money appreciates to ₹ 7,000 after 4 years and to ₹ 10,000 after 8 years at a certain compound interest compounded annually. The initial amount of money was -

- (1) ₹ 4700 (2) 4900 (3) ₹ 4,100 (4) ₹ 4,300

Soln:-

$$\frac{10,000}{7,000} = \frac{\left(1 + \frac{r}{100}\right)^8}{\left(1 + \frac{r}{100}\right)^4} \Rightarrow \left(1 + \frac{r}{100}\right)^4 = \frac{10}{7} \quad \text{--- (1)}$$

$$\text{Now, } 7000 = P \left(1 + \frac{r}{100}\right)^4 \Rightarrow 7,000 = P \left(\frac{10}{7}\right)$$

$$P = 4900$$

Question 5:- what sum will give RS. 244 as the diff? b/w SI and CI at 10% in 1.5 years compounded half yearly? compounded & Half -Yearly $\rightarrow t \rightarrow 2x + r \rightarrow \frac{1}{2}$

Soln:- $t = 1.5 \times 2 = 3, r = \frac{10}{2} = 5\%$

$$244 = P \times 5 \times 5 \times 305 \Rightarrow P = \frac{244 \times 100 \times 100 \times 100}{25 \times 305}$$

$$P = 32,000$$

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Question 6: A person buys a land at Rs. 30 lacs and a year later constructs a building on it at the cost of Rs. 20 lacs. Assuming that land appreciates at 20% annually and building depreciates at 20% for first 2 years and at 10% thereafter, find the total value of property after 5 years from date of purchase of land.

Soln:-

$$\begin{array}{r}
 \text{Land} \\
 30 \\
 \downarrow +20\% \\
 36 \\
 \downarrow \\
 36 \times \frac{120}{100} \times \frac{120}{100} \times \frac{120}{100} \times \frac{120}{100} \\
 = 36 \times \frac{6 \times 6 \times 6 \times 6}{625} \\
 = \frac{46656}{625} = 74.64
 \end{array}$$

$ \begin{array}{r} \text{Building} \\ 20 \text{ lacs} \\ \downarrow \\ \text{after 4 years} \\ \text{Ist 2 years} \\ 4 \times 20 \times \frac{80}{100} \times \frac{80}{100} \times \frac{90}{100} \times \frac{90}{100} \\ = \frac{160 \times 160 \times 100 \times 100}{25} \\ = \frac{4 \times 4 \times 9 \times 9}{5 \times 25} = \frac{1296}{125} \\ = 10.36 \end{array} $	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> To PURCHASE NOTES 4 SSC & BANK EXAMS WHATS APP ON 97284-35915 </div>
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$$\begin{aligned}
 \text{Total value after 5 years} &= 74.64 + 10.36 \\
 &= 85 \text{ lac}
 \end{aligned}$$

Question 7: Find the nominal rate compounded monthly equivalent to 6% compounded semi-annually.

Also find the effective rate of interest-

Soln:-

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Question: I buy of bike at Rs. 20,000 cash payment and three annual installments of Rs. 20,000 each. If rate of interest is 15%. Compounded annually, what is the present worth of the bike? If the rate of depreciation is 10%. what will be the resale value after 3 years?

Soln:-

$$P = 20,000 \left[\frac{1}{\left(1 + \frac{15}{100}\right)^3} + \frac{1}{\left(1 + \frac{15}{100}\right)^2} + \frac{1}{\left(1 + \frac{15}{100}\right)} \right]$$

$$= 20,000 \left[\frac{(20)^3}{(23)^3} + \frac{(20)^2}{(23)^2} + \frac{20}{23} \right]$$

$$= 20,000 \left[\frac{8000 + 9200 + 10580}{12167} \right] = \frac{20,000 \times 27780}{12167}$$

$$P = \frac{555600000}{12167} = 45664.50$$

$$\text{Total Cost of Bike} = 45664.50 + 20,000 \\ = 65664.50$$

Now, Depreciation \rightarrow 10%.

Bike value after 3 year \rightarrow

$$65664.50 \times \frac{90}{100} \times \frac{90}{100} \times \frac{90}{100}$$

$$= \frac{65664.5 \times 729}{1000} = \frac{47869.420.5}{1000} \\ = 47869.42$$

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NOTES 4
SSC & BANK
EXAMS
WHATS APP ON
97284-35915

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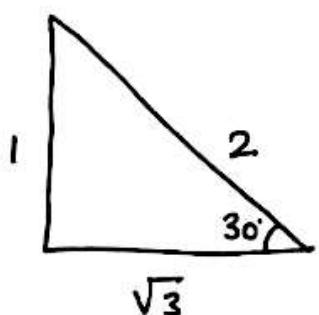
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Trigonometry - Height and Distance.

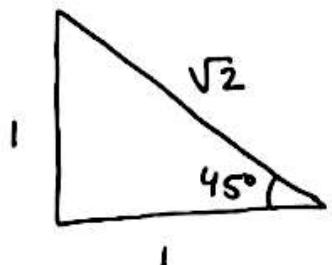
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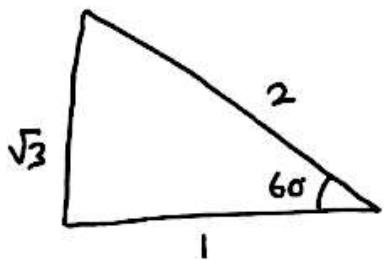
1 : sqrt(3) : 2

2).



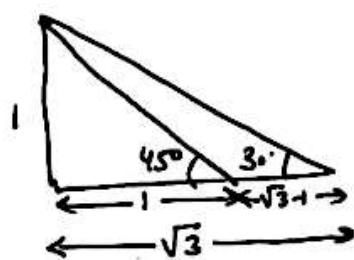
1 : 1 : sqrt(2)

3).



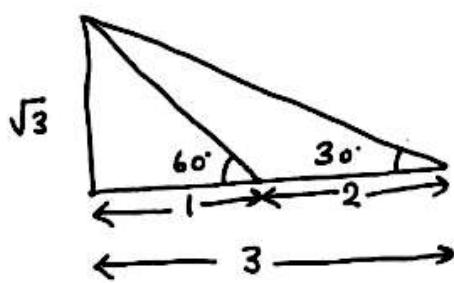
sqrt(3) : 1 : 2

4).

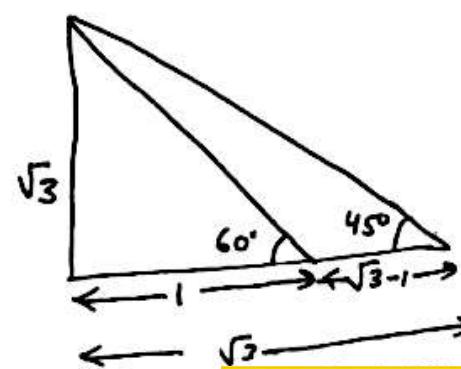


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5).



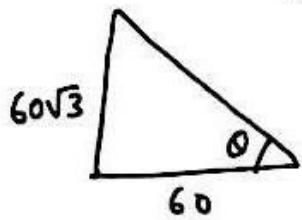
6).



Examples :-

Q.1 A tower is $60\sqrt{3}$ mt. height. Find the angle of elevation of its top from a point 60 mt. away from its foot.

Sol? :-



$$P:B$$

$$\sqrt{3}:1$$

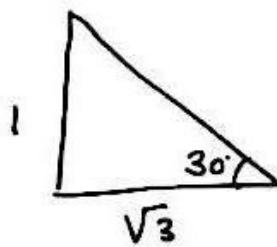
$$80 \boxed{\theta = 60^\circ}$$

$$[DR] \tan \theta = \sqrt{3}$$

$$\boxed{\theta = 60^\circ}$$

Q.2 :- The angle of elevation of the top of a tower at a distance of 500mt. from its top is 30° . The height of tower is

Sol? :-

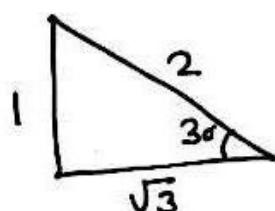


$$\sqrt{3} = 500 \text{ mt}$$

$$\text{so, } 1 = \frac{500}{\sqrt{3}}$$

$$\text{height of Tower} = \frac{500}{\sqrt{3}}$$

Q.3 :- A tree broken by the storm of wind and its top stuck the ground at an angle of 30° and at a distance of 20mt. from the foot of the tree. The height of the tree before broken.



$$\sqrt{3} = 20 \text{ mt}$$

height of the tree before broken

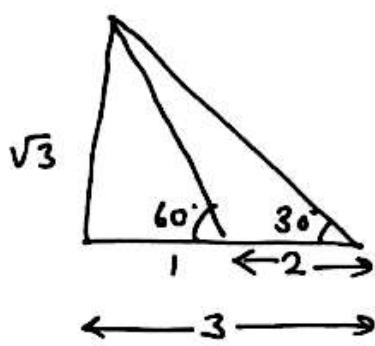
$$= 1 + 2 = 3 \text{ } 80^\circ$$

$$\sqrt{3} = 20$$

$$3 = \frac{20}{\sqrt{3}} \times 3 = \frac{20}{\sqrt{3}} = 20\sqrt{3}$$

Q.4:- A man from the top of a 50m high tower see moving towards the tower at an angle of depression is 60° . The distance travelled by the car during this time.

Sol:-



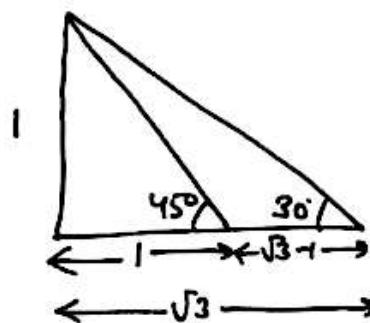
$$\sqrt{3} = 50$$

$$2 = \frac{50 \times 2}{\sqrt{3}} = \frac{100}{\sqrt{3}}$$

Distance travelled by car
= $\frac{100}{\sqrt{3}}$.

Q.5:- The shadow of an electric pole standing on a ground is 40m less when the angle of elevation change 30° to 45° . Find height of the pole?

Sol:-



$$\sqrt{3}-1 = 40$$

$$\begin{aligned} \text{height of the pole } 1 &= \frac{40}{\sqrt{3}-1} \\ &= \frac{40(\sqrt{3}+1)}{\sqrt{3}-1} = 20(\sqrt{3}+1) \end{aligned}$$

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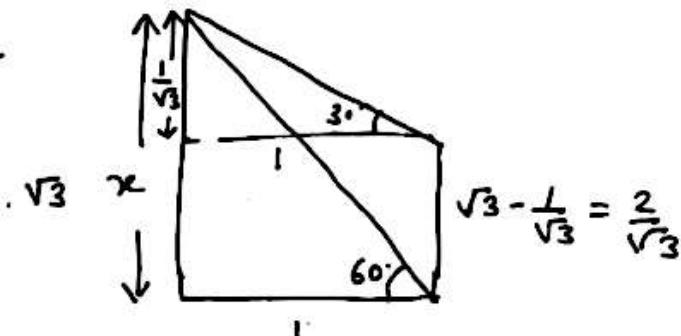
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Q.6 :- From the top of x mt. high cliff the angle of depression of the top and bottom are observed to be 30° and 60° respectively. Height of tower?

Sol? :-



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

$$60 \rightarrow \sqrt{3} = x$$

$$\frac{2}{\sqrt{3}} = \frac{2x}{3}$$

$$\text{height of tower} = 2x/\sqrt{3}$$

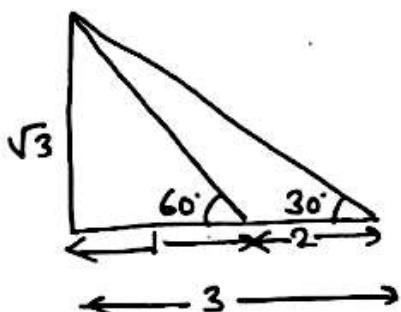
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Q.7 :- A person standing on the bank of a river observes that angle of elevation of the tree top on the opposite side of the bank is 60° . When he moves 50 m from the bank the angle of elevation became 30° . Height of the tree & width of the River are?

Sol? :-



Given

$$2 = 50.$$

$$\text{Height of Tree } \sqrt{3} = \frac{50 \times \sqrt{3}}{2} = 25\sqrt{3} \text{ m.}$$

$$\text{width of River } 3 = \frac{50 \times 3}{2} = 75 \text{ m}$$

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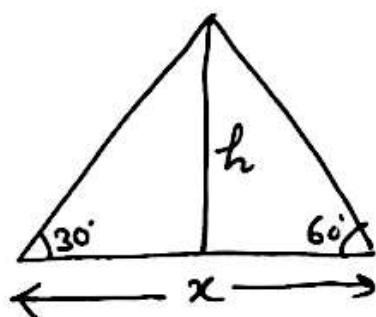
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Ques :-

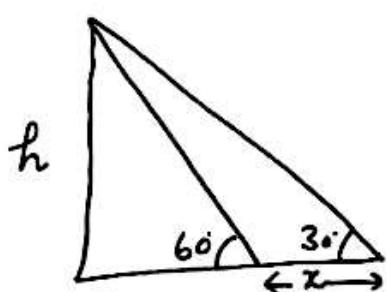
- 1). यदि दी गई हैं विकर्ता की ऊँचाई विकर्ता के विपरीत ओर दी गई हैं और दोनों कोण 30° & 60° हैं तो विकर्ता की दूरी = ?



[Angle must be 30° & 60°]

$$x = \frac{4h}{\sqrt{3}}$$

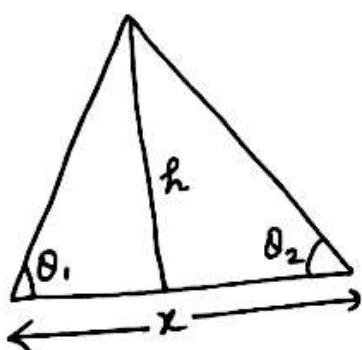
- 2). यदि दी गई हैं विकर्ता की ऊँचाई विकर्ता के विपरीत ओर दी गई हैं तो विकर्ता की दूरी



$$x = \frac{2h}{\sqrt{3}}$$

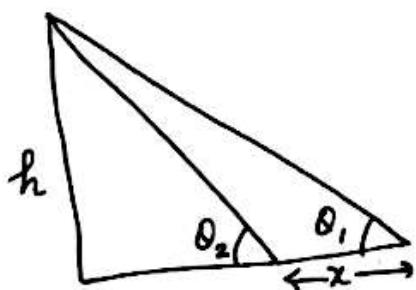
Angle must be 30° and 60°

3.)



$$x = h [\cot \theta_1 + \cot \theta_2]$$

4.).



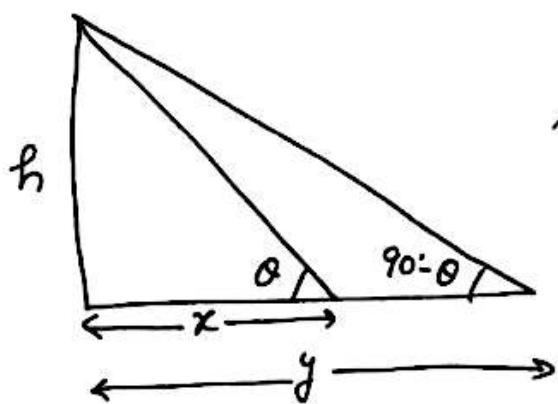
$$x = h [\cot \theta_1 - \cot \theta_2]$$

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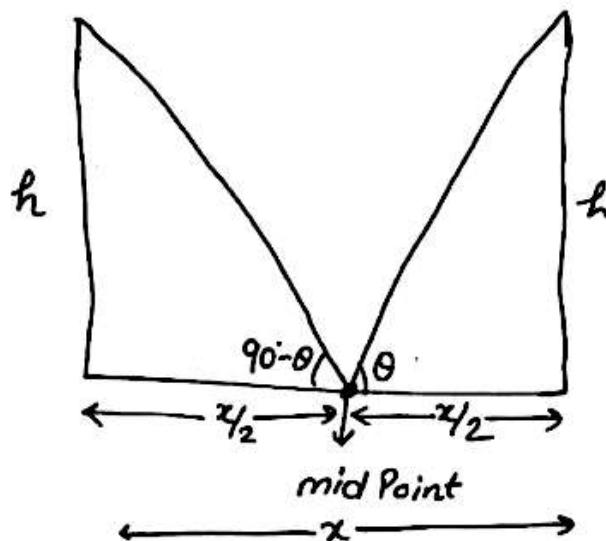
5). Complementary Angle.



so,

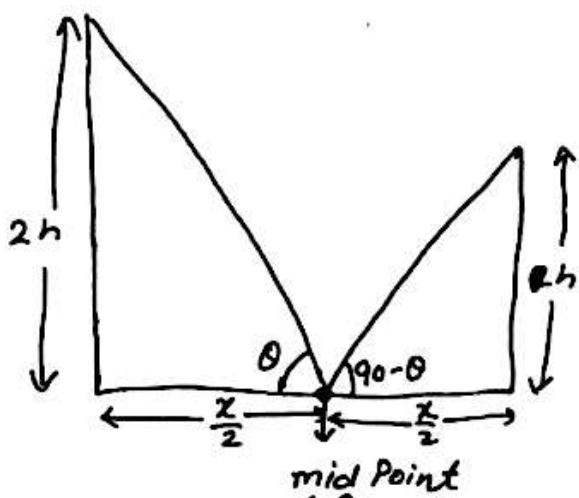
$$h = \sqrt{xy}$$

6).



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

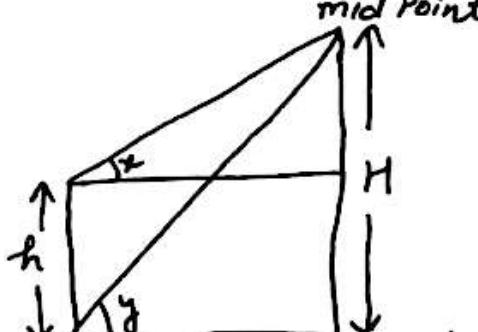
7).



$$h = \frac{x}{2\sqrt{2}}$$

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8).



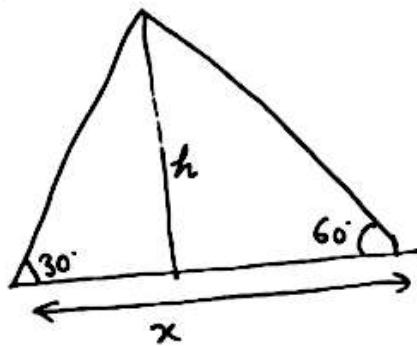
always

$$H = h \left[\frac{\cot x}{\cot x - \cot y} \right]$$

$$x < y$$

Q.:- A person is standing on the top of a tower of 100m high. He observed that 2 cars are approaching towards the tower from opposite direction making an angle of depression of 30° and 60° respectively. What is distance b/w 2 cars?

Solⁿ:—



$$x = \frac{4h}{\sqrt{3}} = \frac{4 \times 100}{\sqrt{3}}$$

$$x = \frac{400}{\sqrt{3}}$$

Q.:- A boy is standing in the middle of a field. He observed that a flying bird in the north makes an angle of elevation of 30° and after 2 minute he observed the same bird in the south and now angle of elevation become 60° . If bird is flying in a straight line at a height of $50\sqrt{3}$ mt. then what is the speed of bird in (km/h)

Dirⁿ → North to South [opposite dirⁿ]
and angle 30° & 60°

Solⁿ:—

$$\text{so, Distance } x = \frac{4h}{\sqrt{3}} = \frac{4 \times 50}{\sqrt{3}} \times \frac{\sqrt{8}}{2} \\ = 200 \text{ mt.}$$

$$\text{Speed} = \frac{200 \times 60}{2 \times 1000} = 6 \text{ km/h.}$$

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Q:- The angle of elevation of aeroplane from a point on the ground is 60° .

After 15 second flight the elevation changes to 30° . If the aeroplane is flying at a height of $1500\sqrt{3}m$. Find the speed of the plane.

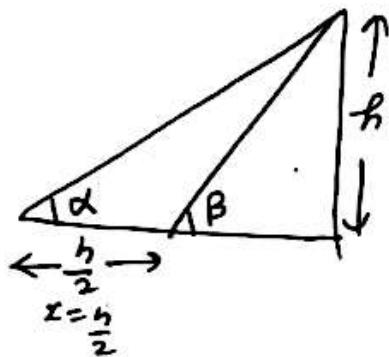
Solⁿ: - NOTE:- सूर्य अन्तर दिशा में Aeroplane → we will consider same dirⁿ.

$$\text{So, } h = 1500\sqrt{3}$$

$$x = \frac{2h}{\sqrt{3}} = \frac{2 \times 1500\sqrt{3}}{\sqrt{3}} = 3000$$

$$\text{Speed} = \frac{d}{t} = \frac{3000}{15} = 200 \text{ m/s.}$$

Q, The height of a tower is h mt. The angle of elevation to the top of tower from a point situated on the ground is α , while going towards the $\frac{h}{2}$ mt, the angle of elevation become β . Find the value of $\cot\alpha - \cot\beta = ?$



$$x = h[\cot\alpha - \cot\beta]$$

$$\frac{x}{2} = \frac{h}{2}[\cot\alpha - \cot\beta]$$

$$\boxed{\cot\alpha - \cot\beta = \frac{1}{2}}$$

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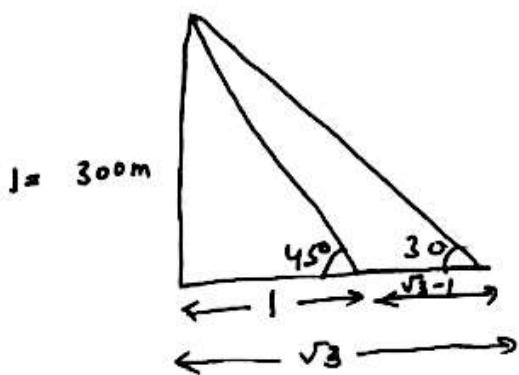
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Ques.:- From the peak of a hill which is 300m high, the angle of depression of two sides of a bridge lying on a ground are 45° and 30° (both ends of the bridge are on the same side of the hill). Then the length of the bridge is

- (1) $300(\sqrt{3}-1)m$
- (2) $300(\sqrt{3}+1)m$
- (3) $300\sqrt{3} m$
- (4) $\frac{300}{\sqrt{3}} m$

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$$h = 300$$

$$\sqrt{3}-1 = 300(\sqrt{3}-1) \text{ mt.}$$

[which is length of the bridge]

OR

$$x = h [\cot \theta_1 - \cot \theta_2]$$

$$x = 300 [\cot 30^\circ - \cot 45^\circ]$$

$$x = 300(\sqrt{3}-1)$$

Ans.

