Fraction To Percentage Conversion Table

Fraction	Percentage I	Percentage II	Fraction	Percentage I	Percentage II
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%	$7\frac{9}{13}$%			

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Derived Fraction To Conversion Table

Fraction	Percentage I	Percentage II	Fraction	Percentage I	Percentage II
$\frac{1}{8}$	12.5%	$12\frac{1}{2}$%	$\frac{2}{3}$	66.67%	$66\frac{2}{3}$%
$\frac{3}{8}$	37.5%	$37\frac{1}{2}$%	$\frac{1}{12}$	8.33%	$8\frac{1}{3}$%
$\frac{5}{8}$	62.5%	$62\frac{1}{2}$%	$\frac{7}{12}$	58.33%	$58\frac{1}{3}$%
$\frac{7}{8}$	87.5%	$87\frac{1}{2}$%	$\frac{11}{12}$	91.67%	$91\frac{2}{3}$%
$\frac{1}{6}$	16.67%	$16\frac{2}{3}$%	$\frac{5}{6}$	83.33%	$83\frac{1}{3}$%

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Larger Fraction/Percentages

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

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

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

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

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

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

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62.5% of $512 + 83\frac{1}{3}\%$ of $216 = ?$

$= \frac{5}{8} \times 512 + \frac{5}{6} \times 216$ $\left[\because 62\frac{1}{2}\% = \frac{5}{8}, \; 83\frac{1}{3}\% = \frac{5}{6}\right]$

$= 5 \times 64 + 5 \times 36 = 5(100)$

$= 500$ ANS.

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

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

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

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

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

<u>Solution</u> :- $P_{2016} = 490000$

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

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

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PERCENTage IS INTERCHANGable

$A\%$ of B = $B\%$ of A = $A \times B / 100$

e.g. 64% of $62.5 = ?$

$= 62.5\%$ of 64 [∵ % is interchangable]

$= \frac{5}{8} \times 64 = 40$ [∵ $62.5\% = \frac{5}{8}$]

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

$= 91\frac{2}{3}\%$ of 72

$= \frac{11}{12} \times 72 = 66$ ANS. [∵ $91\frac{2}{3}\% = \frac{11}{12}$]

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

$= 35\%$ of 42 [∵ $a\%$ of $b = 2a\%$ of $\frac{b}{2}$]

$= 70\%$ of 21

$= 14.7$ ANS.

32% of $250 + 12.5\%$ of $640 = ?$

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

∴ 32% of $250 + 25\%$ of 320

$= 25\%$ of $320 + 25\%$ of 320

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

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Tricky Concepts

1. Convert % into 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 $= +\frac{1}{5}$ → Increase, → Initial

Final = 5+1 = 6

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

Final = 5−1 = 4

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

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

$\Rightarrow F = 6+1 = 7$

$7 \longrightarrow 3430$

$\Rightarrow 6 \longrightarrow \frac{3430}{7} \times 6 = 2940$ <u>Ans.</u>

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Tricky Maths By Sunil Sir

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

Sol. $16\frac{2}{3}\% = \frac{-1 \rightarrow \text{Dec.}}{6 \rightarrow \text{INITIAL}} \Rightarrow \text{Final} = 6-1 = 5$

$5 \rightarrow 225$

$1 \rightarrow 45 \Rightarrow 6 \longrightarrow 45 \times 6 = 270$ ANS.

IF 210 is added in a no. then the no. becomes 137.5% of itself. Find the original Number?

Solution :- $137\frac{1}{2}\% = 100\% + 37\frac{1}{2}\% = 1 + \frac{3}{8} = \frac{11 \rightarrow F}{8 \rightarrow I}$

Final, Initial $\frac{11}{8}$ $3 \rightarrow 210$ $\longrightarrow$ original $= 8 \longrightarrow 8 \times 70$

$1 \rightarrow 70$

560 ANS.

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

Solution :- $12\frac{1}{2}\% = \frac{+1 \rightarrow \text{Increase}}{8 \rightarrow 2009} \Rightarrow P_{2010} = 8+1 = 9$

$9 \rightarrow 72900$

$1 \rightarrow 8100$

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

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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 $P =$ constant

$\Rightarrow A \propto \frac{1}{B}$ [A & B are inversly Proportional]

e.g If $A = 2:3$, & If $P =$ constant

$\Rightarrow B = 3:2$

Application

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

(ii) Expenditure = Price x Consumption

$E = P \times C$

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

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

(v) WORK = Time x 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 :- $20\% \uparrow = +\frac{1}{5}$ → Increase
5 → old Price

New Price = 5+1 = 6

Also $E = P \times C$ as E = constant ⇒ $P \propto \frac{1}{C}$

	original		New
Price →	5	:	6
⇒ Consumption →	6	:	5

[∵ $P \propto \frac{1}{C}$]

$\% \downarrow = -\frac{1}{6} = 16\frac{2}{3}\%$ Ans.

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

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

New length = 8 − 1 = 7

$A = l \times b$, as A = constant ⇒ $l \propto \frac{1}{B}$

	old		New
length	8	:	7
Breadth	7	:	8

[∵ $l \propto \frac{1}{B}$]

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

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If a man goes at a speed of 8 km/hr from his ~~of~~ 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~~
	2	:	3
Time	3	:	2

$\hookrightarrow 40$

9.20
8.40 } 40 min time diff.

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

$D = S \times T = 8 \times 2 = 16$ Km ANS.

#2 let distance $D = 24$ km (LCM of 8 & 12)

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

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

Time diff $= 1$ hr $= 60$ min

$\Rightarrow$ If Time diff $= 60 \longrightarrow D = 24$

but actual " " $= 40 \longrightarrow D = \frac{24}{60} \times 40 = 16$ K

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

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

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

Solution :-

	L	×	B	=	A
original	8		5	=	40
New	9		4	=	36

$12\frac{1}{2}\% = +\frac{1}{8}$

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

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

– shows Area is ↓

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

Solution :-

	Radius	Area
original	10	100
New	9	81

-19

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

New $= 10 - 1 = 9$

% 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?

Solution

	Price	×	Consump.	=	Exp.
original	6		4	=	24
New	7		3	=	21

-3

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

$25\% \downarrow = -\frac{1}{4}$

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

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

Solution :-

	50%	40%		
original	2	5	= 10	−7
New	1	3	= 3	

equivalent d% = $-7/10 \times 100 = 70\%$ 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%		
Original	10	5	10	= 500	−248
New	7	4	9	= 252	

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

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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 :-

	Price	Sale	= Revenue	
original	6	5	= 30	−2
New	7	4	= 28	

% change $= \frac{-2}{30} \times 100 = 6\frac{2}{3}\% \downarrow$ ANS.

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

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

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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

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

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

	old		New
price	4	:	3
CONSUMP	3	:	4

$+1 \rightarrow 4$

$\Rightarrow$ old CONSUMPTION = 3 × 4 = 12 kg

New CONSUMPTION = 4 × 4 = 16 kg

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

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

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

	old		New
price	10	:	13
	13	:	10

$-3 \rightarrow 6$

$1 \rightarrow 2$

old CONS. = 13 × 2 = 26

old Price = $\frac{520}{26}$ = 20 ₹

New Consumpt. = 10 × 2 = 20

New Price = $\frac{520}{20}$ = ₹ 26

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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

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

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

	old		New
price =	5	:	4
Consumption =	4	:	5

$+1 \rightarrow 10$ kg

$\Rightarrow$ old Consum = 10×4 = 40

New " = 10×5 = 50

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

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

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

Solution :→ E = constant

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

	old		New
Price	5	:	6
Consump.	6	:	5

$-1 \rightarrow 2$

New Consumption

$\Rightarrow 5 \rightarrow 5 \times 2 = 10$ egg

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

Price of dozen = 2.4 × 12 = 28.80 ₹ 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 $10\% \downarrow = -\frac{1}{10}$

$$\begin{array}{ccc} 10 & — & 9 \\ 10 & — & 9 \\ 10 & — & 9 \\ \hline 1000 & — & 729 \end{array}$$

$1000 \rightarrow 3645000 \Rightarrow 729 \rightarrow 2657205$ 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 $66\frac{2}{3}\% \uparrow = +\frac{2}{3}$, $16\frac{2}{3}\% \downarrow = -\frac{1}{6}$, $33\frac{1}{3}\% = +\frac{1}{3}$

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

$54 \rightarrow 10800$

$\Rightarrow 100 \rightarrow \boxed{20000}$ 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 × Consumption

let old $100 = 10 \times 10$

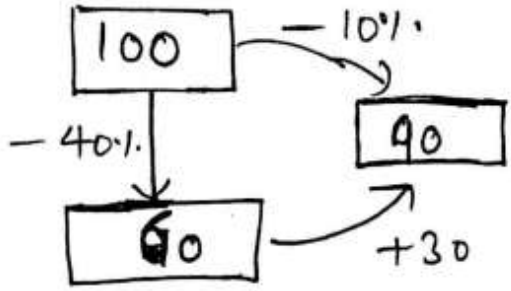
-10% -40%

New $90 = 6 \times$ New Consumption

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

% ↑ in Consumption $= \frac{15-10}{10} \times 100 = 50\%$ Ans.

METHOD 2 :-



$\Rightarrow$ % change $= \frac{30}{60} \times 100$

$= 50\%$

If the Price of Rice is decreased by 20%. By how much % consumption should be increased so that Expenditure also Increased by 20%?

Solution :- 1st Method

$E = P \times C$

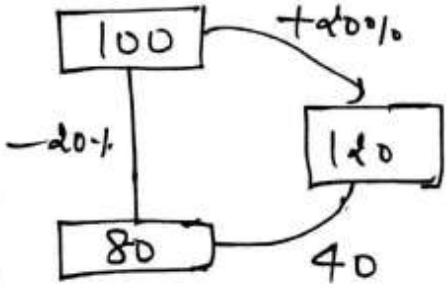
let old $100 = 10 \times 10$

New $120 = 8 \times N_C$

$\Rightarrow N_C = 15$

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

2nd Method



% increase

$= \frac{40}{80} \times 100 = 50\%$

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Focus on Fix :→ The quantity that does not change in intial 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 intial 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 ⇒ acid qty is same

1st METHOD

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

equate Acid

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

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

water added = 80 − 60 = 20

2ND METHOD

By Ratio

	Acid		water
old	$4_{\times 3}$	:	$1_{\times 3}$
New	$3_{\times 4}$	:	$2_{\times 4}$

make Acid equal

12 : 3
12 : 8) 5 water added

15 → 60 ⇒ 5 → $\boxed{20 \text{ ltr}}$

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. $\boxed{\text{ANS. } 100 \text{ gm}}$

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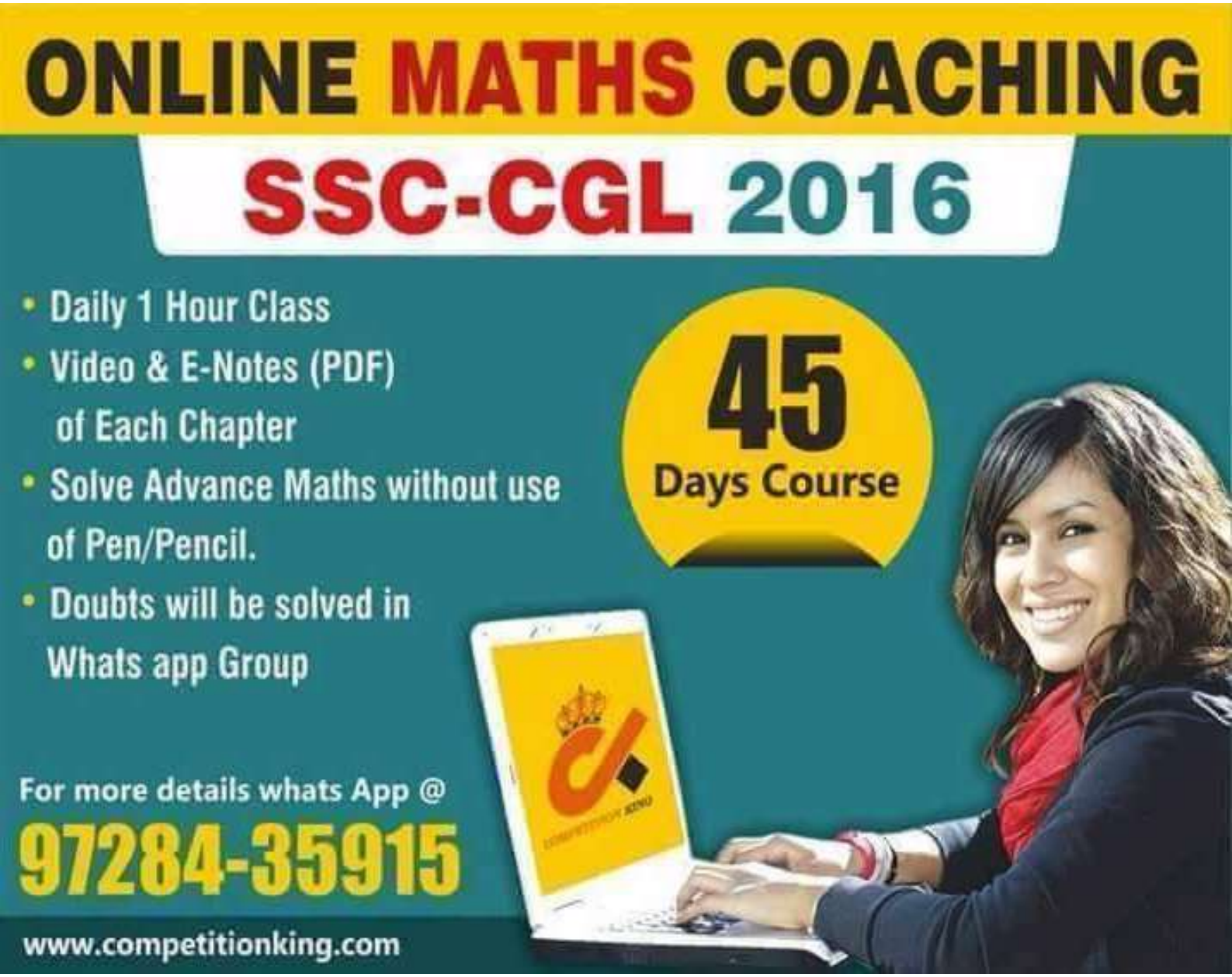

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FRESH grapes contains 90% water while dry grapes contains 20% water. what is the weight of dry grapes obtained from 90 kg FRESH GRAPES.?

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

	PULP		WATER
old	1×4	:	9×4
New	4	:	1

Make PULP same

~~5 : 45~~ 4 : 36 → 40

~~5 :~~ 4 : 1 → 5

40 → 20 kg ⇒ 5 → $\boxed{2.5 \text{ kg}}$

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

let total wt. of fresh grapes $= x$ Kg.

$Pulp_1 = Pulp_2$

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

$\Rightarrow x = 2250$ Kg.

2ND METHOD (Ratio)

	PULP		WATER
old	1×9	:	4×9
New	9	:	1

Dry $10(9+1) = 500$

$1 \rightarrow 50$ kg

FRESH $= 9 + 36 = 45$

wt $= 45 \times 50 = 2250$ kg

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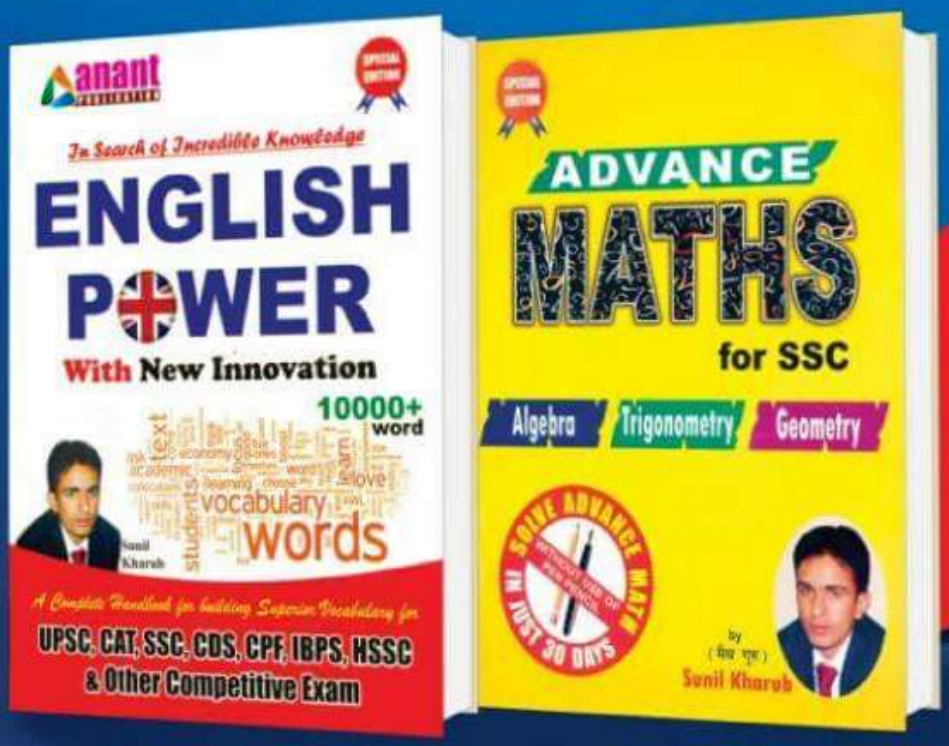

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COMPOUND INTEREST

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 / halfyearly / 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.

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

After one year $CI > SI$

If Rate of INTEREST ARE Different

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

INTEREST COMPOUNDED	New Rate	New Time	Amount
Half yearly	$R/2$	$2T$	$P\left[1+\frac{R}{2\times100}\right]^{2T}$
Quarterly	$R/4$	$4T$	$P\left[1+\frac{R}{4\times100}\right]^{4T}$
monthly	$R/12$	$12T$	$P\left[1+\frac{R}{12\times100}\right]^{12T}$

When Interest is compounded anually 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	
	P	I	P	I
1st yr.	1000	100	1000	100 → same
2ND yr.	1000	100	1100	110
3RD yr.	1000	100	1210	121
		300		331

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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

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Different Techniques For Calculating CI

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

Technique 1 (FORMULA METHOD)

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

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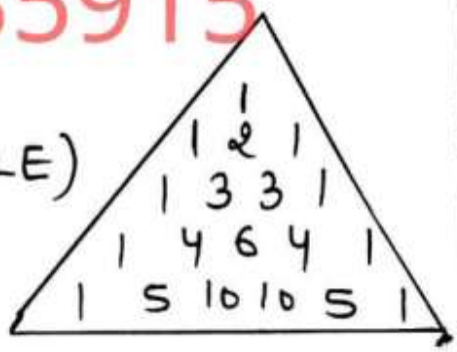
Technique 2 (PASCAL'S TRIANGLE)



PASCAL △ FOR A

CI FOR 2 yrs $= 2A + B$

CI FOR 3 yrs $= 3A + 3B + C$

CI FOR 4 yrs $= 4A + 6B + 4C + D$

CI FOR 5 yrs $= 5A + 10B + 10C + 5D + E$

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

$B = R\%$ of A

$C = R\%$ of B, $D = R\%$ of C, $E = R\%$ of D

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

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

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

Here $CI_3 = 3[\underbrace{10\% \text{ of } 20000}_{A = 2000}] + 3[\underbrace{10\% \text{ of } 2000}_{B = 200}] + [\underbrace{10\% \text{ of } 200}_{C}]$

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

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EXAMPLE SOLVED BY PASCAL TRIANGLE

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

$CI_3 = 3A + 3B + C$

$A = 5\%$ of $5000 = 250$

$B = 5\%$ of $A = 5\%$ of $250 = 12.5$

$C = 5\%$ of $B = 5\%$ of $12.5 = .625$

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

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

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

$A = 12\%$ of $25000 = 3000$

$B = 12\%$ of $A = 12\%$ of $3000 = 360$

$C = 12\%$ of $B = 12\%$ of $360 = 43.2$

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

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

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

$A = 10\%$ of $25000 = 2500$

$B = 10\%$ of $A = 10\%$ of $2500 = 250$

$C = 10\%$ of $B = 10\%$ of $250 = 25$

$D = 10\%$ of $C = 10\%$ of $25 = 2.5$

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

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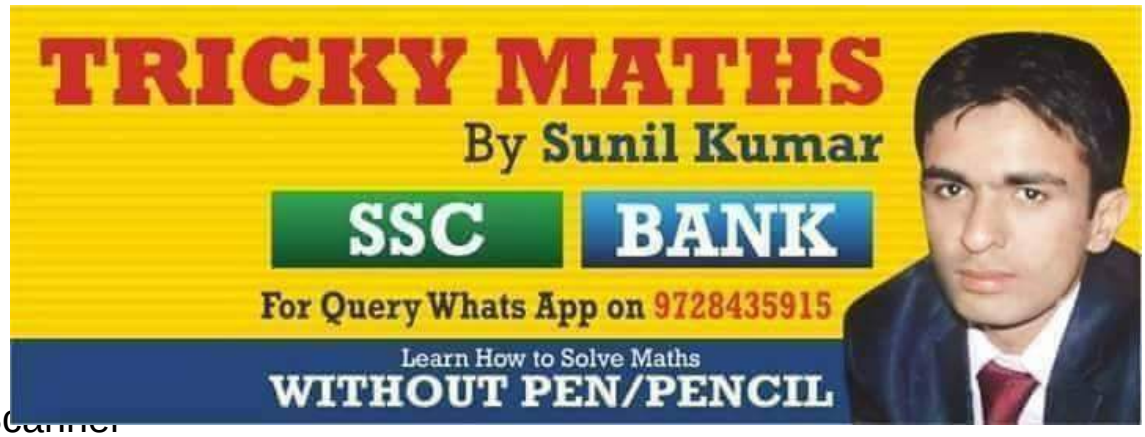

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Technique 3

(i) For 2 yrs

I	$P \times \frac{R}{100}$	
II	$P \times \frac{R}{100}$	$P \times \frac{R}{100} \times \frac{R}{100}$

I	$P \times \frac{R}{100}$	
II	$P \times \frac{R}{100}$	$P \times \frac{R}{100} \times \frac{R}{100}$

→ Add up to get Simple Interest

→ Add up to get compound Interest

→ Difference b/w Simple Interest & compound Int.

(ii) For 3 yrs

Adds Up to SI

I	$P \times \frac{R}{100}$	
II	$P \times \frac{R}{100}$	$P \times \frac{R}{100} \times \frac{R}{100}$
III	$P \times \frac{R}{100}$	$P \times \frac{R}{100} \times \frac{R}{100}$ $P \times \frac{R}{100} \times \frac{R}{100}$ $P \times \frac{R}{100} \times \frac{R}{100} \times \frac{R}{100}$

Adds Up to Difference b/w Simple Interest & Compound Interest for 3 yrs

Adds Up To get CI

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

I 2000

II 2000 200

III 2000 200 200 20

Add all toget CI

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

$= 6620$

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Technique 4 (Ratio/FRACTION METHOD)

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

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

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

D = Denominator

n = No of years

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

Principle$_{New/Assumed} = (10)^3 = 1000$

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

I 100

II 100 + 10

III 100 + 10 + 10 + 1

$\Rightarrow CI_3 = 331$

By Unitary method if $P = 1000 \Rightarrow CI = 331$

but $P = 20{,}000 \Rightarrow CI_3 = \frac{331 \times 20000}{1000}$

$= 6620$

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P = 12000, R = 10 %, T = 2 yrs, CI = ?

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

II YR 1200 120

$CI_2 = 1200 + 1200 + 120 = 2520$ Ans.

Explanation :-

1st yr CI = 1st yr SI = 10 % of 12000 = 1200

2nd yr CI = 10 % of 12000 + 10 % of 1st yr CI (1200)

= 1200 + 120 = 1320

CI_2 = CI 1st YR + CI 2ND YR = 1200 + 1320 = 2520

P = 25000, R = 10 %, T = 3 yrs CI = ?

1st yr CI 2500

2ND YR CI 2500 250

3RD YR CI 2500 250 250 25

CI for 3 year = Add All = 2500 + 2500 + 1500 + 250 + 250 + 250 + 25

= 8275 Ans.

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

$R = 16\frac{2}{3}\% = \frac{1 \rightarrow I}{6 \rightarrow P}$ let $P = (6)^2$ $\{(D)^n$, Here $D = 6\}$

$= 36$

$n = 2$ → No of years

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

I 6 $\frac{1}{6}$

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

if $P = 36 \Rightarrow CI_2 = 13$

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

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

$R = 12.5\% = \frac{1 \rightarrow I}{8 \rightarrow P}$ let $P = (8)^3 = 512$ $\{\because T = 3\text{ yr}\}$

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

I 64 $\frac{1}{8}$

II 64 8 $\frac{1}{8}$

III 64 8 8 1

$CI_3 = 64 + 64 + 64 + 8 + 8 + 8 + 1$

$= 217$

$\Rightarrow$ If $P = 512 \Rightarrow CI = 217$

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

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$= 434000$ ANS.

Explanation → Always assume $P = (D)^n$

where D = denominator of fraction, n = no of yrs

e.g If $R = 30\% = \frac{3}{10}$, $T = 3$ yrs

Assume $P = (10)^3 = 1000$

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Technique 5 (SUCCESSIVE PERCENTAGE)

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

	P	A
I	10	11
II	10	11
III	10	11
	1000	1331

$\underbrace{1000 \text{ — } 1331}_{331 \rightarrow CI}$

IF $P = 1000$

$\Rightarrow CI = 331$

but $P = 20000$

$\Rightarrow CI = \frac{331}{1000} \times 20000$

$= 6620$ ANS.

$\frac{P}{A} = \frac{10}{11} \times \frac{10}{11} \times \frac{10}{11}$

$P : A = 1000 : 1331$

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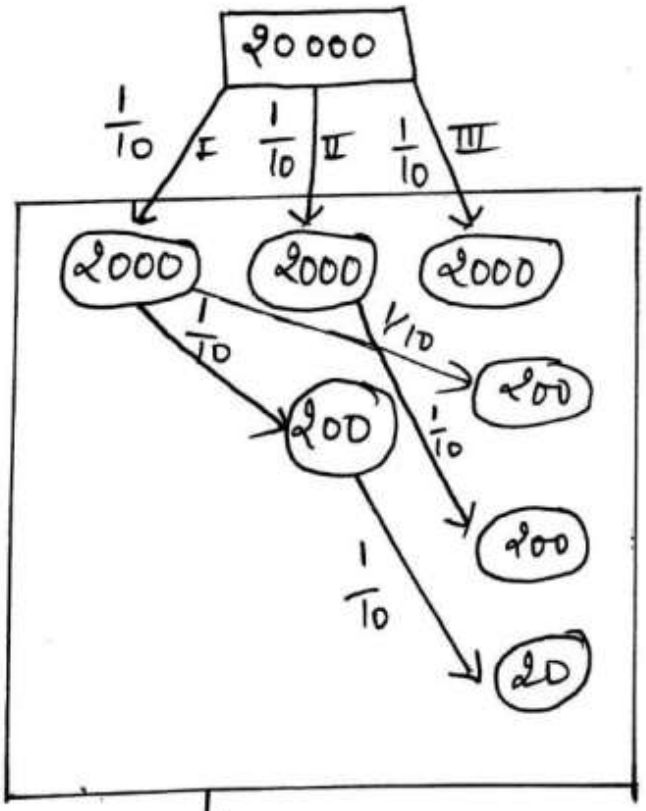
Technique 6 (TREE METHOD)



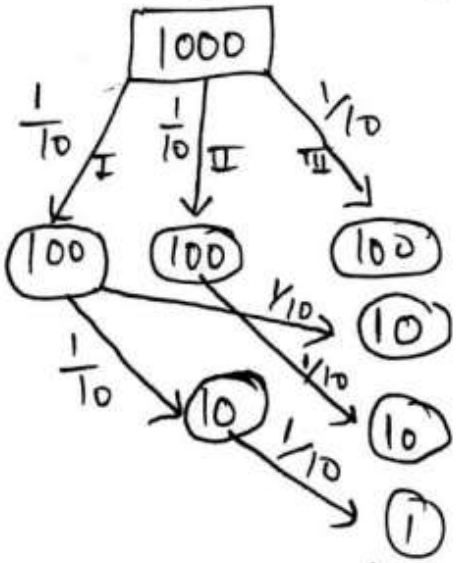
Add all these to get CI

$CI = 2000 + 2000 + 2000 + 200 + 200 + 200 + 20$

$= 6620$ ANS.

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

let $P = (10)^3 = 1000$ {T = 3 yr}



Add all present in Circle

$CI = 100 + 100 + 100 + 10 + 10 + 10 + 1$
$= 331$

If $P = 1000 \Rightarrow CI = 331$

but $P = 20000 \Rightarrow CI = \frac{331}{1000} \times 20000$

$= 6620$ ANS.

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$P = 4000$, $R = 5\%$, $T = 3$ yrs, $CI = ?$

I	200		
II	200	10	
III	200	10	10 .5

$CI = 200 + 200 + 200 + 10 + 10 + 10 + .5$
$= 630.5$ Ans

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

	P	A
I	20	21
II	20	21
III	20	21
(P)	8000	9261 (A)

$1261 \rightarrow CI$

If $P = 8000 \Rightarrow CI = 1261$

but $P = 4000 \Rightarrow CI = \frac{1261}{2} = 630.5$

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

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

	P	A
I	6	7
II	6	7
III	6	7
(P)	216	343 (A)

$127 \rightarrow CI$

IF $P = 216 \Rightarrow CI = 127$

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

$= 2116.67$ Ans.

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

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

	P	A
I	7	8
II	7	8
(P)	49	64 (A)

15

If $A = 64 \Rightarrow P = 49$

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

$= 3136$ Ans

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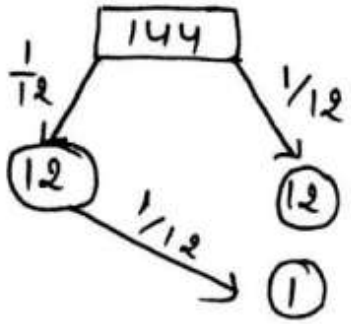
$P = 28800$, $R = 8\frac{1}{3}\%$, $T = 2$ YR, $CI = ?$

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



OR			
I	12		
II	12	1	

$CI_2 = 12 + 12 + 1 = 25$

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

If $P = 144 \Rightarrow CI = 25$

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

$= 5000$ ANS.

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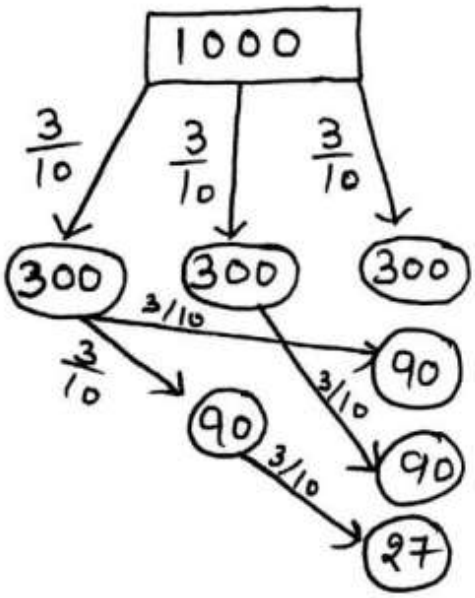
$P = 25000$, $R = 30\%$, $T = 3$ YRS, $CI = ?$

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



OR				
I	300			
II	300	90		
III	300	90	90	27

$CI = 1197$

OR $R = \frac{3 \to I}{10 \to P} \Rightarrow A = 13$

	P	A
I	10	13
II	10	13
III	10	13
(P)	1000	2197 (A)

$1197 \to CI$

add all in circle
$CI = 1197$

Now If $P = 1000 \Rightarrow CI_3 = 1197$

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

$= 29925$ ANS.

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Technique 7 (Linear METHOD)

$$\underset{P}{20000} \xrightarrow[2000]{10\%\uparrow} 22000 \xrightarrow[2200]{10\%\uparrow} 24200 \xrightarrow[2420]{10\%} \underset{A_3}{26620}$$

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

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

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

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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 एक single digit ना आ जाए तब तक जोड़ते रहिए।

Find the digital root of 24567

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

again $2+4 = 6$ ↓ is digital sum/Root of this No.

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

$= 6+5+5+3+6 = 25 = 2+5 = 7$

D.R of 432654

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

$2+4 = 6$

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Digital Root :→ 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

⇒ DR = 4

we can use this to find digital Root of a No. Quickly by cancelling 9 ~~coz~~ (casting out 9)

⇒ 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

5 ~~9~~~~9~~~~9~~ 1 = 5+1 = 6

e.g. 49219

DR = 4 ~~9~~ 2 1 ~~9~~ = 4+2+1 = 7

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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 casting out 9.

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

(ii) $\cancel{5}2134\cancel{9} = 2+1+3=6$ [$\because 5+4=9$]

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

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

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

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[$\because 7+2=9$ $4+5=9$
$6+3=9$]
we can cancel them

e.g.(v) 43712

$= 43\cancel{7}1\cancel{2} = 4+3+1$
$= 8$ [$\because 7+2=9$]

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

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

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

$729 = 7+2+9 = 18 = 1+8$

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

DR OF $786 + 152$

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

$= DR[3+8] = DR[11] = 2$

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

e.g $DR[962-151]$

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

$= DR[8-7] = 1$

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

e.g $DR(35*16)$

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

$= DR[8*7] = DR[56]$

$= 2$

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where DR is digital Root / digital su

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In Any mathematical Calculation Digital Root on both sides of (=) is alway equal.

DR of LHS = DR of RHS.

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e.g.

$12 \times 16 = 192$

3×7 $\quad$ $1+9+2$

21 $\quad$ 12

$3 = 3$

e.g. $1440 + 120 + 210 = 1770$

$9 + 3 + 3$ $\quad$ $1+7+7+0$

15 $\quad$ 15

$6 \xleftrightarrow{\text{equal}} 6$

e.g $12570 - 4322 = 8248$

$6 - 2$ $\quad$ $8+2+4+8$

4 $\quad$ 22

$2+2$

$4 \xleftrightarrow{\text{equal}} 4$

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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 then.

−1 means +8	If we get −a
−2 —— +7	DR = 9 − a
−3 —— +6	e.g −4
so on	DR = 9 − 4 = +5

e.g. 4372 − 4328

7 − 8

(−1) ⇒ +8

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ans have Digital Root +8

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

⇒ 7.28, 728, 72.8 all have same digital Root

⇒ % mean $\frac{1}{100}$ 100 = 1+0+0 = 1

so it does not effect the digital sum

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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.

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1. $(73)^2$

a). 5129 2. 5229 3. 5329 4. 5239

Solution :→ 73×73

$73 \to 10 \to 1$, $73 \to 10 \to 1$

1×1

1 → so Ans. option must have digital sum 1

a.) 5129 = 8 ✗ (b) 5229 = 9 ✗

c). 5329 = 5+3+2 = 1 ✓

c is right choice

2. 637.28 − 781.47 + 257.39 = ?

a) 113.20 b). 104.30 c). 122.40 d) 133.50

✓ 7 8 9 3

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

637.28 − 781.47 + 257.39

DR 8 − 9 + 8 = ~~4~~ 7 → option A has 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

8 × 8 + 3 × 3

1 + 9

10

1

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Now let check OR of option

a). 6 ✗ (c) 1 ✓

b). 9 ✗ (d) 9 ✗

So c is Ans.