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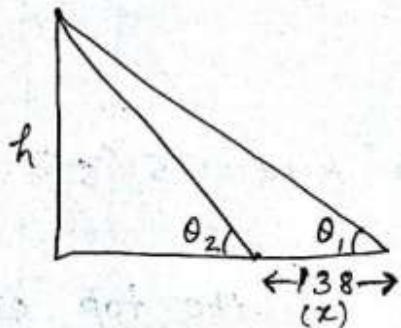
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Question :- At a point on a horizontal line through the base of a monument, the angle of elevation of the top of the monument is found to be such that its tangent is $\frac{1}{5}$. On walking 138 mt. towards the monument the secant of the angle of elevation is found to be $\frac{\sqrt{193}}{12}$. The height of the monument (in metre) is -

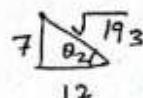
Soln:-



$$\tan \theta_1 = \frac{1}{5}$$

$$\text{so, } \cot \theta_1 = \frac{5}{1}$$

$$\sec \theta_2 = \frac{\sqrt{193}}{12}$$



$$\cot \theta_2 = \frac{12}{7}$$

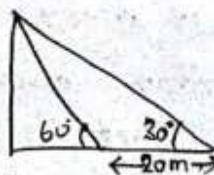
$$x = h[\cot \theta_1 - \cot \theta_2]$$

$$138 = h \left[5 - \frac{12}{7} \right] \Rightarrow h = \frac{138 \times 7}{35 - 12} = \frac{138 \times 7}{23}$$

$$h = 42 \text{ mt.}$$

Question :- The angle of elevation of the top of a tower from a point A on the ground is 30° . On moving a distance of 20 mt. towards the foot of the tower to a point B, the angle of elevation increases to 60° . The height of the tower is

Soln:-



$$x = \frac{2h}{\sqrt{3}} \Rightarrow 20 = \frac{2h}{\sqrt{3}}$$

$$h = 10\sqrt{3}$$

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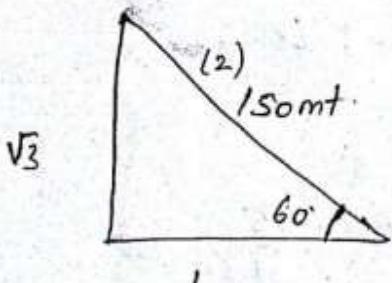
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Question :- One flies a kite with a thread 150 mt long. If the thread of the kite makes an angle of 60° with the horizontal line, then the height of the kite from the ground (assuming the thread to be in a straight line) is -

- (1) 50 mt (2) $75\sqrt{3}$ mt (3) $25\sqrt{3}$ mt. (4) 80 mt

Soln:-



$$2 \rightarrow 150$$

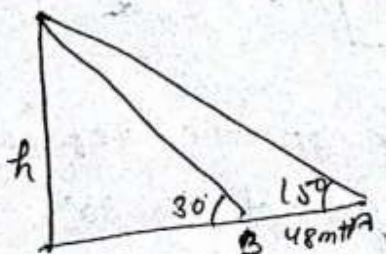
$$1 \rightarrow 75$$

$$\sqrt{3} \rightarrow 75\sqrt{3}$$

$$\text{height of the kite} = 75\sqrt{3}$$

Question :- The angles of elevation of the top of a tower from two points A and B lying on the horizontal through the foot of the tower are respectively 15° and 30° . If A and B are on the same side of the tower and $AB = 48$ mt. Then the height of the tower is?

Soln:-



$$x = h [\cot 30^\circ - \cot 15^\circ]$$

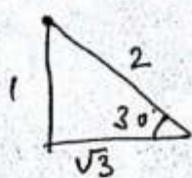
$$48 = h [\cot 15^\circ - \cot 30^\circ]$$

$$48 = h [2 + \sqrt{3} - \sqrt{3}]$$

$$h = \frac{48}{2} = 24 \text{ mt.}$$

Question :- A telegraph post is bent at a point above the ground due to storm. Its top just meets the ground at a distance of $8\sqrt{3}$ mt from its foot and makes an angle of 30° . Then the height of post -

Soln:-



$$\sqrt{3} \rightarrow 8\sqrt{3}$$

$$\text{Height of Post} = 1 + 2 \Rightarrow 3 = \frac{8\sqrt{3}}{\sqrt{3}} \times 3 = 24 \text{ mt.}$$

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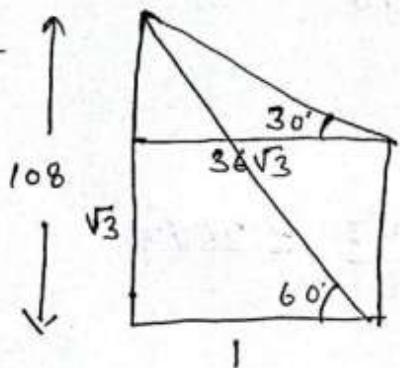
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Question ! - There are two vertical posts one on each side of a road, just opposite to each other. One post is 108 m high from the top of this post, the angle of depression of the top and foot of the other post are 30° and 60° respectively. The height of the other post, in metre, is -

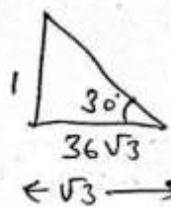
Soln :-



$$\sqrt{3} = 108$$

$$1 = \frac{108}{\sqrt{3}} = \frac{108\sqrt{3}}{3} = 36\sqrt{3}$$

NOW



$$\text{So, } \sqrt{3} = 36\sqrt{3}$$

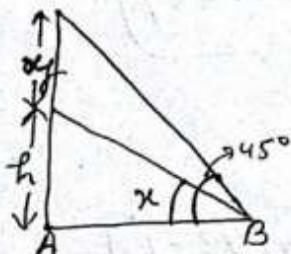
$$1 \rightarrow 36$$

$$\text{Height of other Post} = 108 - 36 = 72 \text{ m.t.}$$

Question :- The angles of elevations of the top of a building and the top of the chimney on the roof of the building from a point on the ground are x and 45° respectively. The height of building is h metre. Then the height of the chimney, in m.t. is

- (1) $h \cot x + h$ (2) $h \cot x - h$ (3) $h \tan x - h$ (4) $h \tan x + h$

Soln :-



$$\tan 45^\circ = \frac{h+z}{AB}$$

$$\boxed{AB = h+z}$$

$$\tan x = \frac{h}{AB}$$

$$AB = \frac{h}{\tan x}$$

$$h+z = \frac{h}{\tan x}$$

$$h+z = h \cot x$$

$$\boxed{x = h \cot x - h}$$

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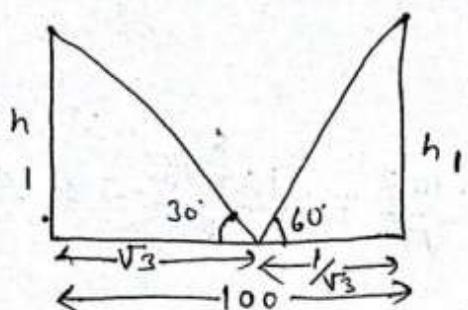
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Question:- Two poles of equal heights are standing opposite to each other on either side of a road which is 100m wide. From a point between them on road, angles of elevation of their tops are 30° and 60° . The height of each pole in metre is -

Soln:-



$$\frac{\sqrt{3} + \frac{1}{\sqrt{3}}}{\sqrt{3}} = 100$$

$$\frac{4}{\sqrt{3}} = 100$$

$$1 \rightarrow \frac{100\sqrt{3}}{4} = 25\sqrt{3}$$

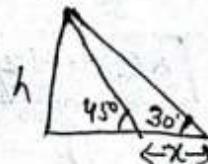
i.e.
1 \rightarrow $h = 2\sqrt{3}$

Question:- If the angle of elevation of the sun changes from 30° to 45° , the length of the shadow of a pillar decreases by 20mt. The height of pillar is ?

Soln:- NOTE, $\text{मूर्ख अनुपात } \frac{x_1}{x_2} \text{ के } 2\pi$ Aeroplane. \rightarrow we will consider same direction.

80, $\left[\frac{2h}{\sqrt{3}} = x \right] \rightarrow \text{for } 30^\circ \& 60^\circ$

and $x = h[\cot 60^\circ - \cot 45^\circ]$



$$20 = h[\cot 30^\circ - \cot 45^\circ] \Rightarrow 20 = h[\sqrt{3} - 1]$$

$$h = \frac{20}{\sqrt{3} - 1} \Rightarrow \frac{20(\sqrt{3} + 1)}{2} = 10(\sqrt{3} + 1) \text{ mt.}$$

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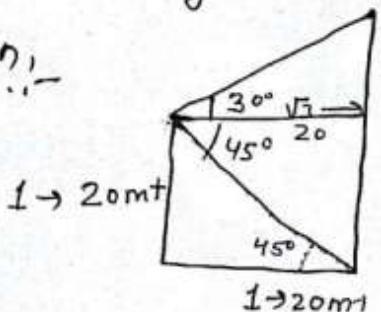
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Question:- From the top of a pillar of a height 20m the angle of elevation and depression of the top and bottom of another pillar are 30° and 45° respectively. The height of the second pillar (in metres) is -

Soln:-



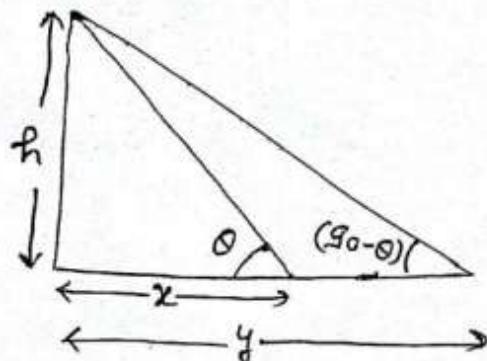
$$80, \sqrt{3} \rightarrow 20$$

$$1 \rightarrow \frac{20}{\sqrt{3}}$$

height of second pillar

$$= 20 + \frac{20}{\sqrt{3}} = 20 \left(\frac{\sqrt{3}+1}{\sqrt{3}} \right)$$

NOTE:-

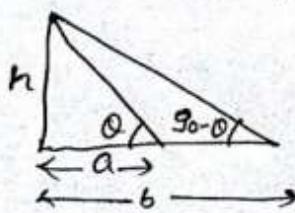


$$h = \sqrt{xy}$$

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Question:- The angle of elevation of the top of a tower two point which are at a distance a and b from the foot in the same horizontal line and on the same side of the tower are complementary the height of the tower is

Soln:-



$$h = \sqrt{ab}$$

$$\text{or } \frac{h}{a} = \tan(90-\theta) = \cot\theta \quad \textcircled{1}$$

$$\frac{h}{b} = \tan\theta \quad \textcircled{2}$$

$$\tan\theta \cdot \cot\theta = \frac{h}{a} \times \frac{h}{b}$$

$$ab = h^2 \Rightarrow h = \sqrt{ab}$$

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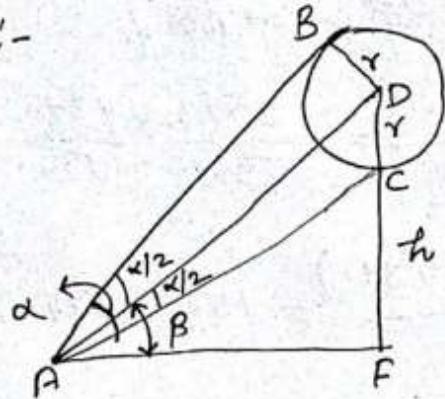
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Height and Distance

Question 1:- A round balloon of radius r subtends an angle α at the eye of the observer while the angle of elevation of its centre is β . Find the height of centre of the balloon is —

Soln:-



$$\sin \frac{\alpha}{2} = \frac{BD}{AD} = \frac{r}{AD}$$

$$AD = r \cosec \frac{\alpha}{2} \quad \text{--- (1)}$$

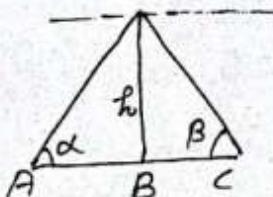
$$\sin \beta = \frac{h}{AD} \quad h \rightarrow DR$$

$$h = AD \sin \beta \quad \text{--- (2)}$$

So,
$$h = r \cosec \frac{\alpha}{2} \cdot \sin \beta$$

Question 2:- From an aeroplane just above a straight plane road, the depression angle of 2 consecutive milestones are α and β . If the plane stay between 2 milestones, then prove that height of the aeroplane is — $\frac{\tan \alpha \times \tan \beta}{\tan \alpha + \tan \beta}$ ($AC = 1$)

Soln:-



$$\tan \alpha = \frac{h}{AB}, \quad \tan \beta = \frac{h}{BC}$$

$$\frac{\tan \alpha \times \tan \beta}{\tan \alpha + \tan \beta} = \frac{\frac{h}{AB} \times \frac{h}{BC}}{\frac{h}{AB} + \frac{h}{BC}} = \frac{\frac{h^2}{AB \times BC}}{\frac{h}{AB} + \frac{h}{BC}} = \frac{h^2}{AB \times BC}$$

$$\frac{\tan \alpha \times \tan \beta}{\tan \alpha + \tan \beta} = h$$

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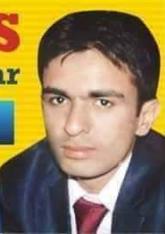
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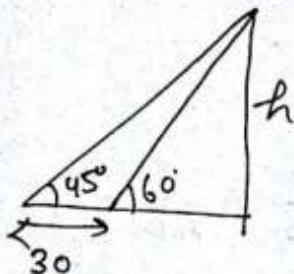
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Question 3:- The shadow of tower standing on a level plane is found to be 30m longer when the sun's altitude changes from 60° to 45° . The height of the tower is -

Sol:-

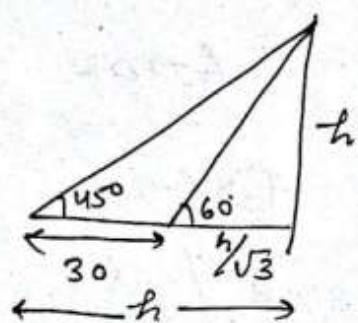


$$30 = h [\cot 45^\circ - \cot 60^\circ]$$

$$h = \frac{30}{1 - \frac{1}{\sqrt{3}}} = \frac{30\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

$$= \frac{15}{2} \sqrt{3} (\sqrt{3}+1) = 15\sqrt{3}(\sqrt{3}+1)$$

or



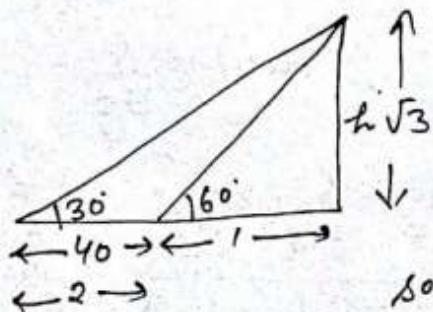
$$h - \frac{h}{\sqrt{3}} \rightarrow 30$$

$$h \left(\frac{\sqrt{3}-1}{\sqrt{3}} \right) \rightarrow 30$$

$$h \rightarrow \frac{30\sqrt{3}}{\sqrt{3}-1} \times \frac{(\sqrt{3}+1)}{(\sqrt{3}+1)} = 15\sqrt{3}(\sqrt{3}+1)$$

Question 4:- A person standing on bank of the river observes that the angle subtended by a tree on the opposite bank is 60° and when he retires 40 m from the bank, he finds the angle of elevation is 30° . Then the breadth of the river is -

Sol:-



$$\begin{array}{l} 2 \rightarrow 40 \\ \boxed{1 \rightarrow 20m} \end{array}$$

so, Breadth of the River $\rightarrow 20m$.

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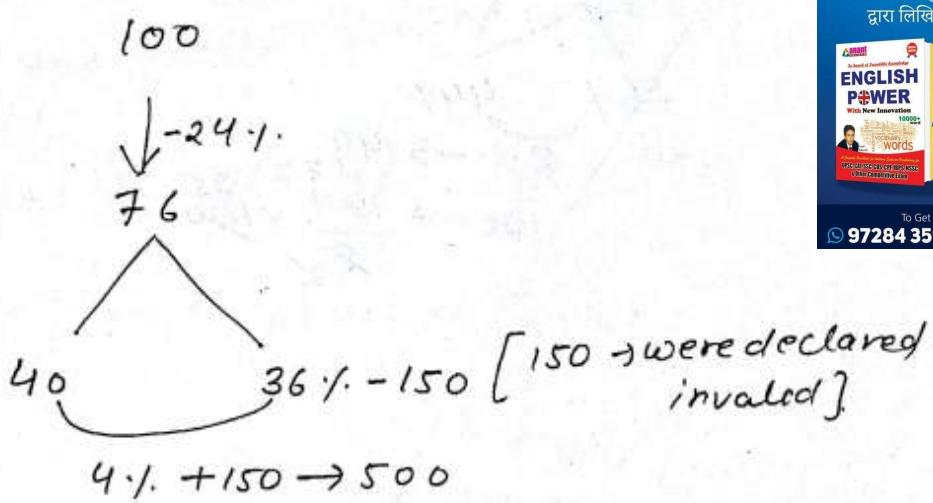
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Voters and Election Questions:-

Question 1:- In an election only two candidates contested, 24% voters did not cast their vote and 150 votes were declared as invalid; the winner got 500 votes more than his opponent and thus he secured 40% votes of the total voter on the voting list. The percentage of the defeated candidate out of the total votes cast is -

Sol:-

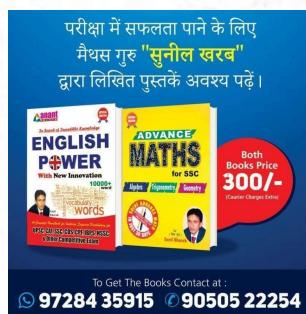


$$36\% - 150 \rightarrow \frac{350}{4} \times \frac{9}{36} - 150 = 3150 - 150 \\ = 3000$$

Defeated candidate secured $\rightarrow 3000$ votes.

$$\text{Total cast vote } 76 \rightarrow \frac{350}{4} \times \frac{19}{36} = 6650$$

$$\% \text{ of the defeated candidate} = \frac{\frac{60}{6650}}{133} \times 100 = 45.11\%.$$



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Question 2. In an election, the total turnout was 80%, out of which 16% of the total voters were declared invalid. Find which of the following can be the percentage of the votes got by the winner of the election. If the candidate who came second got 20% of the total voters on the voting list. (There were only three contestants, only one lost. (There were only three contestants, only one winner, and the total no. of voters on the voter's list = 20,000)

- (a) 44% (b) 46% (c) 48% (d) 49%

Soln :-

Total voters → 22,000
↓
80%
16,000

Invalid 16% → 32,00

2nd position Candidate \rightarrow 20% \rightarrow 4000

$$\text{NO. of votes left} = 16000 - 4000 - 3200 \\ = 8800$$

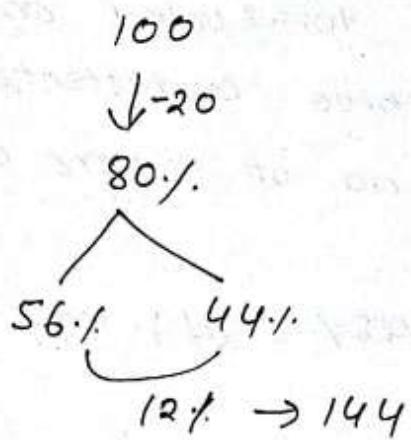
% of votes won by winning candidate

$$= \frac{8800}{20,000} \times 100 = 44\%$$



Question 3. At an election, the candidate who got 56% of the vote cast won by 144 votes. Find the total no. of voters on the voting list. If 80% people cast their vote and there were no invalid vote?

Sol:-



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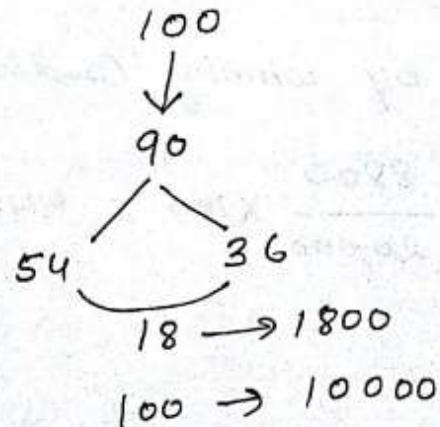
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$$12\% \text{ of } 80 \rightarrow 144$$

$$100 \rightarrow \frac{144}{12} \times 100 = 1200$$

Question 4. In an election between two candidates, 10% of voters were declared invalid. First candidate got 1800 votes which were 60% of the total valid votes. The total no. of voter enrolled in that election was-

Sol:-



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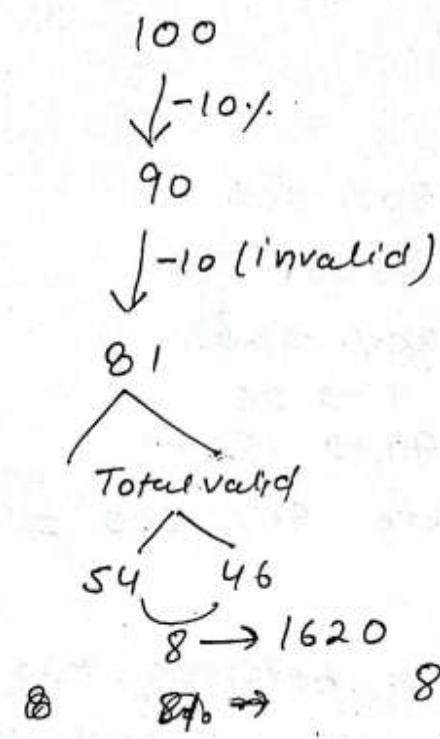
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Question 5:- In an election between two candidates, 10% of the voters did not cast their vote. 10% of the voters polled were found invalid. The successful candidates got 54% of the valid votes and won by a majority of 1620 votes. Find the number of voters enrolled on the voter list.

Sol? :-



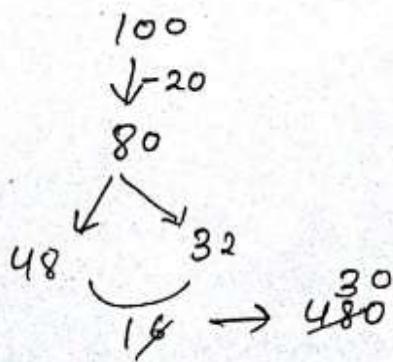
$$8\% \text{ of } 81 \rightarrow 1620$$

$$100\% \rightarrow \frac{1620}{81} \times 100 = 25000$$

No. of enrolled voters $\rightarrow 25,000$

Question 6:- In an election b/w 2 candidates, 20% of votes were declared invalid. First candidate got 480 votes more which were 60% of the total valid votes. The total no. of voters enrolled in that election was -

Sol? :-



$$100 \rightarrow 30 \times 100 = 3000 \text{ votes}$$

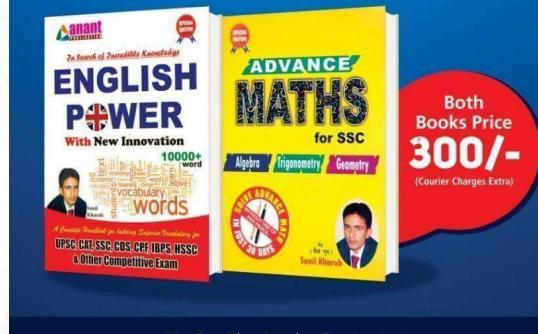
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Question 7 In an election between two candidates 10% of voters did not cast their vote. 300 votes declared invalid and winner get 60% of votes of voter list. He wins by 900 votes. Find the total no. of valid votes?

Soln:-

$$\begin{array}{c}
 100 \\
 \downarrow -10 \\
 90 \\
 \swarrow \searrow \\
 60 \quad 30\% - 300 \\
 \swarrow \searrow \\
 30\% + 300 \rightarrow 900 \\
 30\% \rightarrow 600 \\
 1 \rightarrow 20 \\
 90 \rightarrow 1800
 \end{array}$$

$$\text{Total valid vote } 90\% - 300 = 1500.$$

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Question 8- In an election between two candidates. 10% of the voters did not cast their vote. 20% of the votes polled were found invalid. The successful candidate got 52% of total votes and won by majority of 640 votes. what was the total number of voters?

Soln:-

$$\begin{array}{c}
 100 \\
 \downarrow \\
 90 \\
 \downarrow \\
 72 \\
 \swarrow \searrow \\
 52 \quad 20 \\
 \swarrow \searrow \\
 32 \rightarrow 640 \\
 1 \rightarrow 20 \\
 100 \rightarrow 20,000
 \end{array}$$

Total no. of voters = 20,000

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Question 9- In an election contested by two parties, Party D secured 12% of the total votes more than party R. If party R got 132,000 votes and there are no invalid votes, by how many votes did it lose the election?

- (1) 300,000 (2) 168,000 (3) 36,000 (4) 24,000

Soln:-

$$\begin{array}{c}
 100 \\
 \swarrow \quad \searrow \\
 56 = D \qquad R = 44 \rightarrow 132,000 \\
 \downarrow \qquad \qquad \qquad 12 \rightarrow \frac{132,000}{44} \times 12 \\
 12\% \qquad \qquad \qquad = 36,000
 \end{array}$$

The margin by which Party R lost the election
= 36,000

Question 10- In an election between two candidates, 75% of the voters cast their votes, out of which 2%. votes were declared invalid. A candidate got 9261 votes which were 75% of the valid votes. The total no. of voters enrolled in that election was-

- (a) 16,000 (b) 16400 (c) 16800 (d) 18,000

$$\begin{array}{c}
 100 \\
 \downarrow \\
 75\% \\
 \downarrow -2\% \\
 73.5 \\
 \swarrow \quad \searrow \\
 75\% \qquad 25\%
 \end{array}
 \qquad
 \begin{array}{l}
 73.5 \times 75\% = 9261 \\
 100 \rightarrow \frac{9261 \times 100}{73.5 \times 75\%} \\
 = 16800
 \end{array}$$

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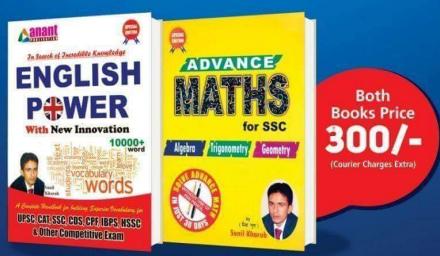


Voters and Elections Questions

Question :- In a local elections, 2400 people were to vote for party A or party B. Party A was bound to win the election. However, on election day, 33% of the voters of party A were kidnapped. Party B was also able to influence the remaining Party A voters and thus double the strength of its voters. In this way, Party A lost by a majority which was half of that by which it would have won had the elections been fair. How many people finally voted for Party A and Party B?

- (A) 600(A), 1200(B)
- (B) 300(A), 600(B)
- (C) 450(A), 900(B)

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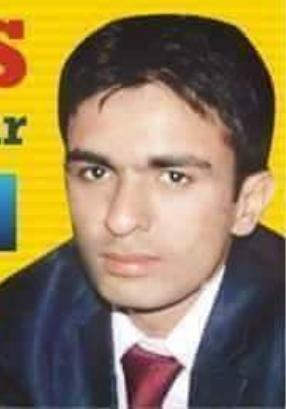
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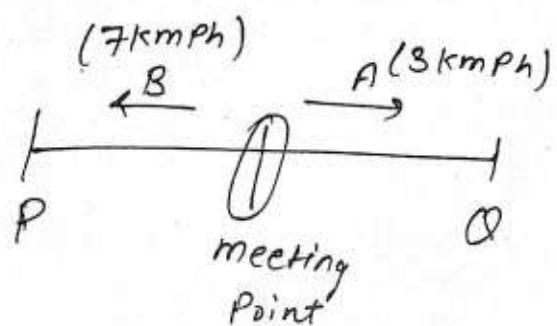
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Ans. 4



$$\frac{s_1}{s_2} = \sqrt{\frac{t_2}{t_1}} \Rightarrow \frac{3}{7} = \sqrt{\frac{x}{100}} \Rightarrow \frac{3}{7} \times \frac{x}{10}$$
$$x = \frac{30}{7} \text{ hours}$$

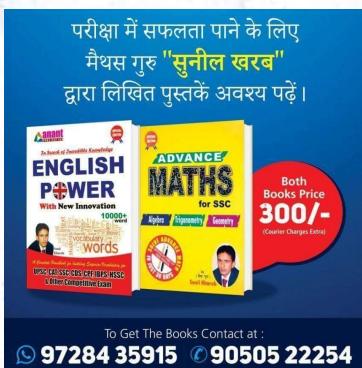
$$\begin{aligned}\text{Total Distance} &= 7 \times \frac{30}{7} + 3 \times \frac{100}{30} \times 7 \\ &= 30 + 70 = 100 \text{ km.}\end{aligned}$$

Question.1 - 8% of the voters in an election did not cast their votes. In this election, there were only two candidates. The winner by obtaining 48% of the total votes defeated his contestant by 1100 votes. The total no. of voters in the election was -

- (1) 21,000 (2) 23500 (3) 22000 (4) 27500

Soln.:

$$\begin{array}{c}
 100 \\
 \downarrow -8 \\
 92 \\
 48 \quad 44 \\
 \swarrow \quad \searrow \\
 4 \rightarrow 1100 \\
 100 \rightarrow \frac{1100 \times 100}{4} = 27500
 \end{array}$$



Question.2 :- In an election between 2 candidates, 75% of the voters cast their votes, out of which 2% votes were declared invalid. A candidate got 9261 votes which were 75% of the valid votes. The total no. of voters enrolled in that election was -

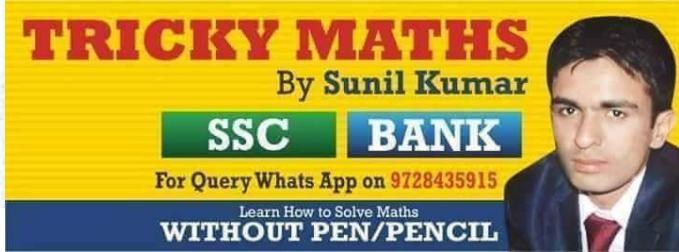
- (1) 16,000 (2) 16,400 (3) 16,800 (4) 18,000

Soln.:

$$\begin{array}{c}
 100 \\
 \downarrow \\
 75 \xrightarrow{-2\%} 73.5\%
 \end{array}$$

$$\begin{array}{c}
 \swarrow \quad \searrow \\
 75\% \quad 25\%
 \end{array}$$

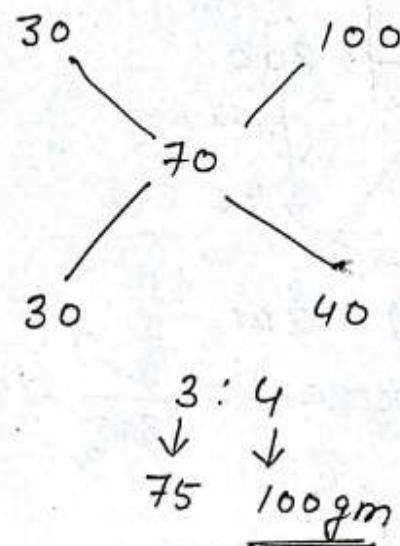
$$75\% \text{ of } 73.5 \rightarrow 9261 \quad \frac{3087}{4} \\
 100 \rightarrow \frac{9261 \times 100 \times 100}{73.5 \times 75} = 16,800$$



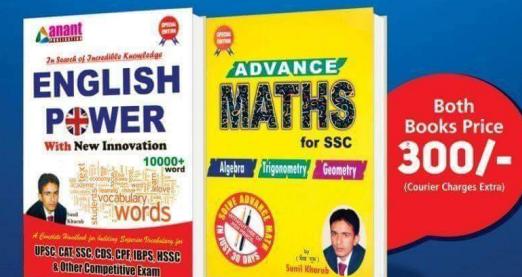
Q.5. :- 75 gm of sugar solution has 30% sugar in it. Then the quantity of sugar that should be added to the solution to make the quantity of the sugar 70% in the solution is -

- (1) 125 gm (2) 100 gm (3) 120 gm (4) 130 gm

Soln:-



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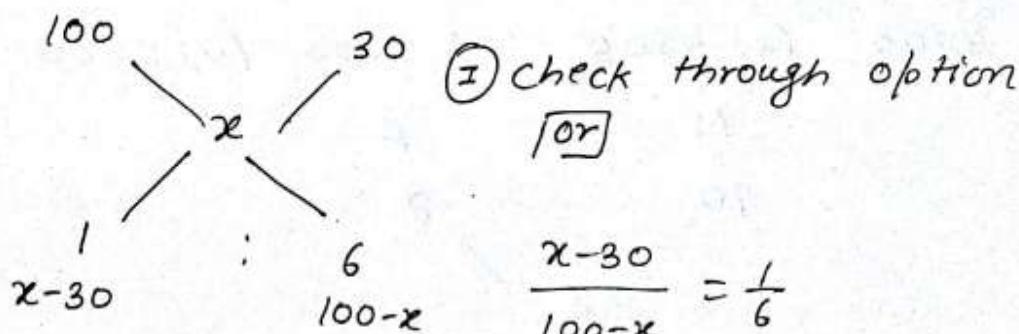
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Q.6. :- A litre of pure alcohol is added to 6 litre of 30% alcohol solution. The percentage of water in the solution is -

- (1) 50%. (2) 65%. (3) 60%. (4) 40%.

Soln:-



$$\frac{x-30}{100-x} = \frac{1}{6}$$

$$7x = 180 + 100 = 280$$

$$x = \frac{280}{7} = 40\%$$

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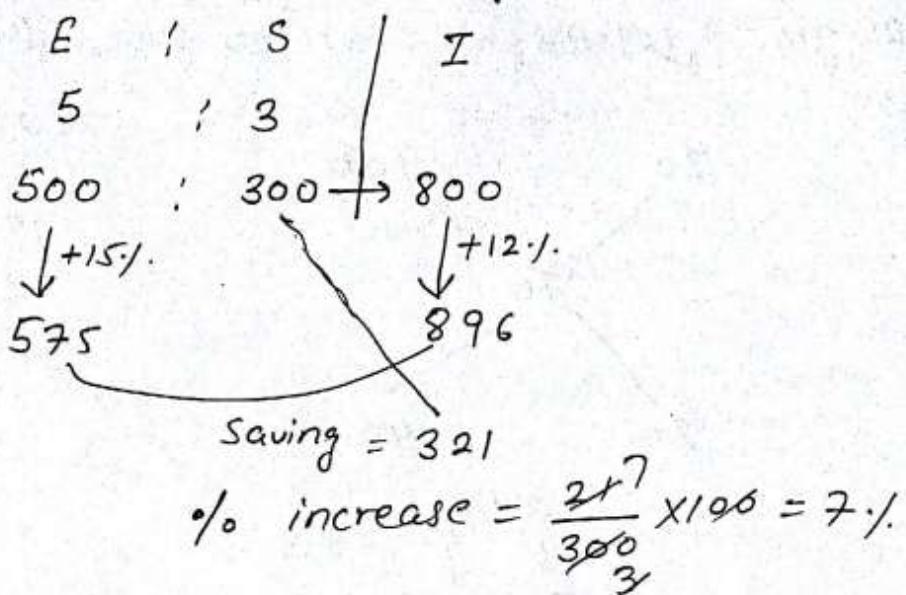
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Q.17:- Rama's expenditure and saving are in the ratio 5:3. If her income increases by 12% and expenditure by 15%, then by how much percent do her savings increase?

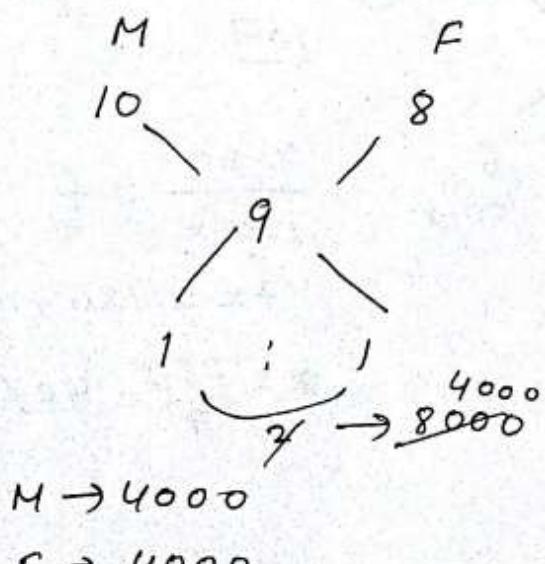
Sol:-



Q.18:- In a town, the population was 8000. In one year, male population increased by 10% and female population increased by 8%, but the total population increased by 9%. The number of males in the town was -

- (1) 4000 (2) 4500 (3) 5000 (4) 6000

Sol:-



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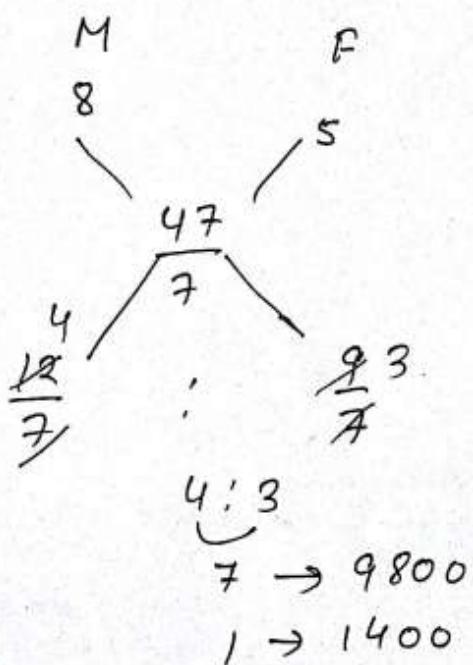
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Q.19:- The population of a village was 9800. In a year, with the increase in population of males by 8% and that of females by 5%, the population of the village became 10458. what was the no. of males in the village before increase?

- (1) 4200 (2) 4410 (3) 5600 (4) 6048

Soln:-



male (4) → 5600

F (3) → 4200

$$\begin{aligned}
 & \text{Total} \\
 & 9800 \xrightarrow{\uparrow} 10458 \\
 & \frac{329}{658} \times 100 \\
 & \frac{658}{9800} \\
 & = 47\%
 \end{aligned}$$

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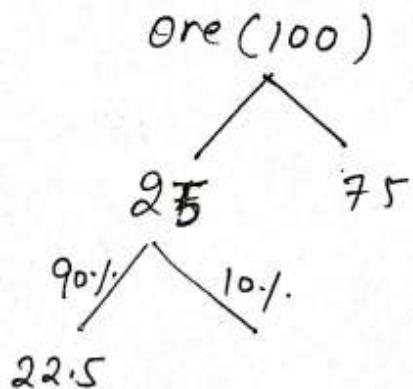
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Q.7:- An ore contains 25% of an alloy that has 90% iron. Other than this, in the remaining 75% of the ore, there is no iron. To obtain 60kg of pure iron, the quantity of the ore needed (in kgs) is approximately -

- (1) 250.57 (2) 266.67 (3) 275.23 (4) 300

Soln:-



$$x \times \frac{22.5}{100} = 60$$

$$x = \frac{60 \times 100}{22.5} = 266.67$$

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$$Q \rightarrow \left. \begin{array}{l} A+B+C = 4\sqrt{3} \\ A^2+B^2+C^2 = 16 \end{array} \right\} \text{ find } A:B:C = 1:1:1$$

Put $A=B=C = \frac{4}{\sqrt{3}}$

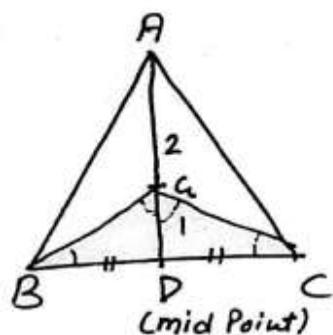
[because $(A+B+C)^2 = A^2+B^2+C^2 + 2(AB+BC+CA)$
 $48 = 16 + 2(AB+BC+CA)$
 $16 \cancel{32} = 2(AB+BC+CA)$

$\therefore A^2+B^2+C^2 = AB+BC+CA$
[only when $A=B=C$]

$$\begin{array}{c}
 \Rightarrow a^2 + \frac{1}{a^2} = 7 \\
 \max^m \quad \min^m \\
 a + \frac{1}{a} = 3 \quad a + \frac{1}{a} = -3 \\
 a^3 + \frac{1}{a^3} = 27 - 9 \quad a^3 + \frac{1}{a^3} = -27 + 9 \\
 v_2 = 18 \quad v_1 = -18 \\
 v_2 - v_1 = 18 - (-18) = 36
 \end{array}$$

Q.:- यदि ΔABC का शीर्ष A को कैंस कर दिया जाए, तो $\angle BGC$ का मान कितना होगा?

Sol.:- (1) 60° (2) 90° (3) 120° (4) 135°



$$AG = 2DG$$

$$\text{and } AG = BC \Rightarrow$$

$$\therefore GD = \frac{1}{2} BC$$

$$\therefore [GD = BD = CD]$$

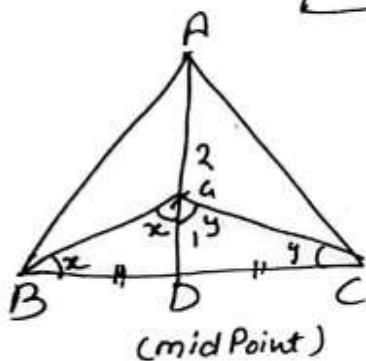
$\therefore \Delta BGD \triangle \Delta DGC$ [Isosceles Δ]

$$\therefore \angle BGC = \angle BGD + \angle DGC = \angle DBG + \angle DCB$$

$$\therefore \angle BGC = 180^\circ - 90^\circ \quad (\Delta \text{ property})$$

$$\boxed{\angle BGC = 90^\circ}$$

OR



$$AG = 2GD = BC$$

$$\therefore GD = BD = CD$$

$\Delta BGD \triangle \Delta DGC \rightarrow$ Isosceles Δ

apply isosceles Δ property.

take $\Delta BGC \Rightarrow$

$$x + y + (x + y) = 180^\circ$$

$$\therefore (x + y) = 180^\circ - 90^\circ$$

$$\therefore$$

$$\boxed{\angle BGC = 90^\circ}$$

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Q:- Brothers A and B had some savings in the ratio 4:5.

They decided to buy a gift for their sister the cost in the ratio 3:4. After they have bought the gift. A spent $\frac{2}{3}$ of his amount while B is left with Rs. 145. Then the value of the gift is?

Soln:-

saving

4:5

A : B

4x 5x

Expenditure 3:4 [?]

A : B

3y 4y

$$\frac{(4x) \times \frac{1}{3}}{5x - 145} \neq \frac{3}{4} \Rightarrow 16x = 9(5x - 145)$$
$$29x = 145 \times 9$$
$$\boxed{x = 45}$$

$$\text{so } 5 \times 45 - 145 = 4y$$

$$\frac{225 - 145}{4} = y \Rightarrow y = \frac{80}{4} = 20$$

$$\text{Gift cost} = 20 \times 7 = 140 \text{ Rs.}$$

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Q:- एक यात्री ने कुदूरी किसी चाल से तय की, यादि वह
 3 km/h अधिक की चाल से वह दूरी तय करता हो तो उसी
 40 मिनट कम समय लगता, यदि वह 2 km/h कम की
 चाल से वह दूरी तय करता, तो उसी 40 मिनट अधिक लगती,
 वह दूरी (km) में है?