#4 22% of 250 + 35% of 460 = ?

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

Solution

22% of 250 + 35% of 460

4 × 7 + 8 × 1

1 + 8

9 → Now see which option digital sum is 9

its (a) ✓

216 → (9)

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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 $333.33 + 33.33 + 3.33 + 30.003$

$\downarrow \quad \downarrow$

$6 + 3 + 9 + 6$

$\downarrow$

24

$\downarrow$

6

check option which give digital sum 6

option c → 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% of 958 + 67% of 1008

$2 \times 4 + 4 \times 9$

$8 + 9$

$\downarrow$

8

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Digital sum of Right side must be 8

x% of 2000

$x \quad 2$

so x be such that $x \times 2 = 8$

option c $60.592 \rightarrow 4 \Rightarrow 4 \times 2 = 8$

$\Rightarrow$ c is Ans.

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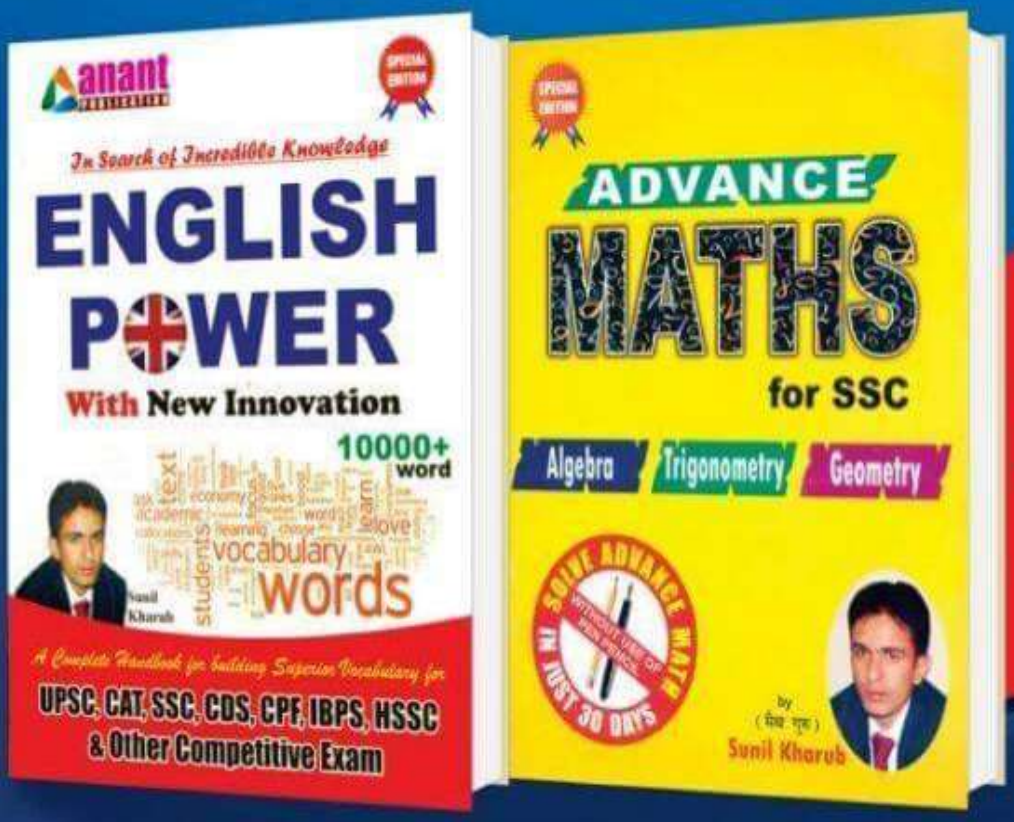

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TRIGONOMETRY TRICKY

by Sunil Sir 97284-35915

#1. If $x = a(\sin\theta + \cos\theta)$,
$y = b(\sin\theta - \cos\theta)$, 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 $\theta = 90°$ सुनील सर

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$\Rightarrow x = a(1+0) = a$

$y = b(1-0) = b$

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

(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 $\theta = 90°$

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

also $a\cos\theta - b\sin\theta = a.0 - b1 = -b$

Put $a = c$ in all the options

option (4) gives $-b$ so (d)

is Ans

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TRICKY MATHS BY SUNIL SIR

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

Solution let $A = 60°$, $B = 30°$

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

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

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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 $(0 < A < 90)$

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

Solution Put $A = 30°$

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 $A = 30°$ in options

only A option will give $4 = 2\operatorname{cosec} 30°$
$= 4$

(A) → ans {सुनील सर की क्लास}

Note → Dont put $A = 45°$ in this question

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

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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 $\alpha = 30°$, $\beta = 60°$

then $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$

also $\sin^2\beta = \sin^2 60° = \frac{3}{4}$

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

check option (c) will give 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). $\frac{\sqrt{3}}{2}$

सुनील SIR की क्लास

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

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

ading both $2\sec^2\theta = 8/3 \Rightarrow \sec^2\theta = 4/3$

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

$\cos 2\theta = \cos 60° = 1/2$

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

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

<u>Sol.</u> put $\theta = 45^\circ$

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

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

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

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

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

<u>solution</u> Put $\theta = 15^\circ$

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

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

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

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

(B) is <u>Ans.</u>

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

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

<u>Sol.</u> put $\theta = 45^\circ$

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

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

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

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

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

<u>solution</u> Put $\theta = 15^\circ$

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

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

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

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

(B) is <u>Ans.</u>

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

Solution :→ let $\theta = 0°$

सुनील MATHS GURU

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

$\therefore x^2 + (1+x^2)\sin\theta = 1 + (1+1) * 0 = 1$

(a). 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 $\beta = 45°$ and $\alpha = 60°$

this will satisfie the given condition

$\tan^2 60° = 1 + 2\tan^2\beta$

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

$3 = 3$

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

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

(a) is Ans.

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If $\sec\theta = x + \frac{1}{4x}$ $[0° < \theta < 90°]$, then $\sec\theta + \tan\theta$ equal to.

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

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Solution Put $x = 1$

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

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

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

[www.competionking.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 $x = y = 45°$

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

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

$$= 9 - (2\sqrt{2})^2 = 1$$ ANS. is (d)

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If $(x\cos\theta-\sqrt{3})^2+(x\sin\theta-1)^2=0$ then the value of $\dfrac{x\tan\theta+\sec\theta}{x\sec\theta+\tan\theta}$ is

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

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

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

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

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

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

$\therefore \dfrac{x\tan\theta+\sec\theta}{x\sec\theta+\tan\theta}=\dfrac{x\tan 30^\circ+\sec 30^\circ}{x\sec 30^\circ+\tan 30}$

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

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the simplified value of $(1+\cot\theta-\operatorname{cosec}\theta)(1+\tan\theta+\sec\theta)$ equal to

Solution put $\theta=45^\circ$

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

$=2$

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सुनील सर की गणित हिसार (हरियाणा)

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Question $2\sin\alpha + 15\sin^2\alpha = 7$ 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) $2\sin^2\alpha\sin^2\beta$ (d) $2\sin\alpha\sin\beta$

(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

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

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

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

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

Now $\cos^2\theta + \cos^4\theta = \cos^2\theta + (\cos^2\theta)^2$

$= \cos^2\theta + \sin^2\theta = 1.$

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

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

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

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

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

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

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

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

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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

<u>Solution:</u> $\sin\theta + \sin^2\theta + \sin^3\theta = 1$

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

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

Squaring Both Sides.

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

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

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

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

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

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

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

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Very Important Concept

If $A+B=C$ then

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

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

$$\Rightarrow \boxed{\tan A \tan B \tan C = \tan C - \tan A - \tan B}$$

e.g. Find the value of

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

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

So

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

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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 given, Debit the receiver"

1. Principal (मूलधन) :→ (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 (दर) (r) :→

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

4. Amount (मिश्रधन)

Amount = Principal + INTEREST

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UNDERSTANDING INTEREST

Some money → say P (called Principle)

[Uses the money for certain Period of time]

Lend = gives (Creditor)

Borrow = Takes (Debtor)

Have to Pay Some Extra money for use of P called

↓

Interest

@

r % p.a (Rate)

r (percent) (per annum) means Rs r is interest on ₹100 for 1 year

How it is calculated

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

CI If Interest is calculated on diff. Principle (P is not same for entire Period)

$A = P + I$

Amount $= P + I$

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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 ₹ r 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.

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

$$\boxed{A = P + SI}$$

↓ amount

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SIMPLE INTEREST

Principal is always 100%

$$P = 100\%$$

Interest for 1 year is Rs r

for 2 yrs is $2r$, for 10 yr $10r$ ....

and so on

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

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

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

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

$A = P + SI$

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

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

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#

If R = 5% p.a. —

T = 6 years

let us understa

P = 15625

SI = ?

solution P = 100

Rt =

SI = 10%

100% ——

10% ⟶

R = 4% T = 5

P =

solution SI = R

20%

⟹ 100%

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Amount = P + SI

$= 100\% + rt\%$

$= (100 + rt)\%$

R = 5% T = 4 yr P = 2000

Amount = ?

<u>solution</u> :→ P = 100%

$Rt\% = 5\% \times 4 = 20\%$

$\Rightarrow A = 120\%$

$100\% \rightarrow 2000$

$120\% \rightarrow \frac{2000}{100} \times 120 = 2400$ ₹ <u>Ans.</u>

R = 5% T = 4 yr A = 480

P = ?

<u>solution</u> P = 100%

$Rt = 5 \times 4 = 20\%$

$\Rightarrow A = 120\%$

$120\% = 480$

$\Rightarrow 100\% = \frac{480}{120} \times 100 = 400$ ₹

<u>Ans</u>

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

500 ₹ की राशि कितने समय में 5% की दर से 625 ₹ हो जाएगी

Sol. $A = P + SI$

$P \rightarrow 100\%$

$500 = 100\%$

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

$A = 125\% \Rightarrow SI = 25\% = Rt\%$

but $R = 5\% \Rightarrow T = 5$ yrs Ans.

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

Solution :→ $A = P + SI$

$P \rightarrow 100\%$

$425 \rightarrow 100\%$

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

$A = 112\% \Rightarrow SI = 12\% = Rt\%$

but $t = 3$ yrs $\Rightarrow R = 4\%$ Ans

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

कोई राशि साधारण ब्याज की दर से 4 वर्ष में 3 गुणी हो गई. ब्याज की दर ज्ञात करें।

Solution $A = P + SI$

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

$\Rightarrow SI = 200\% = rt\%$

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

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

कोई राशि 5% वार्षिक साधारण ब्याज की दर से एक निश्चित समय में दुगनी हो जाती है। समय ज्ञात कीजिए

Solution :→ $A = P + SI$

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

$SI = 100\% = Rt\%$

but $R = 5\% \Rightarrow t = 20$ years.

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

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

Solution $A_1 = P_1 + SI_1$

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

$SI_1 = 200\%$ in 4 yrs.

Note :→ SI is uniform. it will increase by same amount in same time period

$A_2 = 700\%$ $P_2 = 100\%$ ⇒ $SI_2 = 600\%$

200 % in 4 yrs

600 % in $4 \times 3 = 12$ yrs Ans.

कोई राशि 5 साल में साधारण ब्याज की दर से 5 गुणी हो जाती है। वही राशि कितने समय में 7 गुणी हो जाएगी।

Solution $A = P + SI$

$A_1 = 500\%$ $P_1 = 100\%$ $SI_1 = 400\%$

$SI_1 = 400\%$ in 5 yrs

⇒

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

$SI_2 = 600\%$

400 % in 5

600 % in — $\frac{5}{400} \times 600 = 7\frac{1}{2}$

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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% → 480

100% → $480/12 \times 100 = 4000$ ₹

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

Solution $A_5 - A_2 = 800 - 704 = 96$ ₹

Interest for 3 years = 96

——— 1 year = 32

——— 2 ——— = 64

$P = 704 - 64 = 640$

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

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

$= 30\%$

Total Interest $= 76\%$ of P

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

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

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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)

$A : B$	$B : C$
$(2 : 3) \times 4$	$(4 : 5) \times 3$
$8 : 12$	$12 : 15$

$\Rightarrow A : B : C = 8 : 12 : 15$

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

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

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

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

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

$\Rightarrow a = \frac{K}{2} \quad b = \frac{K}{3} \quad c = \frac{K}{4}$

$a : b : c = \frac{1}{2} : \frac{1}{3} : \frac{1}{4} \times 12$

$= 6 : 4 : 3$

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A sum of ₹ 14400 is divided into 3 parts such that 1st part is invested at 20% p.a for 3 years, 2nd part @ 30% 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 (P) of each part

<u>Solution</u> let 3 part are P_1, P_2 & P_3

1st Part SI 2nd Part SI 3rd SI

6% of $P_1 = 12\%$ of $P_2 = 20\%$ of P_3

OR $6P_1 = 12P_2 = 20P_3$

OR $3P_1 = 6P_2 = 10P_3$

let $3P_1 = 6P_2 = 10P_3 = 30$

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

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

So $P_1 = \frac{14400}{18} \times 10 = \underline{8000}$ $P_2 = \frac{14400}{18} \times 5 = \underline{4000}$

& $P_3 = \frac{14400}{18} \times 3 = \underline{2400}$

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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 alloted at present

Solution :→

A_1 $\qquad\qquad\qquad\qquad$ A_2

$100 + 5\% \times 6 = 130\%$ of P_1 $\qquad\qquad$ $100 + 4 \times 5\%$

120% of P_2

130% of $P_1 = 120\%$ of P_2

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

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

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

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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	I	t
4	5	1	t yrs
5	7	2	t+3

we will make P equal by taking LCM (20)

$5\times4=20$	$5\times5=25$	5	t
$4\times5=20$	$7\times4=28$	8	t+3

$\Rightarrow$ I on ₹ 20 for 3 yrs is $= 8-5 = 3$.

$$\therefore r = \frac{3\times100}{20\times3} = 5\% \text{ p.a.}$$

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A person invested some amount at the rate of 12% SI and remaining at 10%. He received yearly interest of ₹ 130. Had he interchange 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% of x + 10% of Y = 130

10% of x + 12% of Y = 134

⇒ $x = 500$, $y = 700$ (d) is correct

Short cut :→ Diff in two rates = 2%

Diff in Interest = ₹ 4

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

Diff in amount is ₹ 200 only in option D

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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

<u>Solution</u> <u>method1</u>

let x be amount invested at 5%

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

$\Rightarrow x = 1200$

<u>method2</u>: By <u>alligation</u>

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

4% 5%

4.6%

.4 .6

2 : 3

$\Rightarrow$ amount at 5% $= \frac{2000}{5} \times 3$

$= \underline{1200}$ ₹

<u>Shortcut by sunil</u> let the whole amount be invested at 4%

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

Diff is <u>due</u> to diff of 2 rates 5% − 4% = 1

1% — 12

100% — <u>1200</u>

so ans is <u>1200</u>

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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

<u>Solution</u> <u>method1</u>

let x be amount invested at 5%

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

$\Rightarrow x = 1200$

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.4 .6

2 : 3

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$= \underline{1200}$ ₹

<u>Shortcut by sunil</u> let the whole amount be invested at 4%

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Diff is <u>due</u> to diff of 2 rates 5% − 4% = 1

1% — 12

100% — <u>1200</u>

so ans is <u>1200</u>

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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%

⇒ annual interest = 16000 × 4% = 640

Interest is short from actual Interest (700) by = 700 − 640 = 60

this diff is CO2 of 5% rate

1% — 60

100% — 6000 this was invested at 5%

So amt invested at 4% = 16000 − 6000 = 10,000

OR. let the whole money invested at 5%

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

this is 100 more CO2 4% is less

1% — 100

100% — 10,000

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

a) 16000 b) 18000 c) 17500 d) 12000

Solution Interest for 2yrs = 6480

Interest for 1yr = 3240

let the whole sum be borrowed at 10%

then total interest = 30,000 × 10% = 3000

this is short from actual interest by 240

240 is equal to 2% of sum borrowed at 12%

2% — 240

100% — 12000 (d) is Ans.

OR let whole sum is borrowed at 12%

⇒ I = 30,000 × 12% = 3600

360 more which is 2% of sum at 10%

2% — 360

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

⇒ sum at 12% = 12000

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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 only

⇒ population after 1yr = 15000 × 8% = 16200

which is 100 less than actual (16300)

100 is 2% of female (as it extra)

100% — 5000 females

OR let the population consist of female only

→ population after 1yr = 15000 × 10%

= 16500

which is 200 extra

2% of male is 200

100% —— $\frac{200}{2} \times 100$ = 10,000 (males)

⇒ females = 5000

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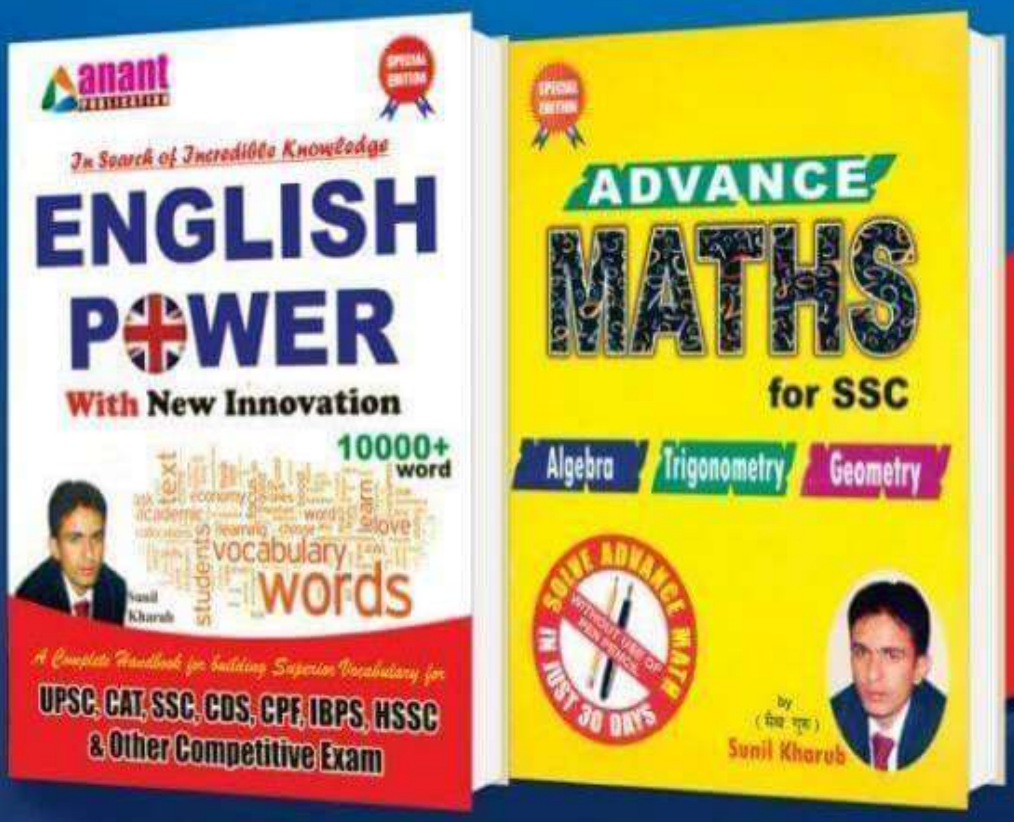

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TRICKY MATHS by Sunil Sir

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

TRICK → $\boxed{7^{\frac{2^n-1}{2^n}}}$ where n is no. of square Roots.

Here $n = 3$

$$x = 7^{\frac{2^3-1}{2^3}} = 7^{7/8}$$

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

$$= 7^{15/16}$$

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

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

So → Ans. is 7

Explanation :→

let $\sqrt{7\sqrt{7\sqrt{7\ldots}}}\ldots\infty = x$

squaring both sides

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

$\Rightarrow x^2 = 7x$

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

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$\sqrt{12+\sqrt{12+\sqrt{12+\cdots\infty}}}$

Explanation :→ let $\sqrt{12+\sqrt{12+\sqrt{12\cdots\infty}}} = x$

Sq. both sides, we get

$$x^2 = 12+\sqrt{12+\sqrt{12+\cdots\infty}}$$

$$\Rightarrow x^2 = 12+x \Rightarrow x^2-x-12=0 \Rightarrow x=4$$

TRICK :→ make the factor of No in form

$N \times (N+1)$

No. के ऐसे Factor बनाओ जिसमे diff. 1 हो

1. If + sign is present ANS. is → N+1 (बड़ा)
2. If − sign is presen ANS is → N (छोटा)

Here $12 = 3\times4$

+ is present ANS is 4

$\sqrt{12-\sqrt{12-\sqrt{12\cdots\infty}}}$

$12 = 4\times3$ but − sign is present

so ANS is 3

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$\sqrt{72+\sqrt{72+\sqrt{72\cdots\infty}}}$ $72 = 8\times9$

ANS. = 9 [+]

$\sqrt{132-\sqrt{132-\sqrt{132\cdots\infty}}}$

$132 = 12\times11$ − is Pres. so ANS.

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But it is not Necessary we are always able to make factor of for N.N+1
So what we do. Here is solution

Universal Trick :→

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

e.g. $\sqrt{20+\sqrt{20+\sqrt{20+\cdots\infty}}} = \frac{\sqrt{4*20+1}+1}{2}$

सुनील सर की क्लास

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

$\sqrt{19+\sqrt{19+\sqrt{19+\cdots\infty}}}$

$a = 19 \Rightarrow \frac{\sqrt{4\times19+1}+1}{2} = \frac{\sqrt{77}+1}{2}$

$\sqrt{19-\sqrt{19-\sqrt{19-\cdots\infty}}}$

$= \frac{\sqrt{4\times19+1}-1}{2} = \frac{\sqrt{77}-1}{2}$

* ——— * ——— * ——— *

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

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Solu. By taking LCM it is very tedious task

1. make Factors

$$\frac{1}{1\times2}+\frac{1}{2\times3}+\frac{1}{3\times4}+\frac{1}{4\times5}+\frac{1}{5\times6}+\frac{1}{6\times7}$$

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

where gap → constant diff.

$$\underset{T_1}{\frac{1}{1\times2}}+\frac{1}{2\times3}+\frac{1}{3\times4}+\frac{1}{4\times5}+\frac{1}{5\times6}+\underset{T_2}{\frac{1}{6\times7}}$$

gap = 1 [diff of 2 and 3 and 3-4 5-6]

$T_1=\frac{1}{1}$ $T_2=\frac{1}{7}$

$$=\frac{1}{1}\left[1-\frac{1}{7}\right]=\frac{6}{7}$$

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

$$=\underset{gap\,2}{\frac{1}{3\times5}}+\underset{gap\,2}{\frac{1}{5\times7}}+\frac{1}{7\times9}+\frac{1}{9\times11}$$

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

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

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If $x\cos\theta - \sin\theta = 1$, then $x^2 + (1+x^2)\sin\theta$ equals

(a) 1 b). −1 (c) 0 d) 2

Solution :→ let $\theta = 0°$

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

$\therefore x^2 + (1+x^2)\sin\theta = 1 + (1+1) * 0 = 1$

(a). 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 $\beta = 45°$ and $\alpha = 60°$

this will satisfie the given condition

$\tan^2 60° = 1 + 2\tan^2\beta$

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

$3 = 3$

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

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

(a) is ANS.

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If $\sec\theta = x + \frac{1}{4x}$ $[0° < \theta < 90°]$, then $\sec\theta + \tan\theta$ equal to.

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

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Solution Put $x = 1$

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

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

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

[www.competionking.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 $x = y = 45°$

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

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

$$= 9 - (2\sqrt{2})^2 = 1$$ ANS. is (d)

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$$\sec\theta + \tan\theta$$

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

the simplified value of

$(1 + \cot\theta - \operatorname{cosec}\theta)\ (1 +$

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If $2y\cos\theta - x\sin\theta = 0$ & $2x\sec\theta - y\,\mathrm{cosec}\,\theta = 3$, 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 $4y - y = 3/\sqrt{2}$ $[\because 2y = x]$

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

$\therefore x^2 + 4y^2 = 2 + 4\times\frac{1}{2} = 4$ (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 $\theta = 15^\circ$

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

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

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

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

(B) is Ans.

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

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

<u>Sol.</u> put $\theta = 45^\circ$

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

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

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

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

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

<u>solution</u> Put $\theta = 15^\circ$

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

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

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

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

(B) is <u>Ans.</u>

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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 $\alpha = 30°$, $\beta = 60°$

then $a = \sqrt{3}$ & $b = \frac{1}{\sqrt{3}}$

also $\sin^2\beta = \sin^2 60° = \frac{3}{4}$

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

check option (c) will give 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). $\frac{\sqrt{3}}{2}$

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

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

adding both $2\sec^2\theta = 8/3 \Rightarrow \sec^2\theta = 4/3$

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

$\cos 2\theta = \cos 60° = 1/2$

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TRICKY MATHS BY SUNIL SIR

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

Solution let $A = 60°$, $B = 30°$

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

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

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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 $(0 < A < 90)$

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

Solution Put $A = 30°$

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 $A = 30°$ in options

only A option will give $4 = 2\,\text{cosec}\,30°$
$= 4$

(A) → ans {सुनील सर के सवाल}

Note → Dont put $A = 45°$ in this question

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

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If $ax + by = m$

$bx - ay = n$

then $(a^2+b^2)(x^2+y^2) = m^2+n^2$

e.g. If $\sin x + \cos x = \frac{17}{13}$

then find $\sin x - \cos x$

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Sol. $\sin x + \cos x = \frac{17}{13}$

let $\sin x - \cos x = m$

by applying above theorem

$a=1, b=1$

$(1^2+1^2)(\sin^2 x + \cos^2 x) = \frac{289}{169} + m^2$

$\Rightarrow 2(1) = \frac{289}{169} + m^2$

$\Rightarrow m^2 = 2 - \frac{289}{169} = \frac{49}{169}$

$\Rightarrow m = \pm 7/13$

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Q ⇒ Find the max^m and min^m value of

$81^{\sin x} \, 27^{\cos x}$

Sol^n $81^{\sin x} \, 27^{\cos x} = 3^{4\sin x} * 3^{3\cos x}$

$= 3^{4\sin x + 3\cos x}$

$\text{max}^m = 3^5$ $\quad [-5 \le 4\sin x + 3\cos x \le 5]$

$\text{min}^m = 3^{-5}$

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Q.1. If $\operatorname{cosec}\theta + \cot\theta = 3$, find $\tan\theta$?

Sol. $\operatorname{cosec}\theta + \cot\theta = 3$ —(1)

$\Rightarrow$ $\operatorname{cosec}\theta - \cot\theta = 1/3$ —(2)

Sub. (1) From (2), we get

$2\cot\theta = 3 - 1/3 = 8/3$

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[SUNIL SIR KE CLASS]

$\Rightarrow$ $\cot\theta = 8/6 = 4/3$ $\Rightarrow$ $\tan\theta = 3/4$

Q.2. If $\sec\theta - \tan\theta = \sqrt{5} - 2$ find $\cos\theta$?

Sol. $\sec\theta - \tan\theta = \sqrt{5} - 2$ —(1)

$\Rightarrow$ $\sec\theta + \tan\theta = \dfrac{1}{\sqrt{5}-2} = \sqrt{5} + 2$ —(ii)

Adding (1) & (ii), we get

$2\sec\theta = 2\sqrt{5} \Rightarrow \sec\theta = \sqrt{5}$

$\therefore$ $\cos\theta = 1/\sqrt{5}$

Q.3. If $\sec\theta + \tan\theta = p$, find $\cos\theta$?

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by Sunil The maths Guru

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TRIGONOMETRY TRICK

1. $\sin\theta \sin 2\theta \sin 4\theta = \frac{1}{4}\sin 3\theta$

$\cos\theta \cos 2\theta \cos 4\theta = \frac{1}{4}\cos 3\theta$

$\tan\theta \tan 2\theta \tan 4\theta = \tan 3\theta$

2. $\sin\theta \sin(60-\theta) \sin(60+\theta) = \frac{1}{4}\sin 3\theta$

$\cos\theta \cos(60-\theta) \cos(60+\theta) = \frac{1}{4}\cos 3\theta$

$\tan\theta \tan(60-\theta) \tan(60+\theta) = \tan 3\theta$

Q. $\sin 10^\circ \sin 30^\circ \sin 20^\circ \sin 40^\circ$

$= \frac{1}{2}\sin 10 \sin 20 \sin 40^\circ = \frac{1}{2}\times\frac{1}{4}\times\sin 30^\circ$

[SUNIL SIR KI CLASS 9728435915] $= \frac{1}{2\times 4}\times\frac{1}{2} = \frac{1}{16}$

Q. $\cos 12^\circ \cos 48^\circ \cos 72^\circ$

$= \cos 12^\circ \cos(60-12^\circ) \cos(60+12)$

$= \frac{1}{4}\cos 36^\circ = \frac{1}{4}\,\frac{\sqrt{5}+1}{4} = \frac{\sqrt{5}+1}{16}$

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SUNIL KUMAR

MATH GURU

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TRIANGLES △

त्रिभुज

- A △ is a polygon having three sides.

Sum of all the angles of a △ = 180°

Types :→ (a) According to angle

△
- Acute Angled △ (all angle < 90°)
- obtuse angled △ (one angle > 90°)
- Right angled △ (one angle = 90°)
- equilateral (all = 60°)

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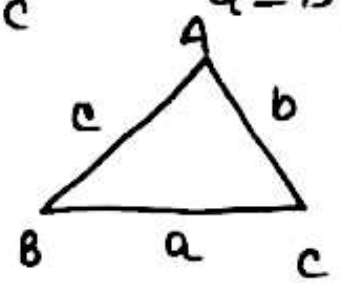
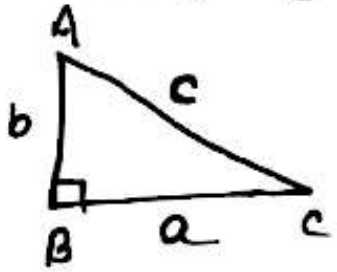
(b) According to length of sides

△
- Scalene △ (विषम भाहु) $a \neq b \neq c$
- Isosceles △ (समद्वि भाहु) $a = b \neq c$
- equilateral △ समभाहु $a = b = c$
- Right angled △ समकोण $a^2 + b^2 = c^2$





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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 Δ is always less than 3rd side.

$$a-b<c.$$

8, 5, 4 $\Rightarrow$ a Δ

$8+5>4$ OR $8-5<4$

$8+4>5$ OR $8-4<5$

$4+5>8$ OR $5-4<8$

$a+b>c$ OR $a-b<c$

but if $a=8$ $b=3$ $c=4$

it will not make a triangle

$\because$ $3+4<8$ which is not possible

$\boxed{a+b<c}$ but it ~~to~~ have to be

$a+b>c$

Q. 2 sides of a triangle is 6, 8. Find the Range of third.

we know $a+b>c$ & $a-b<c$

$6+8>c$ $8-6<c$

$$\boxed{2<c<14}$$

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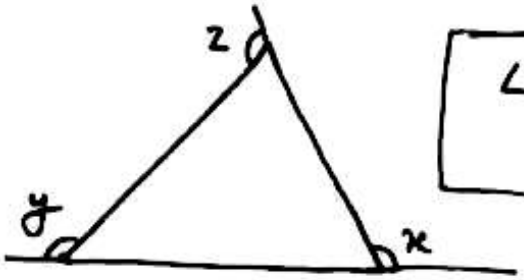
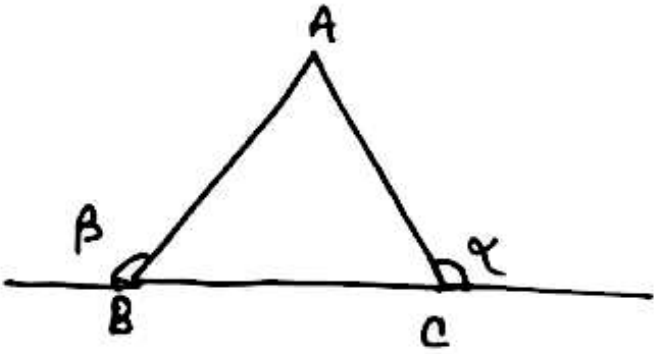
Sum of all the Exterior angles of a Δ is always equal to $360°$



$$\angle x + \angle y + \angle z = 360°$$

Exterior Angle Theorem

The Exterior angle is equal to sum of two interior opposite angles.

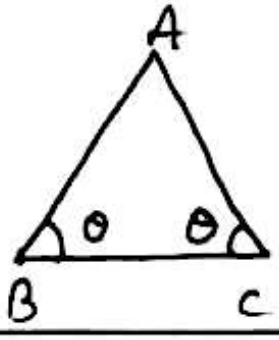


$\alpha = \angle A + \angle B$

$\beta = \angle A + \angle C$

Side opposite to the greatest angle will be greatest and the side opposite the smallest angle will be smallest.

Corolary :→ side opposite to equal angle will be equal



$\Rightarrow$ $AB = AC$

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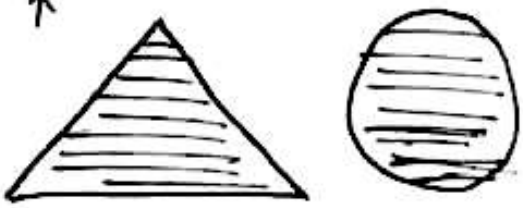
AREA OF a TRIANGLE

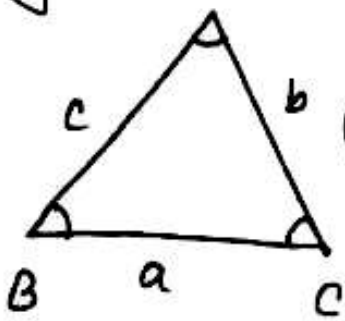
AREA (क्षेत्रफल) :- Area is the Space Covered by any figure.



Shaded portion is Area

Perimeter (परिमाप) :-

total length of sides of any 2-D figure



$p = a+b+c$

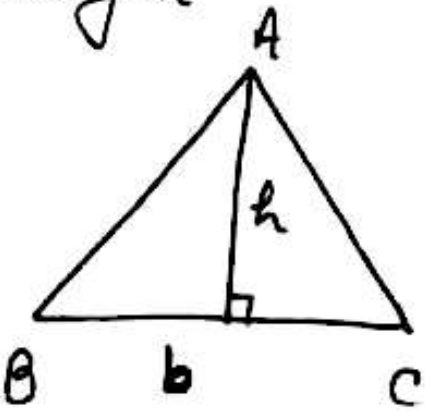
Note

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

$$\Delta = \frac{1}{2} \times \text{base} \times \text{height}$$

$$\Delta = \frac{1}{2} \times b \times h$$



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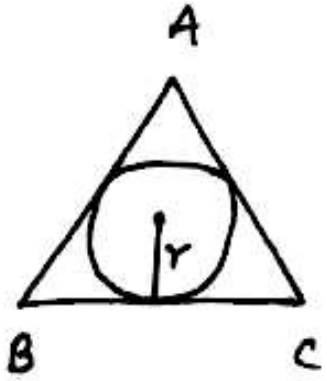
#2. <u>Hero's FORMULA</u> ⇒ when all the sides are given.

$$\Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

where s is semiperimeter

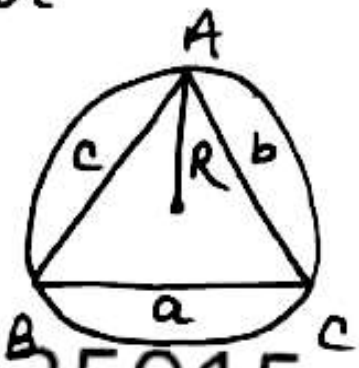
$$s = \frac{a+b+c}{2}$$



#3. $\Delta = r \times s$

where r is <u>inradius</u>

s is semiperimeter



#4. $\Delta = \frac{abc}{4R}$

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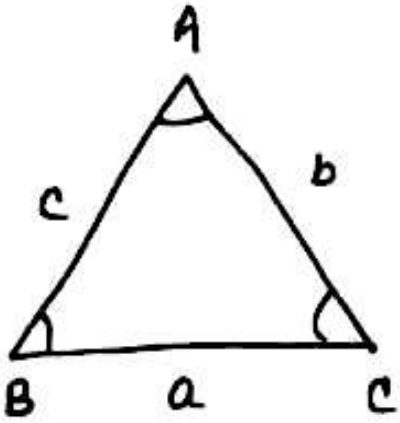
#5. when two sides and angle between them is given.

$$\Delta = \frac{1}{2} ac \sin B$$

$$\Delta = \frac{1}{2} ab \sin C$$

$$\Delta = \frac{1}{2} bc \sin A$$



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#6. when length of medians are given.

trick :→ Assume medians as sides of triangle. and find the Area.

In last multiply the Area by $4/3$.

$$\Delta = \frac{4}{3}\sqrt{s(s-m_1)(s-m_2)(s-m_3)}$$

where m_1, m_2 and m_3 are medians

and $s = \frac{m_1+m_2+m_3}{2}$

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Note → Medians of Right angled Triangle also makes Triplet ($P^2+B^2=H^2$)

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 & calculate Area $\Delta = \frac{1}{2} \times 6 \times 8 = 24$

→ multiply this by $\frac{4}{3}$ so Ans $\frac{4}{3} \times 24 = 32$

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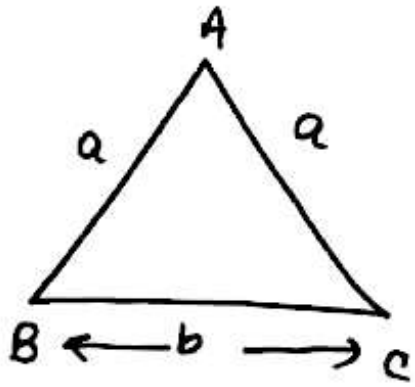
#7 Isosceles Triangle :→

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



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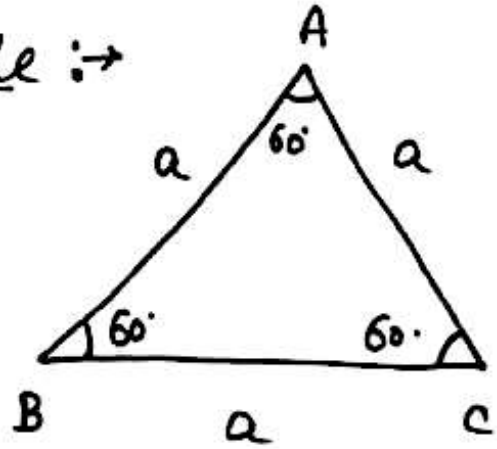
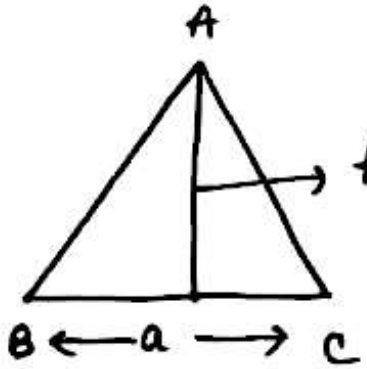
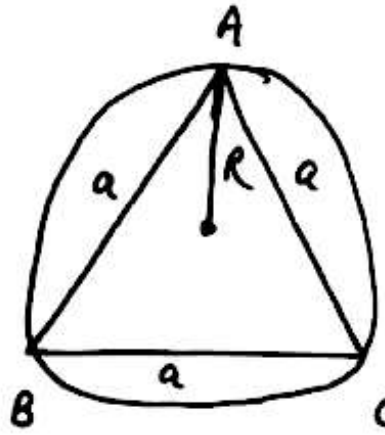
#8. Equilateral Triangle :→

$$\Delta = \frac{\sqrt{3}}{4} a^2$$



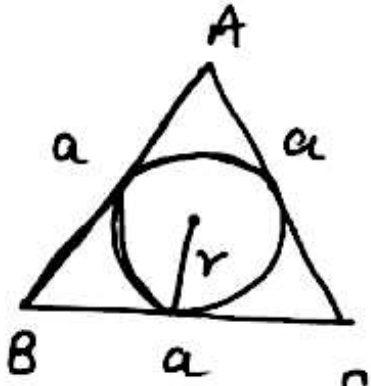


$$h = \frac{\sqrt{3}}{2} a$$



$$R = \frac{a}{\sqrt{3}}$$

Circum Radius



$$\boxed{r = \frac{a}{2\sqrt{3}}}$$

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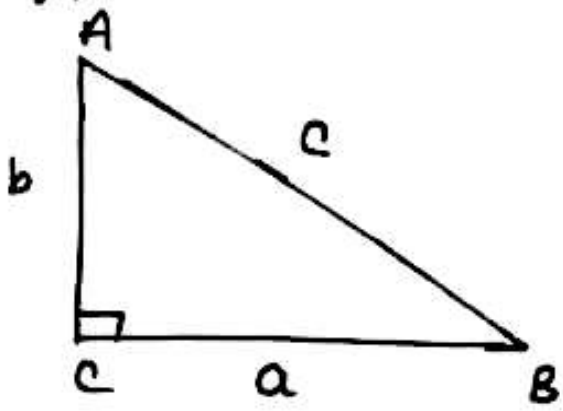
Right angle Triangle :→



→ sides of Right angled triangle is called triplet

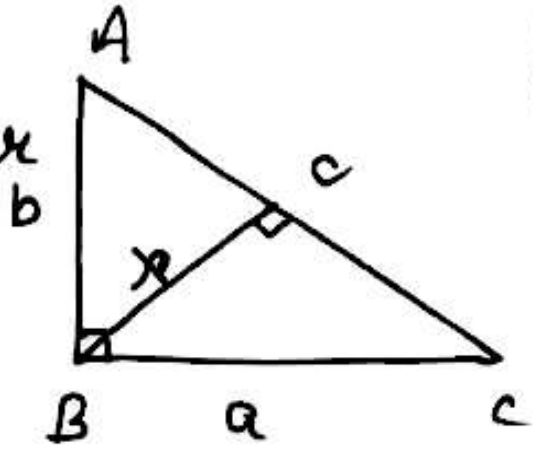
e.g. 3, 4, 5

$$\boxed{c^2 = a^2 + b^2}$$

→ 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

p → length of perpendicular from B to hypotenus.



$$\boxed{p = \frac{a \times b}{c}}$$

also

$$\boxed{\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}}$$

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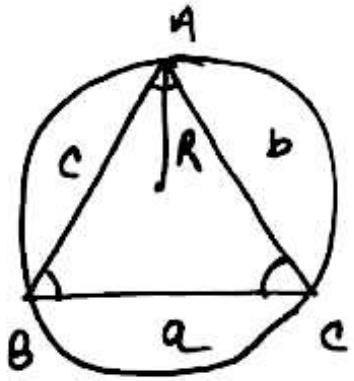
Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$$



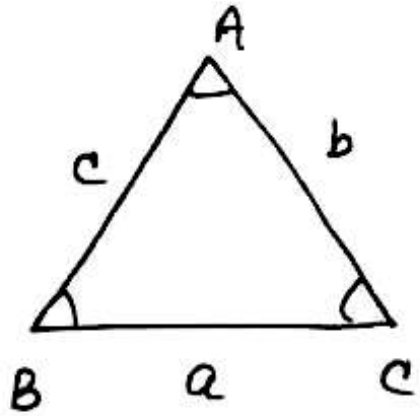
where R = Circum Radius.

Cosine Rule

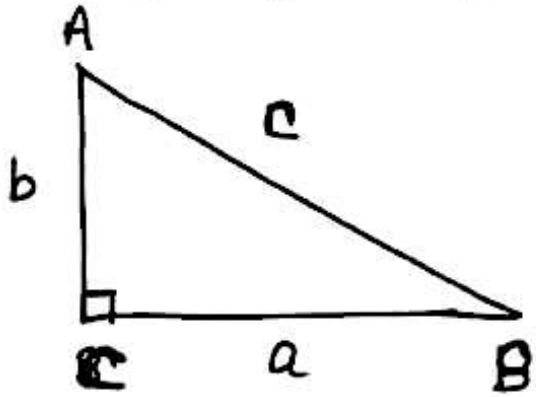
$$\cos A = \frac{b^2+c^2-a^2}{2bc}$$

$$\cos B = \frac{c^2+a^2-b^2}{2ac}$$

$$\cos C = \frac{a^2+b^2-c^2}{2ab}$$



Special Case :→ In Case of Right angled triangle



$\cos C = 0$ $\quad \because \cos 90^\circ = 0$

$C = 90^\circ$

$$\Rightarrow \quad 0 = \frac{a^2+b^2-c^2}{2ab}$$

$$\Rightarrow \quad \boxed{a^2+b^2=c^2}$$

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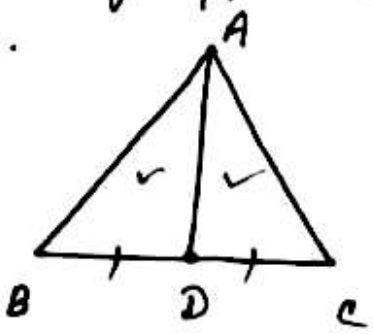
Centres OF A Triangle

median :→ the line joining the vertex to the mid point of opposite side is called median.



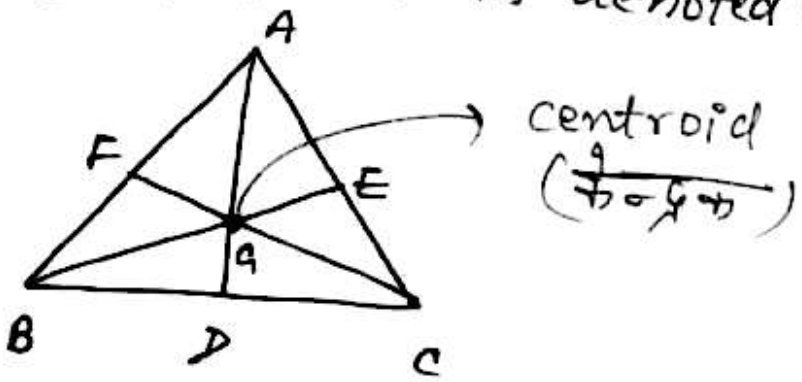
- AD is median

  ⇒ BD = DC

Note :→ A median divides Triangle in 2 equal areas. $\boxed{\Delta ABD = \Delta ADC}$

centroid (केन्द्रक)

the point of intersection of all the three medians of a triangle is called centroid (केन्द्रक). It is denoted by G.



Note :→ In the above figure there are 6 Δ's. The area of all the 6 Δ's are equal.

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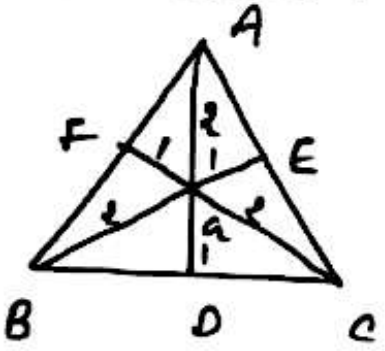
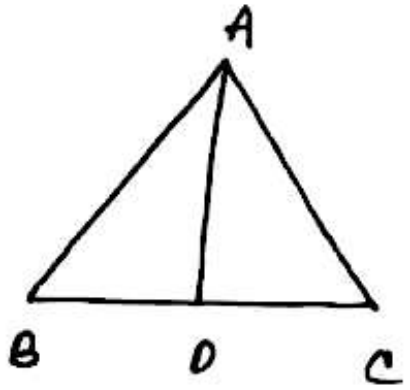
Centroid Divides the median in ratio 2:1.

$$\boxed{\frac{AG}{GD} = \frac{BG}{GE} = \frac{CG}{GF} = \frac{2}{1}}$$



e.g. → if $AD = 30$ ⇒ $AG = 20$, $GD = 10$

Apollonius Theorem:



AD is median

then.

$$AB^2 + AC^2 = 2(AD^2 + BD^2)$$

$$\text{OR } 2(AD^2 + DC^2)$$

$$\text{OR } 2(AD^2 + BD \cdot DC)$$

$$\text{OR } 2\left(AD^2 + \frac{BC^2}{4}\right)$$

$$\left[\because BD = DC = \frac{1}{2} BC\right]$$

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.

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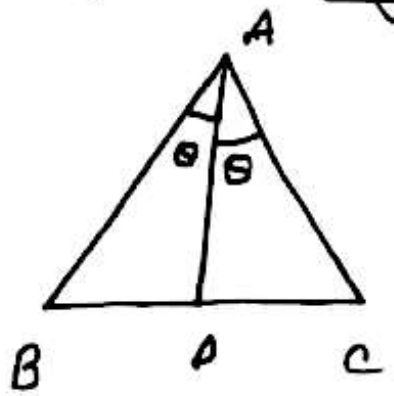
Angle bisector

A st. line that bisects an angle is called angle bisector of that angle

If AO is angle bisector then

$\angle BAO = \angle OAC = \theta$



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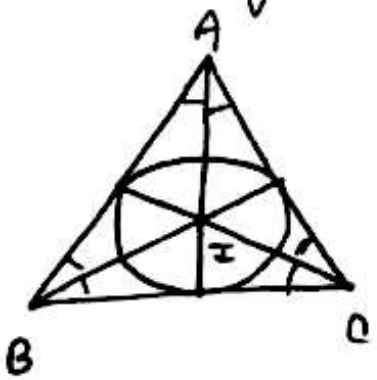
Incentre

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)

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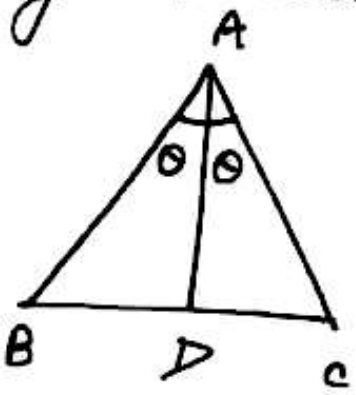
Angle bisector Theorem

It states that angle bisector of an angle of a triangle divides the opposite sides in the rati of remaining 2 sides.

if AD is angle bisector then



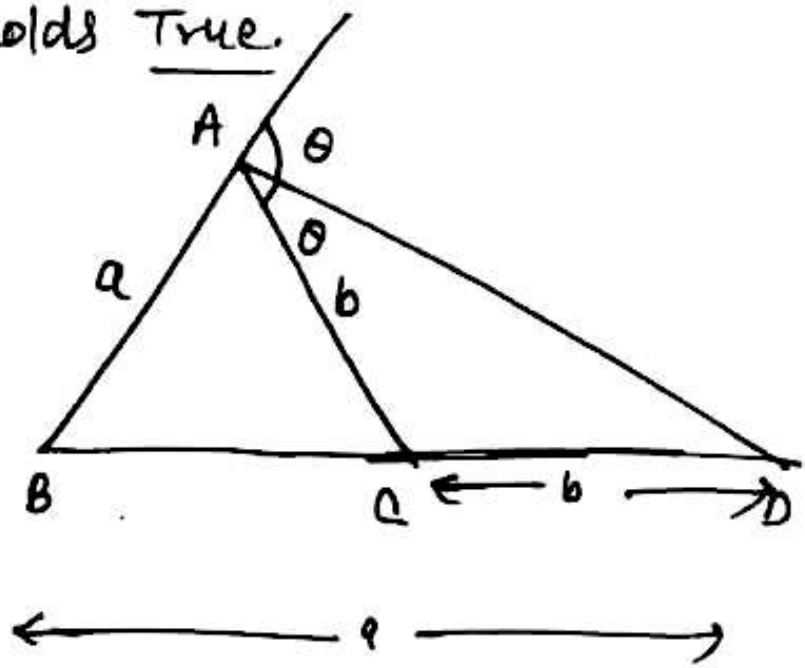
$$\boxed{\frac{BD}{DC} = \frac{AB}{AC}}$$

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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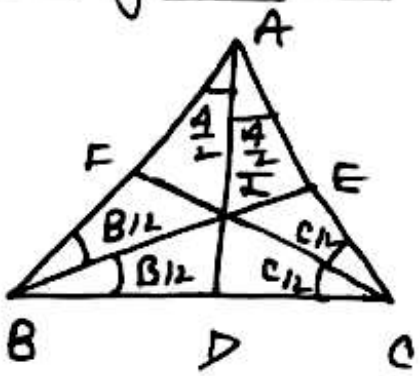
Relation of Angles in angle bisector



IN Δ 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 $\Delta = 180^\circ$]

$$\Rightarrow \angle BIC = 180^\circ - \frac{(180 - A)}{2} = 90 + \frac{\angle A}{2}$$

$$\boxed{\angle BIC = 90^\circ + \frac{\angle A}{2}}$$

Similarly $\angle BIA = 90^\circ + \frac{\angle C}{2}$

& $\angle AIC = 90^\circ + \frac{\angle B}{2}$

e.g. if $\angle A = 30^\circ$

$$\Rightarrow \angle BIC = 90^\circ + \frac{30}{2} = \underline{105^\circ}$$

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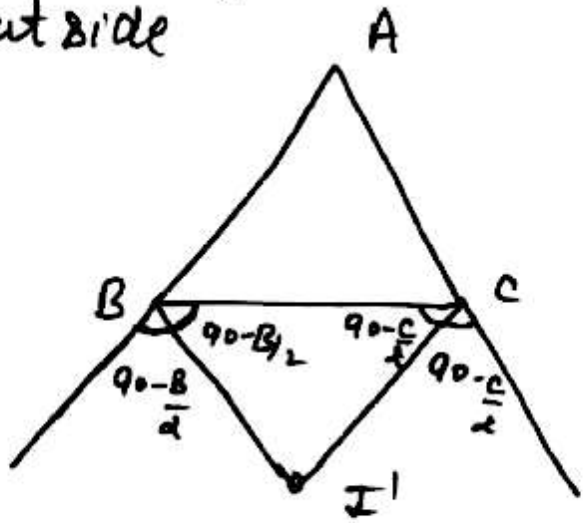
If exterior bisector of B and C meet at I outside

then.

IN $\triangle BI'C$



$$\angle BI'C + 90 - \frac{B}{2} + 90 - \frac{C}{2} = 180^\circ$$

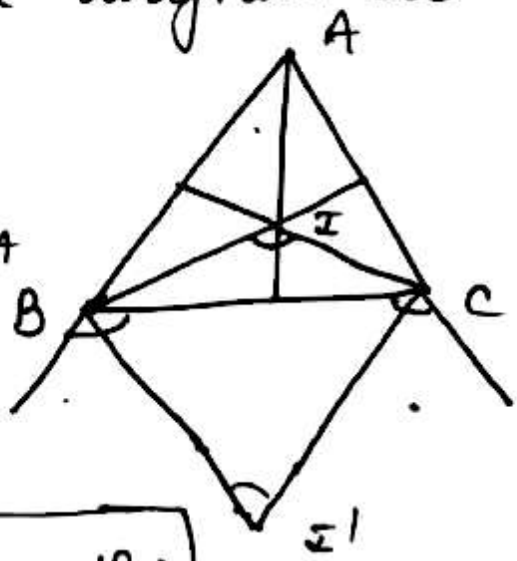
$$\angle BI'C = \frac{B+C}{2} = \frac{180^\circ - A}{2} = 90^\circ - \frac{A}{2}$$

$$\boxed{\angle BI'C = 90^\circ - \frac{\angle A}{2}}$$

Now see the diagram below

$$\angle BIC = 90 + \frac{\angle A}{2}$$

$$\& \ \angle BI'C = 90 - \frac{\angle A}{2}$$



$$\Rightarrow \boxed{\angle BIC + \angle BI'C = 180^\circ}$$

we can say that these are supplementary to each other

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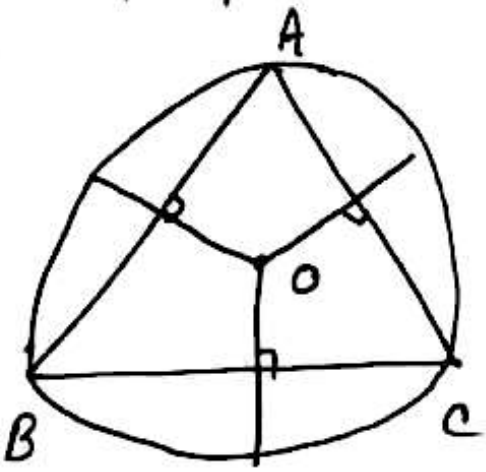
Perpendicular Bisector :

A line that is perpendicular to a side and bisects it is a perpendicular bisector of the side



Circum centre

the point at which the perpendicular bisectors of the sides meet is called circumcentre of the Δ.

→ 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

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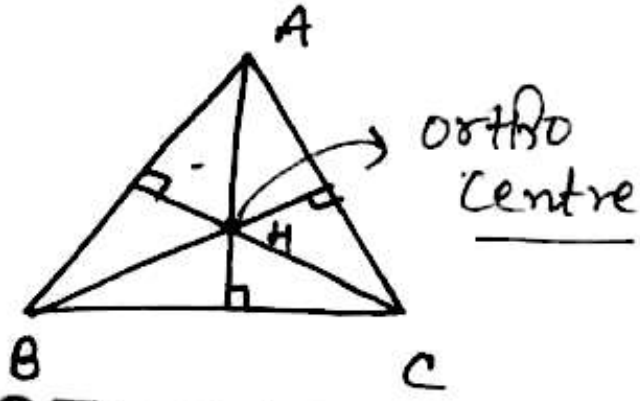
Altitude / Height

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

$$\angle A + \angle BHC = 180^\circ = \angle C + \angle AHB$$

$$= \angle B + \angle AHC$$

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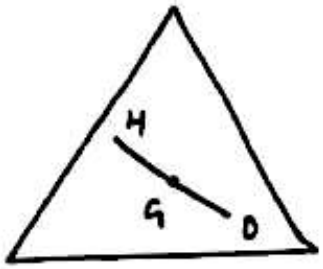
Relationship b/w centroid, orthocentre and circumcentre

1. Centroid, orthocentre and circumcentre of any triangle are collinear (falls 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 circum (O) centre

$$\boxed{GH = 2\,GO}$$



<u>Note</u> :→ Centroid (G) and Incentre (I) of a triangle always lies within (inside) the triangle whatever the type of <u>triangle</u>

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Position of Centres in diff. Triangles

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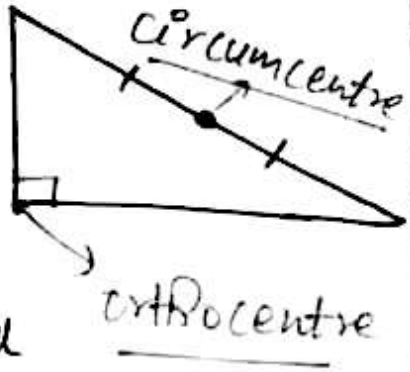
Equilateral Triangle

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 angle Triangle:

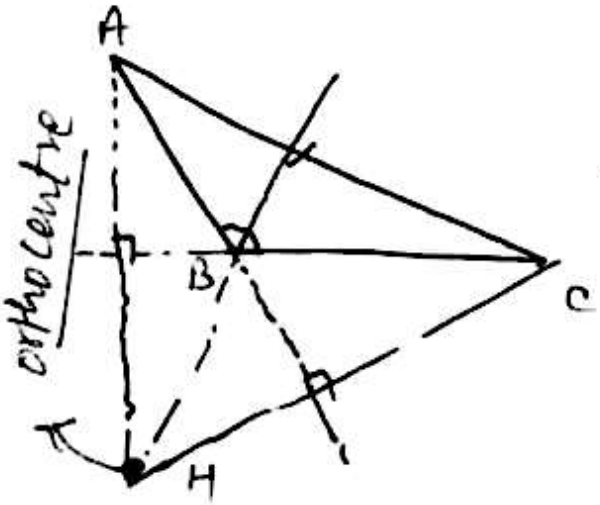


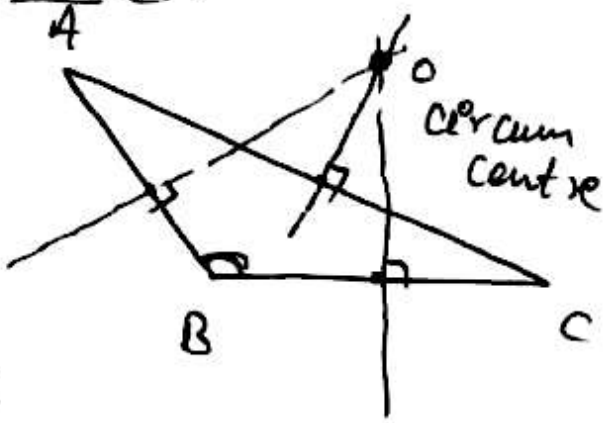
orthocentre at Right angle and circum centre at the mid point of hypoteneus.

Obtuse Angled Triangle

orthocentre lies outside and back of obtuse angle.

Circum centre also lies outside Δ but in front of obtuse angle.





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NOTES 4

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EXAMS

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SPECIAL EDITION

anant

ADVANCE MATHS for SSC

Algebra | Trigonometry | Geometry

SOLVE ADVANCE MATH IN JUST 30 DAYS

WITHOUT USE OF PEN PENCIL

by
(मैथ गुरु)
Sunil Kharub

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TIME AND WORK (काम और समय) ①

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WORK = TIME × EFFICIENCY

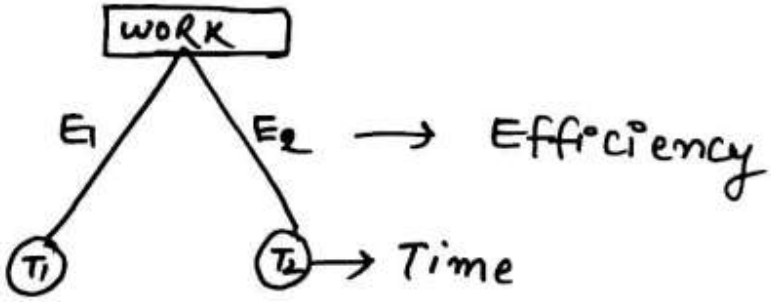
काम = समय × कार्य करने की क्षमता (दक्षता)

$$W = T \times E$$

Time may be in Days/Hours/minutes/seconds

Efficiency :→ (दक्षता) is Per Unit's Time WORK
(दक्षता किसी भी कार्य करने वाले की 1 दिन/घण्टा मिनट/सैकंड का काम होती है।)

Triangle method OR LCM METHOD



e.g. 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 → $\frac{1}{10}$

B का 1 दिन का काम → $\frac{1}{15}$

दोनों का 1 दिन का काम $= \frac{1}{10} + \frac{1}{15} = \frac{1}{6}$ → पूरा काम 6 दिन में

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OR by LCM METHOD

let WORK = LCM OF (10,15) Time = 30 Units

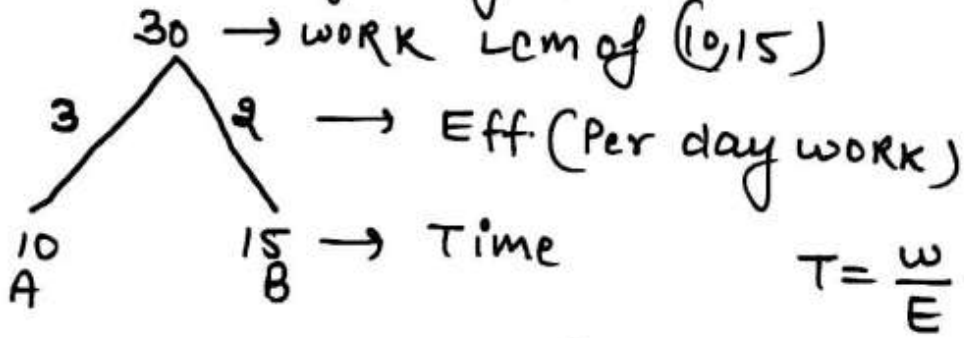
A's 1 day WORK = A's Eff. = $\frac{30}{10}$ = 3 unit Per day

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 $T = \frac{W}{E} = \frac{30}{5} = 6$ days

OR IN SHORT by Diagram

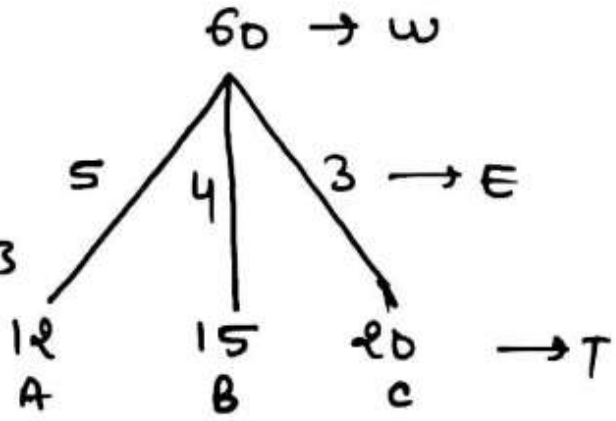


$T = \frac{W}{E}$

$\Rightarrow (A+B)_T = \frac{W}{(A+B)_E} = \frac{30}{5} = 6$

A, B, C तीनों अलग-2 एक काम को क्रमशः 12, 15, और 20 दिन में समाप्त कर सकते है। तीनों मिलकर इस काम को कितने दिनों में समाप्त करेंगे ?

Solution :→



$T_{A+B+C} = \frac{W}{E_{A+B+C}} = \frac{60}{5+4+3}$

$= \frac{60}{12} = 5$ दिन

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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?

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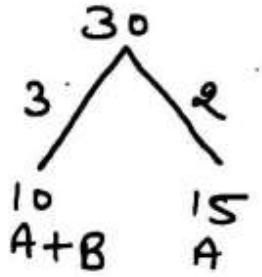
Solution

$E_B = E_{A+B} - E_A$

$= 3 - 2 = 1$



$T_B = \frac{W}{E_B} = \frac{30}{1} = 30$ दिन उत्तर

A और B मिलकर एक कार्य को 12 दिन में, B और C मिलकर उसी कार्य को 15 दिन में, C और A मिलकर उसी कार्य को 20 दिन में समाप्त करते हैं। तीनों मिलकर उसी कार्य को कितने दिन में समाप्त करेंगे। और A, B, C अलग-2 कितने दिनों में करेंगे

Solution

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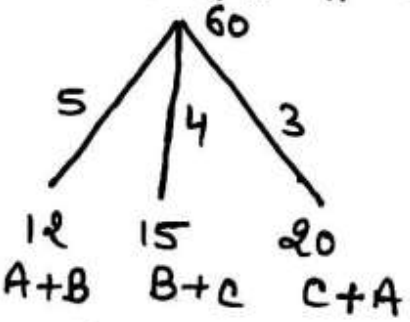
1 दिन का काम



$A+B+B+C+C+A = 12$

$2(A+B+C) = 12$

$\Rightarrow$ A+B+C का 1 दिन का काम $= (A+B+C)$'s Eff $= 6$

$T_{A+B+C} = \frac{W}{E_{A+B+C}} = \frac{60}{6} = 10$ दिन उत्तर

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$E(A+B+C) = 6$
but $E(A+B) = 5$
$\Rightarrow E_C = 1$
$T_C = \frac{60}{1} = 60$

$E(A+B+C) = 6$
but $E(B+C) = 4$
$\Rightarrow E_A = 2$
$T_A = \frac{60}{2} = 30$

$E(A+B+C) = 6$
but $E(A+C) = 3$
$\Rightarrow E_B = 3$
$T_B = \frac{60}{3} = 20$ दिन

उत्तर → 30, 20, 60

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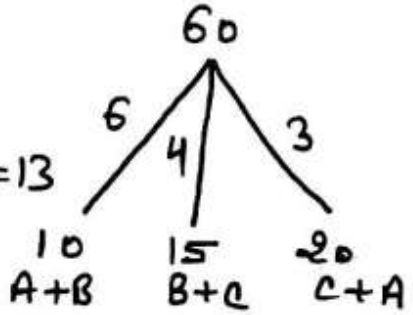
A और B दोनों मिलकर एक काम को 10 दिन में, B और C 15 दिन में, C और A 20 दिन में समाप्त कर सकते हैं। C अकेला उसी काम को कितने दिनों में पूरा करेगा?

Solution



$E(A+B+B+C+C+A) = 6+4+3 = 13$

$\Rightarrow E(A+B+C) = \frac{13}{2}$

but $E_{A+B} = 6 \Rightarrow E_C = E_{A+B+C} - E_{A+B} = \frac{13}{2} - 6 = \frac{1}{2}$

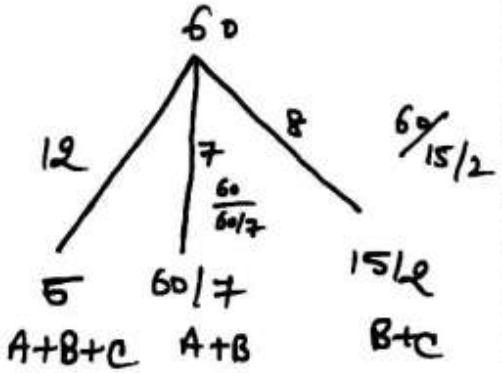
$T_C = \frac{60}{\frac{1}{2}} = 60 \times 2 =$ 120 दिन उत्तर

A, B और C तीनों मिलकर एक काम को 5 दिन में, A और दोनों मिलकर उसी काम को $8\frac{4}{7}$ दिन में, B और C उसी काम को $7\frac{1}{2}$ दिन में समाप्त कर सकते हैं। C अकेला इस कार्य को कितने दिन में करेगा?

Solution :→ $w = \text{LCM of } 5, \frac{60}{7} \text{ & } \frac{15}{2}$

$= \frac{\text{LCM of } (5, 60, 15)}{\text{HCF of } (1, 7, 2)}$

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



$E_{A+B+C} = 12$

$E_{A+B} = 7$

$\Rightarrow E_C = 5$ units

$T_C = \frac{w}{E_C} = \frac{60}{5} = 12$ दिन

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{ALTERNATE DAYS}

जेठा लाल और भिड़े एक काम को क्रमशः 12 और 9 दिन में अकेले-2 समाप्त कर सकते हैं। अगर वो बारी-2 (Alternate days) पे काम करे जैसे पहले दिन भिड़े दूसरे दिन जेठालाल और तीसरे दिन भीर भिड़े और भिड़े काम शुरू करें तो काम कितने दिन में समाप्त होगा?