- | | |
|---------------------|---------------|
| (1) 20 | (3) 35 |
| (2) $36\frac{2}{3}$ | <u>(4)</u> 40 |

Sol:-

$$\begin{aligned}
 & \cancel{s} \quad t \\
 +3 & \cancel{-40} \Rightarrow -40 \cancel{s} + 3t = |-40 \times 3| \quad -\textcircled{1} \\
 -2 & \cancel{+40} \Rightarrow 40 \cancel{s} - 2t = |+40 \times (-2)| \quad -\textcircled{2} \\
 \hline
 & t = 120 + 80 = 200 \text{ minute.}
 \end{aligned}$$

$$S = \frac{80 + 2 \times 200}{40} = \frac{480}{40} = 12 \text{ km/h}$$

$$\text{Distance } D = \frac{12 \times 200}{60} = 40 \text{ km}$$

Q.1:- A tradesman gives 4% discount on the marked price and gives 1 article free for buying every 15 articles and thus gains 35%. The marked price is increased above the cost price by.

- (A) 40%. (B) 39%. (C) 50%. (D) 20%.

Soln:-

$$\frac{16 \times 138}{100} = \left(\frac{18 \times x}{100} \right) \times \frac{96}{100}$$

$$x = \frac{144}{96} \times 100 = 150 \text{ (MRP)}$$

So MRP is above the CP is 50%.

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Q.:- A contractor employed 150 workers to complete a project in a certain number partly payment of wages, every day 4 workers start dropping. It results completion late by 8 days. In how many days the project was completed? He imposed on the contractor because of this delay what do you suggest to smooth working so that the project is completed in time.

Soln:-

$$150(n-8) = \frac{n}{2} [2 \times 150 + (n-1)(-4)]$$

$$150(n-8) = n[150 - 2(n-1)]$$

either satisfy by option [This would be easy]

OR solve the quadratic eqⁿ

$$150n - 150 \times 8 = 150n - 2n^2 + 2n$$

$$2n^2 - 2n - 1200 = 0$$

$$n^2 - n - 600 = 0$$

$$\begin{array}{c} -25 \\ \swarrow \quad \searrow \\ 24 \end{array} \Rightarrow \begin{matrix} \text{factor} \\ +25 \quad -24 \end{matrix}$$

So it takes 25 days to complete the work.

TRICKY MATHS

By Sunil Kumar

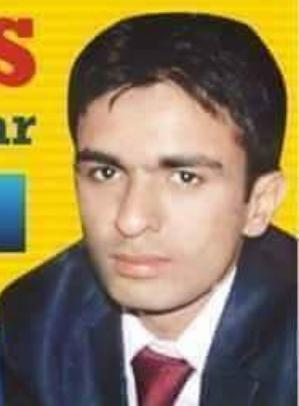
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Q.:- The price of sugar is reduced by 20%. Now a person can buy 500gm sugar for 36Rs. The original price of the sugar per kg was

- (a) 14.40 Rs. (b) 15.60 Rs. (c) 15.60 Rs. (d) Rs. 16.50 (e) 18 Rs.

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

$$P \rightarrow \begin{matrix} 4 \\ \swarrow \\ S \end{matrix} \begin{matrix} \curvearrowleft \\ 5 \end{matrix} \begin{matrix} \searrow \\ 5 \end{matrix} \begin{matrix} \curvearrowright \\ 1 \end{matrix} \begin{matrix} \searrow \\ 500\text{gm} \end{matrix}$$

$$\text{(consumption)} C \rightarrow \begin{matrix} 5 \\ \swarrow \\ \frac{S}{2} \text{ Kg} \end{matrix} \begin{matrix} \curvearrowleft \\ 1 \end{matrix} \begin{matrix} \searrow \\ 500\text{gm} \text{ or } \frac{1}{2} \text{ Kg} \end{matrix}$$

$$\text{original Price} = \frac{36}{2} = 18 \text{ Rs./Kg}$$

$$\text{Reduced Price} = \frac{36 \times 2}{5} = \frac{72}{5} = 14.4 \text{ Rs./Kg.}$$

Q.:- A Reduction of 10% in the price of sugar enables a housewife to buy 6.2kg more for ₹1116. The reduced price per kg?

- (A) ₹12 (B) ₹14 (C) ₹16 (D) ₹18.

Sol.:-

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

$$P \rightarrow \begin{matrix} 9 \\ \swarrow \\ C \end{matrix} \begin{matrix} \curvearrowleft \\ 10 \end{matrix} \begin{matrix} \searrow \\ 10 \end{matrix}$$

$$C \rightarrow \begin{matrix} 10 : 9 \rightarrow 6.2 \times 9 \\ \swarrow \\ 6.2 \times 10 \end{matrix} \begin{matrix} \curvearrowleft \\ 1 \end{matrix} \begin{matrix} \searrow \\ 6.2 \text{ Kg} \end{matrix}$$

$$\text{Reduced Price} = \frac{1116}{6.2 \times 10} = ₹18.$$

Ans.

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Q.:- Due to an increase of 20% in the price of eggs, 2 eggs less are available for Rs. 24. The present rate of eggs per dozen is?

Soln:- (1) 25 Rs. (2) 26.20 Rs. (3) Rs. 27.80 (4) Rs. 28.80

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

$$P \rightarrow \overset{\curvearrowleft}{6} \underset{10 \text{ eggs}}{\overset{\curvearrowleft}{5}}$$

$$C \rightarrow \overset{\curvearrowleft}{5} ; \underset{10 \text{ eggs}}{\overset{\curvearrowleft}{6}} \rightarrow 12 \text{ eggs}$$

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

$$\text{Present Rate} = \frac{24}{10} = 2.4 \text{ /egg}$$

$$\text{Present rate per dozen} = 2.4 \times 12 = 28.80.$$

Q.:- A reduction of 25% in the price of rice enables a person to buy 10kg more rice for ₹600. The reduced price per Kg of rice is

(1) ₹ 30 (2) ₹ 25 (3) ₹ 20 (4) ₹ 15

Soln:-

$$25\% \downarrow = \frac{1}{4}$$

$$P \rightarrow \overset{\curvearrowleft}{3} \underset{40 \text{ kg}}{\overset{\curvearrowleft}{4}}$$

$$C \rightarrow \overset{\curvearrowleft}{4} ; \underset{40 \text{ kg}}{\overset{\curvearrowleft}{3}} \rightarrow 30 \text{ kg}$$

$$1 \rightarrow 10 \text{ kg}$$

$$\text{Reduced Price per kg} = \frac{600}{40} = 15 \text{ Rs.}$$

TRICKY MATHS

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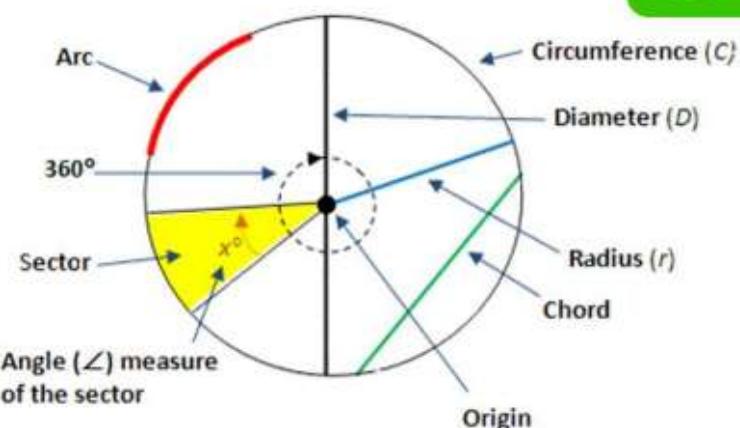
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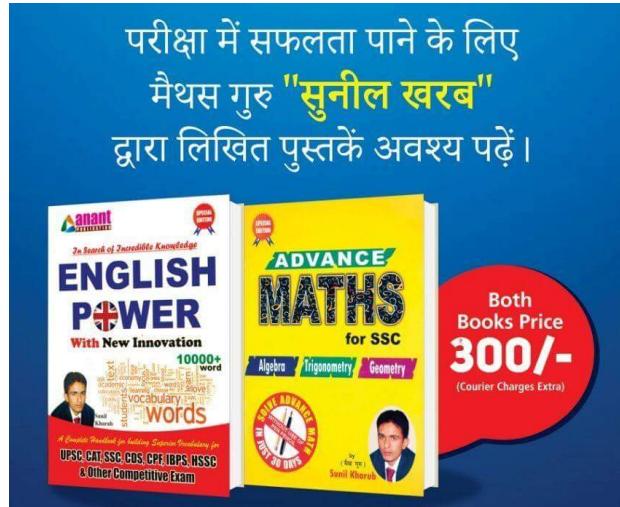
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Geometry - Circles

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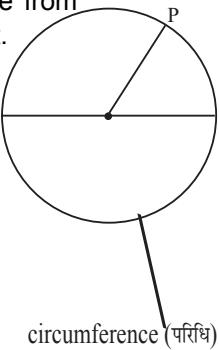
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CIRCLE (वृत्त)

CIRCLES

A circle is a locus i.e. path of a point in a plane which moves in such a way that its distance from a fixed point always remains constant.

In figure, 'O' is the fixed point and P is a moving point in the same plane. The path traced by P is called a circle. Fixed point O is the centre of the circle and the constant distance OP is called radius of the circle.



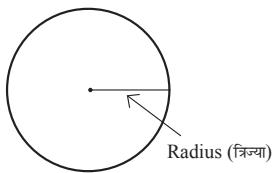
OR A circle is a simple closed curve, all the points of which are at the same distance from a given fixed point.

Circumference

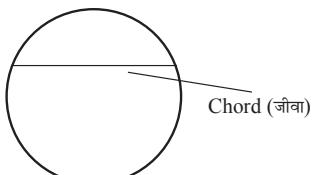
Length of a complete circle is called its circumference.

Terminology Related to CIRCLES

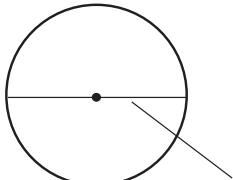
- Radius (क्रिया) : Line segment joining centre and any point of circle.



- Chord (जीवा) : A line segment joining any two points on a circle is called chord of the circle.



- Diameter (व्यास) : A chord passing through the centre of a circle is known as its diameter. Diameter is longest chord.



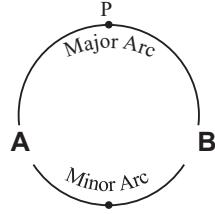
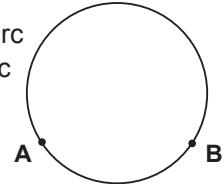
Diameter (व्यास)

- Arc of a circle (चाप) :

A piece of a circle between two points is called an arc. Consider two points M and N on the circle. We find that there are two pieces of circle between A and B. One is longer and other is smaller.

The longer piece is called major arc and smaller piece is called minor arc

Unless stated otherwise, by an arc AB we shall mean the minor arc.



Major arc is denoted by \widehat{APB} and minor arc is denoted by \widehat{AQN}

Note:-When M and N are ends of a diameter then both the arcs are equal and both are called semicircle.

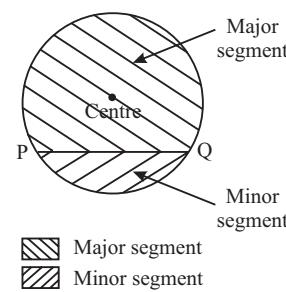
- Segment of a circle (वृत्तखण्ड) :

The region between a chord and an arc of a circle is called a segment.

There are two segments corresponding to two arcs, major segment and minor segment. Major segment is the segment enclosed by major arc.

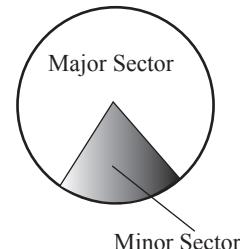
Centre of the circle lies in the major segment.

Minor segment is the segment enclosed by minor arc.

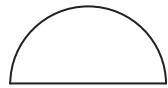


Major segment
Minor segment

- Sector of a circle(क्रियाखण्ड) : The part of a circle enclosed by an arc and two radii is called a sector.

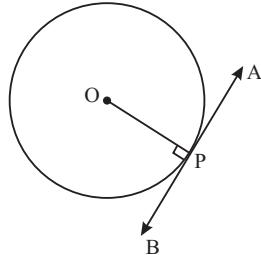


- 7) **Semicircle (अर्धवृत्त)** : A diameter of a circle divides the circumference of the circle into two equal arcs and each of these arcs is known as a semicircle.

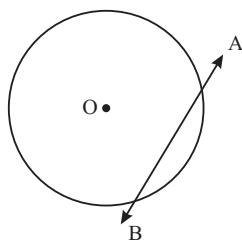


- 8) **Tangent of a circle (स्पर्शरेखा)** :

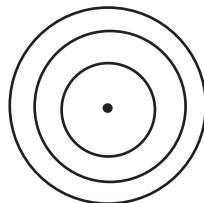
A tangent is a straight line which touches the circumference of a circle at only one point. A tangent does not intersect the circumference, if produced infinitely on either sides.



- 9) **Secant of a circle (प्रतिच्छेदरेखा)** : A straight line intersecting the circle at two points, is called a secant.



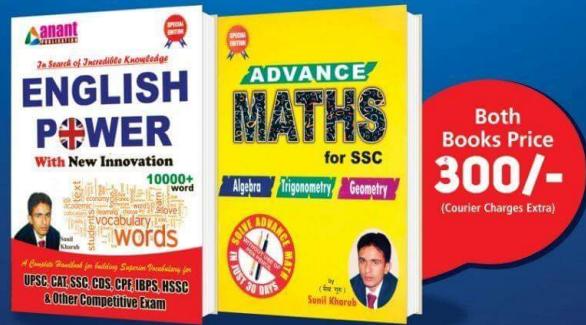
- 10) **Concentric Circles (संकेन्द्रियवृत्त)** : Circles having the same centre are said to be concentric circles.



Important formulas of CIRCLE

1. Area of circle = πr^2
2. Perimetre of circle = $2\pi r$
3. Area of semicircle = $\frac{1}{2}\pi r^2$
4. Perimeter of semicircle = $(\pi+2)r$
5. Area of a quadrant of a circle = $\frac{1}{4}\pi r^2$
6. Perimeter of a quadrant of a circle = $\left(\frac{\pi}{2} + 2\right)r$
7. Area of a sector of a circle = $\frac{\theta}{360^\circ} \times \pi r^2$
8. Length of arc = $\frac{\theta}{360^\circ} \times 2\pi r$

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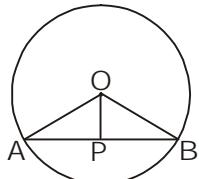
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Properties related to Circle

1). One and only one circle can pass through given three non- collinear points.

In case, the three given points are collinear, then a single circle cannot pass through these 3 points

2).The perpendicular from the centre of a circle to a chord bisects the chord.

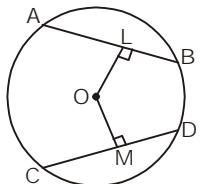


If $OP \perp AB$ then $AP = PB$

Conversely, the line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord.

If $AP = PB$ then $OP \perp AB$.

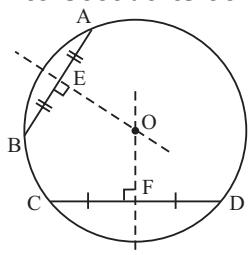
3).Equal chords of a circle are equidistant from the centre.



Chords AB and CD are equidistant from the centre O, ie $OL = OM$ if $AB = CD$.

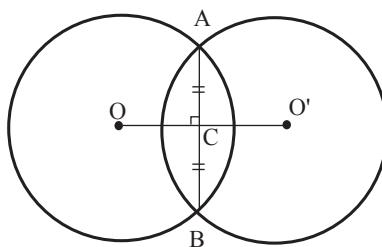
Conversely, chords of a circle which are equidistant from the centre are equal.

4).The perpendicular bisectors of two chords of a circle intersect at its centre.



The perpendicular bisectors of two chords AB and CD of a circle intersect at its centre O.

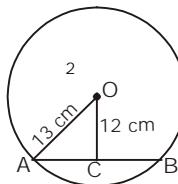
5). If two circles intersect at two points then the line segment joining their centre is perpendicular bisector of common chord.



$$AC = BC \text{ and } OC \perp AB$$

In a circle with radius 13 cm, a chord is drawn at the distance 12 cm from the centre. Find the length of the chord.

Solution:- Distance of the chord from the centre is 12 cm obviously, $OC \perp AB$. C is the midpoint of AB.



By the Pythagoras Theorem,

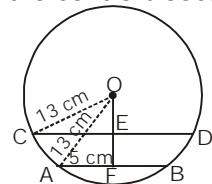
$$OC^2 + AC^2 = OA^2 \Rightarrow (12)^2 + (AC)^2 = 13^2$$

$$\therefore \text{Length of the chord} = AC + CB = 2AC = 10\sqrt{3} \text{ cm}$$

The radius of the circle is 13 cm. The lengths of two parallel chords on same sides of centre of the circle are 24 cm and 10 cm respectively. The distance between the chords is

- 1) 4 cm 2) 7 cm 3) 6 cm 4) 8 cm

Solution:- AB and CD are parallel chords. The perpendicular from the centre bisects the chord.



By the Pythagoras Theorem:

$$OF = \sqrt{13^2 - 12^2} = \sqrt{144} = 12 \text{ cm}$$

$$OE = \sqrt{13^2 - 5^2} = 12 \text{ cm}$$

$\therefore EF$ is the distance between the chords

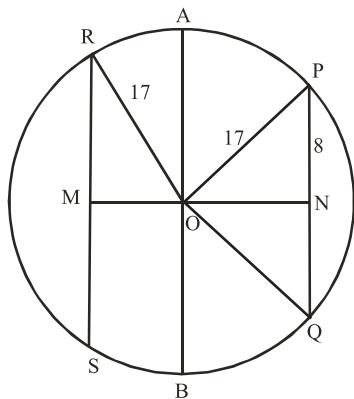
$$\text{and } EF = OF - OE = 12 \text{ cm} - 5 \text{ cm} = 7 \text{ cm}$$

TRICK:- CE will become OF &
AF will become OE
 $OF = CE = 12\text{ cm}$
 $OE = AF = 5\text{ cm}$

$$\text{and } EF = OF - OE = 12 \text{ cm} - 5 \text{ cm} = 7 \text{ cm}$$

In a circle of radius 17 cm, two parallel chords are drawn on opposite sides of a diameter. The distance between the chords is 23 cm. If length of one chord is 16 cm, then the length of the other one is :

Solution: (c) Let PQ and RS be two parallel chords of the circle on the opposite sides of the diameter $AB = 16\text{ cm}$



Now, $PN = 8$ (Since ON is the perpendicular bisector)
 In $\triangle PON$

$$ON^2 = OP^2 - PN^2 \\ = (17)^2 - (8)^2 = 289 - 64 = 225$$

$$\text{or } ON = 15 \Rightarrow OM = 23 - 15 = 8$$

In $\Delta QORM$,

$$RM^2 = QR^2 - QM^2$$

$$17^2 - 8^2 = 289 - 64 = 225$$

$$\text{or } RM = 15 \Rightarrow RS = 15 \times 2 = 30 \text{ cm}$$

TRICK:- NP becomes OM =8

In ΔORM ,

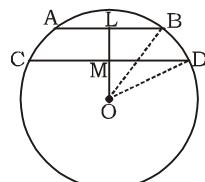
$$RM^2 = OR^2 - OM^2$$

$$17^2 - 8^2 = 289 - 64 = 225$$

$$\text{or } RM = 15 \Rightarrow RS = 15 \times 2 = 30 \text{ cm}$$

Two chords AB and CD of lengths 5 cm and 11 cm respectively of a circle are parallel to each other and both chords are on the same side of its centre. If the distance between AB and CD is 3 cm, then find the radius of the circle.

Solution:- The perpendicular bisector OL of AB and OM of CD are in the same line because $AB \parallel CD$.
 Let $OM = x$ cm and radius of the circle be r cm.



Then, from ΔOMD

$$x^2 + \left(\frac{11}{2}\right)^2 = r^2 \Rightarrow x^2 + \frac{121}{4} = r^2 \dots (1)$$

From AOLB,

$$(x+3)^2 + \left(\frac{5}{2}\right)^2 = r^2 \Rightarrow x^2 + 6x + \frac{61}{4} = r^2 \quad \dots (2)$$

From (1) and (2), we get

$$x^2 + \frac{121}{4} = x^2 + 6x + \frac{61}{4} \Rightarrow 6x = \frac{60}{4} \Rightarrow x = \frac{5}{2}$$

Substituting x into (1), we get

$$r^2 = \left(\frac{5}{2}\right)^2 + \left(\frac{11}{2}\right)^2 = \frac{25}{4} + \frac{121}{4} = \frac{146}{4} \Rightarrow r = \frac{1}{2}\sqrt{146}$$

TRICK:-



In $\triangle OAM$,

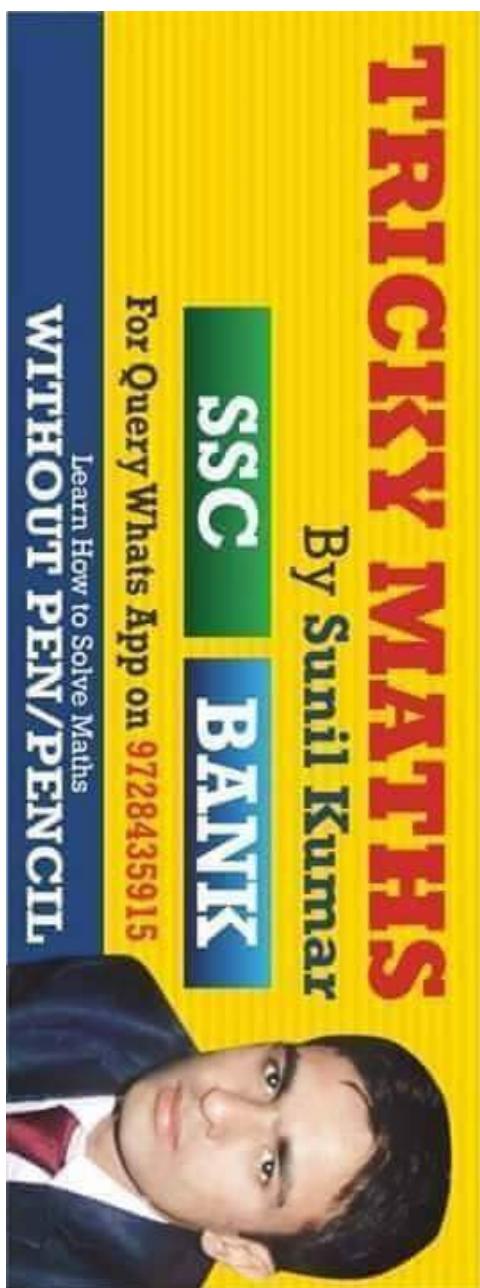
$$OA^2 = OM^2 + AM^2$$

$$(5)^2 = \left(\frac{5}{2}\right)^2 + AM^2$$

$$AM = \sqrt{25 - \frac{25}{4}} = \frac{5\sqrt{3}}{2} \text{ cm}$$

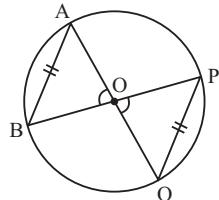
\therefore The length of common chord, $AB = 2 \times AM$

$$= 2 \times \frac{5\sqrt{3}}{2} = 5\sqrt{3} \text{ cm}$$



Properties based on ANGLES of a Circle

1. Equal chord of a circle subtend equal angles at the centre.

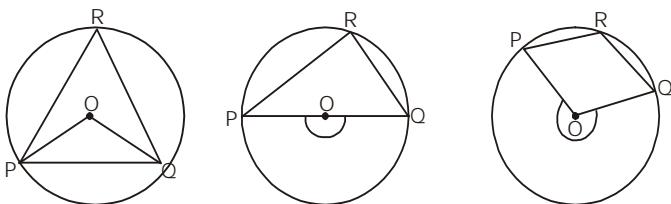


If $AB = PQ$, then $\angle AOB = \angle POQ$

The converse is also true.