Solution :-

36

3 — 12 J

4 — 9 B

7 काम 2 दिन का

⇒ 7×5 काम 2×5 दिन

⇒ 35 काम 10 दिन का

बच्चा काम 1

पहले दिन भिड़े 4 काम

दूसरे दिन Jetha 3 काम

अब 11 वें दिन Bride की बारी आएगी

तो भिड़े 1 काम को कर देगा $= \frac{1}{4}$ दिन

Total $= 10 + \frac{1}{4} = 10\frac{1}{4}$ दिन

A और B अलग-2 एक काम को क्रमशः 12 और 15 दिन में समाप्त कर सकते हैं। वो बारी-2 (Alternate days) पर काम करें और अगर A काम को शुरू करें तो काम कितने दिनों में पूरा हो जाएगा

Solution

60

5 — 12 (A)

4 — 15 (B)

9 काम 2 दिन

9×6 काम 2×6

54 काम 12 दिन

बच्चा → 60 − 54 = 6

इसमें से 5 काम A 1 दिन में

1 काम B $\frac{1}{4}$ दिन में कर देगा

$T = 12 + 1 + \frac{1}{4}$

$13\frac{1}{4}$

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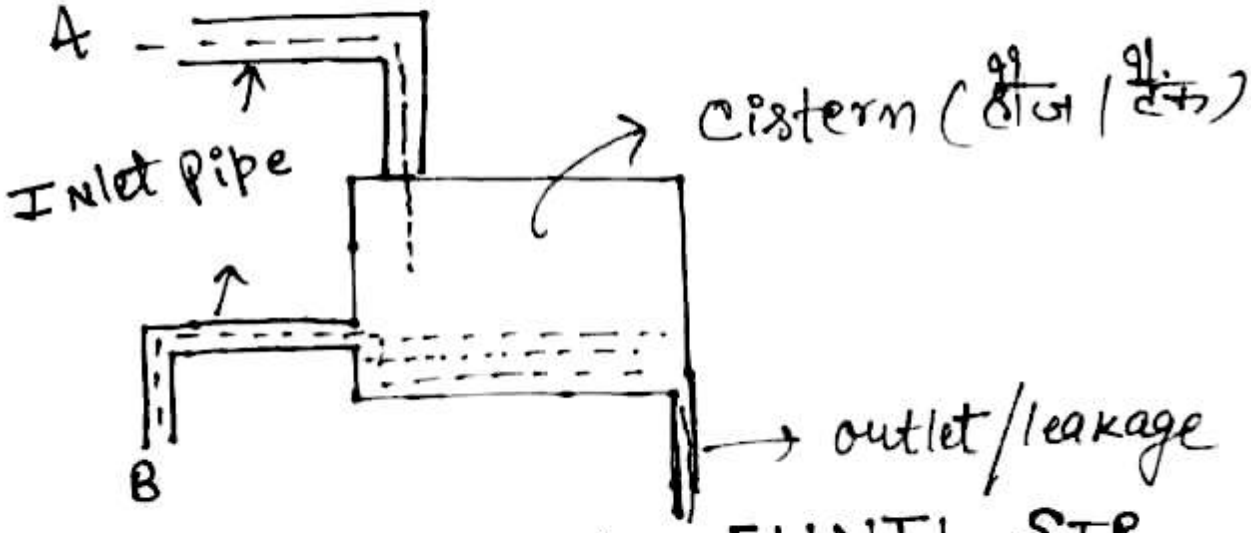
पाईप और टंकी

PIPES & CISTERNS

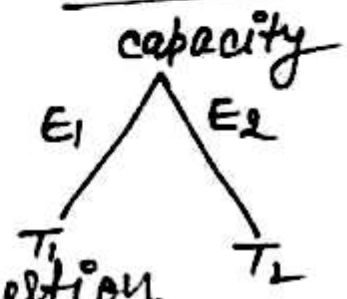
(नल और हौज)



by SUNIL SIR
97284-35915

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

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concept

Capacity of tank = Time × Efficiency → efficiency is the amt of water flowing through pipe in/out in one min/hour.

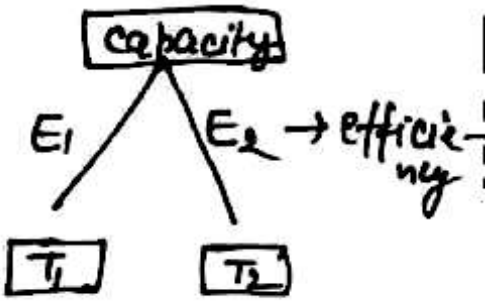
$\boxed{C = T \times E}$

Note :→ Always Assume capacity LCM of time to make question Easy.

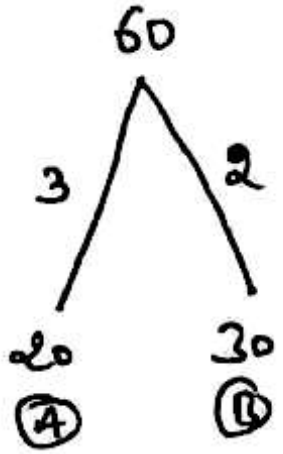
Two pipes A and B can fill a tank in 20 min and 30 min Respectively. If both pipes are opened together time taken to fill the tank is?

Solution

standard diagram



let assume capacity LCM of time (20,30) = 60 ltr



A+B can fill 5 ltr in 1 min (E_1+E_2)

A+B Can fill 60 ltr in

$$T = \frac{C}{E_1+E_2} = \frac{60}{5} = 12 \text{ min}$$

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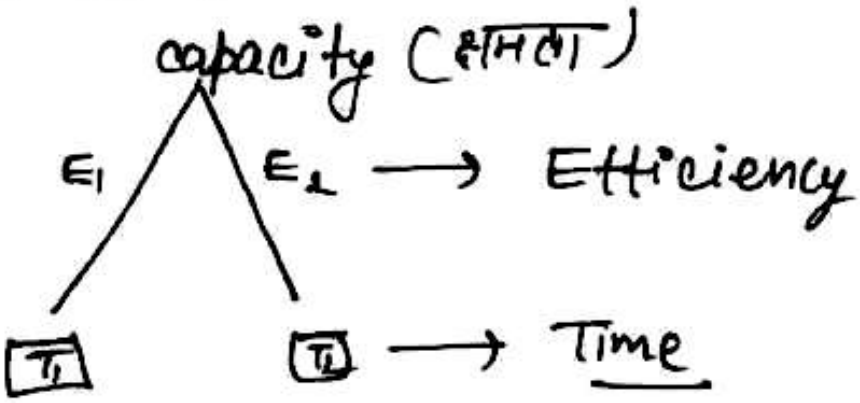
Capacity = Time × Efficiency

Efficiency → नल एक घंटा / मिनट / सेकंड में जितना पानी भरता है या निकालता है।

दो नल एक टंकी को क्रमशः 15 और 20 मिनट में भर सकते हैं। यदि दोनों नल एक साथ खोल दिए जाए तो टंकी को भरने में कितना समय लगेगा?

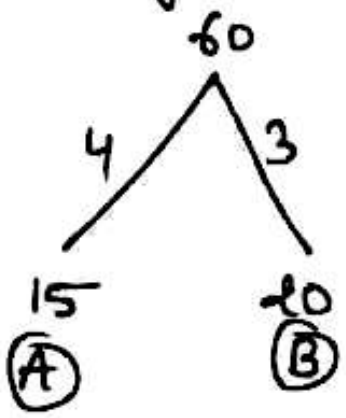
Solution :→ हमेशा समय का LCM ही tank की क्षमता मानें।

Concept



let capacity
LCM of 15 & 20 = 60

⇒



A+B 1 min में (E_1+E_2) भरते हैं = 7 ltr

60 ltr भरने में समय

$$T = \frac{C}{E_1+E_2} = \frac{60}{7} = 8\frac{4}{7}\text{ min}$$

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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 टंकी को 10 min. में भरता है। और B उसी टंकी को 15 min में खाली करता है। तो टंकी कितने मिनट में भरेगी?

Solution

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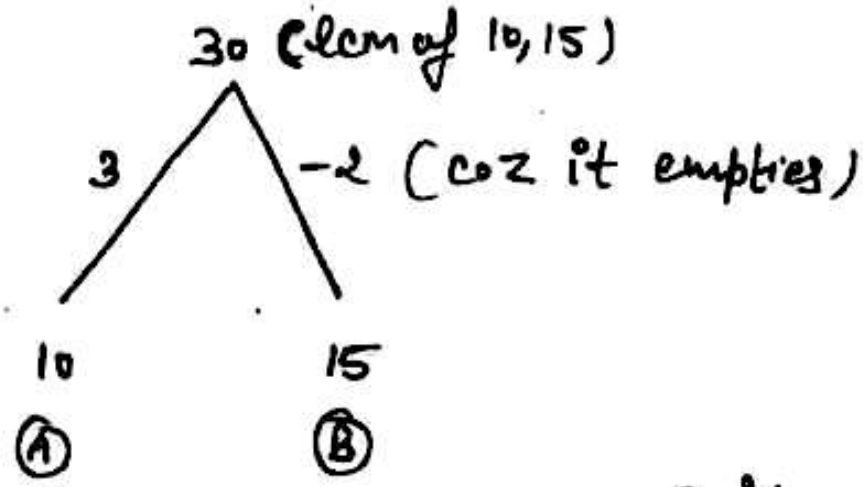

1 min. में टंकी 3-2 = 1 ltr भर रही है।

पूरी टंकी भरेगी

$$T = \frac{C}{E_1 - E_2} = \frac{30}{3-2} = \frac{30}{1} = 30 \text{ min.}$$

सुनील सर की TRICKY क्लास

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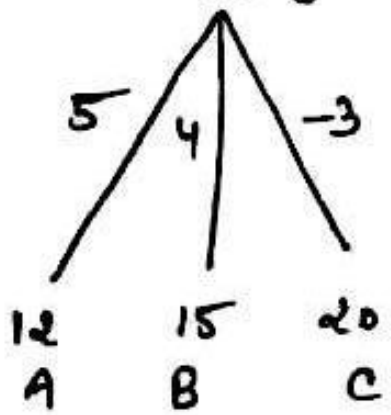
Pipe A and B can fill a tank in 12 min & 15 min. respectively, while 3rd pipe C can empty the tank in 20 min. IN what time tank will be filled if all the 3 pipes are opened together

दो नल A और B किसी हौज को क्रमशः 12 और 15 min. में भर सकते हैं। तिसरा नल भरी हुई टंकी को 20 min. में खाली कर सकता है। यदि तीनों नलों को एक साथ खोल दिया जाए तो हौज कितनी देर में भर जाएगा?

सुनील सर की क्लास

Solution

60 (lcm of 12, 15, 20)



A+B भरते हैं 5+4=9 1 min में

C खाली करता है −3

9−3=6 ltr भरेगी 1 min में

Time taken to fill full tank

$$T = \frac{C}{E_A + E_B - E_C} = \frac{60}{5+4-3} = \frac{60}{6} = 10 \text{ min}$$

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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 :→

300 [LCM of 60, 75, 50]

5 4 6

60 A, 75 B, 50 A+B+C

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(A+B+C)'s eff = 6

⇒ 5 + 4 + C = 6

⇒ C = −3 ltr/min

C can empty the tank in = $\frac{300}{3}$ = 100 min

दो नल A and B एक टंकी को क्रमशः 20 और 30 मिनट में भर सकते हैं। दोनों नलों को एक साथ खोल दिया जाता है। 8 मिनट बाद नल A को बन्द कर दिया जाता है। तो पूरी टंकी कितने समय में भरेगी?

Solution A+B 1 मिनट में भरते हैं = 5 ltr

60

3 2

20 A, 30 B

8 मिनट में 5×8 = 40 ltr

बाकी 60 − 40 = 20 सिर्फ B भरेगा

20 ltr को B भरेगा = $\frac{20}{2}$ = 10 मिनट

Total 8 + 10 = 18 मिनट

MATHS 4 SSC BANK

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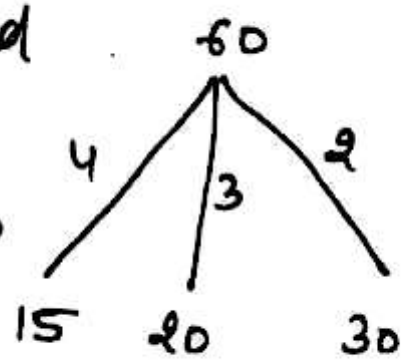
3 Pipes A, B & C can fill a tank in 15, 20 & 30 min. respectively. All 3 are opened together. After 4 min. pipe A is closed. after 4 min more pipe B is also closed. Rem. tank is filled by C alone. In How much time tank is filled

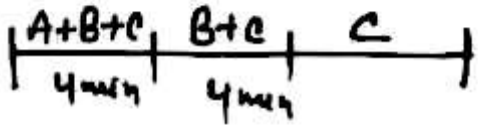


Solution

1 min A+B+C fills = 4+3+2 = 9

4 min ——— = 9×4 = 36

B+C in 4 min = 5×4 = 20



Total in 8 min = 56

Remaining 60 − 56 = 4 filled by C in $\frac{4}{2}$ = 2 min

Total 4+4+2 = 10 min

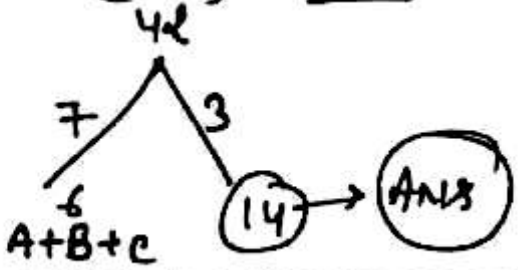
3 pipes A, B & C can fill a cistern in 6 Hrs after working at it together for 2 hours C is closed and A & B can fill the remaining part in 7. The time taken by C alone to fill the cistern?

Solution After 2 hrs of work of A+B+C 4 Hrs work Remaining but A+B takes 7 Hrs to comp

⇒ C's 4 hours = (A+B)'s 3 Hrs

C_E : A+B

3 : 4



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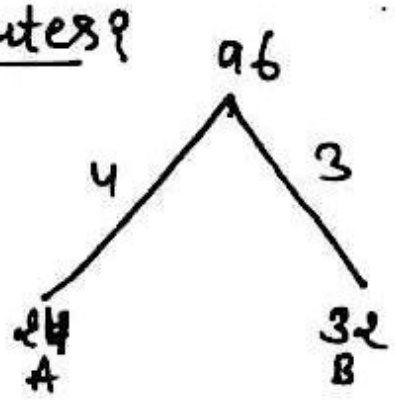
Two pipes A and B can fill a tank in 24 minutes and 32 min. respectively. If both the pipes are opened simultaneously after how much time B is closed so that tank is full in 18 minutes?



सुनील सर की Class HISAR

Solution

Pipe B is closed after some time & tank is filled in 18 min.

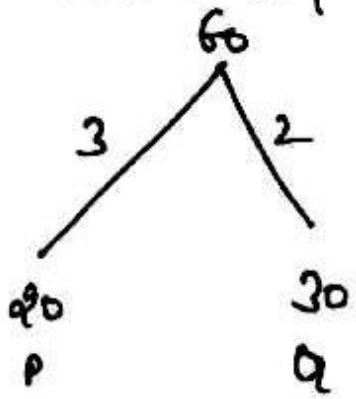
⇒ A has worked for 18 min

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



Sol

Q has worked for 18 min

$= 18 \times 2 = 36$

Rem $= 60 - 36 = 24$

This must be filled by P $= \frac{24}{3} = 8$ min

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सुनील सर की तलाश

EXTRA TIME QUESTION

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?

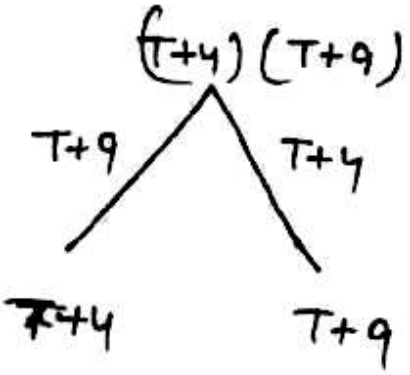
Solution let A+B takes T hrs to fill tank

$\Rightarrow$ A will takes T+4 hrs

B ———— T+9 hrs

Trick A+B will takes $\sqrt{4 \times 9} = \sqrt{36} = 6$ hrs

Basic Approach



A+B can fill

$$\frac{(T+4)(T+9)}{T+4+T+9} = T$$

$$\Rightarrow \frac{1}{T} = \frac{1}{T+4} + \frac{1}{T+9} = \frac{(T+4)+(T+9)}{(T+4)(T+9)}$$

$$\Rightarrow T = \sqrt{4 \times 9} = 6 \text{ Ans.}$$

MATHS BY SUNIL SIR

SSC BANK HISAR (HRY)

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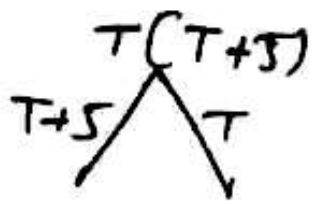
If 2 pipes function simultaneously the reservoir will be filled in 6 hours. One pipe fills the reservoir 5 hours faster than the other. How many hours the faster pipe take to fill the reservoir?

(a) 8 Hrs (b) 10 Hrs (c) 12 Hrs (d) CND

Solution

सुनील सर की तरीका



let the faster pipes take T hrs

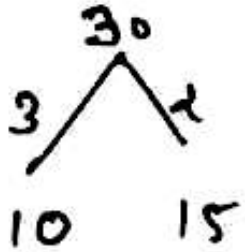
⇒ slower pipe will take T+5 Hr

both pipe fill tank in $= \frac{T(T+5)}{T+(T+5)} = 6$

$\Rightarrow T^2+5T = 12T+30 \Rightarrow T^2-7T-30=0$

$\boxed{T=10}$

OR By options 2nd option



$\frac{30}{5} = 6$

so B is Ans.

BANK SSC MATHS TRICKS

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Ques:- एक हौज को 2 पाइप अलग-2 क्रमशः 12 तथा 16 मिनट में भर सकते हैं। दोनों पाइपों को एक साथ खोला जाता है, कुछ कमी होने के कारण पहले पाइप से पूरी क्षमता का 7/8 भाग पानी बहता है तथा दूसरे पाइप से 5/6 भाग पानी बहता है। तथा कमी दूर करने के 3 मिनट बाद हौज भर जाता है तो ज्ञात कीजिए की कितने समय बाद कमी पूरी की गई।

⇒ 48 → A (12) : +4 → 3.5 ; B (16) : +3 → 2.5

$\frac{27}{6} = 4\frac{1}{2}$ मिनट | $3 \times 7 = 21$

$4 \times \frac{7}{8_2} = \frac{7}{2} = 3.5$

$3 \times \frac{5}{6_2} = 2.5$

Ques:- एक हौज को दो पाइप अलग-2 क्रमशः 15 तथा 25 मिनट में भर सकते हैं। दोनों पाइपों को एक साथ खोला जाता है किन्तु कुछ कमी होने के कारण पहला अपनी क्षमता का 5/6 भाग तथा दूसरा अपनी क्षमता का 5/8 भाग पानी बाहर निकालता है, कमी दूर होने के 5 मिनट बाद हौज भर जाता है। तो ज्ञात कीजिए कितने समय बाद कमी दूर की गई।

⇒ 75 → A (15) : +5 → $\frac{25}{6}$; B (25) : +3 → $\frac{15}{8}$

$\frac{25}{6} + \frac{15}{8} = \frac{145}{24}$

$8 \times 5 = 40$

$\frac{\cancel{145}^{7} \times 24}{\cancel{24}_{29}} = \frac{168}{29}$ मिनट

Ques:- दो नल A तथा B किसी टैंक को अलग-2 क्रमशः 30 तथा 36 मि. में भर सकते हैं। दोनों को एक साथ खोल दिया जाता है तथा कुछ समस्या के कारण वे अपनी क्षमता का क्रमशः 5 तथा 9/10 से टैंक को भरते हैं। कुछ समय बाद समस्या खत्म हो जाती है। तथा इसके $16\frac{1}{2}$ मिनट बाद टैंक भर जाता है तो बताओ समस्या

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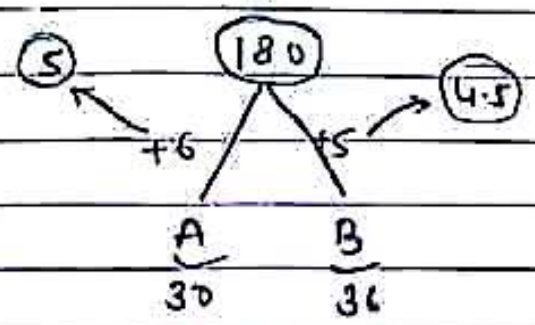
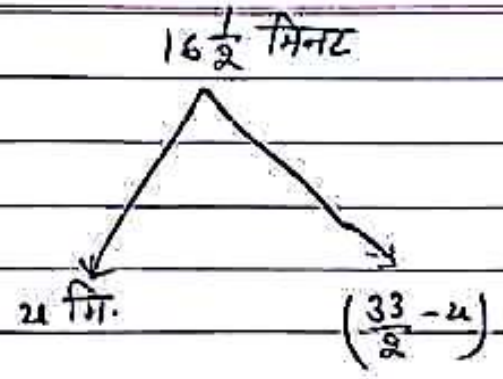
कितनी देर रही ?

⇒





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$$9.5x + 11\left(\frac{33}{2} - x\right) = 180$$

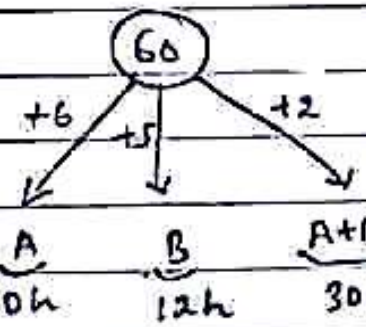
$$9.5x + 181.5 - 11x = 180$$

$$1.5x = 1.5$$

$$x = 1 \text{ मिनट}$$

Ques:- दो नल A तथा B किसी टैंक को अलग-2 क्रमशः 10 तथा 12 घन्टे में भर सकते हैं। टैंक में एक निकासी नल C है। यदि सभी नलों को एक साथ खोल दिया जाता है तो टैंक 30 मि. में भर जाता है। ज्ञात कीजिए अकेला C टैंक को कितने समय में खाली कर देगा।

⇒



$A + B - C = 2$

$6 + 5 - 9 = 2$

C का काम $= \frac{60}{9} = 6\frac{2}{3}$ h.

Ques:- दो नल A तथा B अलग-2 किसी हौज को क्रमशः 1 घन्टा तथा 75 मिनट में भर सकते हैं तथा C हौज को खाली करता है। यदि सभी नलों को एक साथ खोला जाए तो हौज 50 मिनट में भर जाता है तो बताऐ की C भरे हौज को कितनी देर में खाली कर देगा।

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⇒ 300 → +5 → A (60), +4 → B (75), +6 → A+B−C (50)

$A+B-C = 6$

$5+4-3 = 6$

$C \Rightarrow \frac{300}{3} = 100$ मि.

Ques:- दो पाइप एक हौज को अलग-2 क्रमशः 14 तथा 16 घन्टे में भर सकते हैं। दोनो पाइपों को एक साथ खोला जाता है तथा हौज के तल में एक छिद्र होने के कारण हौज भरने में 92 मि. अधिक लगे तो ज्ञात कीजिए कि छिद्र भरे हौज को कितने घन्टों में खाली कर देगा।

⇒ 112 → +8 → A (14), +7 → B (16)

$A+B = \frac{112 \times 60}{15} = 448$

$+92$

540 मि. / $\frac{540}{60} \Rightarrow 9h$

$A+B-C = \frac{112}{9}$

$-C = \frac{112}{9} - 15 \Rightarrow \frac{23}{9} \Rightarrow 2\frac{5}{9}h$

Ques:- दो पाइप एक साथ मिलकर किसी टैंक को क्रमशः 5 व 20 घन्टे में भर सकते हैं। किन्तु तीसरा पाइप खाली करता है जिसके बारे में ओपरेटर को ज्ञात ना होने के कारण टैंक को भरने में एक शून्य का अधिक समय लगा। तो तीसरा पाइप टैंक को कितनी देर में खाली कर देगा।

⇒ 20 → +4 → A (5h), +1 → B (20h)

$A+B = \frac{20}{5} \Rightarrow 4h$

$A+B-C$

$4+1-1 = 4$

$C \Rightarrow \frac{20}{1} = 20h$

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Ques:- एक हौज में दो नल लगे है जो उसे क्रमशः 30 व 20 घन्टे में भर सकते हैं। तीसरा नल हौज से प्रति मिनट 45 ली.

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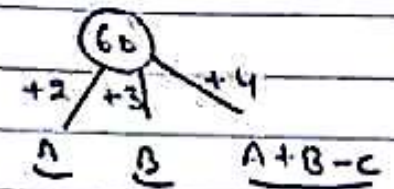
पानी बाहर निकालता है। यदि तीनो को एक साथ खोल दिया जाए तो पूरा हौज 15 घन्टे में भर जाएगा। उस हौज की क्षमता बताओ।

⇒



$2 + 3 - 1$

$A + B - C = 4$

$C \Rightarrow 1 = \frac{60}{1} = 60h$

क्षमता $= (60 \times 45) \times 60 = 162000$ ltr

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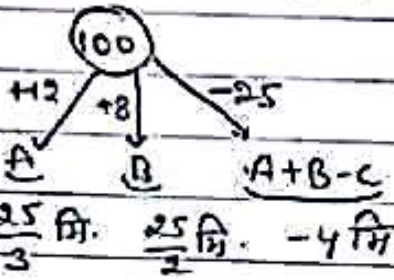
Ques:- दो नल एक हौज को क्रमशः 8 मिनट तथा $12\frac{1}{2}$ मिनट में भर सकते हैं। तीसरा नल एक घन्टे में 162 लीटर पानी बाहर निकालता है। जब हौज पूरी तरह भरी हुई होती है, तब तीनों एक साथ खोल दिए जाते हैं। तथा हौज 5 मिनट में खाली हो जाता है तो उस हौज की क्षमता बताओ।

⇒



$A + B - C$

$12 + 8 - 45 = 25$

$C \Rightarrow 45 = \frac{100}{45} = \frac{20}{9}$ मि.

Capacity $\Rightarrow 162 \times \frac{20}{9} = 360$ ltr.

Ques:- एक टैंक के तल में एक छिद्र उसे 6 मिनट में खाली कर सकता है। एक अन्य नल टैंक को 5 लीटर/मिनट की दर से भरता है। यदि दोनों नलों को एक साथ खोल दिया जाए, तो टैंक 8 घन्टे में खाली हो जाता है। टैंक की क्षमता बताओ।

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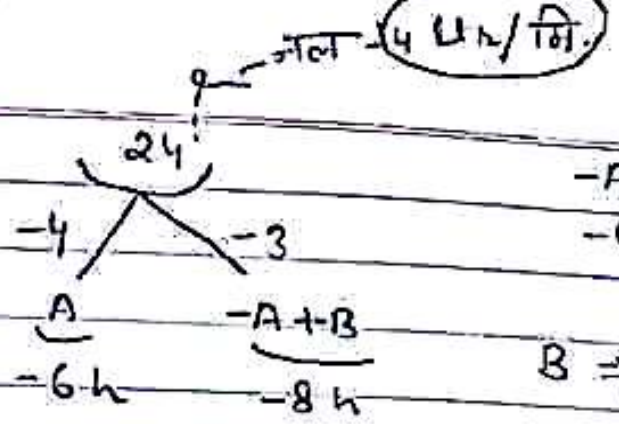
⇒ 

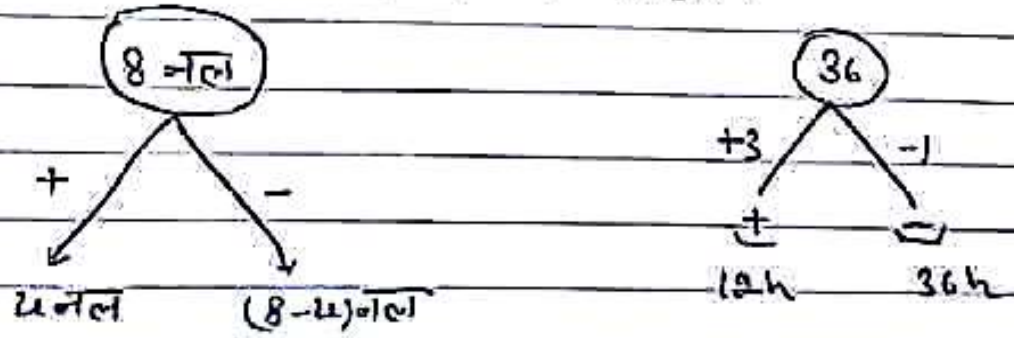
$-A + \frac{B}{1} = -3$

$-4 + \frac{B}{1} = -3$

$B \Rightarrow 1 = \frac{24}{1} = 24\,h$

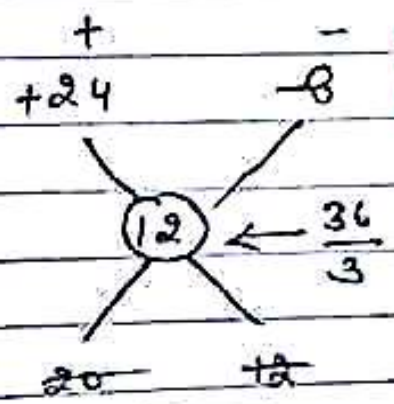
क्षमता = 4 Ltr × 60 × 24 = 5760 Ltr

Ques:- एक टैंक में 8 नल लगे हुए है, जिसमें से कुछ टैंक को भरते हैं तथा कुछ खाली करते है। प्रत्येक भरने वाला नल 12 घन्टे में भर सकता है तथा प्रत्येक खाली करने वाला नल 36 घन्टे में खाली कर सकता है। यदि टैंक 3 घन्टे में भर जाता है तो भरने वाले नलों की संख्या बताओ।

⇒ (I) 

$[3x - 1(8-x)] \times \cancel{3} = \cancel{36}\ 12$

$3x - 8 + x = 12 \Rightarrow 4x = 20 \Rightarrow x = 5$

(II) 

5 : 3

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Ques:- एक टैंक को भरने में तथा खाली करने वाले नलों की कुल संख्या 12 है। प्रत्येक भरने वाला नल 6 घन्टे में भर सकता है तथा प्रत्येक खाली करने वाला 12 घन्टे में खाली कर सकता है। यदि सभी को एक साथ खोल दिए जाए तो टैंक 4 घन्टे में भर जाती है। पानी भरने वाले नलों की संख्या बताओ।

⇒ +24 −12

(3) ← $\frac{12}{4}$

(12)

+2 −1

+ −

~~1~~ : ~~2~~

(5 : 7)

Ques:- एक टैंक में 8 पाइप लगे हुए हैं जिनमें से कुछ पानी भरते हैं तथा कुछ निकालते हैं। प्रत्येक भरने वाला 8 घन्टे में तथा खाली करने वाला 6 घन्टे में खाली कर सकता है। यदि सभी को एक साथ खोल दिया जाए तो टैंक खाली होने में 6 घन्टे लगते हैं। तो पानी भरने वाले नलों की संख्या बताओ।

⇒ (1) +24 −32

(−4) ← $\frac{24}{6}$

(24)

+3 −4

+ −

8h 6h

~~28~~ : ~~28~~

(1 : 1)

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(11) (8 नल)

x (8−x)

$3x - 32 + 4x = -4$

$7x = 28$

$x = 4$

$[3x - 4(8-x)] \times 6 = -24 - 4$

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NOTES 4

SSC & BANK

EXAMS

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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

$$\Rightarrow u = (X+Y) \text{ Km/hr} \quad \text{——} \quad (1)$$

Up stream Speed (धारा के प्रतिकूल/ऊर्ध्व प्रवाह)

Let speed of boat upstream is V Km/hr

$$\Rightarrow V = (X-Y) \text{ Km/hr} \quad \text{——} \quad (2) \quad (X>Y)$$

Solving (1) and (2), we get

$$X = \frac{u+v}{2} = \frac{\text{downstream speed} + \text{Upstream speed}}{2}$$

$$Y = \frac{u-v}{2} = \frac{\text{down stream speed} - \text{Up stream speed}}{2}$$

Note :→ Down stream speed is always greater than Up stream speed.

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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?

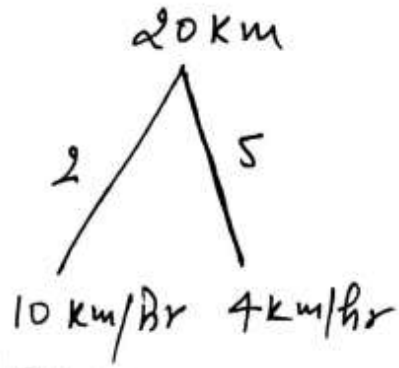
Solution :→ METHOD 1

Let distance is D km

$$\Rightarrow \frac{D}{\underbrace{7+3}_{u}} + \frac{D}{\underbrace{7-3}_{v}} = 14 \Rightarrow D = 40\,km$$

METHOD 2 → $u = 7+3 = 10$ km/hr

$v = 7-3 = 4$ km/hr



let $D = 20$ (LCM of 10 & 4)

If Time is 7 hr (5+2) Distance = 20 km

but time is 14 hr ⇒ $D = 2 \times 20 = 40$ km

METHOD 3 → $D = \dfrac{T(x^2 - y^2)}{2x}$ T → Total time

$T = 14$ hrs, $x = 7$ km/hr, $y = 3$ km/hr

$$\Rightarrow D = \frac{14(7^2 - 3^2)}{2 \times 7} = 40 \text{ km}$$ ANS.

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A boat takes thrice 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?

<u>Solution</u>

	down stream	:	UP stream
Time	1	:	3
⇒ Speed	3	:	1

(D = constant)

$u = 3 \quad v = 1 \Rightarrow x = \frac{3+1}{2} : Y = \frac{3-1}{2}$

$\downarrow$

Boat speed ← 2 : 1 → River speed

but $1 \rightarrow 4$ km/hr

$\Rightarrow 2 \rightarrow 4 \times 2 = 8$ Km/hr <u>ANS.</u>

<u>Note.</u> Average speed if distance is constant

$$\text{Avg speed} = \frac{2 \times u \times v}{u + v}$$

where $u \rightarrow$ down stream speed
$v \rightarrow$ up stream speed

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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

V → upstream speed → X − Y

U → down stream speed → X + Y

So $\frac{40}{V} + \frac{55}{U} = 13 \} \times 3 \rightarrow \frac{120}{V} + \frac{165}{U} = 39 \rightarrow (1)$

$\frac{44}{U} + \frac{30}{V} = 10 \} \times 4 \rightarrow \frac{120}{V} + \frac{176}{U} = 40 \rightarrow (2)$

I − II, we get $-\frac{11}{U} = -1 \Rightarrow U = 11$

Putting either in I or (2) value of $U = 11$

$\Rightarrow V = 5$ km/hr

∴ speed of boat in still water $X = \frac{U+V}{2} = \frac{11+5}{2} = 8$ km/hr

speed of River $Y = \frac{U-V}{2} = \frac{11-5}{2} = 3$ km/hr

METHOD 2 Hit and TRIAL (Think value of U & V that satisfies both equation) but $U > V$

$\frac{40}{V} + \frac{55}{U} = 13 \rightarrow (1)$

$\frac{30}{V} + \frac{44}{U} = 10 \rightarrow (2)$

let $U = 11$ (HCF of 55 & 44)

to make 13 V must be 5 $\Rightarrow X = \frac{11+5}{2} = 8$

$Y = \frac{11-5}{2} = 3$

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METHOD 3 :→

UP STREAM	DOWN stream	Time
30	44	10
40	55	13

down stream speed $u = \dfrac{|30\times55 - 44\times40|}{|30\times13 - 40\times10|} = \dfrac{110}{10} = 11$

UP stream speed $v = \dfrac{|30\times55 - 44\times40|}{|55\times10 - 44\times13|} = \dfrac{110}{22} = 5$

$\Rightarrow x = \dfrac{u+v}{2} = \dfrac{11+5}{2} = 8$, $y = \dfrac{11-5}{2} = 3$

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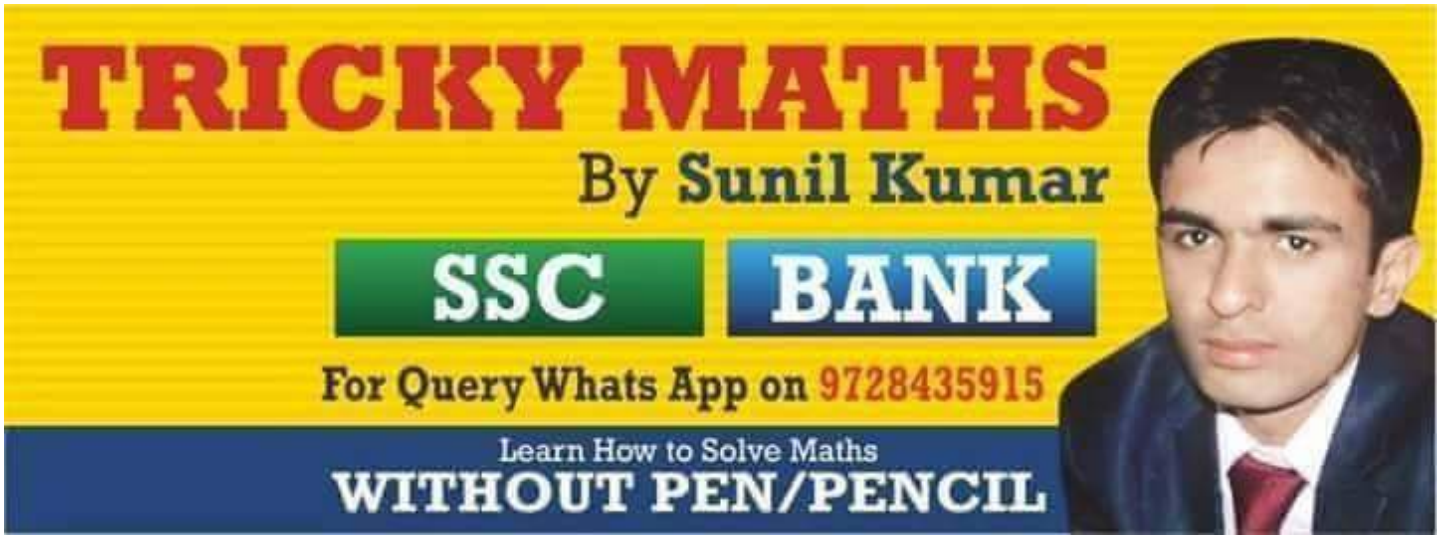

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Ans. 2

Step-1

Downstream Distance ~~Km~~ Upstream Distance

55 40

44 30

$x = |55\times30 - 44\times40| = 10\times11(5\times3 - 4\times4)$

$= |10\times11\times-1| = 110$

Step-2

Downstream Distance time Upstream Distance

55 13 40

44 10 30

$|55\times10 - 44\times13|$ & $|13\times30 - 10\times40|$

$= |11(5\times10 - 4\times13)|$ $= 10$

$= 22$

Now, $a = \frac{x}{10}$, $b = \frac{x}{22}$

$\cancel{a = \frac{110}{22} = 5}$, $b = \frac{110}{22} = 5$

$a = \frac{110}{10} = 11$

So, speed of man in still water $= \frac{1}{2}(a+b) = 8$ kmph

Speed of current $= \frac{1}{2}(a-b) = \frac{1}{2}(11-5) = 3$ 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. $a^2+b^2+c^2 = 0 \Rightarrow a = 0, b = 0 \ \& \ c = 0$

   e.g. If $(a-3)^3 + (b-2)^2 + (c-4)^2 = 0$

   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 :- $a^2 + b^2 + c^2 + 3 = 2a + 2b - 2c$

   $\Rightarrow a^2+b^2+c^2 - 2a - 2b + 2c + 3 = 0$
   $\Rightarrow a^2 - 2a + 1 + b^2 - 2b + 1 + c^2 + 2c + 1 = 0$
   $\Rightarrow (a-1)^2 + (b-1)^2 + (c+1)^2 = 0$
   $a = 1, b = 1, c = -1$
   $a+b+c = 1+1-1 = 1$

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

  $x^{99} + \frac{1}{x^{100}} = (1)^{99} + \frac{1}{(1)^{100}} = 2$

  & $x^{99} - \frac{1}{(1)^{100}} = (1)^{99} - \frac{1}{(1)^{100}}$ 1 - 1 = 0

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- Special use in trigonometry
  if $\sin\theta + \operatorname{cosec}\theta = 2$, then $\sin^n\theta + \operatorname{cosece}^n\theta = 2$

  if $\cos\theta + \sec\theta = 2$, then $\operatorname{con}^n\theta + \operatorname{secn}^n\theta = 2$
  if $\tan\theta + \cot\theta = 2$, then $\tan^n\theta + \cot^n = 2$
- 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 $x - \frac{1}{x} = 5 \Rightarrow x^3 - \frac{1}{x^3} = 125 + 3 \times 5 = 140$
- $x + \frac{1}{x} = 3$ $\qquad$ $x - \frac{1}{x} = 3$

  $x^2 + \frac{1}{x^2} = 9 - 2 = 7$ $\qquad$ $x^2 + \frac{1}{x^2} = 9 + 2 = 11$

  $x^4 + \frac{1}{x^4} = 49 - 2 = 47$ $\qquad$ $x^4 + \frac{1}{x^4} = 11^2 - 2 = 119$

  $x^8 + \frac{1}{x^8} = 2209 - 2 = 2207$

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Q. If $x+\frac{1}{x}=3$ find $\left[x^2-\frac{1}{x^2}\right]$

Solution :- $x+\frac{1}{x}=3 \rightarrow x^2+\frac{1}{x^2}=7$

and $x-\frac{1}{x}=\sqrt{x^2+\frac{1}{x^2}-2}=\sqrt{7-2}=\sqrt{5}$

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 $x+\frac{1}{x}$

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 $x^5+\frac{1}{x^5}= ?$

Solution - $x+\frac{1}{x} = 3 \Rightarrow x^2+\frac{1}{x^2}= 7 \Rightarrow x^4+\frac{1}{x^4}= 49 - 2 = 47$

$\left[x^4+\frac{1}{x^4}\right]\left[x+\frac{1}{x}\right]= 47 \times 3 = 141$

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$x^5 + x^3 + \frac{1}{x^3} + \frac{1}{x^5} = 141$

$x^5 + \frac{1}{x^5} = 141 - \left(x^3 + \frac{1}{x^3}\right) = 141 - 18 = 123$

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 :- $x + \frac{1}{x} = 1 \Rightarrow x^3 = -1$

  $x^{54} + x^{48} + x^{12} + x^6$

  $= (x^3)^{18} + (x^3)^{16} + (x^3)^4 + (x^3)^2$

  $= (-1)^{18} + (-1)^{16} + (-1)^4 + (-1)^2$

  $= 1 + 1 + 1 + 1 = 4$

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- $x + \frac{1}{x} = -1 \quad \Rightarrow x^3 = +1$

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 $x + \frac{1}{x} = \sqrt{3}$, Find $x^{18} + x^{12} + x^6 + 1$

Solution- $x + \frac{1}{x} = \sqrt{3} \Rightarrow x^6 + 1 = 0$

$x^{18} + x^{12} + x^6 + 1$

$= x^{12}(x^6+1) + (x^6 + 1)$

$= x12 \times 0 + 0 = 0 \qquad [\because x^6+1 = 0]$

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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 = $\sqrt{3}$ $\Rightarrow$ $a^2 + b^2 = 4 + 3 = 7$

  Solution: - $\sqrt{7+4\sqrt{3}} = \sqrt{\left(2+\sqrt{3}\right)^2} = 2+\sqrt{3}$

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 $\sqrt{1+x}+\sqrt{1-x}$

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

$$= \sqrt{\frac{4+2\sqrt{3}}{4}} = \frac{1}{2}\left(\sqrt{3}+1\right) = \frac{\sqrt{3}+1}{2}$$

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 $a^3 + b^3 + c^3 - 3abc$ = ?

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

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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

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

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, and c = 2

$a^3 + b^3 + c^3 - 3abc = \frac{1}{2}(a+b+c)[(a-b)^2 + (b-c)^2 + (c-a)^2]$

$= \frac{1}{2} \times 9[1 + 1 + 4] = 27$

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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

$= 16^4-16^4-16^3-16^3-16^2-16^2-16+14 = -2$

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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) $x+\frac{1}{x}=\sqrt{3}$ = $x^6+1=0$

$x^{72}+x^{66}+x^{54}+x^{36}+x^{24}+x^{6}+1$

$[x^6]^{12}+[x^6]^{11}+[x^6]^9+[x^6]^6+[x^6]^4+x^6+1$

$=[-1]^{12}+[-1]^{11}+[-1]^9+[-1]^6+[-1]^4+0$

$=1-1-1+1+1=1$

(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 $x=\left(a+\sqrt{a^2+b^3}\right)^{\frac{1}{3}}+\left(a-\sqrt{a^2+b^3}\right)^{\frac{1}{3}}$ then find the value of $x^3+3bx-2a$

(a) $2a^3$ (b) $-2a^3$ (c) 0 (d) 1

Solution:- $x=\left(a+\sqrt{a^2+b^3}\right)^{\frac{1}{3}}+\left(a-\sqrt{a^2+b^3}\right)^{\frac{1}{3}}$

cubing both sides, we get

$x^3=\left(a+\sqrt{a^2+b^3}\right)+\left(a-\sqrt{a^2+b^3}\right)$

$+3\left(a+\sqrt{a^2+b^3}\right)^{\frac{1}{3}}\left(a-\sqrt{a^2+b^3}\right)^{\frac{1}{3}}(x)$

$\Rightarrow x^3=2a+3[a^2-(a^2+b^3)]^{1/3}[x]$

$=2a+3[-b^3]^{1/3}x$

$=2a-3bx$

$\Rightarrow x^3+3bx-2a=0$

Q. If $x=2+2^{\frac{1}{3}}+2^{\frac{2}{3}}$, then value of x^3-6x^2+6x+1 is

(a) 3 (b) 2 (c) 1 (d) 0

Solution:- $x=2+2^{\frac{1}{3}}+2^{\frac{2}{3}} \Rightarrow x-2=2^{\frac{1}{3}}+2^{\frac{2}{3}}$

cubing both sides, be get

$x^3-8-3.2x[x-2]=2+2^2+3\times 2^{1/3}\times 2^{2/3}(x-2)$

$\Rightarrow x^3-8-6x^2+12x=2+4+6(x-2)$

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$\Rightarrow x^3 - 6x^2 + 6x = 2$

$\Rightarrow x^3 - 6x^2 + 6x + 1 = 2+1 = 3$

Q. If $a = 3+2\sqrt{2}$, then find the value of $\frac{a^6+a^4+a^2+1}{a^3}$

Solution:- $a = 3 + 2\sqrt{2} \Rightarrow \frac{1}{a} = 3 - 2\sqrt{2}$

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

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:- $2\left[x^2 - \frac{1}{x^2}\right] = 2\left[x - \frac{1}{x}\right]\left[x + \frac{1}{x}\right]$

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$\left[x+\frac{1}{x}\right]^2=\left[x-\frac{1}{x}\right]^2+4 = 2\ 5+4 = 29$

$\Rightarrow\ x+\frac{1}{x} = \sqrt{29}$

$2\left[x^2-\frac{1}{x^2}\right]= 2 \times 5 \times \sqrt{29} = 10\sqrt{29}$

Q. If x = $3+2\sqrt{2}$,then find the value of $x^3+\frac{1}{x^3}$

Solution:- x = $3+2\sqrt{2}\ \Rightarrow\ \frac{1}{x}= 3-2\sqrt{2}$

x + $\frac{1}{x}$ = 6

$\therefore x^3+\frac{1}{x^3} = \left[x+\frac{1}{x}\right]^3 - 3\left[x+\frac{1}{x}\right]$

= 216 - 3 [6] = 198

Q. If $\frac{a}{b}+\frac{b}{a}$=1, then find the value of a^3+b^3

Solution:- $\frac{a}{b}+\frac{b}{a}= 1 \Rightarrow a^2+b^2 = ab$

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

$= (a+b)(ab-ab) = 0$

Q. If p = 101, then find the value of $\sqrt[3]{p^3-3p^2+3p-1}$

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

Q. If $\frac{a}{1-a}+\frac{b}{1-b}+\frac{c}{1-c}$ = 1, then find the value of $\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}$

Solution:- $\frac{a}{1-a}+\frac{b}{1-b}+\frac{c}{1-c} = 1$

$\frac{a}{1-a}+1+\frac{b}{1-b}+1+\frac{1}{1-c}+1= 1+3 = 4$

$\frac{a+1-a}{1-a}+\frac{b+1-b}{1-b}+\frac{c+1-c}{1-c}= 4$

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$$\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}=4$$

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) $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{bc+ac+ab}{abc}$

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

$\Rightarrow (101^2 = 38 +2(ab+bc+ca)$

$\Rightarrow ab +bc +ca = 31 \Rightarrow \frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{31}{30}$

(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 = $2\sqrt{3}$ b = 1

$a^2 + b^2 = 12 + 1 = 13$

$$\sqrt{13+2\sqrt{3}}=\sqrt{\left(2\sqrt{3}+1\right)^2}=2\sqrt{3}+1$$

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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 = $5\sqrt{3}$

$a^2 + b^2 = 75 + 1 = 76$

$\Rightarrow \frac{1}{\sqrt{2}} \sqrt{76+10\sqrt{3}} = \frac{1}{\sqrt{2}}\left(5\sqrt{3}+1\right)$ 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

$\frac{x+\sqrt{8}}{x-\sqrt{8}} = \frac{\sqrt{12}+\sqrt{2}+\sqrt{3}}{\sqrt{12}-\sqrt{2}-\sqrt{3}} = \frac{3\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$ - i

Simillary $\frac{x}{\sqrt{12}} = \frac{\sqrt{8}}{\sqrt{2}+\sqrt{3}}$

Applying C & D, we get

$\frac{x+\sqrt{12}}{x-\sqrt{12}} = \frac{\sqrt{8}+\left(\sqrt{2}+\sqrt{3}\right)}{\sqrt{8}-\left(\sqrt{2}+\sqrt{3}\right)} = \frac{3\sqrt{2}+\sqrt{3}}{\sqrt{2}-\sqrt{3}}$ - ii

Adding (i) of (ii), we get

$\frac{x+\sqrt{8}}{x-\sqrt{8}} + \frac{x+\sqrt{12}}{x-12} = \frac{3\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} + \frac{3\sqrt{2}+\sqrt{3}}{\sqrt{2}-3} = 2$

In these type of Qu. Ans. is always 2

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- $\sqrt{a \pm \sqrt{a \pm \sqrt{a \pm}}} \ldots\ldots \infty = \frac{\sqrt{4a+1} \pm 1}{2}$ [This tricx applies to all]

e.g. $\sqrt{12 - \sqrt{12 - \sqrt{12 -}}} \ldots\ldots\ldots \infty$ [a= 2]

$= \frac{\sqrt{12 \times 4 + 1} - 1}{2} = 3$

e.g. $\sqrt{19 + \sqrt{19 + \sqrt{19 +}}} \ldots\ldots\ldots\infty$ [a=19]

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

e.g. $\sqrt{72 + \sqrt{72 +}} \ldots\ldots\ldots\infty$ [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

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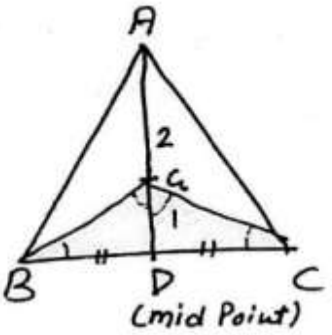
Q.:- यदि G एक ΔABC का ऐसा केंद्रक हो, जिसमें $AG = BC$ हो, तो $\angle BGC$ का मान कितना होगा?

Solⁿ:- (1) 60° (2) 90° (3) 120° (4) 135°



$AG = 2DG$

and $AG = BC$

so, $GD = \frac{1}{2}BC$

so, $[GD = BD = CD]$

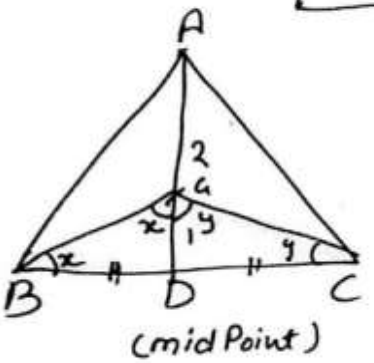
so ΔBGD & ΔDGC [Isosceles Δ]

so, $\angle BGC = \angle BGD + \angle DGC = \angle DBG + \angle DCG$

so, $\cancel{2}\angle BGC = \cancel{180}^{90^\circ}$ (Δ property)

$\boxed{\angle BGC = 90^\circ}$

OR



$AG = 2GD = BC$

$\therefore GD = BD = CD$

ΔBGD & $\Delta DGC \rightarrow$ Isosceles Δ

apply isosceles Δ property.

take $\Delta BGC \Rightarrow$

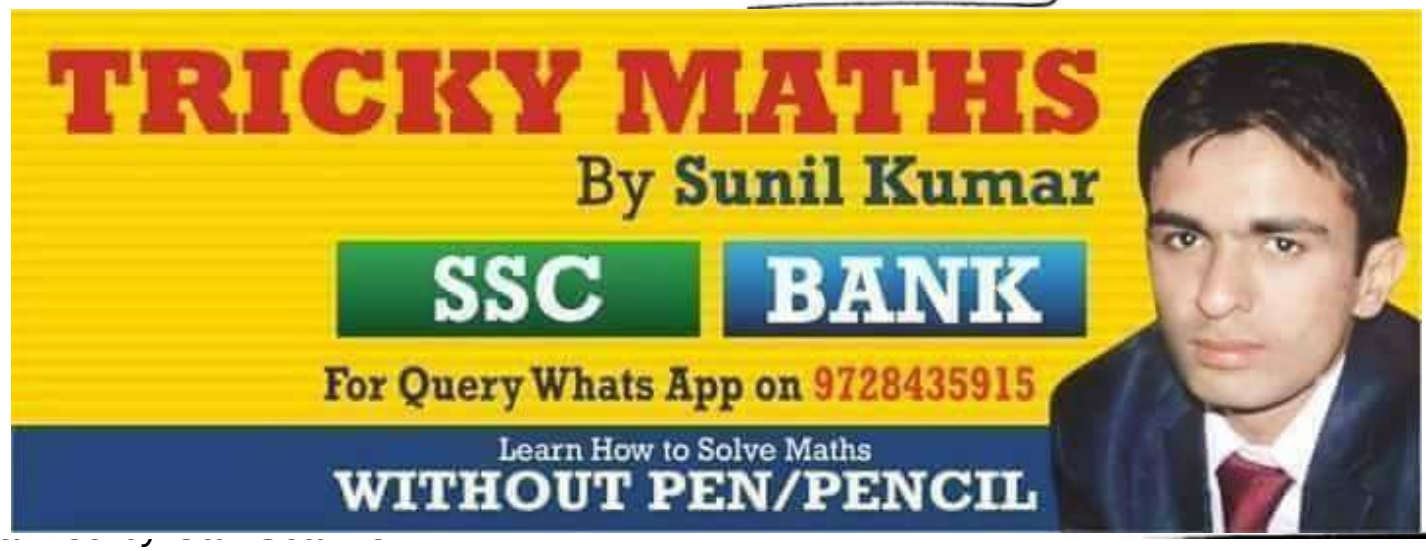
$x + y + (x + y) = 180$

$\cancel{2}(x+y) = \cancel{180}\ 90^\circ$

$\Downarrow$

$\angle BGC$

$\boxed{\angle BGC = 90^\circ}$



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 2/3 of his amount while B is left with Rs. 145. Then the value of the gift is?

Sol^n:- saving 4:5 → A : B → 4x 5x

Expenditure 3:4 [gift cost 7] → A : B → 3y 4y

$$\frac{(4x)\times\frac{1}{3}}{5x-145} \times \frac{3}{4} \Rightarrow 16x = 9(5x-145)$$

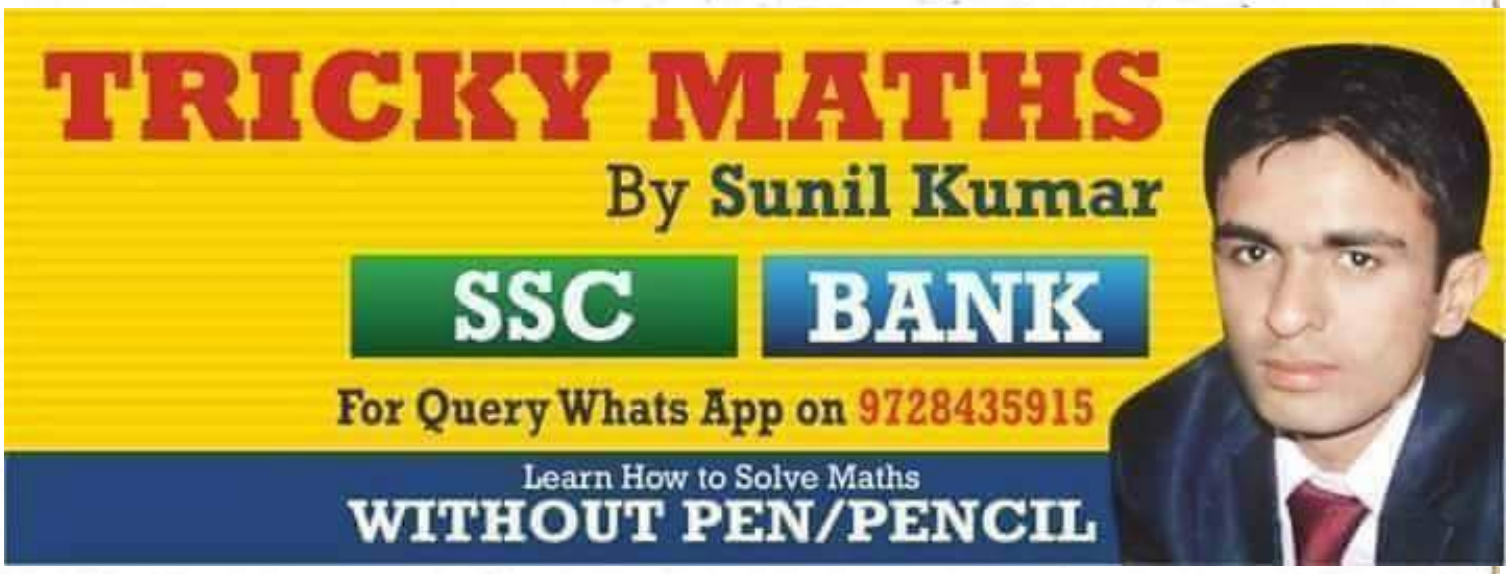
$$29x = 145\times 9$$

$$\boxed{x = 45}$$

so → $5\times 45 - 145 = 4y$

$$\frac{225-145}{4} = y \Rightarrow \boxed{y = \frac{80}{4} = 20}$$

gift cost $= 20\times 7 = 140$ Rs.



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Q:- एक व्यक्ति ने कुछ दूरी किसी चाल से तय की। यदि वह 3 km/h अधिक की चाल से वह दूरी तय करता तो उसे 40 मिनट कम समय लगता। यदि वह 2 km/h कम की चाल से वह दूरी तय करता, तो उसे 40 मिनट अधिक लगेंगे। वह दूरी (km) में है?

(1) 20 (3) 35

(2) $36\frac{2}{3}$ (4) 40

Solⁿ:-

$$\begin{array}{ccc} s & & t \\ +3 & \times & -40 \end{array} \Rightarrow -40s + 3t = |-40 \times 3| \quad \text{--(1)}$$

$$\begin{array}{ccc} s & & t \\ -2 & \times & +40 \end{array} \Rightarrow 40s - 2t = |+40 \times (-2)| \quad \text{--(2)}$$

$t = 120 + 80 = 200$ minute.

$$s = \frac{80 + 2 \times 200}{40} = \frac{480}{40} = 12 \text{ Km/h}$$

Distance $D = \frac{12 \times 200}{60} = 40$ km

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Q.:- 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.

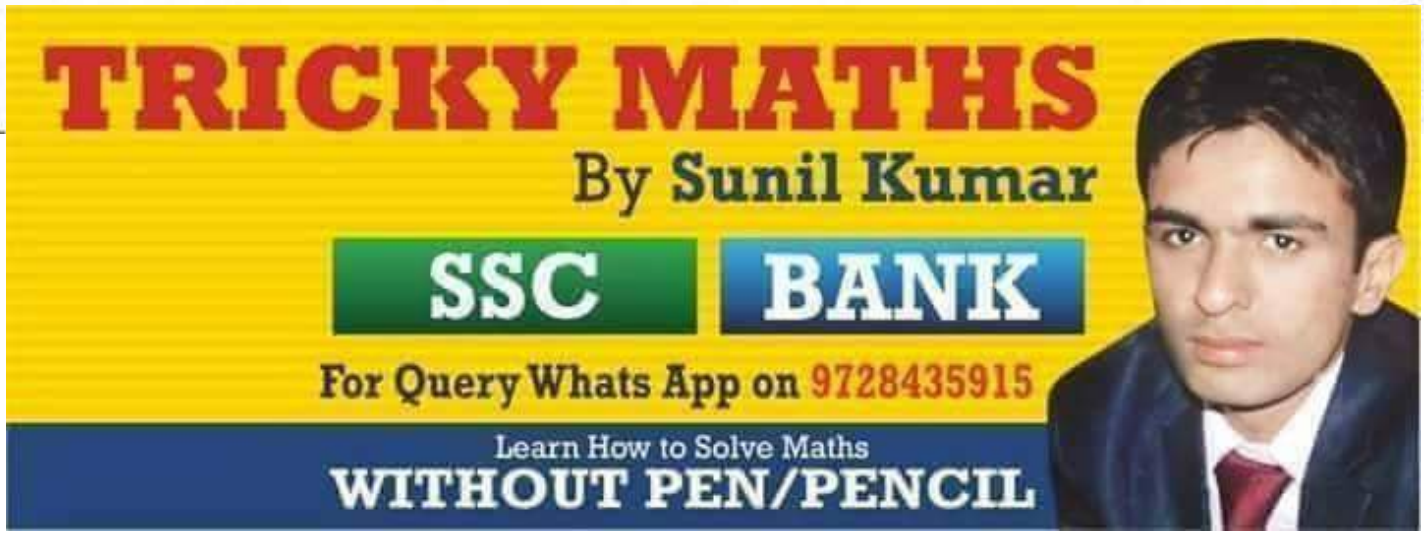
(A) 40% (B) 39% (C) 50% (D) 20%.

Solⁿ:-

$$16 \times \frac{138}{100} = \left(\cancel{15} \times \frac{x}{100}\right) \times \frac{96}{100}$$

$$x = \frac{144}{96} \times 100 = 150 \text{ (MRP)}$$

So, MRP ↑ed 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:-

$$150(n-8) = \frac{n}{2}\left[2\times150+(n-1)(-4)\right]$$

$$150(n-8) = n[150-2(n-1)]$$

either satisfy by option [This would be easy]

OR solve the quadratic eqn

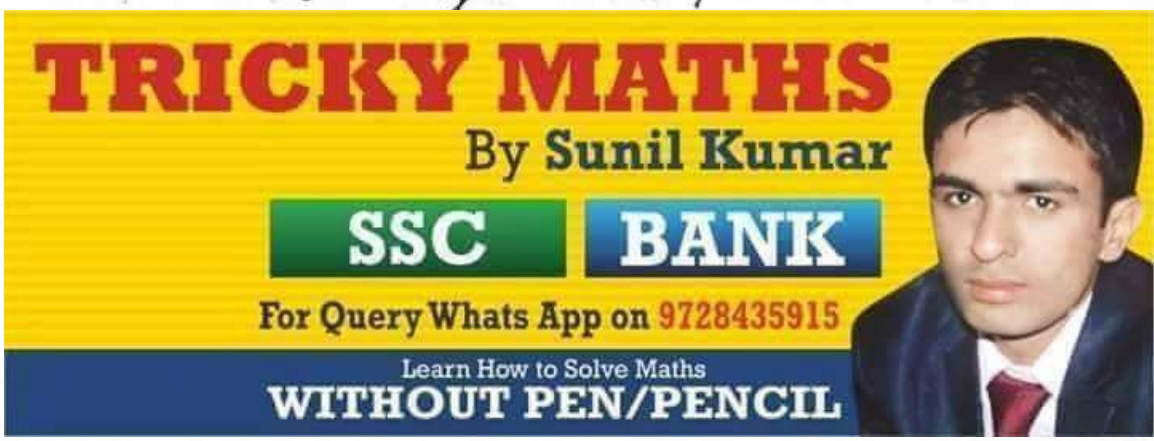
$$150n - 150\times8 = 150\times n - 2n^2 + 2n$$

$$2n^2 - 2n - 1200 = 0$$

$$n^2 - n - 600 = 0$$

$$-25 \quad 24 \Rightarrow \text{factor } +25 \ \& \ \cancel{-24}$$

So It takes 25 days to complete the work.



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 → 4 5

(consumption) C → 5 : 4 → 2kg

$\frac{5}{2}$ kg 1 → 500gm or $\frac{1}{2}$ kg

original Price $= \frac{36}{2} = 18$ Rs./kg

Reduced Price $= \frac{36 \times 2}{5} = \frac{72}{5} = 14.4$ 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.

Solⁿ.:- $10\% \rightarrow \frac{1}{10}$

P → 9 10

C → 10 : 9 → 6.2×9

6.2×10 1 → 6.2kg

Reduced Price $= \frac{1116}{62.0} =$ ₹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

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

$P \rightarrow 6 \quad 5$

$C \rightarrow 5 : 6 \rightarrow 12$ eggs

10 eggs $\quad 1 \rightarrow 2$ 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:-

$25\% \downarrow = 1/4$

$P \rightarrow 3 \quad 4$

$C \rightarrow 4 : 3 \rightarrow 30$kg

40kg. $\quad 1 \rightarrow 10$kg

$$\text{Reduced Price per kg} = \frac{600}{40} = 15 \text{ Rs.}$$

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Profit and Loss

Cost Price (CP) – The Price at which an article is purchased, is called it cost price.

Selling Price (SP) – The price at which an article is sold, is called its selling price.

$$\text{Profit/Loss} = \pm(SP - CP)$$

$+ \rightarrow$ Profit

$- \rightarrow$ Loss

Generally, Profit / Loss is calculated on Cost Price, Until, It is mentioned ~~by~~ in the questioned. And, we will take $\rightarrow$ $\boxed{CP = 100}$

Percentage or 100 Method

1) $CP = 100$

Profit $\rightarrow 20\%$.

$CP \rightarrow 100$

Profit $= 100$

$SP \rightarrow 100 + 20 = 120$

2) $CP = 100$

Loss $\rightarrow 25\%$.

CP	Loss	SP
100	25	75

Fraction Method

$CP = 100$

Profit $\rightarrow 20\%$.

fraction $\rightarrow \frac{1}{5}$)

CP	Profit	SP
5	1	6

2) $CP = 100$

Loss $\rightarrow 25\% \rightarrow \frac{1}{4}$

CP	Loss	SP
4	1	3

$$\boxed{\text{Profit/Loss}\% = \left(\frac{\text{Profit/Loss}}{CP}\right) \times 100}$$

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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?

Sol^n :-

	Loss	SP
CP → 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?

Sol^n :-

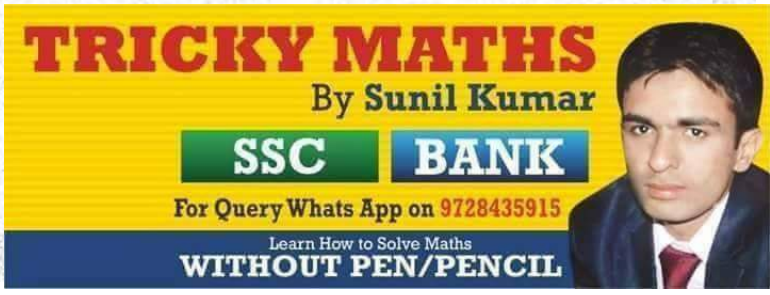
	Profit	SP
CP → 100	25	(100+25) = 125
↓	↓	↓
$\frac{6}{125} \times 100$	$\frac{6}{125} \times 25$	6.
= 4.8	= 1.2	

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.

Sol^n :-

	Loss	SP
CP 100	10	(100−10) = 90
↓	↓	↓
15	1.5	13.5

NOTE → Generally, Profit/Loss calculated on Cost price.



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Profit And Loss

Cost Price
↑
CP = 100 , SP → Selling Price , P → Profit , L → Loss

%	Profit	Loss
10%	110	90
20%	120	80
$33\frac{1}{3}$%	$133\frac{1}{3}$	66.67
$14\frac{2}{7}$%		
$57\frac{1}{7}$%		

fraction	Profit	Loss
# $\frac{1}{10}$	$\frac{11}{10}$	$\frac{9}{10}$
# $\frac{1}{5}$	$\frac{6}{5}$	$\frac{4}{5}$
# $\frac{1}{3}$	$\frac{4}{3}$	$\frac{2}{3}$
# $\frac{1}{7}$	$\frac{8}{7}$	$\frac{6}{7}$
# $\frac{4}{7}$	$\frac{11}{7}$	$\frac{3}{7}$

NOTE → For Profit, find SP = CP + Profit | if Loss SP = CP − Loss

⇒ if Profit 10%

Then simply → $\frac{1}{10}$ → Profit, CP and SP = CP + Profit

SP = 10 + 1 = 11

% → $\frac{1}{10}$ → 10 + 1 → SP
→ CP

Loss 10% → take fraction $\frac{1}{10}$ → Loss, CP

⇓

$\frac{1}{10}$ → $\frac{9}{10}$ → SP, CP

SP = CP − Loss $\boxed{\text{or}}$ Loss = CP − SP

Profit → $14\frac{2}{7}$% ⇒ fraction → $\frac{1}{7}$ → Profit, CP

7 + 1 → 8 → 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 = $57\frac{1}{7}\% \rightarrow \frac{4}{7}$

SP : CP
11 : 7
↓ ↓
$\frac{770}{7} \times 11$ 770
↓
SP → 1210

Ex :- if CP = 600, Loss → $33\frac{1}{3}\%$ $\left(\frac{1}{3}\right)$ → Loss, → CP

SP ← CP
2 3
↓ ↓
600
$\frac{600}{3} \times 2$
↳ 400

Ex :- if SP = 720, Profit = 20% i.e → $\frac{1}{5}$

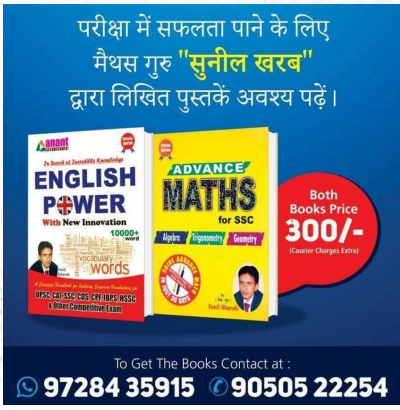
SP (5+1) CP
6 5
↓ ↓
720 $\frac{720}{6} \times 5 = 600$

Ex :- if SP = 880, Profit = $14\frac{2}{7}\%$ i.e → $\frac{1}{7} \rightarrow CP$

SP (7+1) CP
8 7
↓ ↓
880 $\frac{880}{8} \times 7 = 770$

Ex :- if SP = 400, Loss ⇒ $33\frac{1}{3}\%$ i.e → $\frac{1}{3} \rightarrow CP$

SP (3+1) CP
2 3
↓ ↓
400 $\frac{400}{2} \times 3 = 600$



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Ex :- if SP = 650 , Profit → 30 %.
find Profit = ?