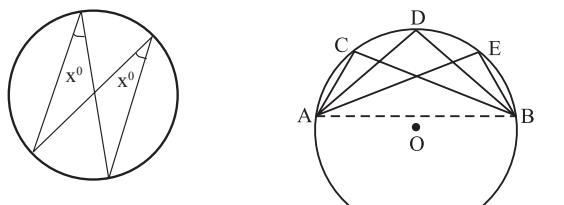
If the angles subtended by two chords of a circle at the centre are equal, the chords are equal.

2. The angle subtended by an arc of a circle at the centre is double the angle subtended by it at any point on the remaining part of the circle.



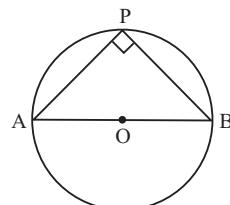
In each of the above figures,
 $\angle POQ = 2\angle PRQ$

3. Angles in the same segment of a circle are equal.



$\therefore \angle ACB = \angle ADB = \angle AEB$.

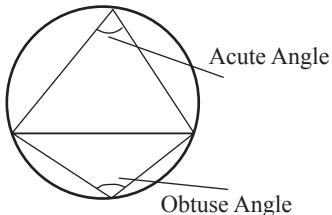
4. Angle in a semicircle is a right angle.



In figure, AOB is a diameter, hence $AOPB$ is a semicircle, therefore $\angle APB = 90^\circ$.

Conversely, the arc of a circle subtending a right angle at any point of the circle in its alternate segment is a semi-circle.

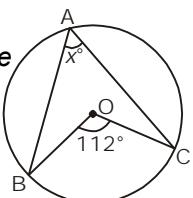
5. Angle made by a chord in minor segment is obtuse and in major segment is acute.



Find the value of x in the following circle with centre O.

Solution:- We know that the angle subtended by a chord at the centre is twice that at the circumference.

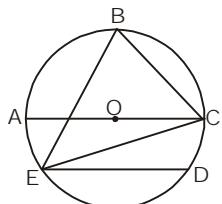
$$\therefore 2x = 112^\circ$$



$$\Rightarrow x = 56^\circ$$

In the given figure, chord ED is parallel to the diameter AC of the circle. If $\angle CBE = 65^\circ$ then what is the value of $\angle DEC$?

- 1) 25° 2) 65°
3) 45° 4) 35°



Solution:- Draw the line from point A to point E.

$\angle EAC = \angle CBE$ (Angles made by the same chord

on the circumference are equal) $= 65^\circ$

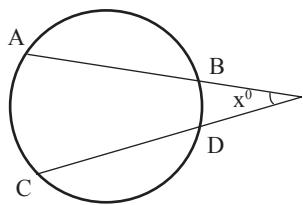
Also, $\angle AEC = 90^\circ$ (Angle made by diameter on the circumference)

$$\Rightarrow \angle ACE = 180^\circ - (90^\circ + 65^\circ) = 25^\circ$$

And $\angle ACE = \angle DEC = 25^\circ$ (**Alternate** angles)

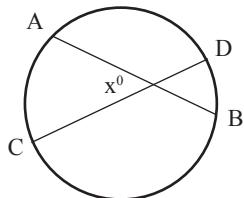


TRICK:- If two chords intersect each other then angle made by them on point of intersection –



$$x = \frac{1}{2} \times \text{angle by}$$

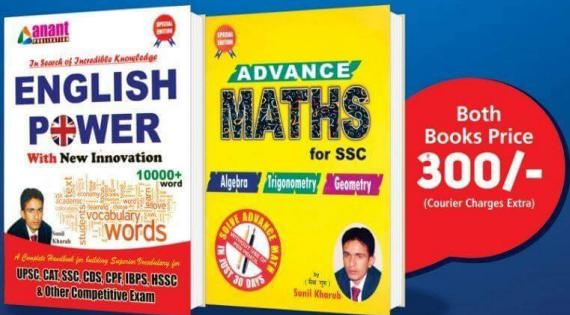
(arc AC – arc BD) at the centre



$$x = \frac{1}{2} \times \text{angle by}$$

(arc AC + arc BD) at centre

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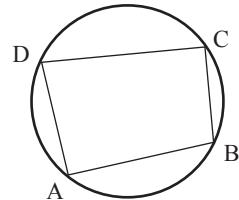


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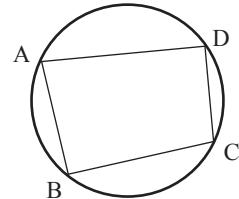
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Cyclic Quadrilateral Properties

Cyclic quadrilateral (चक्रियचतुर्भुज) : A cyclic quadrilateral is called cyclic quadrilateral if its all vertices lie on a circle.

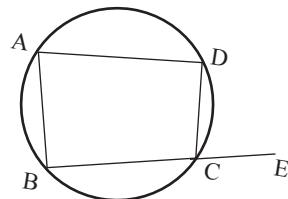


1. The sum of either pair or opposite angles of a cyclic quadrilateral is 180° .



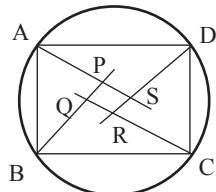
$$\angle A + \angle C = 180^\circ \text{ and } \angle B + \angle D = 180^\circ$$

2. If the sum of any pair of opposite angles of a quadrilateral is 180° , then the quadrilateral is cyclic.
3. If one side of a cyclic quadrilateral is produced, then the exterior angle is equal to interior opposite angle.



$$\angle CDE = \angle A$$

4. The quadrilateral formed by angle bisectors of a cyclic quadrilateral is also cyclic.



PQRS is cyclic quadrilateral

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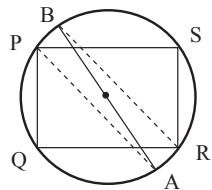
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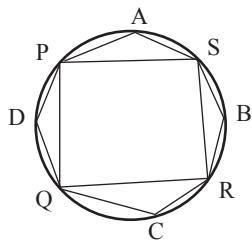
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5. If two sides of a cyclic quadrilateral are parallel then the remaining two sides are equal and diagonal are also equal.
6. If two opposite sides of a cyclic quadrilateral are equal, then the other two sides are parallel.
7. If the bisectors of the opposite angles $\angle P$ and $\angle R$ of a cyclic quadrilateral PQRS intersect the corresponding circle at A and B respectively, then AB is a diameter of the circle.

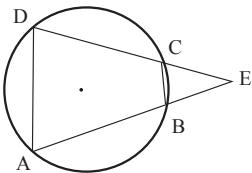


8. The sum of the angles in the four segments exterior to a cyclic quadrilateral is equal to 6 right angles.

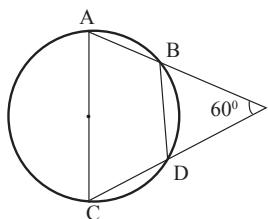


$$\angle A + \angle B + \angle C + \angle D = 90^\circ \times 6 = 540^\circ$$

9. ABCD is a cyclic quadrilateral. AB and DC are produced to meet in E, then $\Delta EBC \sim \Delta EDA$.

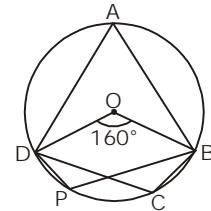


10. AB is diameter of a circle. Chord CD is equal to radius. If AC and BD when produced intersect at P, then $\angle APB = 60^\circ$



In the given figure, ABCD is a cyclic quadrilateral; O is the centre of the circle. If $\angle BOD = 160^\circ$, find the measure of $\angle BPD$

- 1) 20°
2) 100°
3) 80°
4) None of these



Consider the arc BCD of the circle. This arc make angle $\angle BOD = 160^\circ$ at the centre of the circle and $\angle BAD$

at a point A on the circumference.

$$\therefore \angle BAD = \frac{1}{2} \angle BOD = 80^\circ$$

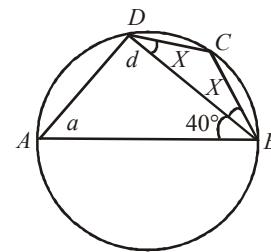
Now, ABPD is a cyclic quadrilateral.

$$\therefore \angle BAD + \angle BPD = 180^\circ$$

$$\Rightarrow 80^\circ + \angle BPD = 180^\circ$$

$$\Rightarrow \angle BPD = 180^\circ - 80^\circ = 100^\circ$$

In the adjoining figure, ABCD is a cyclic quadrilateral. If AB is a diameter, $BC = CD$ and $\angle ABD = 40^\circ$, find the measure of $\angle DBC$.



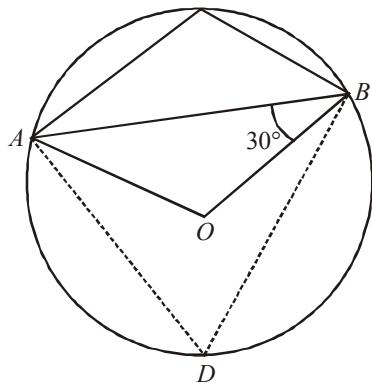
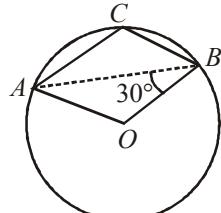
- (a) 65
(b) 25
(c) 45
(d) 60

SOLUTION:- (b) In ΔBCD , $BC = CD$, $\angle BDC = \angle CBD = x$
In cyclic quadrilateral ABCD, $\angle ABC + \angle ADC = 180^\circ$
 $40^\circ + x + 90^\circ + x = 180^\circ \Rightarrow x = 25^\circ$.

In the following figure, O is the centre of the circle and $\angle ABO = 30^\circ$, find $\angle ACB$.

- (a) 60°
(c) 75°

- (b) 120°
(c) 90°



$$OB = OA = \text{radius of the circle}$$

$$\angle AOB = 180 - (30 + 30)$$

$$\quad \quad \quad \{\text{Sum of angles of triangle} = 180^\circ\}$$

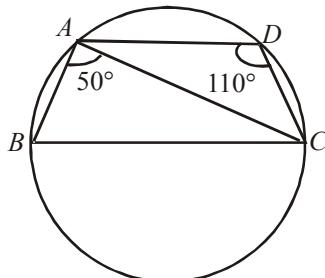
$$\Rightarrow 120^\circ$$

Then $\angle ADB = \frac{120}{2} = 60^\circ$, because the angle subtended by a chord at the centre is twice of what it can subtend at the circumference. Again, $ABCD$ is a cyclic quadrilateral;
So $\angle ACB = 180^\circ - 60^\circ = 120^\circ$ (because opposite angles of cyclic quadrilateral are supplementary).

$ABCD$ is a cyclic quadrilateral in which $BC \parallel AD$, $\angle ADC = 110^\circ$ and $\angle BAC = 50^\circ$ find $\angle DAC$

- (a) 60°
(b) 45°
(c) 90°
(d) 120°

SOLUTION:- (a) $\angle ABC + \angle ADC = 180^\circ$ (sum of opposite angles of cyclic quadrilateral is 180°)



$$\Rightarrow \angle ABC + 110^\circ = 180^\circ$$

$$(ABCD \text{ is a cyclic quadrilateral})$$

$$\Rightarrow \angle ABC = 180 - 110 \Rightarrow \angle ABC = 70^\circ$$

$$\therefore AD \parallel BC$$

$$\therefore \angle ABC + \angle BAD = 180^\circ \text{ (Sum of the interior angles on the same side of transversal is } 180^\circ)$$

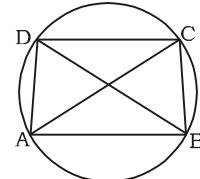
$$70^\circ + \angle BAD = 180^\circ$$

$$\Rightarrow \angle BAD = 180^\circ - 70^\circ = 110^\circ$$

$$\Rightarrow \angle BAC + \angle DAC = 110^\circ \Rightarrow 50^\circ + \angle DAC = 110^\circ$$

$$\Rightarrow \angle DAC = 110^\circ - 50^\circ = 60^\circ$$

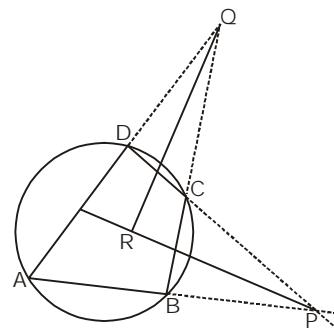
If two sides of a cyclic quadrilateral are parallel then the remaining two sides are equal and the diagonals are also equal. or
A cyclic trapezium is isosceles and its diagonals are equal. Conversely, If two nonparallel sides of a trapezium are equal it is cyclic. or
An isosceles trapezium is always cyclic.



If there is a cyclic quadrilateral $ABCD$ in which $AB \parallel CD$ then

- (i) $AD = BC$ (ii) $AC = DB$

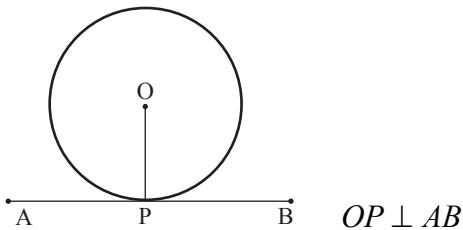
The bisectors of the angles formed by producing the opposite sides of a cyclic quadrilateral (provided that they are not parallel), intersect at right angle.



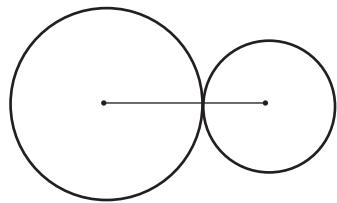
In a cyclic quadrilateral $ABCD$, AB and DC when produced meet at P and AD and BC when produced meet at Q . Bisectors of $\angle P$ and $\angle Q$ meet at a point R . Then $\angle PRQ = 90^\circ$.

TANGENT AND ITS PROPERTIES

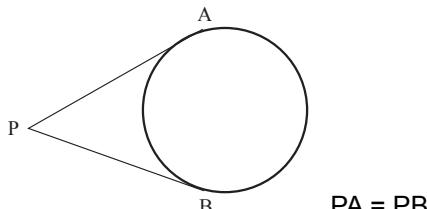
- 1) A tangent to a circle is perpendicular to the radius through the point of contact.



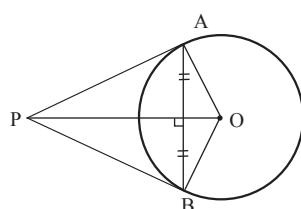
- 2) A line drawn through the end point of a radius and perpendicular to it is a tangent to the circle.
- 3) One and only one tangent can be drawn to a circle at a given point on the circumference.
- 4) The perpendicular to a tangent through its point of contact passes through the centre of the circle.
- 5) If two circles touch each-other, the point of contact lies on the straight line joining their centers.



- 6) From any point outside a circle two tangents can be drawn to it and they are equal in length.



7)



(i) $PA = PB$

(ii) $\Delta PAO \cong \Delta PBO$

(iii) $\angle P + \angle O = 180^\circ$

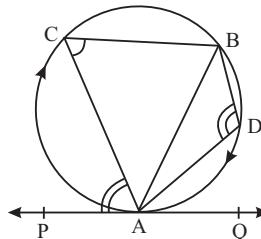
(iv) PO is a angle bisector of $\angle P$ & $\angle O$

(v) OP is perpendicular bisector of AB

(vi) $\widehat{AB} < \widehat{BA}$

8. ALternate segment THEOREM

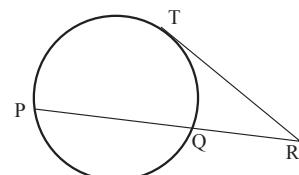
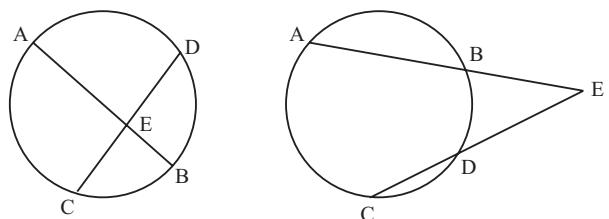
If a chord is drawn through the point of contact of a tangent to a circle, then the angle which this chord makes with the given tangent is equal to the angle formed in the alternate segment.



In the figure, AB is a chord of a circle. PQ is a tangent at an end point A of the chord to the circle. C is any point on arc AB and D is any point on arc BA.

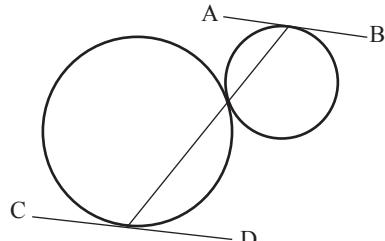
$\angle BAQ$ and $\angle ACB$ are angles in the alternate segments
 $\angle BAP$ and $\angle ADB$ are angles in the alternate segments.
 Angles in the alternate segments of a circle are equal i.e.
 $\angle BAQ = \angle ACB$ and $\angle BAP = \angle ADB$

9. If two chords AB and CD of a circle intersect inside a circle (or outside a circle when produced) at point E, then $AE \times EB = CE \times ED$.



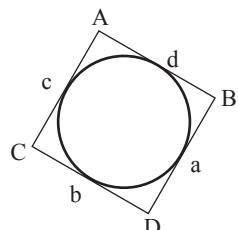
$PR \times RQ = TR^2$

- 10) Two circles touch externally and through the point of contact a straight line is drawn, touches the circumference of both circle, then the tangent at its extremities are parallel.



$$AB \parallel CD$$

- 11) If a circle touches all the four sides of a quadrilateral then the sum of opposite pair of sides are equal.

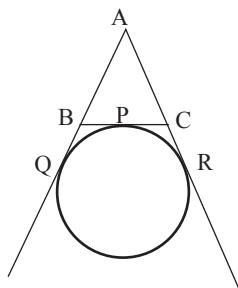


$$AB + DC = BC + DA$$

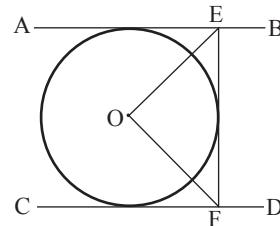
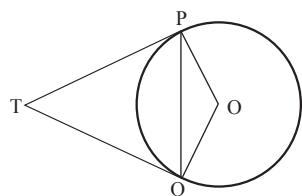
$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)(s-d)}$$

- 12) A circle touching the side BC of $\triangle ABC$ at P and touching AB and AC produced at Q and R respectively

$$\text{then } AQ = \frac{1}{2} (\text{perimeter of } \triangle ABC)$$

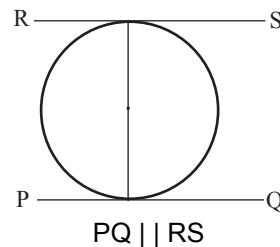


- 13) Two tangents TP and TQ are drawn to a circle with centre O from an external point T, then $\angle PTQ = 2\angle OPQ$.

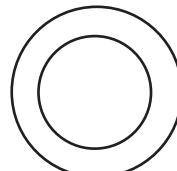


$$\text{If } AB \parallel CD \text{ then } \angle EOF = 90^\circ$$

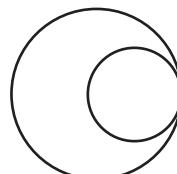
- 15) Tangents at the end point of a diameter of a circle are parallel.



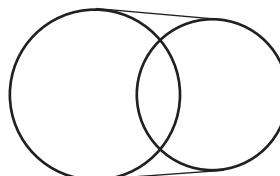
- 16) Common tangents to two circles



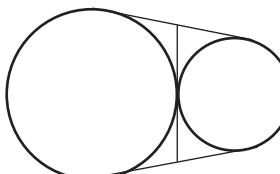
No common tangent



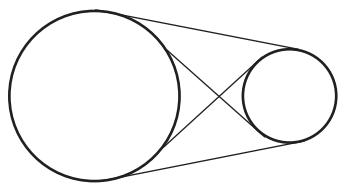
One common tangent



Two common tangent

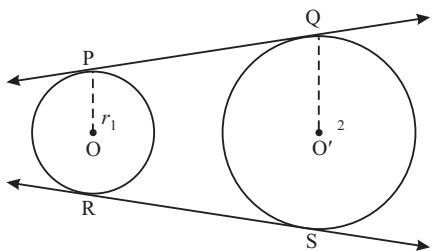


Three common tangent



Four common tangent

- # **Direct common tangent:** A tangent to two circles are such that the two circles lies on the same side of the tangent, then the tangent is called direct tangent to the two circles.