30% → $\frac{3}{10}$ → Profit, 10 → CP 3+10 = 13 → SP

SP	CP	Profit
13	10	3
↓		↓
650		$\frac{650}{13} \times 3 = 150$

Ex :- if Profit → 280 , Profit % → $57\frac{1}{4}$ (i.e → $\frac{4}{7}$ → CP)
find CP & SP

CP	SP	Profit
7	11	4
↓	↓	↓
$\frac{280}{4} \times 07$	$\frac{280}{4} \times 11$	280
↳ 490	↳ 770	

Question1 :- A man buy a cycle for Rs. 1400 and sells it at a loss of 15%. what is selling Price of the cycle?

Sol^n :- Loss = 15% i.e $\frac{\cancel{15}\,3}{\cancel{100}\,20} = \frac{3}{20}$ → CP

CP	SP	Loss
20	(20-3=17)	3
↓	↓	
1400	$\frac{\cancel{1400}\,70}{\cancel{20}} \times 17 = 1190$	

Question2 :- A TV is purchased at Rs. 5000 and sold at Rs. 4000. Find Lost Percent?

Sol^n :- Loss % = $\frac{\cancel{1000}}{\cancel{5000}} \times \cancel{100}\,20 = 20\%$

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Question 3:- A person incurs a loss of 5% be selling a match for Rs. 1140. At what price should the match be sold to earn 5% profit?

Sol^n:-

CP → 100

−5% → 95 → 1140

for +5% Profit → 105 → $\frac{1140}{95} \times 105 = 1260$ Rs.

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^n:-

Profit → 10% → 1 → Profit, 10 → CP

CP	Profit	SP
↓	↓	
10	1	11
↓		↓
$\frac{27.50}{11} \times 10$		27.50

CP = 25, Now, SP → 25.75

Profit → 0.75

$P\% = \frac{0.75}{25} \times 100 = 3.00\%$

OR

110 → 27.50

100 → 25

if SP → 25.75

The $P\% = \frac{0.75}{25} \times 100 = 3\%$

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Profit and Loss Based on Selling Price :-

Example :- A toy is sold for 400 Rs. at at profit of 25% of selling price. Seperate this selling price into cost and profit?

Sol^n :- 25% → $\frac{1}{4}$ → Profit, 4 → SP (CP = SP − Profit)

SP	CP	Profit
↓	↓	↓
4	(4−1=3)	1
↓	↓	
400	300	

Profit on Cost Price $= \frac{100}{300} \times 100$

$= 33\frac{1}{3}\%$.

Example :- At a sale, neckles selling at Rs. 50 are sold at a loss of 60% of selling price. what is the loss and the original cost?

Sol^n :- 60% → $\frac{\cancel{6}3}{\cancel{10}5}$ → $\frac{3}{5}$ → Loss, 5 → SP (CP = SP + Loss)

SP	Loss	CP (SP+Loss)
↓		
5	−3	8
↓	↓	↓
50	−30	80

CP = 80

Loss → 30

and Loss at CP $= \frac{30}{80} \times 100 = \cancel{60\%}$

$= 37.5\%$.

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Example :- If the cost price is 25% of selling price. Then what is the Profit percent?

Sol^n :- $CP = \frac{1}{4} SP \Rightarrow \frac{CP}{SP} = \frac{1}{4}$ P = SP − CP = 3

$P\% = \frac{3}{1} \times 100 = 300\%$.

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Question1 :- If the cost price is 95% of the selling price, what is profit percent?

Sol^n :- $CP = \frac{95}{100} SP \Rightarrow$ CP : SP

19 : 20

1 → Profit

$P\% = \frac{1}{19} \times 100 = 5.26\%$

Question2 :- 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-

Sol^n :- 20% → 1 → Profit, 5 → CP

CP	SP	P
5	6	1

Profit on SP $= \frac{1}{6} \times 100 = 16\frac{2}{3}\%$

Question3 :- If selling price of an article is $1\frac{1}{3}$ of cost price, find gain%.

Sol^n :- $SP = \frac{4}{3} CP \Rightarrow$ SP : CP

4 : 3

P → 1

gain% $= \frac{1}{3} = 33\frac{1}{3}\%$

CGL-2013 & 2014

Question4- A shopkeeper sold a sewing machine in Rs.1080 with 10% loss. Find the price so that he would get 10% profit?

Sol^n :- 90 → 1080

110 → $\frac{1080}{90} \times 110 = 1320$ Rs.

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Question5:- 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:-

CP → 100

-8 / \ +10

92 110

18% → 540

100 → 3000

actual SP (i.e → 92) $= \frac{3000}{100} \times 92$

$= 2760$

Question6:- A man sold an item at 7% loss, had he been able to sale it at a gain of 9%. It would have gain Rs. 64 that it did. What was cost price.

Soln:-

CP → 100

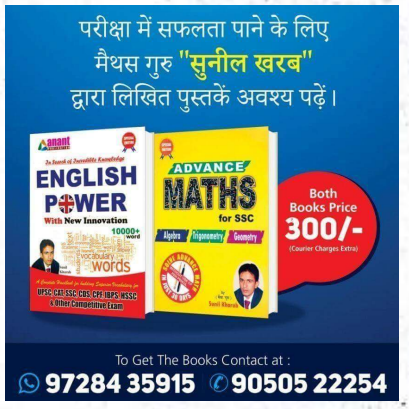
-7 / \ if +9

93 109

16% → 64

100 → 400

$\boxed{CP = 400 Rs.}$



Question7. 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?

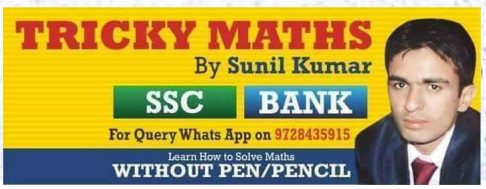
Soln:- 20% → $\frac{1}{5}$

CP	P	SP
5	1	6

↓ if sell double the Price.

P = 7 12

$P\% = \frac{7}{5} \times 100 = 140\%$



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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%.

Sol^n:-

$$100 \xrightarrow{+15} 115$$

$$-15 \swarrow$$

$$85 \rightarrow 18,700$$

$$115 \rightarrow \frac{\cancel{18700}^{1100}}{\cancel{85}_{\cancel{5}}} \times \cancel{115}^{23} = 1100 \times 23 = 25300$$

Question 9:- A person sold an item at 20% profit, has it been able to purchase 10% less. Then his profit % becomes?

Sol^n:-

	CP		SP
	100	$\xrightarrow{+20}$	120
if CP	90	$\xrightarrow{+30}$	

$$\rightarrow P\% = \frac{30}{90} \times 100 = 33\frac{1}{3}\%$$

Question 10. A man sold an item 10% less, If he had bought it at 20% less then his profit%.

Sol^n:-

	CP		SP
	100	$\xrightarrow{-10}$	90
if CP	80	$\xrightarrow{+10}$	

$$P\% \rightarrow \frac{10}{80} \times 100 = 12\frac{1}{2}\%$$

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 gain 25%. Find CP=?

Sol^n:-

	CP		SP
	100	$\xrightarrow{+10}$	110
if CP	90	$\xrightarrow{+25\%}$	$90 \times \frac{5}{4} = 112.50$

$$02.5 \rightarrow 3$$

$$100 \rightarrow \frac{3}{\cancel{12.5}_{\cancel{5}}} \times \cancel{1000}^{\cancel{40}^{8}} = \cancel{200}\ 120$$

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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 = ?

Sol^n:-

CP 100 $\xrightarrow{-10}$ SP 90

if −20

CP 80 $\xrightarrow{40\%}$ 112

22 → 55

$100 \rightarrow \frac{\cancel{55}^{5}}{\cancel{22}_{2}} \times \cancel{100}^{50} = 250$

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 = ?

Sol^n:-

CP 100 $\xrightarrow{+20}$ SP 120

if −20

CP 80 $\xrightarrow{25\% \text{ gain}}$ 100

20 → 75

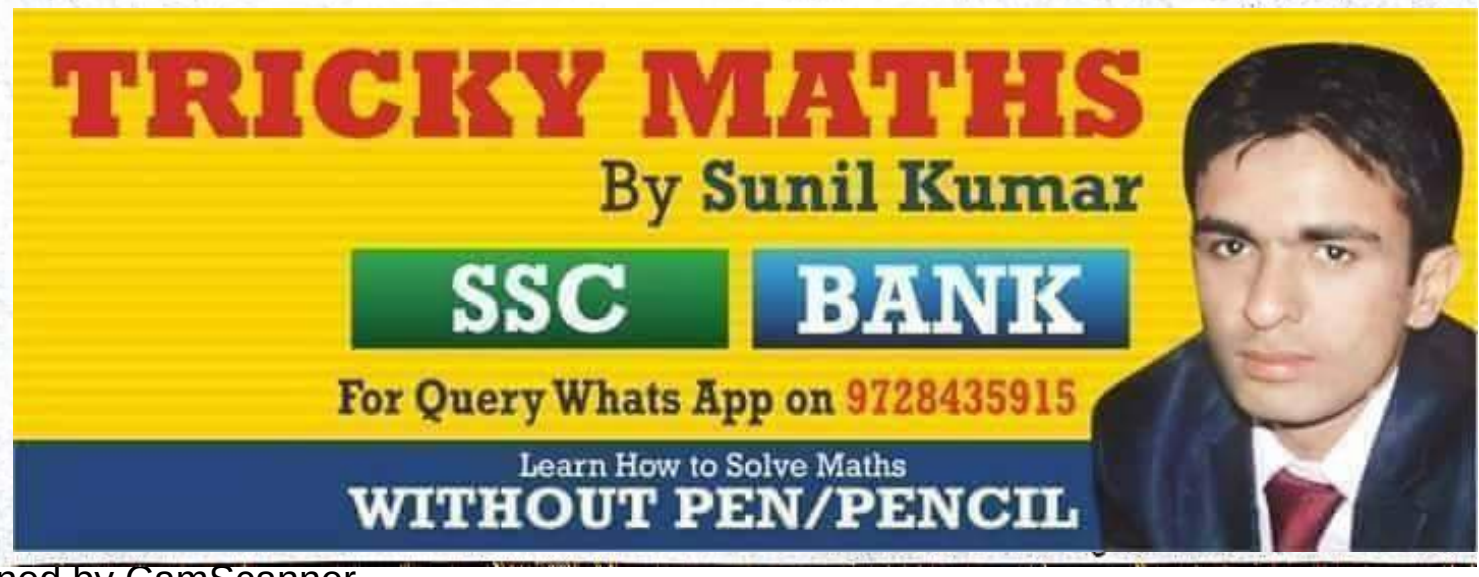
$100 \rightarrow \frac{75}{\cancel{20}} \times \cancel{120}^{5} = 375.$

Question 14- A man wanted to sell an article with 20% but he actually sold at 20% loss for Rs. 480. At what price he wanted to sell it to earn the profit?

Sol^n:-

100 $\xrightarrow{-20\%}$ 80 → 480

$\xrightarrow{+20}$ 120 → $\frac{\cancel{480}^{6}}{\cancel{80}} \times 120 = 720$



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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

$100 \longrightarrow 120 \xrightarrow{+10} 132$

$132 \rightarrow 396$

$100 \rightarrow \frac{396}{132} \times 100 = 300$

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

$100 \longrightarrow 80 \xrightarrow{+15\%} 92 \xrightarrow{-5\%} 87.4 \xrightarrow{+10\%} 96.14$

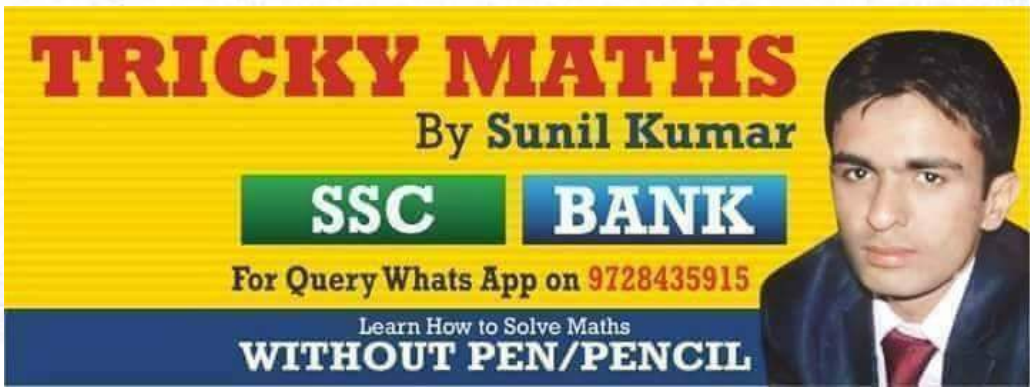
$96.14 = 500$

$100 = \frac{\cancel{500}^{250}}{\underset{48.07}{\cancel{96.14}}} \times 100 = 520.07$

or A to E $\rightarrow$ $100 \times \frac{80}{100} \times \frac{115}{100} \times \frac{95}{100} \times \frac{110}{100} \longrightarrow 500$

$100 \longrightarrow \frac{\cancel{500}^{102} \times \cancel{100}^{25} \times 100 \times 10 \times 100}{\underset{4}{\cancel{80}} \times \underset{23}{\cancel{115}} \times \underset{19}{\cancel{95}} \times 11}$

$= 520.07$



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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^n:-

Original Ravi

$100 \xrightarrow{-25} 75 \xrightarrow{+50\%} 112.5$

12.5%

So → 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 allow certain discount and suffer a loss of 2%. Find the discount percentage?

Sol^n:-

MP CP SP

$112 \xleftarrow{+12} 100 \longrightarrow$ loss 98

D

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

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^n:-

A B C

$100 \xrightarrow{+20\%} 120 \xrightarrow{+25\%} 150$

$150 \rightarrow 225$

$100 \rightarrow \frac{3}{2} \times 100 = 150$

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⟹ when Quantities at Cost Price and at selling Price are different :-

Question1 :- A man bought toffes at the rate of 15 for a rupee and sold them at the rate of 12 for a rupee. Find gain/ loss percentage ?

Sol^n :-

Quantity		Price	
x	15	1	← CP
y	12	1	← SP

$$\text{Profit} = \frac{15-12}{12} \times 100 = \frac{\cancel{3}}{\cancel{12}_{4}} \times 100^{25}$$

$$\boxed{P\% \rightarrow 25\%}$$

NOTE → If CP & SP are same but Quantities are different.

Then $\text{Profit/Loss}\% = \left(\frac{x-y}{y}\right) \times 100$

Profit → if +ve

Loss → if -ve.

$x \rightarrow$ Quantity bought at (CP)

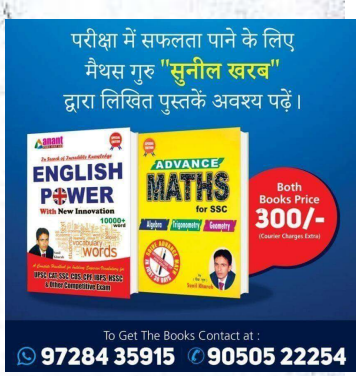
$y \rightarrow$ Quantity sold at SP.

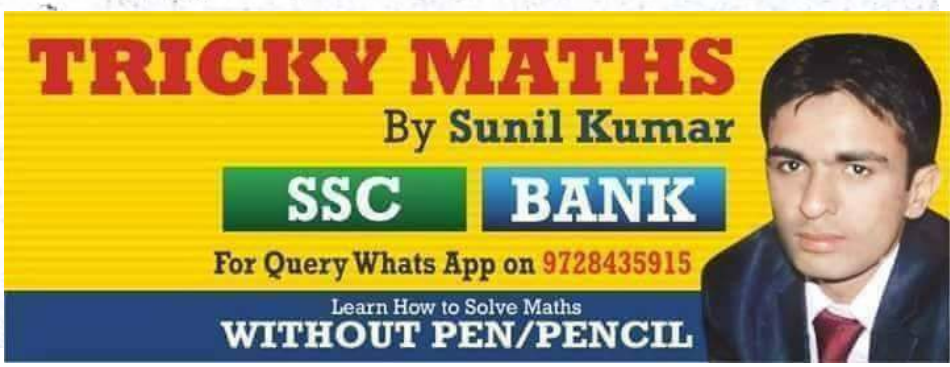
Question2 :- A person buys some pencils at 5 for a rupee and sells them at 3 for a rupee. His gain percent will be -

Sol^n :-

Quantity		Cost	
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 →

Sol^n:-

$$\text{gain\%} = \frac{36-30}{30} \times 100 \qquad \left(\frac{x-y}{y} \times 100 = P\%\right)$$

$$= \frac{6}{30} \times 100 = 20\%$$

(or)

$$36\,CP = 30\,SP$$

$$\frac{CP}{SP} = \frac{30}{36}$$

CP	SP
5	6

$$P\% = \frac{1}{5} \times 100 = 20\%$$

Question 4:- If I would have purchased 11 article for Rs. 10 and sold all the articles at the rate 10 for Rs. 11. The profit percent would have been

Sol^n:-

Quantity	Cost	
11	10	← CP
10	11	← SP

$$P\% = \frac{11\times11 - 10\times10}{10\times10} \times 100 = \frac{121-100}{100} \times 100$$

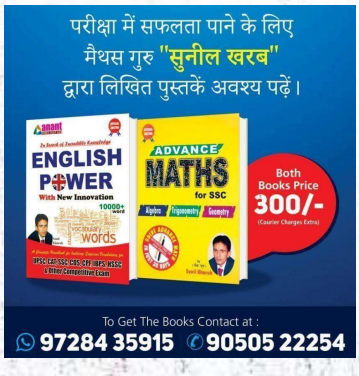
$$= 21\%$$

Question 5:- Banans are bought at the rate of 6 for Rs. 5 and sold at the rate of 5 for Rs. 6 profit percent is-

Sol^n:-

Quantity	Cost	
6	5	← CP
5	6	SP

$$P\% = \frac{36-25}{25} \times 100 = 11 \times 4 = 44\%$$



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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^n:-

$CP = \frac{4}{7}$

$SP = \frac{5}{8}$

$\text{Profit} = SP - CP = \frac{5}{8} - \frac{4}{7} = \frac{3}{56} \rightarrow$ Profit Rs / article

56 article → Profit 3 Rs.

Profit 30 Rs. ⟶ on 560 article.

Question 7:- A man bought oragnes 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^n:-

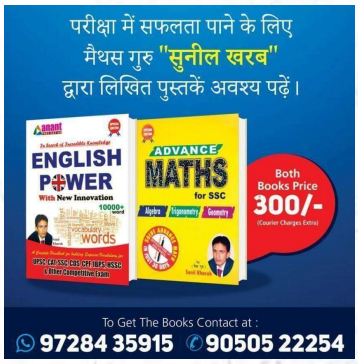
$CP = \frac{\cancel{34}^{17}}{\cancel{8}_{4}} = \frac{17}{4}$

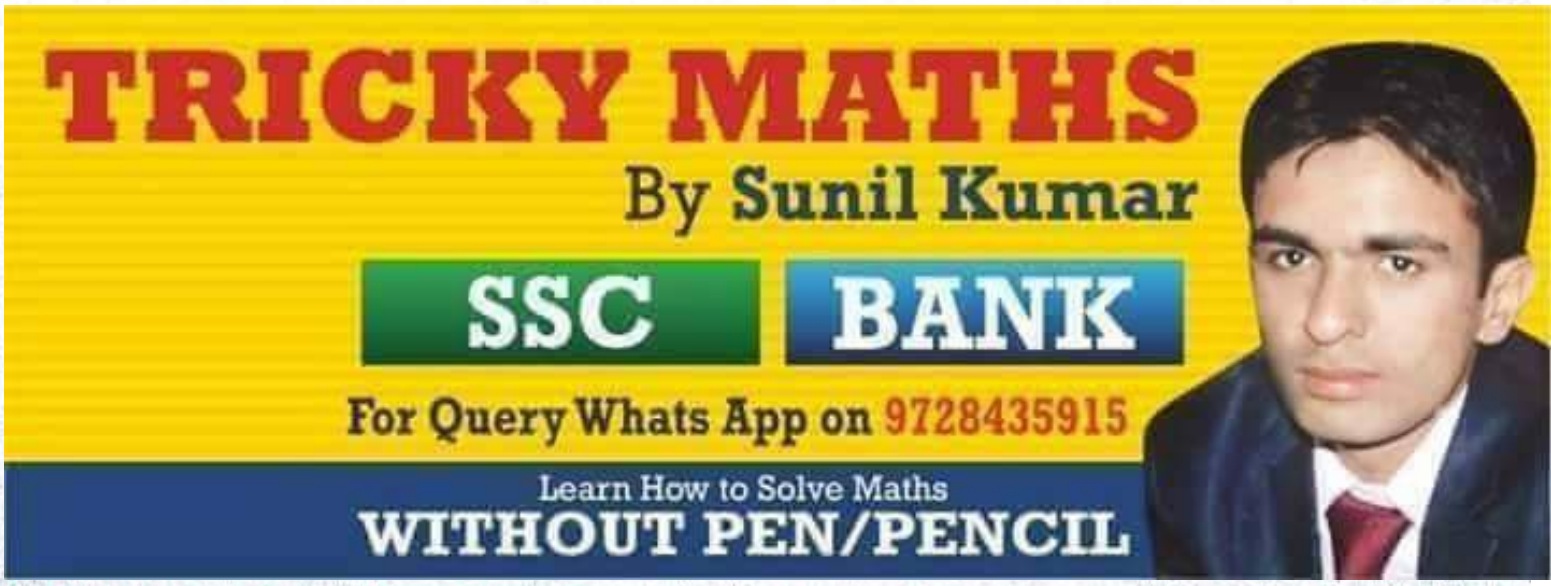
$SP = \frac{\cancel{57}^{19}}{\cancel{12}_{4}} = \frac{19}{4}$

$\text{Profit} = \frac{19}{4} - \frac{17}{4} = \frac{\cancel{2}1}{\cancel{4}2} \rightarrow$ Profit / article

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 –

Sol^n :-

$$\text{Gain \%} = \frac{1000-960}{960} \times 100 = \frac{40}{960} \times 100 = 4\frac{1}{6}\%$$

Question 2 :- A dealer professes to sell his goods at CP but unfortunately he weigh 1200 gm instead of 1 kg. Find loss %.

Sol^n :-

$$\text{loss \%} = \frac{200}{1200} \times 100 = 16\frac{2}{3}\%$$

Question 3 :- A dishonest dealer professes to sell his goods at CP but he use 20% less weight. Find Profit %?

Sol^n :-

$$\text{Profit \%} = \frac{20}{80} \times 100 = 25\%$$

Question 4 :- A merchant profes to loss 4% on a certain tea. But he use a weight equal to 840 grams instead of 1 kg. Find his real loss/gain?

Sol^n :- Method-1

Q	Cost	
1000	100	← CP
840	96	← SP

$$\frac{960-840}{840} \times 100 = \frac{120}{840} \times 100 = 14\frac{2}{7}\%$$

OR

$$\left.\begin{matrix} 96 \\ 100 \\ 84 \end{matrix}\right\} \rightarrow 12 \qquad \frac{12}{84} \times 100 = 14\frac{2}{7}\%$$

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Question5:- A grocer sells rice at a profit of 10% and uses a weight which is 20% less. Find his total percentage gain?

Sol^n :- Method-1

$$1000 \longrightarrow 100$$
$$800 \longrightarrow 110.0$$

$$\frac{1100-800}{800} \times 100 = \frac{300}{800} \times 100$$
$$= 37.5\%$$

Method-2 ⇒ $\% \text{ Gain} = \frac{1000-800}{800} \times 100 = \frac{200}{800} \times 100 = 25\%$

10% Profit → selling Time

$$\text{Net Profit} = x + y + \frac{xy}{100}$$
$$= 25 + 10 + \frac{25 \times 10}{100} = 37.5\%$$

Method-3

$$\left(\frac{\text{Profit\%} + \text{Less in weight\%}}{100 - \text{Less in weight\%}}\right) \times 100$$

$$= \left(\frac{10+20}{100-20}\right) \times 100 = \frac{30}{80} \times 100 = 37.5\%$$

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^n:- (Buy time) 20 — 100

(Selling time) 15 — 90

$$\frac{18-15}{15} \times 100 = \frac{3}{15} \times 100 = 20\%$$

Profit = 20%.

Question7:- A dishonest dealer sells the goods at $6\frac{1}{4}$% loss on cost price but uses $12\frac{1}{2}$% less weight. what is his percentage profit or loss?

Sol^n:-

weight	Price	
1000	10	(Buy time)
875	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^n:-

Quantity	Price	
1000	100	(Buy time)
800	130	(sell time)

$$\frac{1300-800}{800} \times 100 = \frac{500}{8} = 62.5\%$$

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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 → always take 100%.

Example :- An article was sold for Rs. 490 after giving discount of 30%, what is the marked Price?

[Here CP is not given so simple taken MP = 100]

Sol^n :-

MP — 100

Discount → − 30

SP 70 = 490

so 100 = 700

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?

Sol^n :-

100 = 450

D = −10

90 = $\frac{450}{100} \times 90$ = 405 Rs

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

Sol^n :-

MP	CP	SP
120	100	102

+20 ; 15% Discount

so profit % = 2%.

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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?

Sol^n:-

MP	CP	SP
125	100	105

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?

Sol^n:-

MP	CP	SP
$133\frac{1}{3}$	100	120

if D ↑ → 15%

CP 100

Then profit → $\frac{400}{3} \times \frac{85}{100} = \frac{340}{3} = 113.33$ (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?

Sol^n:-

MP	CP	SP
$\frac{1120}{9}$	100	112

D = 10%

Ratio $\frac{CP}{MP} = \frac{100 \times 9}{1120} = \frac{90}{112} = \frac{45}{56}$

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Question4:- 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^n:-

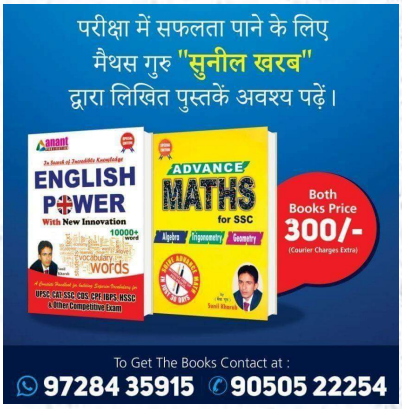
MP	CP	SP
150	← 100 ⇒ 400	SP = (500)
↓ +20%		↓ +20%
180		$\frac{6}{5}$ SP

$150 \rightarrow 600$

$100 \rightarrow 400$

$$\frac{6}{5}SP - 400 = 2(SP - 400)$$

$$\frac{\cancel{4}}{5}SP = \cancel{400}^{100} \qquad \boxed{SP = 500}$$



Question5:- 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^n:-

MP	CP	SP
125	← 100	105

actual Profit = 5%.

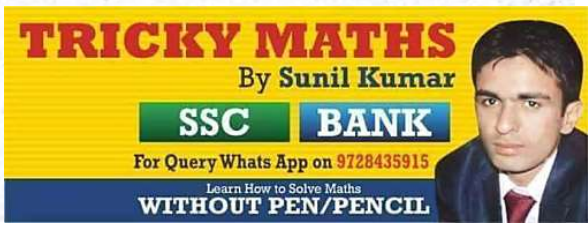
$$\xrightarrow[D]{16\%} 125 \times \frac{\cancel{84}^{21}}{\cancel{100}_{4}} = 105$$

Question6:- A shopkeeper fixes the MP of an item 35% above its CP. The percentage of discount allowed to gain 8% is-

Sol^n:-

MP	CP	SP
135	← 100	→ 108

$$D = \frac{\cancel{27}}{\cancel{135}_{5}} \times \cancel{100}^{20} = 20\%$$



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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
Rs. 50	20 (Q)
Rs. 40	20 (Q)
Rs. 90	40]×4 (Total Q)
20	9]×40

P	Q
810	360 (Buy)
800	360 (sell)

So → Here clearly loss, CP = 810
SP → 800

$$\text{loss} = \frac{10}{810} \times 100 = 1\frac{19}{81}\%$$

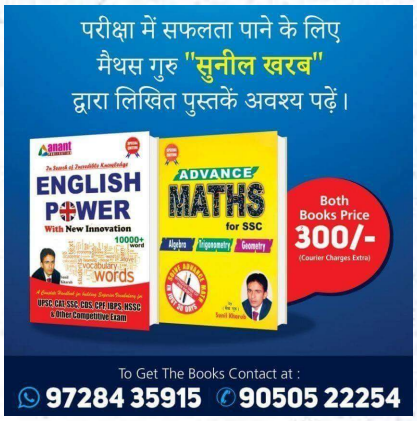
Question 2: Some article bought at the rate of 11 for Rs. 10 and the same no. of article at the rate of 9 for Rs. 10. If whole lot was sold at 1 Rs. per article then gain/loss

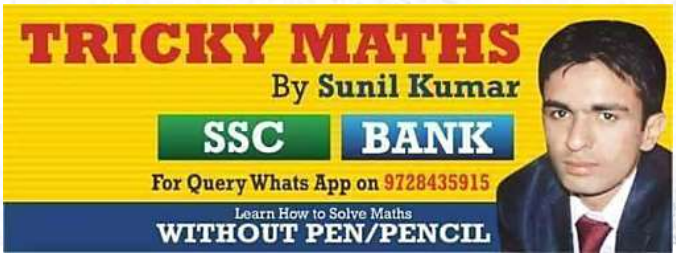
Soln:

P	Q	P	Q
10	11]×9 →	90	99
10	9]×11 →	110	99
		200	198 (Q)
		198	198 (∵ 1 Rs. Per article

loss → 2

$$\text{loss}\% = \frac{2}{200} \times 100 = 1\%$$





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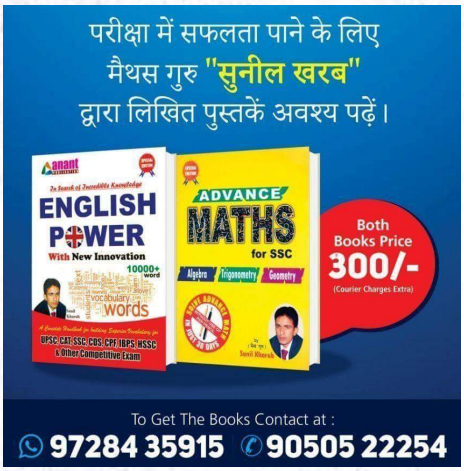
Question 3:- A man bought a certain no. of pen at the rate of 6 for Rs. 2 and equal no. of pen at the rate of 8 for Rs. 4. At what price per dozen should he sell them to make a profit of 10%.

Sol^n:-

P	Q		P	Q	
2	6]×4	→	8	24	
4	8]×3		12	24	
			20	48	
			x	12]×4	
			20	48 (Q)	(CP)
			$4x$	48 (Q)	(SP)

$$\frac{4x-20}{20} \times 100 = 10$$

$$4x = 22 \Rightarrow \boxed{x = \frac{22}{4} = 5.5}$$



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.

Sol^n:-

P	Q		P	Q	
2	1]×2	→	4	2	
1	2	→	1	2	
			5	4	(CP)
			x	4	CSP

$$\frac{x-5}{5} \times 100 = 10$$

$$x - 5 = 0.5 \Rightarrow \boxed{x = 5.5}$$

SP of 1 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 equal loss, then CP of both quantity?

Question 1:- A sales man sells 2 matches 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 –

Sol^n:- NOTE This type of questions always occur → Loss

Imp If a person sells two items at the same price; one at a gain of x% and another at a loss of x%. then the seller always incurs a loss.

and $loss = \left(\frac{x}{10}\right)^2$

So → Ans → $x = 20\%$

$$loss = \left(\frac{\cancel{20}^{2}}{\cancel{10}}\right)^2 = -4\%$$

Question 2- A person sells two machines at Rs. 396 each. One he gains 10% and on the other he loses 10%. His profit or loss in the whole transaction is –

Sol^n:- $loss = \left(\frac{10}{10}\right)^2 = -1\%$

Question:- 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 –

Sol^n:- $loss = \left(\frac{\cancel{20}^{2}}{\cancel{10}}\right)^2 = -4\%$

$96 \rightarrow 2$ lakh

$-4\% = \frac{2 \times 4}{\cancel{96}_{12}} = \frac{1}{12}$ lakh.

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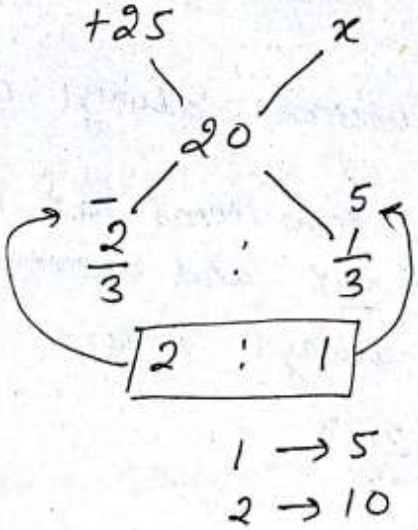
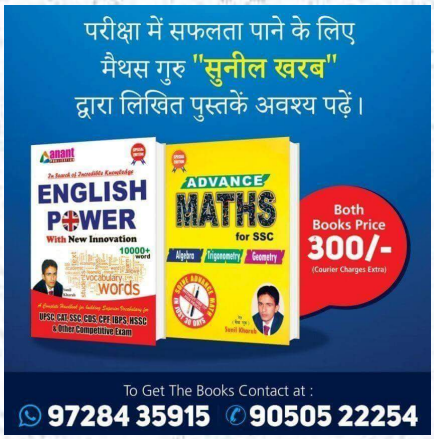
⇒ Some Profit / Loss question using Allegation Method →

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 20% on the whole transaction –

Sol^n:-

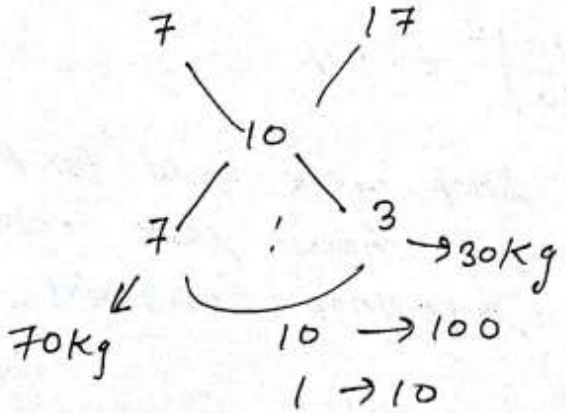




So → $\frac{1}{3}$ of it sold at → 10%.

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^n:-



Ans → 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-

Solⁿ :- Two Article →

one at a profit → 75%.

CP	SP	
100	175	(A)

$250 = \frac{175}{70} \times 100 \xrightarrow{-30\%} 175$ (B) (because SP is same

Total CP = 350
Total SP = 350 } so There is no profit NO Loss.

CGL-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 diffⁿ of the cost price of the two bicycle was-

Solⁿ :- $A + B = 1600$ — (1)

and I^{st} $(1.1A + 1.2B)$ Then $1.2A + 1.1B$

So, $1.2A + 1.1B - 1.1A - 1.2B = 5$

$0.1A - 0.1B = 5$

$A - B = 50$ — (2)

$A = \frac{1600+50}{2}$, $B = \frac{1600-50}{2}$

$\boxed{A = 825}$ $\boxed{B = 775}$

Diffⁿ b/w Their Cost Price

$= 825 - 775 = 50$ Rs.

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Question3:- 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?

Sol^n:-

MP	CP	SP
120 ←	100	
⇓	⇓	
540	450	496.80

$$D\% = \frac{432}{5400} \times 100 = \frac{432}{54} = 8\%$$

Question4: 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 -

Sol^n:

MP

$100 \xrightarrow{-20\%} 80 \xrightarrow[-35\%]{D} 52$

$80 \to 52 \to 1300$

$100 \to 2500$ Rs.

Question5:- 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?

Sol^n:

1st hen

CP	SP
$\frac{105}{75} \times 100 = 140$	105

2nd

CP	SP
$\frac{105}{150} \times 100 = 70$	105

$\frac{105 \times 2}{3} = 70$

Total CP $= 140 + 70 = 210$

Total SP $= 105 + 105 = 210$

So, There is NO profit NO loss.

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$$\frac{B}{9} + 2 = \frac{B-3}{6} \Rightarrow \frac{B}{9} + 2 = \frac{B}{6} - \frac{1}{2}$$

$$\frac{B}{9} - \frac{B}{6} = -2 - \frac{1}{2}$$

$$\frac{B}{\cancel{18}\,9} = \frac{5}{\cancel{2}} \Rightarrow \boxed{B = 45}$$

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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 it if 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?

Sol^n :-

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?

Sol^n :- assume he buys n goods.

$\therefore$ Total CP $= 20n$

$SP = \frac{140}{100} \times 20n = 28n$.

Total SP $2+4+6+8+\ldots$ n terms $\geq 28n$

$2(1+2+3+\ldots+n) \geq 28n$

$\cancel{2} \times \frac{\cancel{n}(n+1)}{\cancel{2}} \geq 28\cancel{n}$

$\boxed{n \geq 27}$

- He should sell a minimum of 27 goods.

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Question :- After selling 10 candles a man earn a profit of the SP of 3 Pens; while selling 10 pen 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?

Sol^n :-

Price	Candle	Pen
CP	x	$2x$
SP	A	B

$10(A-x) = 3B \Rightarrow$ Profit % $= \frac{3B}{10x} \times 100 = \frac{30B}{x}$

$10(2x-B) = 4A \Rightarrow$ loss % $= \frac{4A}{20x} \times 100 = \frac{40A}{2x}$

$20x \rightarrow 10 \times 2x$

$3B = 2A \Rightarrow \boxed{\frac{A}{B} = \frac{3}{2}}$

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?

Sol^n :-

$-10 \qquad +15$

0

$3 \qquad 2$

$15 \qquad 10$

$3 : 2 \rightarrow 5 \rightarrow 30,000$ [because there are NO Profit NO LOSS]

SO Total CP = Total SP

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 %?

Sol^n :-

MP	CP	SP
140	100	119

$\xrightarrow{+10\%}$ 154 $\qquad$ $\xrightarrow{+12\%}$ 112 $\longrightarrow$ 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. Gaining 10% of the total CP of 2 article. Had he sold the watch at 435 ₹ and Pen at CP. He would have loss 5% on total CP. Find CP of watch?

Sol^n :- SP → $(\overset{W}{492} + \overset{P}{168}) = 660$ ← (i.e 110) SP

$$600 = \frac{660}{110} \times 100 \leftarrow CP\ (100)$$

How ⇒ Total SP = $\overset{W}{435}$ + P (at CP

$\Downarrow -5\%$

100 → 600 $\xrightarrow{-5\%}$ 570

435 $\quad$ $\boxed{135}$ ← CP of Pen

So CP of watch = 600 − 135 = 465

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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 :-

	Q	P
Buying Time	x	160
Selling Time	45	160

Price is same so $\frac{x-45}{\cancel{45}_{9}} = -\frac{1}{\cancel{9}}$

$\boxed{x = 36}$

Total amount → 160 + 112 = 272

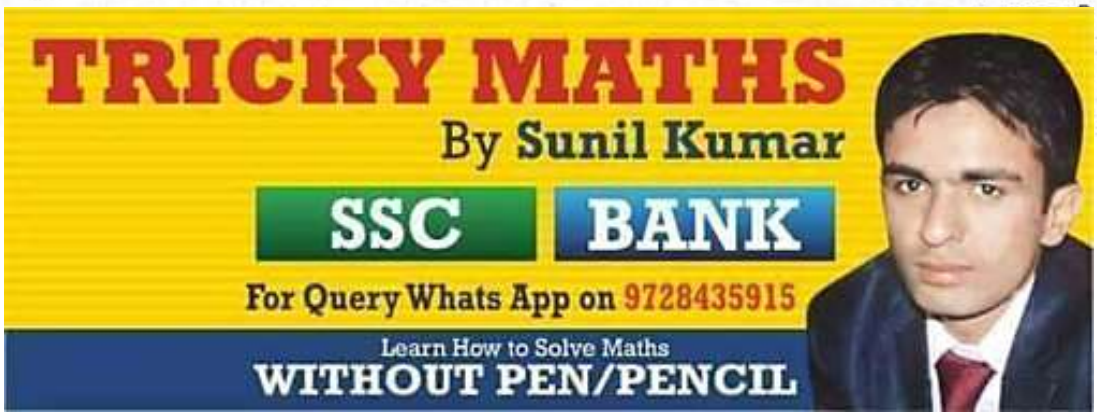
and make profit → 20%

	Q	P
Buying Time	36	160
Selling Time	x	272

$$\frac{36 \times 272 - 160 \times x}{\cancel{160}x_{32}} = +\frac{1}{\cancel{9}}$$

$$36 \times 272 = 192x \Rightarrow x = \frac{\cancel{36}^{3\cancel{6}} \times \cancel{272}^{6\cancel{8}17}}{\cancel{192}_{\cancel{32}\cancel{8}4}} = 51$$

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%.

Sol^n :-

3000 (copies) $\longrightarrow$ 2400

$\downarrow$ −500 (philanthropic Institutions)

Now $\rightarrow$ 2500 (for sell) -

published price $\rightarrow$ 3.25 $\xrightarrow{D=25\%}$ SP $3.25 \times \frac{75}{100}$

$= \frac{9.75}{4}$

1 copy SP $= \frac{9.75}{4}$

when he sell 25 copies at a time $\rightarrow$ + 1 free

So, 2500 copies

$(25+1) \times 96 = 2496$ — 4 copies at SP $\frac{9.75}{4}$

$\Downarrow$

26 copies at 25 copies's price

26 copies SP $= \frac{9.75}{4} \times 25 = \frac{243.75}{4}$

Total SP $= \frac{243.75}{4} \times 96 + \frac{9.75}{4} \times 4 = 5850 + 9.75$

$= 5859.75$

Total CP = 2400

$P\% = \frac{5859.75 - 2400}{2400} \times 100 = \frac{3459.75}{24} = 144.156\%$

$\sim 144\%$.

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Question :- As a marketing ~~company~~ campaign a company decides to offer an extra amount of 20% of a toothphaste 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?

(a) 40% (b) 50% (c) 60% (d) 70%

Soln :-

Q	P
1	100
1.2	180 (SP ↑ed by 80%)

$$P\% = \frac{180-120}{120} \times 100 = \frac{60}{120} \times 100 = 50\%$$

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
↓ +30	But SP
130	104

$$loss\% = \frac{26}{130} \times 100 = 20\%$$

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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.

Sol^n :-

	P	Q		Q	P
	100	5]×4	→	400	20
	100	4]×5	→	500	20
				900	40]×9
(CP)	8100	360 ⇐			
				200	9]×40 (sold)
(SP)	8000	360			

loss → 100₹ at 360 Pen

300Rs. loss $= \frac{360}{100} \times 300 = 1080$

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

Sol^n :-

M → W → S → C → 56100

100 → 110 → 132 → 112.2

112.2 ⇒ 56100

$100 \rightarrow \frac{56100}{112.2} \times 100 = 50{,}000$

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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^n :- (A) 116 % (B) 166.66 % (C) 60 % (D) 100 %.

$$CP \rightarrow 6X$$

$$SP \rightarrow 8(2X) = 16X$$

$$p\% = \frac{10X}{6X} \times 100 = \frac{1000}{6} = 166.66\%$$

Question :- Two merchants sell, each an article for Rs. 1000. If merchant A computers 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^n :- $25\% = \frac{1}{4}$

A			B		
CP	P	SP	CP	P	SP
4	1	5	3	1	4
↓		↓	↓		↓
800	200	1000	750	250	1000

50

So Merchant B makes 50 more profit than Merchant A

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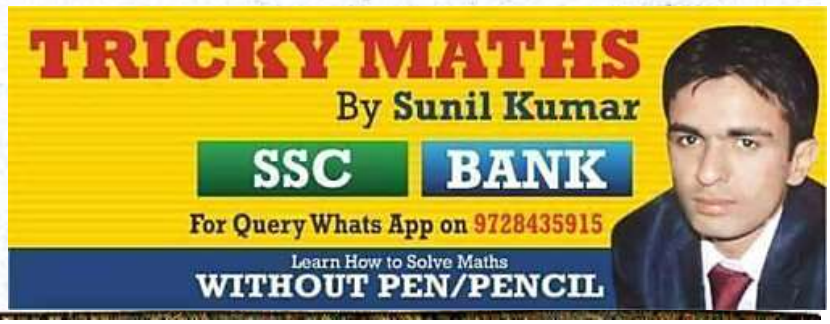

Question :- A dealer of scientific Instrument to allows 20% discount on the marked price of the instrument and still makes a profit of 25%. If his gain over the sale of an instrument is ₹150. Find the marked price of the instrument?

Sol^n :-

MP CP SP

$\frac{125}{80} \times 100$ (5, 4) $\quad 100 \longrightarrow 125$

D = 20%

$25 \longrightarrow 150$

$1 \longrightarrow 6$

$\frac{125 \times 5}{4} \rightarrow \frac{6 \times 125 \times 5}{4}$

$= \frac{3750}{4} = 937.50$

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^n :-

CP SP

$100 \longrightarrow 120$

but buy −10%

$12 \longrightarrow 30$

$90 \xrightarrow{+20\%} 108$

$100 \rightarrow \frac{30}{12} \times 100$ (5, 50, 2)

$= 250$ ₹

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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

Sol^n :-

1 year → 200 Rs. + 1 Shirt

9 month → $\frac{3}{4}(200+S)$

↳ $120+S$

So, $\frac{3}{\cancel{4}} \times \cancel{200}^{50} + \frac{3}{4}S = 120+S$

$30 = \frac{1}{4}S \Rightarrow \boxed{S=120}$

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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%

Sol^n :-

MRP	Manufacturing Cost (CP)	SP
155 ←	100	139.5 ↖ i.e (with 23% profit)

D → 10%

So, Retailer sells the product 139.5 = 123% of x → purchase price of Retailer

$x = \frac{\cancel{139.5}^{465}}{\cancel{123}_{41}} \times 100 = 113.4$

So profit → 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
sell → 1210 gm } profit % = 21 %.

$\boxed{\text{OR}}$ 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 suits 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:-

$$100 \xrightarrow{-25\%} \underset{\text{Ist week}}{75} \xrightarrow{-20\%} \underset{\text{2nd week}}{60.0}$$

↓ 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:-

$$\underset{T}{100} \longrightarrow \underset{W}{110} \longrightarrow \underset{R}{121} \longrightarrow \underset{C}{121 \times \frac{\left(100+\frac{23}{11}\right)}{100}} = 123.53$$

$$123.53 \rightarrow 990$$

$$100 \longrightarrow \frac{990}{123.53} \times 100 = 801.42$$

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:-

$$80 \longrightarrow 800$$

$$85 \longrightarrow \frac{\cancel{800}^{10}}{\cancel{80}} \times 85 = 850$$

difference $= 850 - 800 = 50$ Rs.

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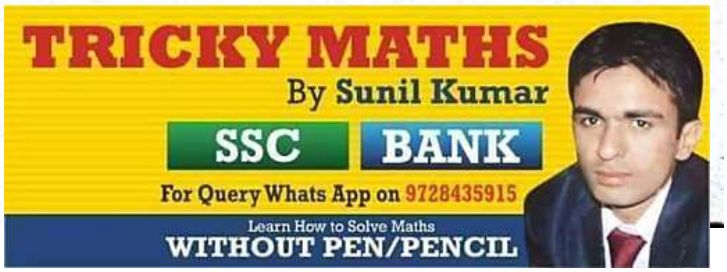

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Question :- A milkman buys some milk contained in 10 vessels of equal size. If he sells his milk at Rs. 5 a litre, he loses Rs. 200, while selling it at Rs. 6 a litre, he would gain Rs. 150 on the whole. Find the no. of litres contained in each vessel.

Solⁿ :- suppose Total milk $= x$ ltr.

So, $5x + 200 = 6x - 150$

$$\boxed{x = 350}$$

each vessel contains $= \frac{350}{10} = 35$ litres.

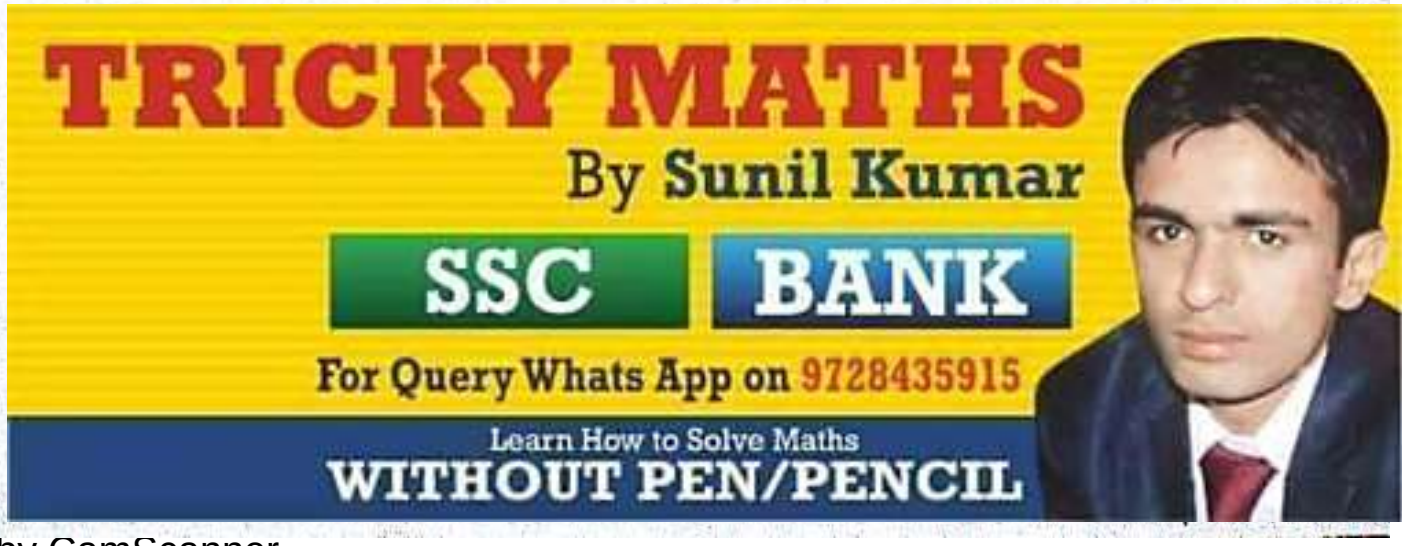
Question :- A shopkeeper sold 12 cameras at a profit of 20% and 8 cameras at a profit of 10%. If he had sold all the 20 cameras at a profit of 15%, then his profit would have been reduced by Rs. 36. what is the cost price of each camera?

Solⁿ :- $(12 \times 120 + 8 \times 110) - 115 \times 20 = 36$

$2320 - 2300 = 36$

$20 \longrightarrow 36$

$100 \rightarrow \frac{36}{\cancel{20}} \times \cancel{100}^{5} = 180$



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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

Solⁿ :-

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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

1000 $\xrightarrow{10\%}$ 100 $\xrightarrow{10\%}$ 10

1000 $\xrightarrow{10\%}$ 100

$SI = \frac{1000 \times 10 \times 2}{100} = 200$

Total CI = 200 + 10 = 210

NOTE : In first year, No difference between Simple Interest and Compount Interest.

Therefore, To find CI, P = 1000, r = 10%.

when				CI
	$1000 \times \frac{10}{100} = 100$	$100 \times \frac{10}{100} = 10$		
t = 2	2	1		→ 2×100 + 10 = 210
	100	10	$10 \times \frac{10}{100} = 1$	
t = 3	3	3	1	→ 3×100 + 3×10 + 1 = 331
	100	10	1	$1 \times \frac{10}{100} = 0.1$
t = 4	4	6	4	1 → 4×100 + 6×10 + 4×1 + 0.1 = 464.1
	100	10	1	0.1 $\quad 0.1 \times \frac{10}{100} = .01$
t = 5	5	10	10	5 $\quad$ 1

$= 500 + 10 \times 10 + 10 \times 1 + 5 \times 0.1 + .01$

$= 610.51$

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Example:- $P = 5000$, $r = 5\%$ find $CI = ?$

when

$t = 2$ $\quad 5000 \times \frac{5}{100} = 250$ $\quad 250 \times \frac{5}{100} = 12.5$

$\quad 2 \qquad 1$

$= 250 \times 2 + 12.5 = 512.5$

$t = 3$ $\quad 250 \quad 12.5 \quad 12.5 \times \frac{5}{100} = .625$

$\quad 3 \qquad 3 \qquad 1$

$= 250 \times 3 + 37.5 + .625 = 788.125$

Table:- To find CI

when $\quad P \times \frac{r}{100} \quad 1 \quad \left(P \times \frac{r}{100}\right) \times \frac{r}{100}$

$t = 2$ $\quad 2 \quad 1 \quad \Rightarrow 2 \times \left(\frac{Pr}{100}\right) + 1 \times \left(\frac{Pr}{100}\right) \frac{r}{100}$

$Pr/100 \quad (Pr/100) \times \frac{r}{100} \quad \left(\frac{Pr}{100}\right) \times \frac{r}{100} \times \frac{r}{100}$

$t = 3$ $\quad 3 \quad 3 \quad 1$

$t = 4$ $\quad 4 \quad 6 \quad 4 \quad 1$

$t = 5$ $\quad 5 \quad 10 \quad 10 \quad 5 \quad 1$

$t = 6$ $\quad 6 \quad 15 \quad 20 \quad 15 \quad 6 \quad 1$

Diff^n b/w SI & CI.

I^{st} Row $\rightarrow$ SI

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Case-1 → when r → yearly calculation

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^n :- $t = 2$ $\quad 8000 \times \frac{5}{100} = 400$ $\quad \frac{400 \times 5}{100} = 20$

$$CI = 400 \times 2 + 20 = 820$$

$$A = P + SI = 8000 + 820 = 8820$$

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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 $(t) = 2 \times t$

Quarterly → rate $(r) = \left(\frac{r}{4}\right)\%$ and time $(t) = 4 \times t$

Monthly → rate $(r) = \left(\frac{r}{12}\right)\%$ and time $(t) = 12 \times t$

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^n :- Half yearly → $r = \frac{10}{2} = 5\%$, $t = 2$ half years

$15000 \times \frac{5}{100} = 750$ $\quad 750 \times \frac{5}{100} = 37.5$

$t = 2$

$$CI = 750 \times 2 + 37.5 = 1537.5$$

$$A = P + SI = 15000 + 1537.5 = 16537.5$$

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Ex :- Find the compound interest on Rs. 15,625 for 9 months at 16% per annum compounded quarterly?

Sol^n :- Compounded Quarterly

$r = \frac{16}{4} = 4\%$, $t = \frac{9}{\cancel{12}_{3}} \times \cancel{4} = 3.$

$t=3$

$15625 \times \frac{4}{100} = 625$ (3) $\quad 625 \times \frac{4}{100} = 25$ (3) $\quad \frac{25 \times 4}{100} = 1$ (1)

$CI = 625 \times 3 + 25 \times 3 + 1 = 1951$ //.

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Example :- Find the compound interest on Rs. 5000 for 4 months at 48% per annum compounded monthly?

Sol^n :- $P = 5000$, $t = \frac{4}{12} \times 12 = 4$, $r = \frac{48}{12} = 4\%$ (monthly)

$t = 4$

$5000 \times \frac{4}{100} = 200$ (4) $\quad \overset{2}{\cancel{200}} \times \frac{4}{100} = 8$ (6) $\quad 8 \times \frac{4}{100} = 0.32$ (4) $\quad 0.32 \times \frac{4}{100} = 0.0128$ (1)

Total $CI = 200 \times 4 + 8 \times 6 + 4 \times 0.32 + 0.0128$

$= 800 + 48 + 1.28 + .0128$

$\boxed{CI = 849.2928}$

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⇒ Difference between Compound interest and Simple Interest

(1) Diff^n (CI − SI) when $t = 2$ years

$$\text{Difference} \quad D = \frac{Pr^2}{(100)^2}$$

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(2) $D = (CI - SI)$, when $t = 3$ years

$$D = \frac{Pr^2(300 + r)}{(100)^3}$$

(3) when [Difference $D = CI - SI$] time more than 3 year

	$P \times \frac{r}{100}$	$\left(P \times \frac{r}{100}\right) \times \frac{r}{100}$	$\left(P \times \frac{r}{100}\right) \times \frac{r}{100} \times \frac{r}{100}$	$\left(P \times \frac{r}{100}\right) \times \frac{r^3}{(100)^3}$
$t = 4$	4	6	4	1
	SI	Diff^n b/w CI & CI		

$t = 5$	5	10	10	5	1
		diff^n b/w CI & SI			

Example:- $P = 10{,}000$, $r = 5\%$, $t = 4$, find $D = CI - SI$

	$10{,}000 \times \frac{5}{100} = 500$	$\overset{5}{\cancel{500}} \times \frac{5}{\cancel{100}} = 25$	$25 \times \frac{5}{100} = 1.25$	$1.25 \times \frac{5}{100} = .0625$
$t = 4$	4	6	4	1
		diff^n b/w CI & SI		

$$D = 25 \times 6 + 4 \times 1.25 + 0.0625$$
$$= 150 + 5 + .0625$$
$$\boxed{D = 155.0625}$$

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Ques:- The difference between simple and compound interest on a certain sum of money at 5% rate of interest per annum for 2 years is ₹15. Then the sum is –

Sol^n:- $t=2$

$$D = \frac{Pr^2}{(100)^2} \Rightarrow \cancel{15}^{3} = \frac{P \times \cancel{5} \times \cancel{5}}{100 \times \cancel{100}_{20}}$$

$$\boxed{P = 6000}$$

Question:- The difference between compound and simple interest on ₹2500 for 2 years at 4% per annum is –

Sol^n:- $t=2$

$$D = \frac{Pr^2}{(100)^2} = \frac{2500 \times 4 \times 4}{100 \times \cancel{100}_{4}} = 4.₹$$

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 –

Sol^n:-

$$D = \frac{Pr^2(300+r)}{(100)^3}$$

$$\cancel{15.25}^{.25} = \frac{P \times \cancel{5} \times \cancel{5} \times \cancel{305}^{61}}{\cancel{100}_{4} \times \cancel{100}_{20} \times 100}$$

$$P = 25 \times 80 = 2000$$

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Question:- On what sum of money will the diff^n b/w CI & SI for 2 years at 5% per annum be equal to 25₹.

Sol^n:-

$$\cancel{25} = \frac{P \times \cancel{5} \times \cancel{5}}{100 \times 100} \Rightarrow \boxed{P = 10{,}000}$$

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⇒ when a principal becomes n_1 times after t_1 year then it will become – n_2 times after t_2 years –

$$(n_1)^{1/t_1} = (n_2)^{1/t_2}$$

$$\boxed{\text{or}} \quad (n_1)^{t_2} = (n_2)^{t_1}$$

Principal, rate of interest } same

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?

Sol^n :-

$n_1 \to 8, \quad t_1 \to 3$

$n_2 \to 16, \quad t_2 \to ?$

$$(8)^{t_2} = (16)^3$$

$$(2)^{3t_2} = (2)^{4\times 3} \Rightarrow 3t_2 = 12$$

$$\boxed{t_2 = 4 \text{ years}}$$

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 –

Sol^n :-

$n_1 \to 3, \quad t_1 \to 3$

$n_2 \to 9, \quad t_2 \to ?$

$$(3)^{t_2} = (9)^3$$

$$(3)^{t_2} = (3)^{2\times 3}$$

$$\boxed{t_2 = 6}$$

$\boxed{\text{or}}$

times	year
3	3
3^{2}	$\times 2$
9	6 years

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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.

Sol^n :-

$$2^{3} \left(\begin{array}{l} 2 \\ 8 \end{array} \right. \quad \begin{array}{c} \text{times} \longrightarrow \text{year} \\ 4 \\ \times 3 \\ \hline 12 \end{array}$$

or

$$(2)^{t_2} = (8)^4$$

$$(2)^{t_2} = (2)^{3\times 4}$$

$$\boxed{t_2 = 12 \text{ years}}$$

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?

Sol^n :-

$$2^{2} \left(\begin{array}{l} 2 \\ 4 \end{array} \right. \quad \begin{array}{c} \longrightarrow 10 \\ \times 2 \\ \hline 20 \text{ years} \end{array}$$

or

$$(2)^{t_2} = (4)^{10}$$

$$(2)^{t_2} = (2)^{2\times 10}$$

$$\boxed{t_2 = 20 \text{ years}}$$

Question :- A sum of ₹ 12,000 deposited at CI becomes double after 5 years. How much will it be after 20 years?

Sol^n :-

$$2^{4} \left(\begin{array}{l} 2 \longrightarrow 5 \\ \qquad\qquad \Big) \times 4 \\ 16 \longrightarrow 20 \end{array} \right.$$

It will become 16 times $\rightarrow 12{,}000 \times 16$

$= 1{,}92{,}000$

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Installments in Compound Interest :-

$$P = \frac{x}{\left(1+\frac{R}{100}\right)^1} + \frac{x}{\left(1+\frac{R}{100}\right)^2} + \frac{x}{\left(1+\frac{R}{100}\right)^3} + \cdots + \frac{x}{\left(1+\frac{R}{100}\right)^n}$$

$x \rightarrow$ 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?

Sol^n :- no. of installment = 3

$$6000 = x\left[\frac{1}{\left(1+\frac{10}{100}\right)} + \frac{1}{\left(1+\frac{10}{100}\right)^2} + \frac{1}{\left(1+\frac{10}{100}\right)^3}\right]$$

$$6000 = x\left[\frac{10}{11} + \frac{100}{121} + \frac{1000}{1331}\right]$$

$$6000 = x\left[\frac{121\times10 + 11\times100 + 1000}{1331}\right]$$

$$x = \frac{600\cancel{0}\times1331}{331\cancel{0}} = 2412.68$$

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OR

$$6000\left(1+\frac{10}{100}\right)^3 = x\left[\left(1+\frac{10}{100}\right)^2 + \left(1+\frac{10}{100}\right) + 1\right]$$

$$6000\left(\frac{1331}{1000}\right) = x\left[\frac{121}{100} + \frac{11}{10} + 1\right]$$

$$x = \frac{6000(1.331)}{3.31} = 2412.68.$$

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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. — $(n=3)$

Solⁿ :-

$$P = \frac{x}{\left(1+\frac{R}{100}\right)^1} + \frac{x}{\left(1+\frac{R}{100}\right)^2} + \frac{x}{\left(1+\frac{R}{100}\right)^3}$$

$$= 200\left[\frac{1}{\left(1+\frac{20}{100}\right)} + \frac{1}{\left(1+\frac{20}{100}\right)^2} + \frac{1}{\left(1+\frac{20}{100}\right)^3}\right]$$

$$= 200\left[\frac{5}{6} + \frac{25}{36} + \frac{125}{216}\right]$$

$$= 200\left[\frac{5\times36 + 25\times6 + 125}{216}\right] = \frac{100\times455}{108}$$

$$\boxed{P = 421.29}$$

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 —

Solⁿ :- $n=2$

$$P = 441\left[\frac{1}{\left(1+\frac{5}{100}\right)} + \frac{1}{\left(1+\frac{5}{100}\right)^2}\right]$$

$$= 441\left[\frac{20}{21} + \frac{400}{441}\right] = 441\left[\frac{20\times21+400}{441}\right]$$

$$= 400 + 420 = 820$$

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 _

Sol^n :-

$$D = \frac{Pr^2}{(100)^2} \Rightarrow \cancel{16}^{2} = \frac{P \times \cancel{8} \times \cancel{8}\,4}{100 \times \cancel{100}\,25}$$

$$\boxed{P = 2500}$$

Now, CI → Half-yearly, $r = \frac{8}{2} = 4\%$. $t = 2 \times 2 = 4$

	$2500 \times \frac{4}{100} = 100$	$100 \times \frac{4}{100}$	$4 \times \frac{4}{100} = 0.16$	$0.16 \times \frac{4}{100} = .0064$
CI →	4	6	4	1

$$CI = 100 \times 4 + 6 \times 4 + 0.64 + .0064$$
$$= 400 + 24 + 0.64 + 0.0064 = 424.6464$$

$$SI \text{ of } 2 \text{ years} = \frac{2500 \times 2 \times 8}{100} = 400$$

diff^n $D = 424.6464 = 24.64$ //.

OR

	$2500 \times \frac{4}{100}$	$100 \times \frac{4}{100}$	$4 \times \frac{4}{100} = 0.16$	$0.16 \times \frac{4}{100} = 0.0064$
CI =	100	4	0.16	.0064
$t = 4$	4	6	4	1
	SI	Diff^n 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 ~~any~~ 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?

Sol^n :-

$$x\left[1+\frac{8\times 10}{100}\right] = y\left[1+\frac{12.5\times 10}{100}\right]$$

$$x\times\frac{3}{2} = \frac{4.5y}{2} \Rightarrow \frac{x}{y} = \frac{4.5}{3}$$

$x : y$

$3 : 2 \rightarrow 14$ lakh

$5 \rightarrow 35$ lakh

21 Lakh $\quad 1 \rightarrow 7$ lakh

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?

Sol^n :-

$$\frac{144}{121} = \left(1+\frac{r}{100}\right)^2 \Rightarrow 1+\frac{r}{100} = \frac{12}{11} \Rightarrow \frac{r}{100} = \frac{12}{11}-1 = \frac{1}{11}$$

$$r = \frac{100}{11}\%$$

Now at SI $\rightarrow$ $2P = \frac{P\times t\times 100}{11\times 100} \Rightarrow \boxed{t = 22 \text{ years}}$

[Principal trebles so SI $\rightarrow$ 2P]

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Question :- The compound interest on Rs. 2000 in 2 years. If the rate of interest is 4% per annum for the I^{st} year and 3% per annum for the 2nd year will be –

Solⁿ:- I^{st} year → $2000 \times \frac{4}{100} = 80$

2nd year, $P = 2000 + 80 = 2080$

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 –

Solⁿ:- After 2 year → 9680
After 3 year → 10648 } After 1 year

So, we take
$P = 9680$
Interest $= 10648 - 9680$
$= 968$
$t = 1$ year.

So simply Interest $= \frac{9680 \times 1 \times r}{100}$

$968 = \frac{9680 \times 1 \times r}{100}$

$\boxed{r = 10\%}$

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Question:- A man invest Rs. 5000 for 3 years at 5% p.a Compound interest recokned 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.

$5000 \times \frac{4}{100} = 200$ $\quad$ $200 \times \frac{4}{100} = 8$ $\quad$ $8 \times \frac{4}{100} = 0.32$

$t = 3$ $\quad$ 3 $\quad$ 3 $\quad$ 1

$CI = 200 \times 3 + 8 \times 3 + 0.32 = 624.32$

The amount end of the year $= 5000 + 624.32$
$= 5624.32$

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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?

Solⁿ:- $S\left(1+\frac{r}{100}\right)^9 = R\left(1+\frac{r}{100}\right)^{11} \Rightarrow \frac{S}{R} = \left(1+\frac{5}{\cancel{100}_{20}}\right)^2$

$\frac{S}{R} = \frac{441}{400}$) $841 \longrightarrow 5887$

shyam (441) $\rightarrow \frac{5887}{841} \times 441 = 3087$

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Question:- Find the difference between the CI and SI on ₹ 32,000 at 10% p.a for 4 years.

Sol^n:- $t = 4$

$32{,}000 \times \frac{10}{100} = 3200$ (4)

$3200 \times \frac{10}{100} = 320$ (6)

$320 \times \frac{10}{100} = 32$ (4)

$32 \times \frac{10}{100} = 3.2$ (1)

I^st Row → SI

Diff^n 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^n:-

2 year CI → 282.15

2 year SI → 270 → 1 year SI $= \frac{270}{2} = 135$

$D = CI - SI = 282.15 - 270 = 12.15$

D → Interest on interest

and $135 \times \frac{r}{100} = 12.15$

$r = \frac{\cancel{1215}^{\cancel{243}\,81}}{\cancel{135}_{\cancel{27}\,9}} = 9\%$

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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?

Sol^n :-

2 year

CI	SI
605	550

1 year $SI = \frac{550}{2} = 275$

55 ← Interest on Interest

$\therefore \; r = \frac{55}{275} \times 100 = 20\%$

$275 = \frac{P \times 20}{100} \Rightarrow P = 1375$

So, Total saving before Investing $= 1375 \times 2$
$= 2750$ ₹

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Question :- Rs. 100 doubled in 5 years when compounded annually. How many years will it take to get another Rs. 200 compound interest?

Sol^n :-

$2 \rightarrow 5$
$\times 2$
10

So, To earn another 200 interest, It will take another 5 years.

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Compound Interest →

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 of 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?

Sol^n:-

2 year	CI	—	SI
	2400		2000

400

1 year SI $= \frac{2000}{2} = 1000$

Interest on Interest

$1000 \times \frac{r}{100} = 400$

$\boxed{r = 40\%}$

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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?