In the figure, PQ and RS are two direct common tangent to the same two circles. Length of these two common tangents to the same two circles are equal.

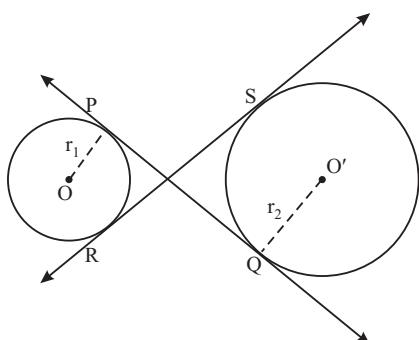
$$\text{i.e. } PQ = RS$$

$$\text{Also } PQ = RS = \sqrt{(OO')^2 + (r_2 - r_1)^2}$$

Here O, O' are the centres and r_1, r_2

- # **Indirect or Transverse Common Tangent:** If a tangent to two circles is such that the two circles lie on opposite sides of the tangent, then the tangent is called indirect tangent.

Length of two indirect tangents to two circles is equal.



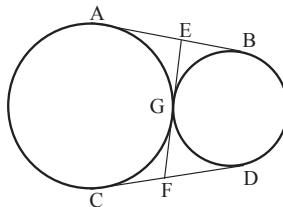
In the figure, PQ and RS are two indirect common tangents to the same two circles.

$$\therefore PQ = RS$$

$$\text{Also } PQ = RS = \sqrt{(OO')^2 - (r_1 + r_2)^2}$$

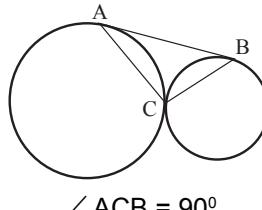
Here O, O' are centres r_1, r_2 are radii of the two circles respectively.

IMPORTANT RESULT



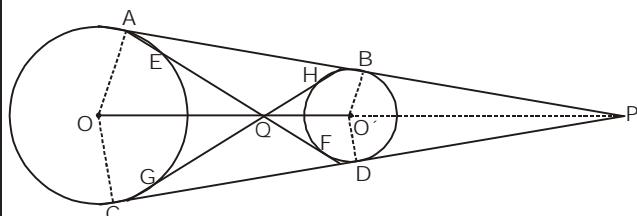
- (i) $AB = CD = EF$
- (ii) $AE = EB = EG = GF = CF = FD$

IMPORTANT RESULT



$$\angle ACB = 90^\circ$$

- # **The point of intersection of direct common tangents and indirect (transverse) common tangents to two circles divide the line segment joining the two centres, both externally and inter-nally, in the ratio of their radii.**



In the above figure, there are two non-intersecting circles. AB and CD are their direct common tangents, which when produced meet at P . Also, EF and GH are the transverse common tangents intersecting at Q . r is the radius of the circle having centre O and s is the radius of circle having centre O' . Then

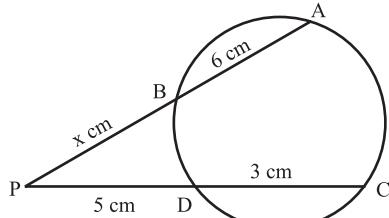
- (i) P divides OO' externally in the ratio $r : s$.

$$\text{ie } \frac{OP}{O'P} = \frac{r}{s}$$

- (ii) Q divides OO' internally in the ratio $r : s$

$$\text{ie } \frac{OQ}{O'Q} = \frac{r}{s}$$

In the given figure, chords AB and CD of a circle intersect externally at P . If $AB = 6 \text{ cm}$, $CD = 3 \text{ cm}$ and $PD = 5 \text{ cm}$, then $PB = ?$

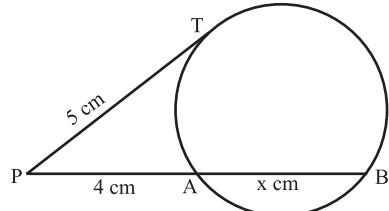


- (a) 5 cm (b) 6.25 cm
(c) 6 cm (d) 4 cm

Solution: (d) $PA \times PB = PC \times PD$ (According to property of circle)

$$\begin{aligned} \Rightarrow & (x+6) \times x = 8 \times 5 \\ \Rightarrow & x^2 + 6x - 40 = 0 \\ \Rightarrow & (x+10)(x-4) = 0 \Rightarrow x = 4 \\ \therefore & PB = 4 \text{ cm} \end{aligned}$$

In the given figure, PAB is a secant and PT is a tangent to the circle from P . If $PT = 5 \text{ cm}$, $PA = 4 \text{ cm}$ and $AB = x \text{ cm}$, then x is equal to



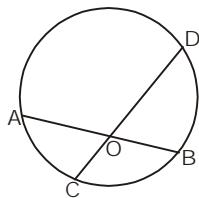
- (a) 2.5 cm (b) 2.6 cm
(c) 2.25 cm (d) 2.75 cm

Solution: (c) $PA \times PB = PT^2 \Rightarrow 4 \times (4+x) = 25$

$$\Rightarrow 4+x = \frac{25}{4} = 6.25 \Rightarrow x = 2.25 \text{ cm}$$

In the given figure, two chords AB and CD intersect each other at O . If $AO = 8 \text{ cm}$, $CO = 6 \text{ cm}$ and $OD = 4 \text{ cm}$, find OB .

- 1) 3 cm 2) 4 cm
3) 5 cm 4) 6 cm

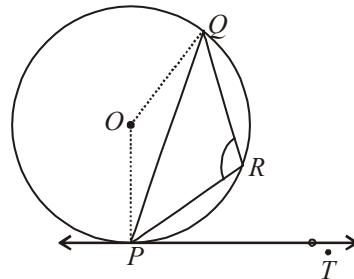


We know that, $OA \times OB = OC \times OD$

$$\Rightarrow 8 \times OB = 6 \times 4$$

$$OB = 3 \text{ CM}$$

In the given fig. PQ is a chord of a circle and PT is the tangent at P such that $\angle QPT = 60^\circ$. Then $\angle PRQ$ is equal to



- (a) 135° (b) 150°
(c) 120° (d) 110°

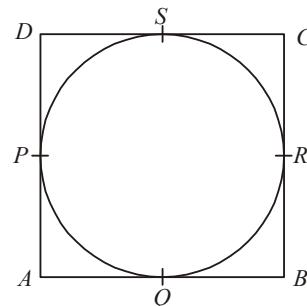
$\angle QPT = 60^\circ$
 $\Rightarrow \angle PSQ = 60^\circ$
[Alternate segment theorem]
 Now $SQRP$ is cyclic quadrilateral
 $\Rightarrow \angle S + \angle R = 180^\circ \Rightarrow \angle R = 180^\circ - 60^\circ = 120^\circ$

If four sides of a quadrilateral $ABCD$ are tangential to a circle, then.

- (a) $AC + AD = BD + CD$ (b) $AD + BC = AB + CD$
(c) $AB + CD = AC + BC$ (d) $AC + AD = BC + DB$

(b) Since $ABCD$ is a quadrilateral

Again AP, AQ are tangents to the circle from the point A .



$$\therefore AP = AS$$

$$\text{Similarly } BR = BQ$$

$$CR = CS$$

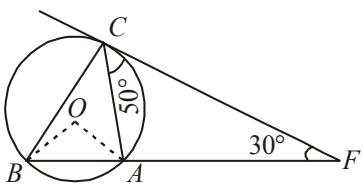
$$DP = DS$$

$$\therefore (AP + DP) + (BR + CR) = AQ + DS + BQ + CS$$

$$= (AQ + BQ) + (CS + DS)$$

$$\Rightarrow AD + BC = AB + CD$$

Find $\angle BOA$.

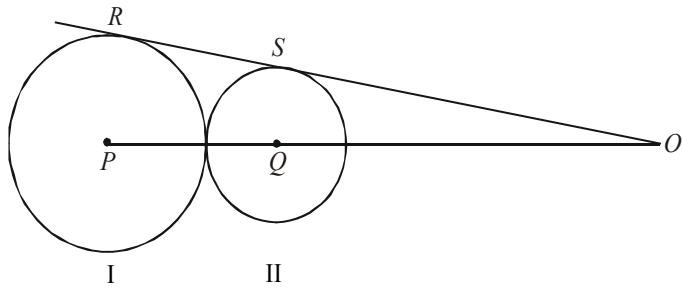


- (a) 100°
(b) 150°
(c) 80°
(d) Indeterminate

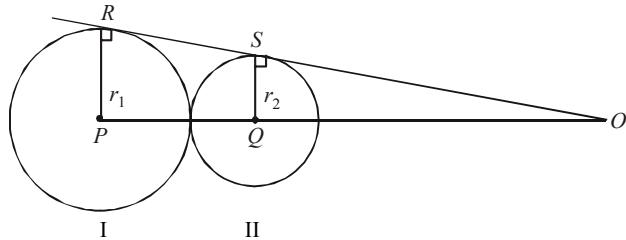
(a) $\angle CAF = 100^\circ$. Hence $\angle BAC = 80^\circ$
Also, $\angle OCA = (90 - ACF) = 90 - 50 = 40^\circ = \angle OAC$ (Since the triangle OCA is isosceles)
Hence $\angle OAB = 40^\circ$
In isosceles $\triangle OAB$, $\angle OBA$ will also be 40°
Hence, $\angle BOA = 180 - 40 - 40 = 100^\circ$

Directions for Questions 1–3: Answer the questions on the basis of the information given below.

In the adjoining figure, I and II are circles with centers P and Q respectively. The two circles touch each other and have a common tangent that touches them at points R and S respectively. This common tangent meets the line joining P and Q at O. The diameters of I and II are in the ratio 4 : 3. It is also known that the length of PO is 28 cm.



1. What is the ratio of the length of PQ to that of QO ?
(a) 1 : 4
(b) 1 : 3
(c) 3 : 8
(d) 3 : 4
2. What is the radius of the circle II?
(a) 2 cm
(b) 3 cm
(c) 4 cm
(d) 5 cm
- 3.. The length of SO is
(a) $8\sqrt{3}$ cm
(b) $10\sqrt{3}$ cm
(c) $12\sqrt{3}$ cm
(d) $14\sqrt{3}$ cm



1. (b) In $\triangle SOQ$ and $\triangle ROP$
 $\angle O$ is common
 $\angle S = \angle R = 90^\circ$ (tangent at circle)

$$\therefore \triangle SOQ \sim \triangle ROP$$

$$\Rightarrow \frac{RP}{SQ} = \frac{OP}{OQ} = \frac{PQ + OQ}{OQ} = \frac{PQ}{OQ} + 1$$

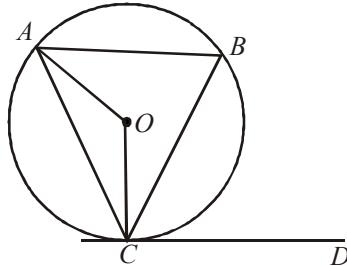
$$\Rightarrow \frac{4}{3} = \frac{PQ}{OQ} + 1 \text{ or } \frac{PQ}{OQ} = \frac{4}{3} - 1 = \frac{1}{3}$$

$$\Rightarrow PQ = 7 \text{ and } OQ = 21$$

$$\therefore \text{Required ratio} = \frac{7}{21} = \frac{1}{3}$$

2. (b) $PQ = r_1 + r_2 = 7$
As the ratio of radii is 4 : 3.
So, the only value which satisfies the radii of circle II = 3
3. (c) In $\triangle SOQ$,
 $\Rightarrow SO^2 + SQ^2 = OQ^2$
 $\Rightarrow SO^2 = 21^2 - 3^2 = (21 - 3)(21 + 3) = 18 \times 24 = 432$
 $\Rightarrow SO = 12\sqrt{3}$

- # In the given diagram O is the centre of the circle and CD is a tangent. $\angle CAB$ and $\angle ACD$ are supplementary to each other. $\angle OAC = 30^\circ$. Find the value of $\angle OCB$:



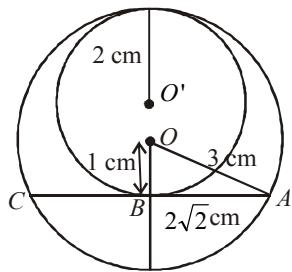
- (a) 30°
(b) 20°
(c) 60°
(d) None of these
- $\angle OCD = 90^\circ$
 $\angle OAC = \angle OCA = 30^\circ$
 $\angle ACD = \angle ACO + \angle OCD = 30^\circ + 90^\circ = 120^\circ$
 $\therefore \angle BAC = 180^\circ - 120^\circ = 60^\circ$
 $\Rightarrow \angle BCD = 60^\circ$ ($\angle BCD = \angle BAC$)
 $\Rightarrow \angle OCB = \angle OCB - \angle BCD$
 $= 90^\circ - 60^\circ = 30^\circ$

- # Two circles touch each other internally. Their radii are 2 cm and 3 cm. The biggest chord of the outer circle which is outside the inner circle is of length

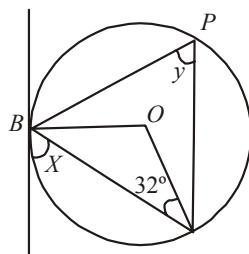
- (a) $2\sqrt{2}$ cm (b) $3\sqrt{2}$ cm
 (c) $2\sqrt{3}$ cm (d) $4\sqrt{2}$ cm
(d)

$$AB = \sqrt{3^2 - 1^2} = 2\sqrt{2} \text{ cm}$$

$$\therefore AC = 4\sqrt{2} \text{ cm}$$



- # In the given figure, AB is chord of the circle with centre O , BT is tangent to the circle. The values of x and y are



- (a) $52^\circ, 52^\circ$ (b) $58^\circ, 52^\circ$
 (c) $58^\circ, 58^\circ$ (d) $60^\circ, 64^\circ$

- (e) Given AB is a chord and BT is a tangent, $\angle BAO = 32^\circ$
 Here, $\angle OBT = 90^\circ$

[\because Tangent is \perp to the radius at the point of contact]
 $OA = OB$ [Radii of the same circle]
 $\therefore \angle OBA = \angle OAB = 32^\circ$

[Angles opposite to equal side are equal]
 $\therefore \angle OBT = \angle OBA + \angle ABT = 90^\circ$ or $32^\circ + x = 90^\circ$.
 $\angle x = 90^\circ - 32^\circ = 58^\circ$.

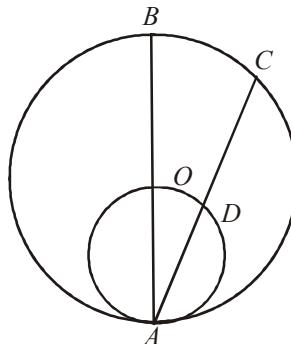
Also, $\angle AOB = 180^\circ - \angle OAB - \angle OBA$
 $= 180^\circ - 32^\circ - 32^\circ = 116^\circ$

$$\text{Now } Y = \frac{1}{2} \angle AOB$$

[Angle formed at the center of a circle is double the angle formed in the remaining part of the circle]

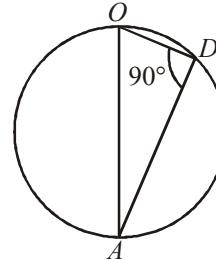
$$= \frac{1}{2} \times 116^\circ = 58^\circ.$$

- # A smaller circle touches internally to a larger circle at A and passes through the centre of the larger circle. O is the centre of the larger circle and BA , OA are diameters of the larger and smaller circles respectively. Chord AC intersects the smaller circle at a point D . If $AC = 12 \text{ cm}$, then AD is:

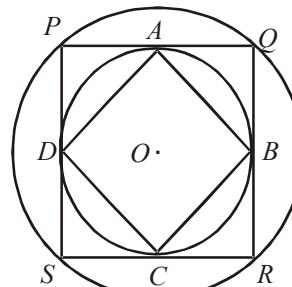


- (a) 4 cm (b) 6 cm
 (c) 5.6 cm (d) Data insufficient

- (b) $\angle ADO$ is a right angle (angle of semicircle)
 Again when OD is perpendicular on the chord AC and OD passes through the centre of circle ABC , then it must bisect the chord AC at D .
 $\therefore AD = CD = 6 \text{ cm}$



- # The figure below shows two concentric circles with centre O . $PQRS$ is a square inscribed in the outer circle. It also circumscribes the inner circle, touching it at point B , C , D and A . What is the ratio of the perimeter of the outer circle to that of polygon $ABCD$?



- (a) $\frac{\pi}{3}$ (b) π
 (c) $\frac{\pi}{2}$ (d) $\frac{\pi}{4}$

(c) Let the diagonal of $PQRS$ be $2r$.

Therefore, side = $r\sqrt{2}$.

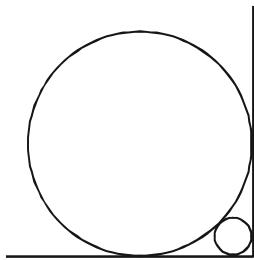
Now, $ABCD$ is a square. And side $\frac{r\sqrt{2}}{2} \times \sqrt{2} = r$.

Perimeter of $ABCD = 4r$.

Circumference of bigger circle = $2\pi r$.

Therefore, required ratio = $\frac{\pi}{2}$

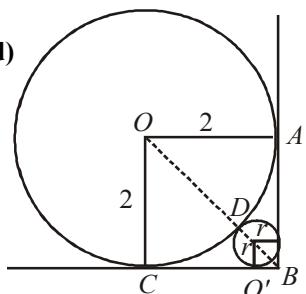
- # A circle with radius 2 is placed against a right angle. Another smaller circle is also placed as shown in the adjoining figure. What is the radius of the smaller circle?



(a) $3 - 2\sqrt{2}$
(c) $7 - 4\sqrt{2}$

(b) $4 - 2\sqrt{2}$
(d) $6 - 4\sqrt{2}$

SOL:- (d)



$OABC$ is square with side = 2

$$\therefore OB = \sqrt{2^2 + 2^2} = 2\sqrt{2}$$

$$OB = 2\sqrt{2} = OD + r + O'B = 2 + r + r\sqrt{2}$$

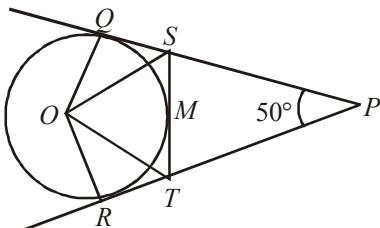
$$\Rightarrow r(\sqrt{2} + 1) = 2(\sqrt{2} - 1)$$

$$\Rightarrow r = \frac{2(\sqrt{2} - 1)}{(\sqrt{2} + 1)} = \frac{2(\sqrt{2} - 1)^2}{2 - 1} = 2(2 + 1 - 2\sqrt{2})$$

$$= 6 - 4\sqrt{2}$$



- # In the adjoining figure 'O' is the centre of the circle and PQ , PR and ST are the three tangents. $\angle QPR = 50^\circ$, then the value of $\angle SOT$ is:



- (a) 30°
(c) 65°
(b) 75°
(d) can't be determined

(e) $\angle ROQ = 180^\circ - 50 = 130^\circ$

$$\left(\because \angle OQP + \angle ORP + \angle QOR + \angle QPR = 360^\circ \right)$$

and $\angle OQP = \angle ORP = 90^\circ$

Now, since $RT = TM$ and $QS = SM$

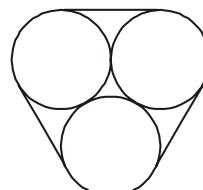
\therefore also $OR = OM = OQ$

$$\therefore \angle ROT = \angle TOM \text{ and } \angle MOS = \angle SOQ$$

$$\therefore \angle SOT = \frac{1}{2} \angle ROQ$$

$$\therefore \angle SOT = \frac{130}{2} = 65^\circ$$

- # The diagram below represents three circular garbage cans, each of diameter 2 m. The three cans are touching as shown. Find, in metres, the perimeter of the rope encompassing the three cans.



- (a) $2\pi + 6$
(c) $4\pi + 6$
(b) $3\pi + 4$
(d) $6\pi + 6$

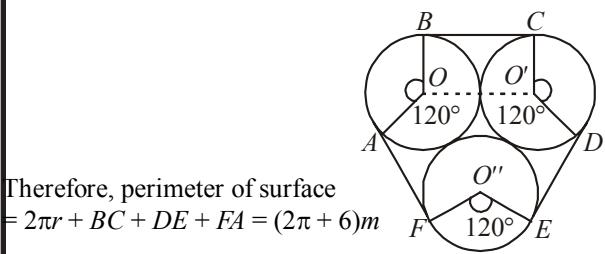
(a) $\angle AOB = \angle COD = \angle FO'E = 120^\circ$

Distance between 2 centres = 2 m

$$\therefore BC = DE = FA = 2 m$$

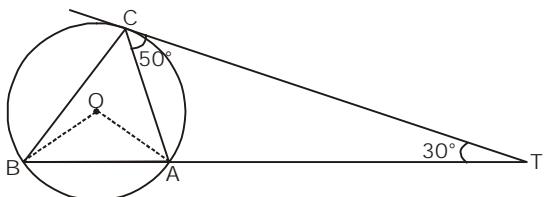
Perimeter of the figure = $BC + DE + FA +$ circumference of sectors AOB , COD and $FO'E$.

But three equal sectors of $120^\circ = 1$ full circle of same radius.



Therefore, perimeter of surface
 $= 2\pi r + BC + DE + FA = (2\pi + 6)m$

In the given figure (not drawn to scale), A, B and C are three points on a circle with centre O. The chord BA is extended to a point T such that CT becomes a tangent to the circle at point C. If $\angle ATC = 30^\circ$ and $\angle ACT = 50^\circ$ then $\angle BOA$ is



- 1) 100°
 2) 80°
 3) 40°
 4) 65°

1; From the alternate segment theorem

$$\angle ABC = \angle ACT \Rightarrow \angle ABC = 50^\circ$$

$$\text{Also, } \angle CAB = \angle ACT + \angle ATC = 50^\circ + 30^\circ = 80^\circ$$

$$\therefore \angle BCA = 180^\circ - (\angle ABC + \angle CAB) = 180^\circ - (50^\circ + 80^\circ) = 50^\circ \text{ Now, } \angle BOA = 2 \cdot \angle BCA = 2 \times 50^\circ = 100^\circ$$

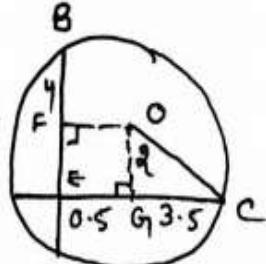
[Angle made by chord at the centre is double that at the circumference]

Chords AB and CD of a circle intersect at E and are perpendicular to each other. Segments AE, EB and ED are of lengths 2 cm, 6 cm and 3 cm respectively. Then the length of the diameter of the circle (in cm) is

- (a) $\sqrt{65}$
 (b) $\frac{1}{2}\sqrt{65}$
 (c) 65
 (d) $\frac{65}{2}$

6. (a)

$$\begin{aligned} AE \times EB &= DE \times EC \\ l \times 6 &= 3 \times CE \\ \Rightarrow CE &= 4 \text{ cm} \end{aligned}$$



Draw $OB \perp AB$ & $OC \perp DC$
 $\Rightarrow F$ is mid point as \perp from
 centre O is drawn.

$$FB = AF = 4$$

$$\Rightarrow EF = EB - FB = 6 - 4 = l$$

$$\text{At } \triangle OEB \quad OG = GC = \frac{7}{2} = 3.5 \text{ cm}$$

$$\begin{aligned} \triangle OEC \quad EG &= 3.5 - 3 = .5 \text{ cm} \\ OC &= \sqrt{(3.5)^2 + (l)^2} = \sqrt{65} \Rightarrow D = \sqrt{65} \end{aligned}$$



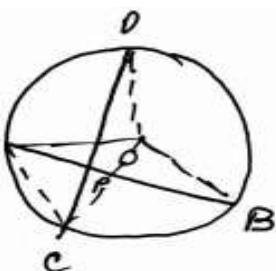
Two chords AB and CD of a circle with centre O, intersect each other at P. If $\angle AOD = 100^\circ$ and $\angle BOC = 70^\circ$, then the value of $\angle APC$ is

- (a) 80° (b) 75°
 (c) 85° (d) 95°

13.

$$\angle BAC = \frac{1}{2} \angle BOC$$

$$= \frac{70^\circ}{2} = 35^\circ$$



$$\angle ACD = \frac{1}{2} \angle AOD$$

$$= \frac{1}{2} \times 100^\circ = 50^\circ$$

IN $\triangle APC$

$$\therefore \angle APC = 180^\circ - (35^\circ + 50^\circ)$$

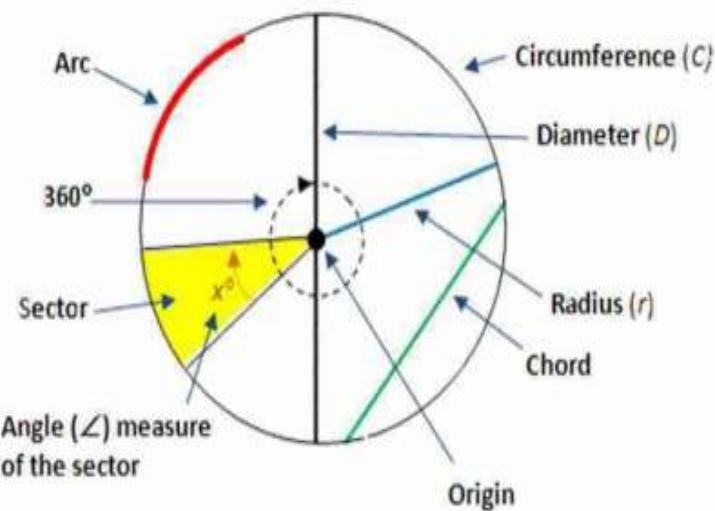
$$= 95^\circ \underline{\text{ANS.}}$$

4

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GEOMETRY

1. If the circumcentre of a triangle lies outside it, then the triangle is
 (a) Equilateral (b) Acute angled
 (c) Right angled (d) Obtuse angled
2. ABC is a right angled triangle, right angled at C and p is the length of the perpendicular from C on AB. If a, b and c are the length of the sides BC, CA and AB respectively, then
 (a) $\frac{1}{p^2} = \frac{1}{b^2} - \frac{1}{a^2}$ (b) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$
 (c) $\frac{1}{p^2} + \frac{1}{a^2} = \frac{1}{b^2}$ (d) $\frac{1}{p^2} = \frac{1}{a^2} - \frac{1}{b^2}$
3. D and E are two points on the sides AC and BC respectively of $\triangle ABC$ such that $DE = 18$ cm, $CE = 5$ cm
 $\tan \angle ABC = 3.6$, then $AC : CD =$
 (a) $BC : 2CE$ (b) $2CE : BC$
 (c) $2BC : CE$ (d) $CE : 2BC$
4. BL and CM are medians of $\triangle ABC$ right-angled at A and $BC = 5$ cm. If $BL = \frac{3\sqrt{5}}{2}$ cm, then the length of CM is
 (a) $2\sqrt{5}$ cm (b) $5\sqrt{2}$ cm
 (c) $10\sqrt{2}$ (d) $4\sqrt{5}$ cm
5. The sum of interior angles of a regular polygon is 1440° . The number of sides of the polygon is
 (a) 10 (b) 12
 (c) 6 (d) 8
6. Chords AB and CD of a circle intersect at E and are perpendicular to each other. Segments AE, EB and ED are of lengths 2 cm, 6 cm and 3 cm respectively. Then the length of the diameter of the circle (in cm) is
 (a) $\sqrt{65}$ (b) $\frac{1}{2}\sqrt{65}$
 (c) 65 (d) $\frac{65}{2}$
7. From a point P, two tangents PA and PB are drawn to a circle with centre O. If OP is equal to diameter of the circle, then $\angle APB$ is
 (a) 45° (b) 90°
 (c) 30° (d) 60°
8. I and O are respectively the incentre and circumcenter of a triangle ABC. the line AI produced intersects the circumcircle of $\triangle ABC$ at the point D. If $\angle ABC = x^\circ$, $\angle BID = y^\circ$ and $\angle BOD = z^\circ$, then $\frac{z+x}{y}$
 (a) 3 (b) 1
 (c) 2 (d) 4
9. If the $\triangle ABC$ is right angled at B, find its circumradius if the sides AB and

DE PERPENDICULAR TO BC

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- BC are 15 cm and 20 cm respectively.
- 25 cm
 - 20 cm
 - 15 cm
 - 12.5 cm
10. If the circumradius of an equilateral triangle ABC be 8 cm, then the height of the triangle is
- 16 cm
 - 6 cm
 - 8 cm
 - 12 cm
11. If AD, BE and CF are medians of $\triangle ABC$, then which one of the following statements is correct
- $(AD + BE + CF) < AB + BC + CA$
 - $AD + BE + CF > AB + BC + CA$
 - $AD + BE + CF = AB + BC + CA$
 - $AD + BE + CF = \sqrt{2} (AB + BC + CA)$
12. In a triangle, if orthocentre, circumcentre, incentre and centroid coincide, then the triangle must be
- obtuse angled
 - isosceles
 - equilateral
 - right angled
13. Two chords AB and CD of a circle with centre O, intersect each other at P. If $\angle AOD = 100^\circ$ and $\angle BOC = 70^\circ$, then the value of $\angle APC$ is
- 80°
 - 75°
 - 85°
 - 95°
14. In $\triangle ABC$, a line through A cuts the side BC at D such that $BD : DC = 4 : 5$.
5. If the area of $\triangle ABD = 60 \text{ cm}^2$, then the area of $\triangle ABC$ is:
- 50 cm^2
 - 60 cm^2
 - 75 cm^2
 - 90 cm^2
15. The measure of an angle whose supplement is three times as large as its complement, is
- 30°
 - 45°
 - 60°
 - 75°
16. If PQRS is a rhombus and $\angle SPQ = 50^\circ$, then $\angle RSQ$ is
- 75°
 - 45°
 - 55°
 - 65°
17. 'O' is the circumcentre of triangle ABC. If $\angle BAC = 50^\circ$ then $\angle OBC$ is
- 100°
 - 130°
 - 40°
 - 50°
18. In a rhombus ABCD, $\angle A = 60^\circ$ and $AB = 12 \text{ cm}$. Then the diagonal BD is:
- $2\sqrt{3} \text{ cm}$
 - 6 cm
 - 12 cm
 - 10 cm
19. The chord of a circle is equal to its radius. The angle subtended by this chord at the minor arc of the circle is
- 150°
 - 60°
 - 75°
 - 120°
20. Two circles with their centres at O and P and radii 8 cm and 4 cm respectively

- touch each other externally. The length of their common tangent is
 (a) 8 cm (b) 8.5 cm
 (c) $8\sqrt{2}$ cm (d) $8\sqrt{3}$ cm
21. The interior angle of regular polygon exceeds its exterior angle by 108° . The number of sides of the polygon is
 (a) 10 (b) 14
 (c) 12 (d) 16
22. AB is a diameter of a circle with centre O. The tangents at C meet AB produced at Q. If $\angle CAB = 34^\circ$, then measure of $\angle CBA$ is
 (a) 56° (b) 68°
 (c) 34° (d) 124°
23. The length of two parallel chords of a circle of radius 5 cm are 6 cm and 8 cm in the same side of the centre. The distance between them is
 (a) 1 cm (b) 2 cm
 (c) 3 cm (d) 1.5 cm
24. ABCD is a cyclic quadrilateral, AB is the diameter of the circle. If $\angle ACD = 50^\circ$, the measure of $\angle BAD$ is
 (a) 130° (b) 40°
 (c) 50° (d) 140°
25. BE, CF are the two medians of $\triangle ABC$ and G is their point of intersection. EF cuts AG at O. Ratio of AO : OG is equal to
 (a) 3 : 1 (b) 1 : 2
 (c) 2 : 3 (d) 1 : 3
26. In $\triangle ABC$, the external bisectors of the angles $\angle B$ and $\angle C$ meet at the point O. If $\angle A = 70^\circ$, then the measure of $\angle BOC$ is
 (a) 75° (b) 50°
 (c) 55° (d) 60°
27. The distance between the centers of two circles of radii 6 cm and 3 cm is 15 cm. The length of the transverse common tangent to the circles is:
 (a) $7\sqrt{6}$ cm (b) 12 cm
 (c) $6\sqrt{6}$ cm (d) 18 cm
28. In $\triangle ABC$, the internal bisectors of $\angle B$ and $\angle C$ meet at point O. If $\angle A = 80^\circ$ then $\angle BOC$ is of:
 (a) 120° (b) 140°
 (c) 130° (d) 100°
29. In $\triangle ABC$, $\angle B = 60^\circ$, and $\angle C = 40^\circ$, AD and AE are respectively the bisector of $\angle A$ and perpendicular on BC. The measure of $\angle EAD$ is:
 (a) 9° (b) 11°
 (c) 10° (d) 12°
30. In $\triangle ABC$, O is the orthocentre and $\angle BOC = 80^\circ$, the measure of $\angle A$ is

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- (a) 120° (b) 90°
 (c) 80° (d) 100°
31. The medians CD and BE of a triangle ABC intersect each other at O. The ratio of $\triangle ODE : \triangle ABC$ is equal to
 (a) 1 : 12 (b) 12 : 1
 (c) 4 : 3 (d) 3 : 4
32. If radius of a circle is increased by 5%, then the increment in its area is
 (a) 10.25% (b) 5.75%
 (c) 10% (d) 5%
33. There is a pyramid on a base which is a regular hexagon of side $2a$ cm. If every slant edge of this pyramid is of length $\frac{5a}{2}$ cm, then the volume of this pyramid is
 (a) $3a^3$ cm³ (b) $3\sqrt{2} a^2$ cm³
 (c) $3\sqrt{3} a^3$ cm³ (d) $6a^3$ cm³
34. The base of a right prism is a trapezium. The length of the parallel sides are 8 cm and 14 cm and the distance between the parallel sides is 8 cm. If the volume of the prism is 1056 cm³, then the height of the prism is
 (a) 44 cm (b) 16.5 cm
 (c) 12 cm (d) 10.56 cm
35. The length of each edge of a regular tetrahedron is 12 cm. The area (in sq. cm) of the total surface of the tetrahedron is
 (a) $288\sqrt{3}$ (b) $144\sqrt{3}\sqrt{2}$
 (c) $108\sqrt{3}$ (d) $144\sqrt{3}$
36. The base of right prism is a triangle whose perimeter is 28 cm and the in radius of the triangle is 4 cm. If the volume of the prism is 366 cc, then its height is
 (a) 6 cm (b) 8 cm
 (c) 4 cm (d) None of these
37. Each edge of a regular tetrahedron is 4 cm. Its volume (in cubic cm) is
 (a) $\frac{16\sqrt{3}}{3}$ (b) $16\sqrt{3}$
 (c) $\frac{16\sqrt{2}}{3}$ (d) $16\sqrt{2}$
38. If the area of the base, height and volume of a right prism be $\frac{3\sqrt{3}}{2} p^2$ cm², $10\sqrt{3}$ cm and 700 cm³ respectively, then the value of P (in cm) will be?
 (a) 4 (b) $\frac{2}{\sqrt{3}}$
 (c) $\sqrt{3}$ (d) $\frac{3}{2}$
39. Base of a right pyramid is a square of side 10 cm. If the height of the pyramid is 12 cm, then its total surface area is
 (a) 360 cm² (b) 400 cm²
 (c) 460 cm² (d) 260 cm²
40. The base of a prism is a right angled triangle with two sides 5 cm and 12 cm. The height of the prism is 10 cm. The total surface area of the prism is
 (a) 360 sq. cm (b) 300 sq. cm
 (c) 330 sq. cm (d) 325 sq. cm
41. Find the maximum area that can be enclosed in a triangle of perimeter 24 cm:
 (a) 32 cm² (b) $16\sqrt{3}$ cm²
 (c) $16\sqrt{2}$ cm² (d) 27 cm²

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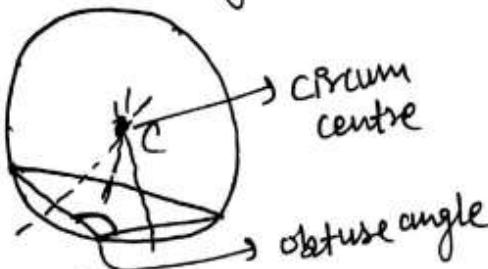
42. The lengths of perpendiculars drawn from any point in the interior of an equilateral triangle to the respective side of the triangle are P_1 , P_2 and P_3 , then the side of triangle is:
- (a) $\frac{5}{\sqrt{3}} (P_1 + P_2 + P_3)$ (b) $\frac{1}{\sqrt{3}} (P_1 + P_2 + P_3)$
 (c) $\frac{2}{3} (P_1 + P_2 + P_3)$ (d) $\frac{2}{\sqrt{3}} (P_1 + P_2 + P_3)$
43. The lengths of perpendiculars drawn from any point in the interior of an equilateral triangle to the respective sides are 6 cm, 8 cm, and 10 cm. The length of each side of the triangle is:
- (a) $24\sqrt{3}$ cm (b) $8\sqrt{3}$ cm
 (c) $16\sqrt{3}$ cm (d) 48 cm
44. ABC and MNC are two secants of a circle whose centre is O. AN is the diameter of the circle is $\angle BAN = 38^\circ$ and $\angle ACM = 20^\circ$ then $\angle MBN$
- (a) 38° (b) 42°
 (c) 28° (d) 32°
45. PT is a tangent of a circle at T and AB is a chord. If $AB = 18$ cm and $PT = 2AP$ then find PT?
- (a) 12 cm (b) 18 cm
 (c) 6 cm (d) 9 cm
46. O and C are respectively the orthocentre and circumcentre of an acute-angled triangle PQR. The points P and O are joined and produced to meet the side QR at S. If $PQS = 60^\circ$ and $\angle QCR = 130^\circ$, then $\angle RPS =$
- (a) 30° (b) 35°
 (c) 100° (d) 60°
47. In triangle ABC, M is the midpoint of BC and N is the mid point of AM. BN when extended intersect AC at D.
- If area of triangle ABC is 20 sq. units then what is the area of $\triangle AND$?
- (a) 1.67 sq. units (b) 1.5 sq. units
 (c) 2 sq. units (d) 3 sq. units
48. An isosceles triangle ABC is rightangled at B. D is a point inside the triangle ABC. P and Q are the feet of the perpendiculars drawn from D on the side AB and AC respectively of $\triangle ABC$. If $AP = a$ cm, $AQ = b$ cm and $\angle BAD = 15^\circ$, $\sin 75^\circ = ?$
- (a) $\frac{2b}{\sqrt{3}a}$ (b) $\frac{a}{2b}$
 (c) $\frac{\sqrt{3}a}{2b}$ (d) $\frac{2a}{\sqrt{3}b}$
49. In triangle PQR, points A, B and C are taken on PQ, PR and QR respectively such that $QC = AC$ and $CR = CB$. If $\angle QPR = 40^\circ$, then $\angle ACD$ is equal to:
- (a) 140° (b) 40°
 (c) 70° (d) 100°
50. D is any point on side AC of $\triangle ABC$. If P, Q, X, Y are the mid-point of AB, BC, AD and DC respectively, then the ratio of PX and QY is
- (a) 1 : 2 (b) 1 : 1
 (c) 2 : 1 (d) 2 : 3

Answer Key

1. (d) 2. (b) 3. (a) 4. (a) 5. (a)
6. (a) 7. (d) 8. (c) 9. (d) 10. (d)
11. (a) 12. (c) 13. (d) 14. (c) 15. (b)
16. (d) 17. (c) 18. (c) 19. (a) 20. (a) **c**
21. (a) 22. (a) 23. (a) 24. (b) 25. (a)
26. (c) 27. (b) 28. (c) 29. (c) 30. (a)
31. (d) 32. (a) 33. (c) 34. (c) 35. (d)
36. (d) 37. (c) 38. (a) 39. (a) 40. (a)
41. (b) 42. (d) 43. (c) 44. (d) 45. (a)
46. (b) 47. (a) 48. (c) 49. (d) 50. (b)

GEOMETRY SOLUTION by SUNIL SIR

1. a) obtuse angled \triangle

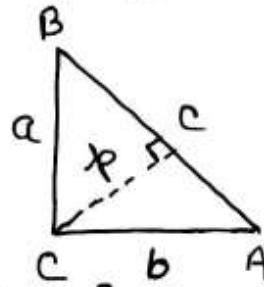


Note: Circumcentre of

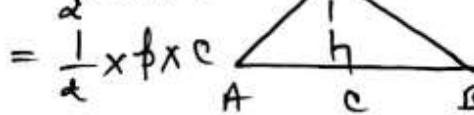
orthocentre of obtuse angled
 \triangle always lies outside.

2. b.)

$$\Delta = \frac{1}{2} \times a \times b$$



$$\text{also } \Delta = \frac{1}{2} \times AB \times p$$



$$\text{but } c = \sqrt{a^2 + b^2}$$

$$\Rightarrow \frac{1}{2} \times a \times b = \frac{1}{2} \times p \times \sqrt{a^2 + b^2}$$

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

$$\Rightarrow \frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$$

3. (a) draw $DF \parallel AB$

$$\angle ABC = \angle DFC$$

$$\tan \angle ABC = \tan \angle DFC$$

$$3.6 = \frac{DE}{FE} \quad [\tan \theta = \frac{p}{b}]$$

$$\Rightarrow FE = \frac{18}{3.6} = 5 \quad [\therefore DE = 18]$$

$$\text{Also } FE = CE = 5 \quad [\because CE = 5 \text{ given}]$$

$$\triangle ABC \sim \triangle DFC$$

$$\frac{AC}{CD} = \frac{BC}{FC} = \frac{BC}{2CE}$$

$$\Rightarrow AC : CD = BC : 2CE$$

4. use (a).

$$4(BL^2 + CM^2) = SBc^2$$

$$4\left(\frac{45}{4} + CM^2\right) =$$

$$5 \times 25 \quad CM^2 = \frac{125}{4} - \frac{45}{4} = \frac{80}{4} = 20$$

$$\Rightarrow CM = \sqrt{20} = 2\sqrt{5} \text{ cm}$$

5. sum of interior angle of regular polygon $= (n-2) \times 180^\circ$

$$\therefore (n-2) \times 180^\circ = 1440^\circ$$

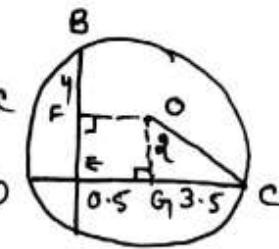
$$\Rightarrow n-2 = 8 \Rightarrow n = 10 \quad (q)$$

6. @

$$AE \times EB = DE \times EC$$

$$2 \times 6 = 3 \times CE$$

$$\Rightarrow CE = 4 \text{ cm}$$



Draw $OF \perp AB$ & $OG \perp DC$

$\Rightarrow F$ is mid point of AB & from centre O is drawn.

$$FB = AF = 4$$

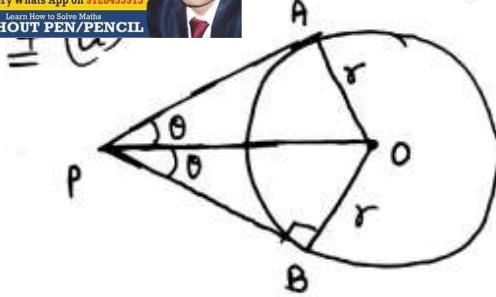
$$\Rightarrow EF = EB - FB = 6 - 4 = 2$$

$$\text{Also } DG = GC = \frac{7}{2} = 3.5 \text{ cm}$$

$$\text{In } \triangle DGC, EG = 3.5 - 3 = 0.5 \text{ cm}$$

$$OC = \sqrt{(3.5)^2 + (2)^2} = \sqrt{65} \Rightarrow D = \sqrt{65}$$

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$$OP = \sqrt{3}/2 r = 0$$

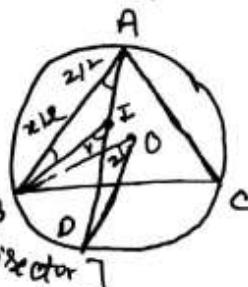
$$\text{IN } \triangle AOP \quad \sin \theta = \frac{AO}{OP} = \frac{r}{\frac{\sqrt{3}}{2}r} = \frac{2}{\sqrt{3}}$$

$$\Rightarrow \theta = 30^\circ \Rightarrow \angle APB = 2\theta = 60^\circ \quad (a)$$

8. (c)

$$\angle ABD = \angle ABC = \frac{x}{2}$$

[angle bisector]



$$\angle BAD = \frac{x}{2} \quad [\text{angle at centers double of arc}]$$

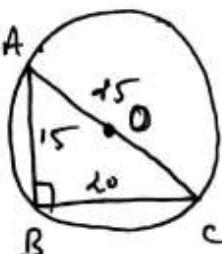
IN $\triangle AIB$

$$Y = \frac{x}{2} + \frac{z}{2} \quad [\text{Exterior Angle}]$$

$$\frac{x+2}{2} = Y \Rightarrow \boxed{\frac{x+2}{Y} = 2}$$

(d)

9. Circumcentre of Right angled triangle lies at mid point of hypotenuse.



$$AC = \sqrt{(15)^2 + (10)^2} = 25$$

$$\text{Circumradius} = \frac{25}{2} = 12.5$$

Note → orthocentre of rt angled triangle lies at the right angle.

$$\therefore R = \frac{a}{\sqrt{3}} \Rightarrow 25 = \frac{a}{\sqrt{3}} \Rightarrow a = 25\sqrt{3}$$

$$\text{altitude} = \frac{\sqrt{3}}{2} a = \frac{\sqrt{3}}{2} \times 25\sqrt{3} \\ = 12.5 \times 3 = 37.5 \text{ cm (a)}$$

Note r (inradius) of equilateral $\triangle = \frac{a}{2\sqrt{3}}$

11. Points D, E & F

are mid points of BC, CA & AB
sum of

Any 2 sides of a \triangle is greater than twice the median drawn to 3rd side

$$\therefore AB + AC > 2AD$$

$$AB + BC > 2BE$$

$$BC + CA > 2CF$$

on adding

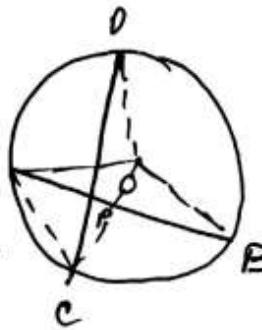
$$2(AB + BC + CA) > 2(AD + BE + CF)$$

$$\Rightarrow AB + BC + CA > (AD + BE + CF) \quad (a)$$

∴ equilateral.

Note → Orthocentre, circumcentre, incenter, and centroid of any triangle are always collinear. But if they lie at same point
 $\Rightarrow \triangle$ is equilateral.

$$\begin{aligned} \therefore \angle BAC &= \frac{1}{2} \angle BOC \\ &= \frac{70^\circ}{2} = 35^\circ \end{aligned}$$



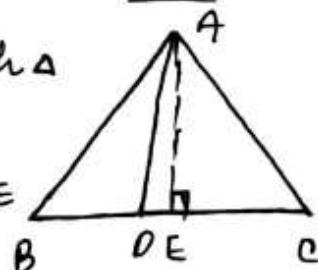
$$\begin{aligned} \angle ACD &= \frac{1}{2} \angle AOD \\ &= \frac{1}{2} \times 100^\circ = 50^\circ \end{aligned}$$

IN $\triangle APC$

$$\begin{aligned} \bullet \angle APC &= 180^\circ - (35^\circ + 50^\circ) \\ &= 95^\circ \text{ ANS.} \end{aligned}$$

14.

height of both $\triangle ABD$ and $\triangle ADC$
are equal = AE



$$\frac{\text{ar } \triangle ABD}{\text{ar } \triangle ADC} = \frac{BD}{DC} = \frac{4}{5} \quad [\because \text{height is same}]$$

$$\frac{60 \times 5}{4} = \text{ar } \triangle ADC \Rightarrow \text{ar } \triangle ADC = 75 \text{ cm}^2$$

15. 2 angles are supplementary
if $\alpha + \beta = 180^\circ$

not complementary if $\alpha + \beta = 90^\circ$
let angle O

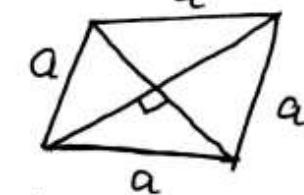
$$180 - \theta = 3(90 - \theta)$$

$$2\theta = 90$$

$$\theta = 45^\circ \text{ ANS.}$$

Rhombus

is a parallelogram
whose all four
sides are equal.



1. diagonal are perpendicular
bisector of each other

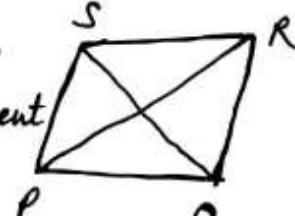
2. diagonal is also angle bisector

3. sum of adjacent two angle
is 180°

4. Area = $\frac{1}{2} \times d_1 \times d_2$

5. $a = \frac{1}{2} \sqrt{d_1^2 + d_2^2}$

16. as $\angle S$ & $\angle P$
are adjacent



$$\Rightarrow \angle RSP = 180^\circ - \alpha = 130^\circ$$

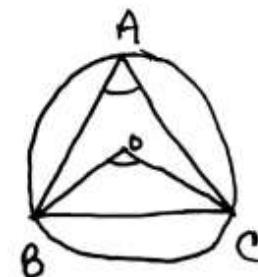
as diagonal is
angle bisector

$$\Rightarrow \angle RSQ = \frac{1}{2} \times 130^\circ = 65^\circ$$

$$17. \angle BAC = 50^\circ$$

$$\Rightarrow \angle BOC = 100^\circ$$

but in $\triangle OBC$



as OB = OC [Rhombus]

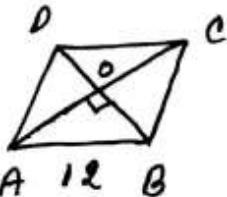
$$\Rightarrow \angle OBC = \angle OCB$$

$$\Rightarrow \theta + \theta + 100^\circ = 180^\circ$$

$$\Rightarrow \theta = 40^\circ \text{ ANS.}$$

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$$= \underline{\angle A = 60^\circ}$$



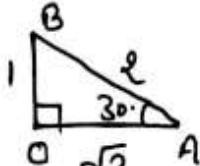
$$\angle OAB = 30^\circ$$

NOW FOCUS ON $\triangle OAB$

$$2 \rightarrow 12$$

$$1 \rightarrow OB \rightarrow 6$$

$$BD = 2 \times 6 = 12 \text{ cm ANS.}$$



19.

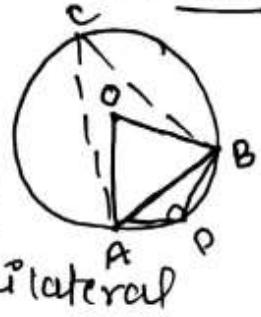
$$\text{as } AB = r$$

$$\Rightarrow OA = OB = AB = r$$

$\triangle OAB$ is equilateral

$$\angle AOB = 60^\circ$$

$$\Rightarrow \angle AOB = 30^\circ \Rightarrow \angle ADB = 180^\circ - 30^\circ = 150^\circ \text{ ANS.}$$



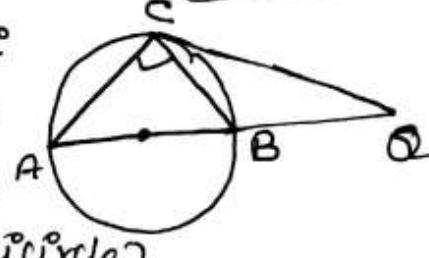
$$\frac{(n-2) \times 180^\circ}{n} - 360^\circ = 108^\circ$$

$$\Rightarrow 72n = 720 \Rightarrow n = 10$$

$$22. \quad \angle CAB = 34^\circ$$

$$\angle ACB = 90^\circ$$

[angle in semicircle]



$$\Rightarrow \text{in } \triangle ABC \quad \angle B = 180^\circ - 90^\circ - 34^\circ = 56^\circ \text{ ANS.}$$

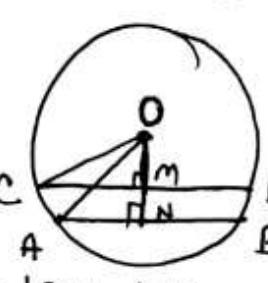
23. Tnck

cm become cm

of AN become OM

$$\Rightarrow MN = 3 - 2$$

$$= 1 \text{ cm ANS.}$$



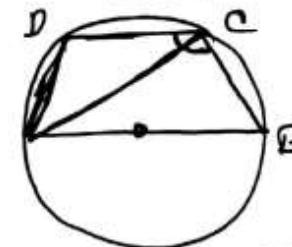
24.

$$\angle ACD = 50^\circ$$

also

$$\angle ACD = 90^\circ$$

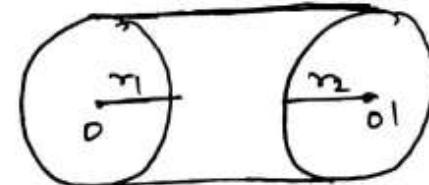
[angle in semicircle]



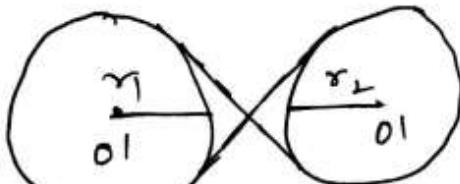
$$\Rightarrow \angle BCD = 90^\circ + 50^\circ = 140^\circ$$

$$\Rightarrow \angle BAD = 180^\circ - 140^\circ = 40^\circ$$

[cyclic Quadrilate
ral]



$$= \sqrt{(O_1O_2)^2 - (r_1 - r_2)^2}$$



$$= \sqrt{(O_1O_2)^2 - (r_1 + r_2)^2}$$

$$25. \quad OP = 12$$

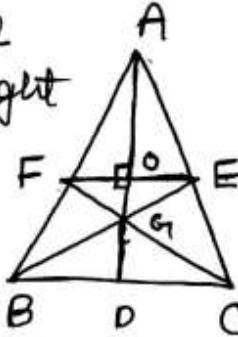
$$DCT = \sqrt{(12)^2 - (8-4)^2} = \sqrt{144 - 16} = 8\sqrt{2}$$

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GEOMETRY PART-2

25. Let $\triangle ABC$ base
is $\frac{a}{2}$ of height
of $\triangle ABC$.

if $\triangle ABC$ is equilateral
 $\Rightarrow h = \frac{\sqrt{3}}{2}a$



as F & E are mid points.

$$\Rightarrow FE \parallel BC \Rightarrow FE = \frac{1}{2}BC$$

$$\Rightarrow \triangle GFE \sim \triangle BGC$$

also For equilateral \triangle
altitude of median are
same

$$\frac{OG}{GD} = \frac{FE}{BC} = \frac{BC}{BC \times 2} = \frac{1}{2}$$

$$OG = \frac{1}{2}GD = \frac{1}{2} \times \frac{a}{2\sqrt{3}}$$

$$\text{Also } AD = AG - OG$$

$$= \frac{a}{\sqrt{3}} - \frac{a}{4\sqrt{3}} = \frac{3a}{4\sqrt{3}}$$

$$\Rightarrow AO:OG = \frac{3}{2} \times \frac{a}{2\sqrt{3}} : \frac{a}{4\sqrt{3}} = 3:1$$

(c)

$$26. \angle BOC = 90 - \frac{\angle A}{2}$$

$$= 90 - \frac{70}{2} = 55^\circ \quad \text{32. } 5\% = \frac{1}{20}$$

$$27. (b) = \sqrt{(O_1)^2 - (R_1 + R_2)^2}$$

$$= \sqrt{225 - (6+3)^2}$$

$$= \sqrt{144} = 12 \text{ cm}$$

$$28. \angle BOC = 90^\circ + \frac{\angle A}{2}$$

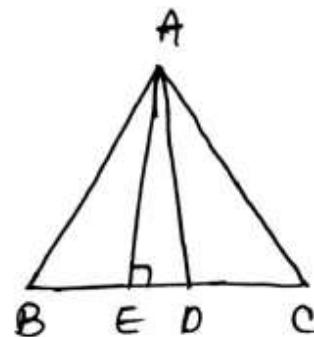
$$= 90^\circ + 40^\circ = 130^\circ$$

29. (c)

TRICK

$$\angle EAD = \frac{1}{2}(B-C)$$

$$= \frac{1}{2}(60-40) = 10^\circ$$



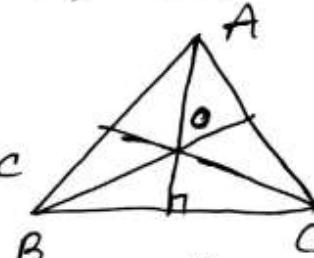
30. (d)

$$\angle BAC$$

$$= 180^\circ - \angle BOC$$

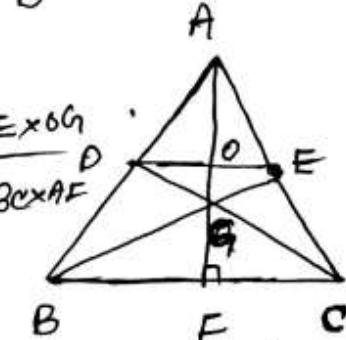
$$= 180^\circ - 80^\circ$$

$$= 100^\circ$$



31. (a)

$$\frac{\Delta ODE}{\Delta ABC} = \frac{\frac{1}{2}DE \times OG}{\frac{1}{2} \times BC \times AF}$$



assume $\triangle ABC$ equilateral

also as explained in Q. 25

$$ODE \sim BGC$$

$$\frac{\Delta ODE}{\Delta ABC} = \frac{BC}{2} \times \frac{a}{4\sqrt{3}} = \frac{1}{12}$$

$$\frac{BC \times \frac{\sqrt{3}}{2}a}{}$$

(a)

$$20 \rightarrow 21$$

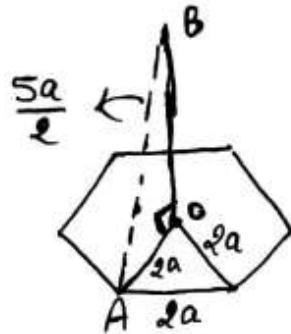
$$20 \rightarrow 21$$

$$\frac{400 \rightarrow 441}{}$$

$$\% \text{ Increase} = \frac{41}{400} \times 100$$

$$= 10.25\%$$

33. (c)



$$V_p = \frac{1}{3} \times \text{AREA OF base} \times \text{height}$$

$$= \frac{1}{3} \times \frac{3\sqrt{3}}{2} \times (2a)^2 \times BO \quad (1)$$

$$BO = \sqrt{AB^2 - OA^2} = \sqrt{\frac{25a^2}{4} - 4a^2}$$

$$= \frac{3a}{2}$$

$$\Rightarrow V_p = \frac{1}{3} \times \frac{3\sqrt{3}}{2} \times 4a^2 \times \frac{3a}{2}$$

$$= 3\sqrt{3} a^3 \text{ cm}^3$$

34. (c)

$$V_{prism} = \text{AREA OF base} \times \text{height}$$

$$1056 = \text{AREA OF base} \times h$$

$$A_{TRAPEZIUM} = \frac{1}{2} (8+14) \times 8$$

$$= 88$$

$$\Rightarrow h = \frac{1056}{88} = \frac{96}{8} = 12 \text{ cm}$$

35. (d)

$$\text{Total S.A.} = 4 \times \frac{\sqrt{3}}{4} a^2 = \sqrt{3} a^2$$

$$= \sqrt{3} \times 12 \times 12 = 144\sqrt{3}$$

36. (a)

$$V_p = A \times h \Rightarrow 366 = A \times h$$

$$\Delta = 9 \times 8 = 4 \times \frac{28}{2} = 56$$

$$\Rightarrow h = \frac{366}{56} = 6 \text{ cm}$$

37. (c).

$$V = \frac{\sqrt{2}}{12} a^3 = \frac{\sqrt{2}}{12} \times 64$$

$$= \frac{16\sqrt{2}}{3} \text{ cm}^3$$

38. (a).

$$V = A \times R$$

$$\therefore 20 = \frac{3\sqrt{3}}{2} \rho^2 \times 10\sqrt{3}$$

$$\rho = 4 \text{ cm}$$

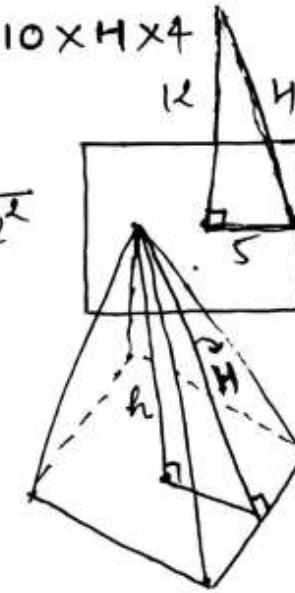
39. (a)

$$\text{C.S.A.} = \text{AREA OF } 4 \Delta$$

$$= \frac{1}{2} \times 10 \times 13 \times 4$$

$$H = \sqrt{5^2 + 12^2}$$

$$= 13$$



$$\text{C.S.A.} = \frac{1}{2} \times 10 \times 13 \times 4$$

$$= 260$$

$$\text{T.S.A.} = 260 + 10 \times 10 = 360$$

40. (a)

$$\text{C.S.A.} = \rho \times H$$

$$= (5 * 12 + 13) \times 10$$

$$= 300$$

$$\text{T.S.A.} = 300 + 2 \times 30$$

$$= \underline{360}$$

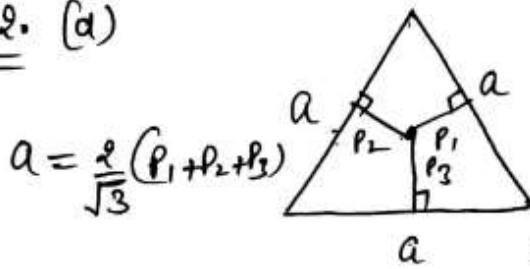
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Max AREA of given perimeter when \triangle is equilateral.

$$a = \frac{24}{3} = 8 \text{ cm}$$

$$\Delta = \frac{\sqrt{3}}{4} \times 8 \times 8 = 16\sqrt{3} \text{ cm}^2$$

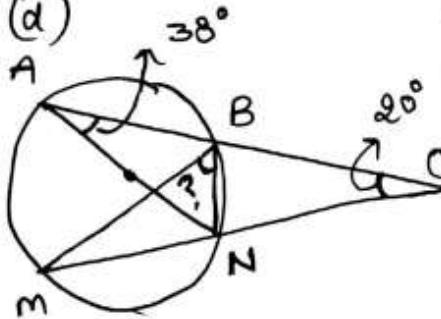
42. (a)



$$a = \frac{2}{\sqrt{3}} (p_1 + p_2 + p_3) \\ = 16\sqrt{3} \text{ cm}$$

(c).

44. (a)



$$\angle ABN = 90^\circ \text{ [semicircle]}$$

$$\angle ANM = 20^\circ + 38^\circ \\ = 58^\circ \text{ [exterior angle]}$$

$$\angle ABM = \angle ANM$$

$= 58^\circ$ [angle by same chord AM]

$$\Rightarrow \angle MBN = \angle ABN - \angle ABM \\ = 90^\circ - 58^\circ \\ = 32^\circ$$

45. (a)

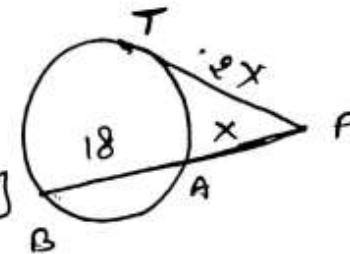
$$PT^2 = PA \times PB$$

$$4x^2 = x(x+18)$$

$$\Rightarrow 3x^2 - 18x = 0$$

$$3x[x-6] = 0 \Rightarrow x=6$$

$$PT = 2 \times 6 = 12$$



46. IN $\triangle PQS$

$$\angle QPS = 180^\circ - (60^\circ + 90^\circ)$$

$$= 30^\circ$$

$$\angle QPR = \frac{130^\circ}{2} \\ = 65^\circ$$

$$\therefore \angle RPS = 65^\circ - 30^\circ = 35^\circ$$

(c)

48. $\angle B = 90^\circ$

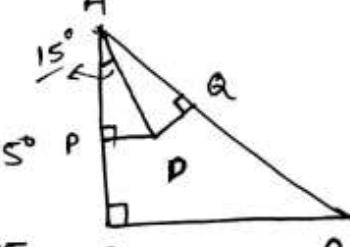
$$AB = BC$$

$$\therefore \angle A = \angle C = 45^\circ$$

$$\angle BAD = 15^\circ$$

$$\angle CAD = 45^\circ - 15^\circ \\ = 30^\circ$$

$$\angle APD = 90^\circ \Rightarrow \angle PDA = 90^\circ - 15^\circ \\ = 75^\circ$$



$$\therefore \sin 75^\circ = \frac{AP}{AD} = \frac{a}{x}$$

$$\triangle AQP \quad \cos 30^\circ = \frac{AQ}{AD} = \frac{b}{x}$$

$$\Rightarrow x = \frac{ab}{\sqrt{3}}$$

$$\sin 75^\circ = \frac{a}{2p} \times \sqrt{3} = \frac{\sqrt{3}}{2} \frac{a}{b} \text{ Ans.}$$

(b)

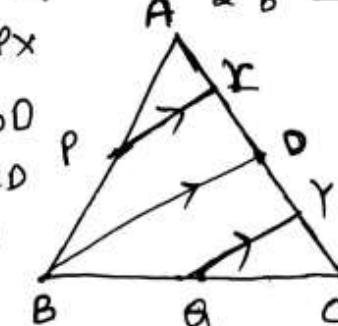
50. IN $\triangle APX$

$$PX = \frac{1}{2} BD$$

IN $\triangle BCD$

$$QY = \frac{1}{2} BD$$

$$\Rightarrow PX = QY \text{ OR } PX : QY = 1:1$$



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