Sol^n:- for $t = 3$

$\frac{20,000 \times 10}{100} = 2000$ $\quad$ $\frac{2000 \times 10}{100} = 200$ $\quad$ $\frac{200 \times 10}{100} = 20$

3 $\quad$ 3 $\quad$ 1

Total CI $= 6000 + 600 + 20 = \underline{6620}$

He pays 2000 as part repayement

$$2000\left(1+\frac{10}{100}\right)^2 + 2000\left(1+\frac{10}{100}\right) + 2000$$

$$= 2000\left[\frac{121}{100} + \frac{11}{10} + 1\right] = 2000 \times \frac{331}{100}$$

$$= \underline{6620}.$$

Remaining amount $= 20,000 + \cancel{6620} - \cancel{6620}$

$= 20,000$

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Question3:- 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

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Sol^n:- $\frac{1}{5} \rightarrow 20\%$

$100 \rightarrow 120 \rightarrow 144$

$\Downarrow$ 50 $\Downarrow$

$\frac{50}{100} \times 144 = 72m$

Question4:- 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

Sol^n:-

$$\frac{10,000}{7,000} = \frac{\left(1+\frac{r}{100}\right)^8}{\left(1+\frac{r}{100}\right)^4} \Rightarrow \left(1+\frac{r}{100}\right)^4 = \frac{10}{7} \quad \text{—(1)}$$

Now, $7000 = P\left(1+\frac{r}{100}\right)^4 \Rightarrow 7,000 = P\left(\frac{10}{7}\right)$

$$\boxed{P = 4900}$$

Question5: what sum will give Rs. 244 as the diff^n b/w SI and CI at 10% in 1.5 years compounded half yearly?

compounded Half-yearly $\rightarrow t \rightarrow 2\times t$, $r \rightarrow r/2$

Sol^n:- $t = 1.5\times2 = 3$, $r = \frac{10}{2} = 5\%$

$$244 = \frac{P\times5\times5\times305}{(100)^3} \Rightarrow P = \frac{244\times100\times100\times100}{25\times305}$$

$$\boxed{P = 32,000}$$

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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.

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Sol^n:-

Land

30

$\downarrow +20\%$

36

$\downarrow$

$$36 \times \frac{120}{100} \times \frac{120}{100} \times \frac{120}{100} \times \frac{120}{100}$$

$$= 36 \times \frac{6 \times 6 \times 6 \times 6}{625}$$

$$= \frac{46656}{625} = 74.64$$

Building

20 lakh

$\downarrow$

after 4 year

$$\cancel{4}\,\cancel{20} \times \underbrace{\frac{\cancel{80}_{4} \times \cancel{80}_{4}}{\cancel{100} \times \cancel{100}}}_{\text{Ist 2 year}} \times \underbrace{\frac{\cancel{90} \times \cancel{90}}{\cancel{100} \times \cancel{100}}}_{\text{thereafter}}$$

$$= \frac{4 \times 4 \times 9 \times 9}{5 \times 25} = \frac{1296}{125}$$

$$= 10.36$$

Total value after 5 year $= 74.64 + 10.36$

$= 85$ lac

Question 7: Find the nominal rate compounded monthly equivalent to 6% compounded semi-annually. Also find the effective rate of interest.

Sol^n:-

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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 depriciation is 10%. what will be the resale value after 3 years?

Solⁿ:-

$$P = 20{,}000\left[\frac{1}{\left(1+\frac{15}{100}\right)^3} + \frac{1}{\left(1+\frac{15}{100}\right)^2} + \frac{1}{\left(1+\frac{15}{100}\right)}\right]$$

$$= 20{,}000\left[\frac{(23)^3}{(23)^3} + \frac{(23)^2}{(23)^2} + \frac{23}{23}\right]$$

$$= 20{,}000\left[\frac{8000+9200+10580}{12167}\right] = \frac{20{,}000 \times 27780}{12167}$$

$$P = \frac{555600000}{12167} = 45664.50$$

Total cost of Bike $= 45664.50 + 20{,}000$
$= 65664.50$ ₹

Now, Depriciation → 10%

Bike value after 3 year →

$$65664.50 \times \frac{90}{100} \times \frac{90}{100} \times \frac{90}{100}$$

$$= \frac{65664.5 \times 729}{1000} = \frac{47869.420.5}{1000}$$

$$= 47869.42$$

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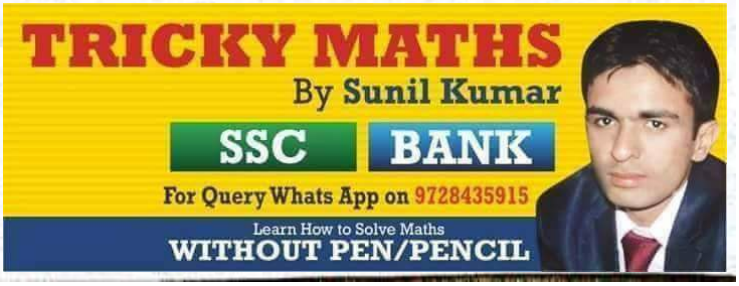

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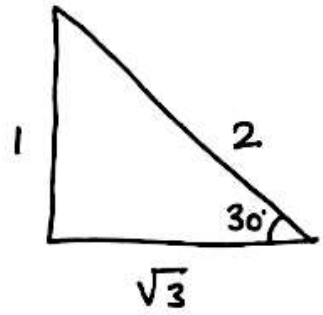
Trigonometry – Height and Distance.

P : B : H

$1 : \sqrt{3} : 2$

1).



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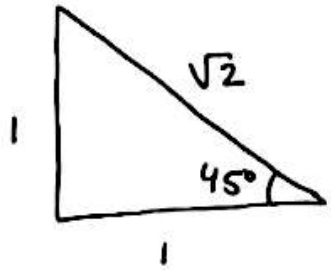
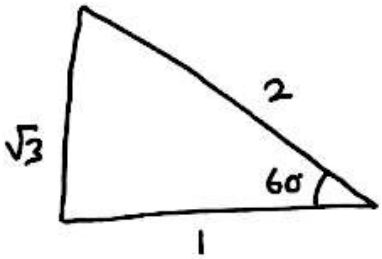


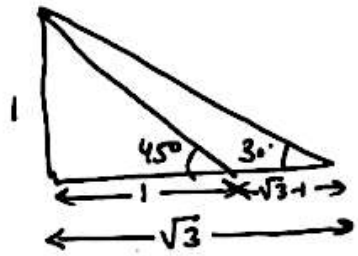
$1 : 1 : \sqrt{2}$

3).



$\sqrt{3} : 1 : 2$

4).



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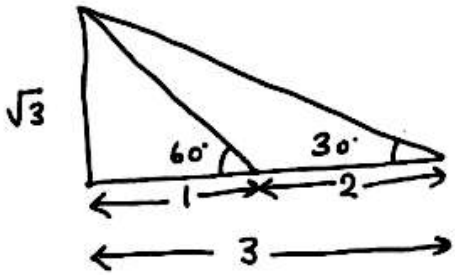
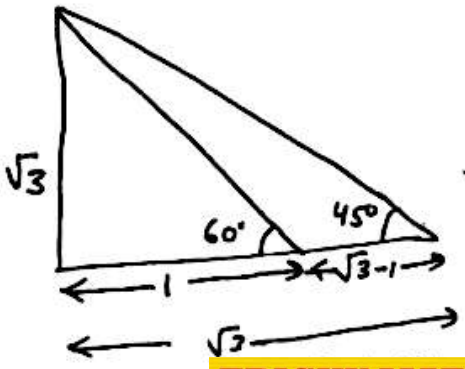
5).



6).



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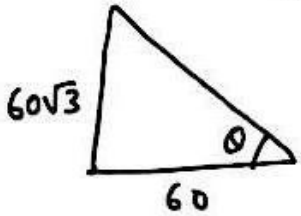
Examples :-

Q.1 A tower is $60\sqrt{3}$ mt. height. Find the angle of elevation of its top from a point 60 mt. away its foot.

Sol^n:-



P : B

$\sqrt{3} : 1$

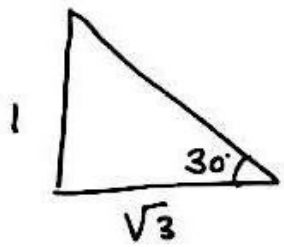
so $\boxed{\theta = 60^\circ}$

OR $\tan\theta = \sqrt{3}$

$\boxed{\theta = 60^\circ}$

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^n:-

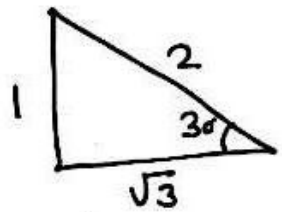


$\sqrt{3} = 500$ mt

so, $1 = \frac{500}{\sqrt{3}}$.

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.



$\sqrt{3} = 20$ mt

height of the tree before broken

$= 1 + 2 = 3$ so.

$\sqrt{3} = 20$

$3 = \frac{20}{\sqrt{3}} \times 3 = \frac{\cancel{60}^{20}\sqrt{3}}{\cancel{3}} = 20\sqrt{3}$.

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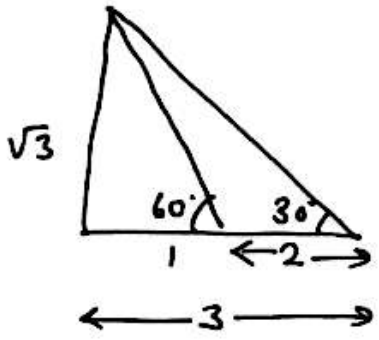
Q.4 :- A man from the top of a 50mt high tower see moving towards the tower at an angle of depression is 60°. The distance travelled by the car during this time.

Sol^n :-



$\sqrt{3} = 50$

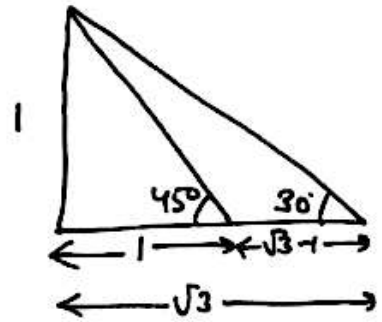
$a = \frac{50 \times 2}{\sqrt{3}} = \frac{100}{\sqrt{3}}$.

Distance travelled by car

$= \frac{100}{\sqrt{3}}$.

Q.5 :- The shadow of an electric hole standing on a ground is 40mt less when the angle of elevation change 30° to 45°. Find height of the pole?

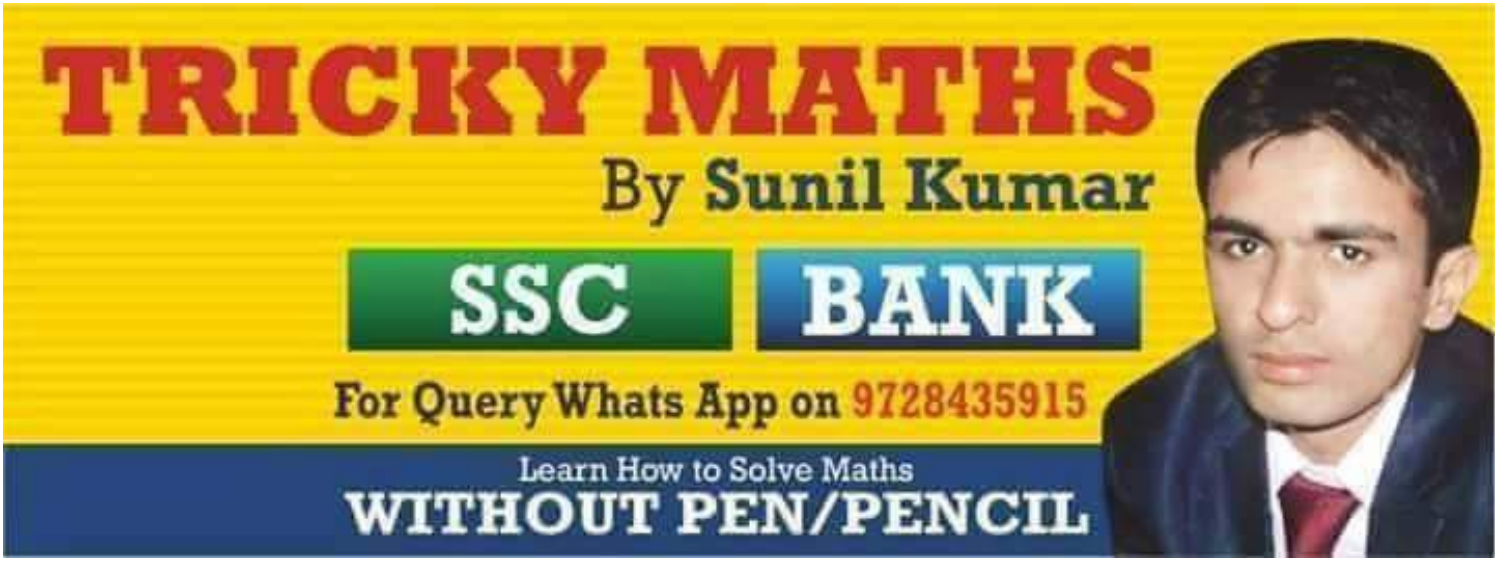
Sol^n :-



$\sqrt{3}-1 = 40$

height of the pole $1 = \frac{40}{\sqrt{3}-1}$

$= \frac{40(\sqrt{3}+1)}{3-1} = 20(\sqrt{3}+1)$



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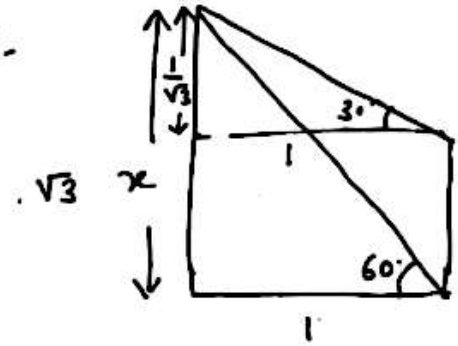
Q.6 :- From the top of x mt. high cliff the angle of depression of the top and bottom are observed to be 30° and 60° respectively. Height of tower ?

Solⁿ :-



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

so → $\sqrt{3} = x$

$$\frac{2}{\sqrt{3}} = \frac{2x}{3}.$$

height of tower $= 2x/3$.

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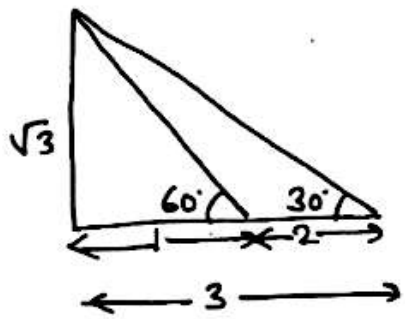
Q.7 :- A person standing on the bank of a river observes that angle of elevation of the tree top on the opposite side of the bank is 60°. when he moves 50mt from the bank the angle of elevations became 30°. Height of the tree & width of the River are ?

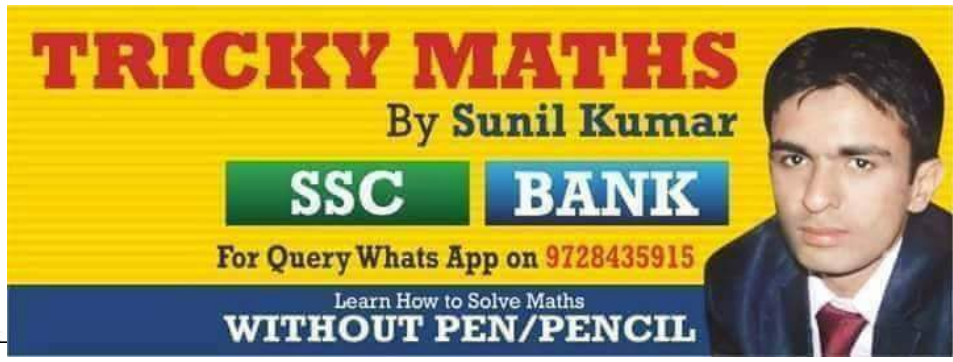
Solⁿ :-



Given
2 = 50.

Height of Tree $\sqrt{3} = \frac{50}{2} \times \sqrt{3} = 25\sqrt{3}$ m.

width of River $3 = \frac{50}{2} \times 3 = 75$ m



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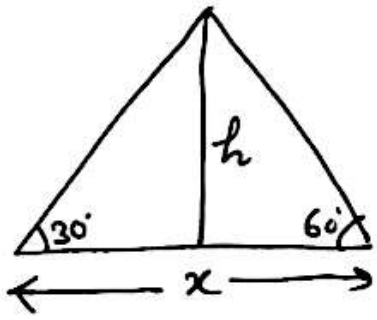
Imp :-

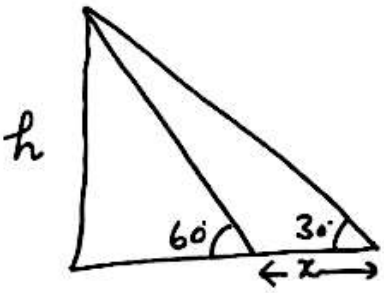
1). जब दो object एक height object के opposite side में हो and angle 30° & 60° बना रहे हो तो, उनके बीच की दूरी = ?



[Angle must be 30° & 60°]

$$x = \frac{4h}{\sqrt{3}}$$

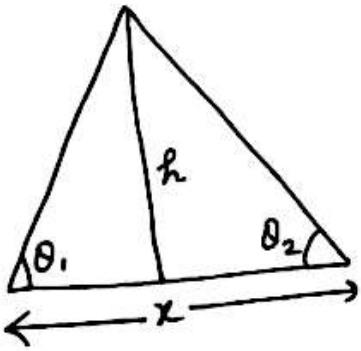
2). जब दोनो object एक ही side angle form करते है तब दोनो object के बीच की दूरी



$$x = \frac{2h}{\sqrt{3}}$$

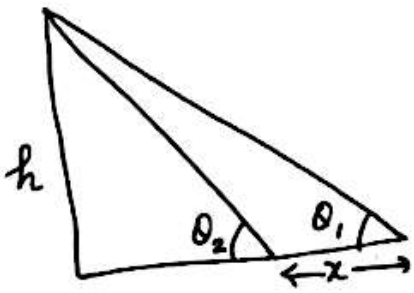
Angle must be 30° and 60°

3.)

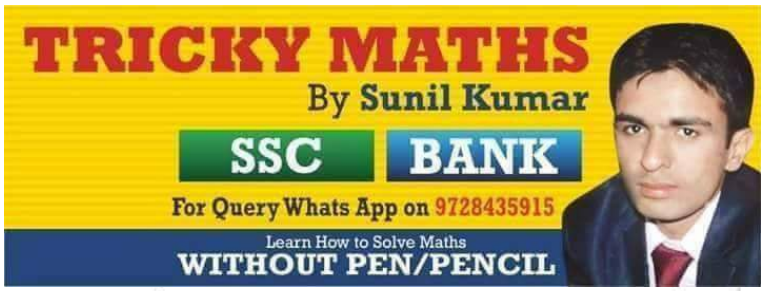


$$x = h[\cot\theta_1 + \cot\theta_2]$$

4.).



$$x = h[\cot\theta_1 - \cot\theta_2]$$



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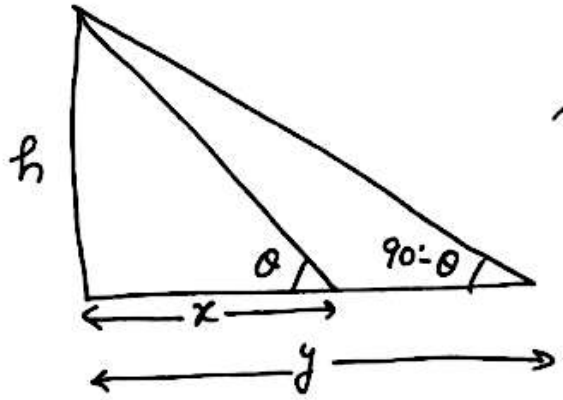
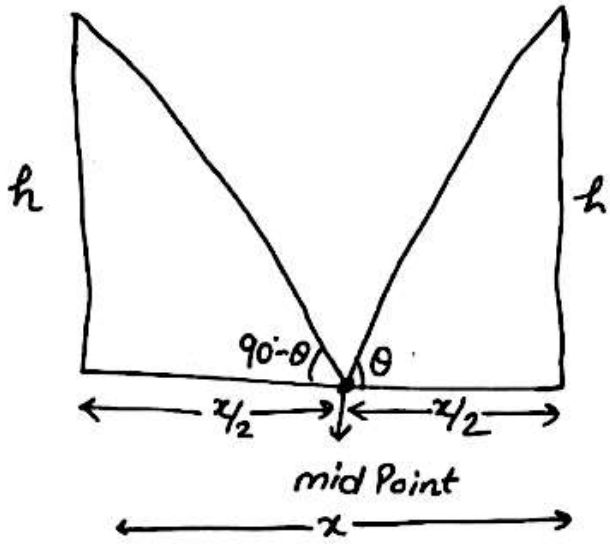
5). Complementry Angle.



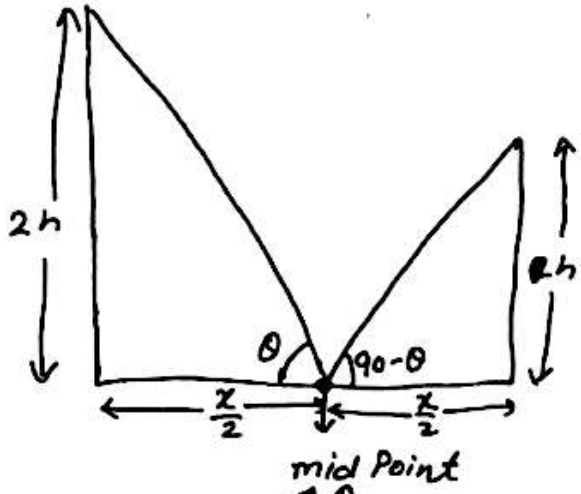
so, $\boxed{h = \sqrt{xy}}$

6).



$\boxed{h = \frac{x}{2}}$

7).



$\boxed{h = \frac{x}{2\sqrt{2}}}$

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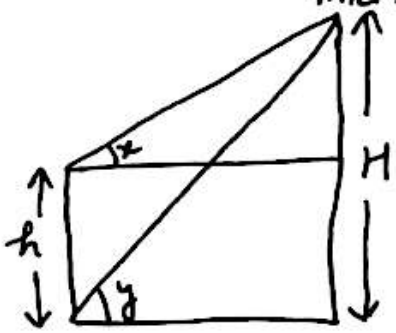
8).



always $\boxed{x < y}$

$$H = h\left[\frac{\cot x}{\cot x - \cot y}\right]$$

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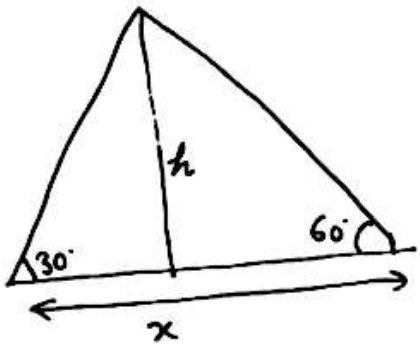
Q:- A person is standing on the top of a tower of 100m high. He observed that 2 cars are approaching towards the tower from opposite direction making an angle of depressing of 30° and 60° respectively. What is distance b/w 2 cars?

Sol^n:-



$$x = \frac{4h}{\sqrt{3}} = \frac{4 \times 100}{\sqrt{3}}$$

$$\boxed{x = \frac{400}{\sqrt{3}}}$$

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)

Sol^n:- Dir^n → North to South [opposite Dir^n]

and angle 30° & 60°

So, Distance $x = \frac{4h}{\sqrt{3}} = \frac{4 \times 50}{\sqrt{3}} \times \frac{\sqrt{3}}{2}$

$= 200$ 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 अपना स्थान बदले या Aeroplane → we will consider same dirⁿ.

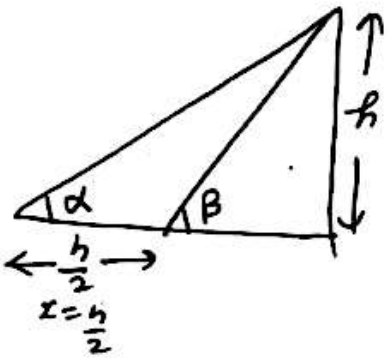
So, $h = 1500\sqrt{3}$

$$x = \frac{2h}{\sqrt{3}} = \frac{2 \times 1500\sqrt{3}}{\sqrt{3}} = 3000$$

$$\text{Speed} = \frac{d}{t} = \frac{3000}{15} = 200 \text{ m/s}.$$

Q, The height of a tower if 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 $\cot\alpha - \cot\beta = ?$

Solⁿ:-



$$x = h[\cot\theta_1 - \cot\theta_2]$$

$$\frac{\cancel{h}}{2} = \cancel{h}[\cot\alpha - \cot\beta]$$

$$\boxed{\cot\alpha - \cot\beta = 1/2}$$

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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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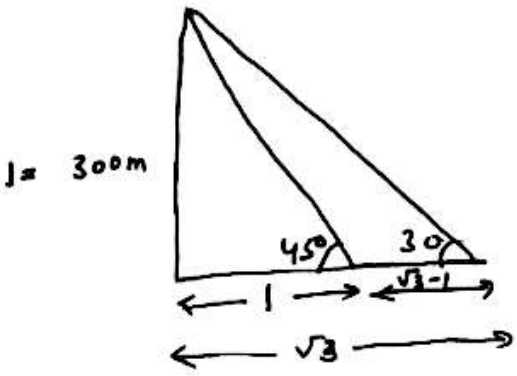


$1 = 300$

$\sqrt{3}-1 = 300(\sqrt{3}-1)$ mt.

[which is length of the bridge]

OR

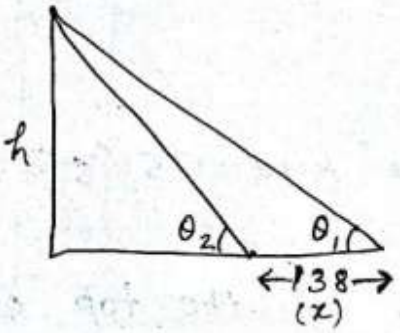
$x = h[\cot\theta_1 - \cot\theta_2]$

$x = 300[\cot 30° - \cot 45°]$

$x = 300(\sqrt{3}-1)$ Ans.

Question :- At a point on a horizontal line through the base of a monument, the angle of elevation of the top of the mounment is found to be such that its tangent is $1/5$. On walking 138 mt. towards the ~~mou~~ monument the secant of the angle of elevation is found to be $\frac{\sqrt{193}}{12}$. The height of the monument (in metre) is –

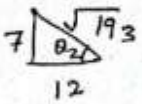
Sol^n:-



$\tan\theta_1 = \frac{1}{5}$

so, $\cot\theta_1 = \frac{5}{1}$

$\sec\theta_2 = \frac{\sqrt{193}}{12}$



$\cot\theta_2 = \frac{12}{7}$

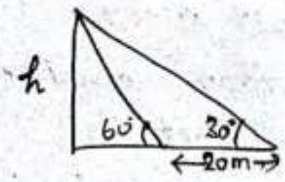
$x = h[\cot\theta_1 - \cot\theta_2]$

$138 = h\left[5 - \frac{12}{7}\right] \Rightarrow h = \frac{138 \times 7}{35-12} = \frac{\cancel{138}^{6} \times 7}{\cancel{23}}$

$\boxed{h = 42}$ 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

Sol^n:-



$x = \frac{2h}{\sqrt{3}} \Rightarrow \cancel{20}^{10} = \frac{\cancel{2} \times h}{\sqrt{3}}$

$\boxed{h = 10\sqrt{3}}$

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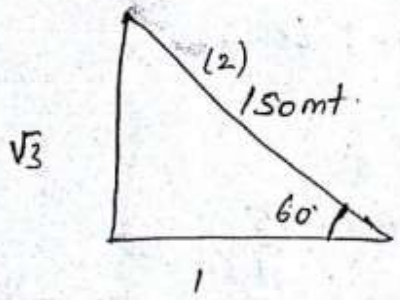
Question :- One flies a kite with a thread 150 mt long. If the thread of the kite makes an angle of 60° with the horizontal line, then the height of the kite from the ground (assuming the thread to be in a straight line) is -

(1) 50 mt (2) $75\sqrt{3}$ mt (3) $25\sqrt{3}$ mt. (4) 80 mt

Sol^n:-



$2 \rightarrow 150$

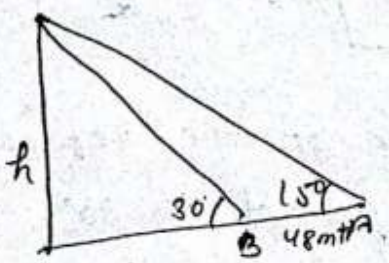
$1 \rightarrow 75$

$\sqrt{3} \rightarrow 75\sqrt{3}$

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?

Sol^n:-



$x = h[\cot\theta_1 - \cot\theta_2]$

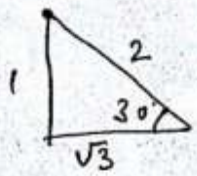
$48 = h[\cot 15° - \cot 30°]$

$48 = h[2 + \cancel{\sqrt{3}} - \cancel{\sqrt{3}}]$

$h = \frac{48}{2} = 24$ 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 -

Sol^n:-



$\sqrt{3} \rightarrow 8\sqrt{3}$

Height of Post $= 1+2 \Rightarrow 3 = \frac{8\sqrt{3}}{\sqrt{3}} \times 3 = 24$ mt.

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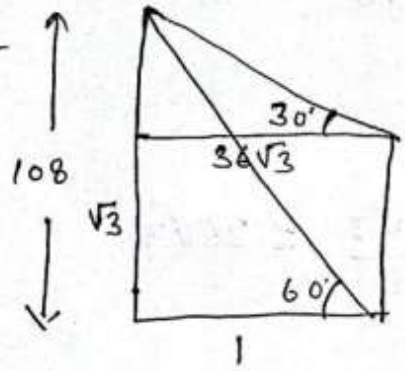
Question :- There are two vertical posts one on each side of a road, just opposite to each other. One post is 108 mt high from the top of this post, the angle of depression of the top and foot of the other post are 30° and 60° respectively. The height of the other post, in metre, is -

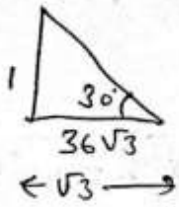
Sol^n :-



$\sqrt{3} = 108$

$1 = \frac{108}{\sqrt{3}} = \frac{108\sqrt{3}}{3} = 36\sqrt{3}$

Now



so, $\sqrt{3} = 36\sqrt{3}$

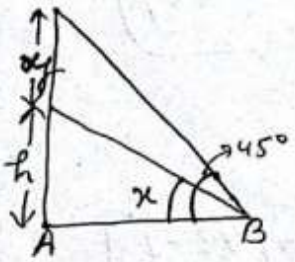
$1 \rightarrow 36$

Height of other Post $= 108 - 36 = 72$ mt.

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 mt. is:

(1) $h\cot x + h$ (2) $h\cot x - h$ (3) $h\tan x - h$ (4) $h\tan x + h$

Sol^n :-



$\tan 45° = \frac{h+y}{AB}$

$\boxed{AB = h+y}$

$\tan x = \frac{h}{AB}$

$AB = \frac{h}{\tan x}$

$h+y = \frac{h}{\tan x}$

$h+y = h\cot x$

$\boxed{x = h\cot x - h}$

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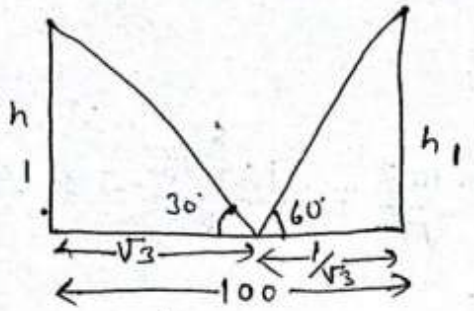
Question:- Two poles of equal heights are standing opposite to each other on either side of a road which is 100m wide. From a point between them on road, angles of elevation of their tops are 30° and 60°. The height of each pole in metre is:-

Soln:-



$$\sqrt{3}+\frac{1}{\sqrt{3}} = 100$$

$$\frac{4}{\sqrt{3}} = 100$$

$$1 \rightarrow \frac{100\sqrt{3}}{4} = 25\sqrt{3}.$$

i.e

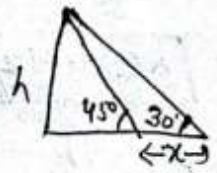
$$1 \rightarrow \boxed{h = 2\sqrt{3}}$$

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 → सूर्य अपना स्थान बदले तो Aeroplane → we will consider same Direction.

So, $\boxed{\frac{2h}{\sqrt{3}} = x}$ → for 30° & 60°

and $\boxed{x = h[\cot\theta_1 - \cot\theta_2]}$



$$20 = h[\cot 30° - \cot 45°] \Rightarrow 20 = h[\sqrt{3}-1]$$

$$h = \frac{20}{\sqrt{3}-1} \Rightarrow \frac{20(\sqrt{3}+1)}{2} = 10(\sqrt{3}+1)\text{ mt.}$$

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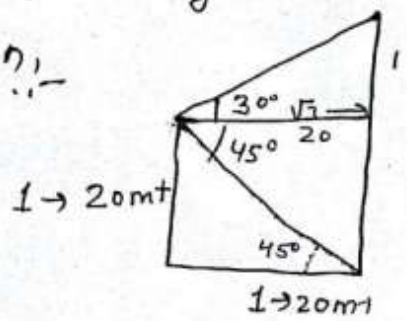
Question :- From the top of a pillar of a height 20m the angle of elevation and depression of the top and bottom of another pillar are 30° and 45° respectively. The height of the second pillar (in metre) is -

Sol^n :-



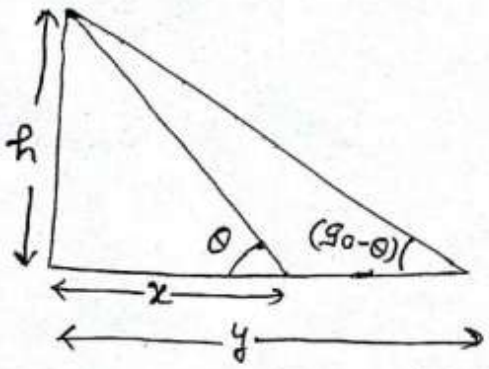
So, $\sqrt{3} \rightarrow 20$

$1 \rightarrow \frac{20}{\sqrt{3}}$

height of second pillar

$= 20 + \frac{20}{\sqrt{3}} = 20\left(\frac{\sqrt{3}+1}{\sqrt{3}}\right)$

NOTE :-



$\boxed{h = \sqrt{xy}}$

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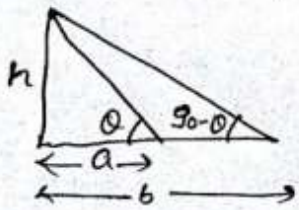
Question :- The angle of elevation of the top of a tower two point which are at a distance a and b from the foot in the same horizontal line and on the same side of the tower are complementry the height of the tower is

Sol^n :-



$\boxed{h = \sqrt{ab}}$

or $\frac{h}{a} = \tan(90-\theta) = \cot\theta$ — (1)

$\frac{h}{b} = \tan\theta$ — (2)

$\tan\theta . \cot\theta = \frac{h}{a} \times \frac{h}{b}$

$ab = h^2 \Rightarrow \boxed{h = \sqrt{ab}}$

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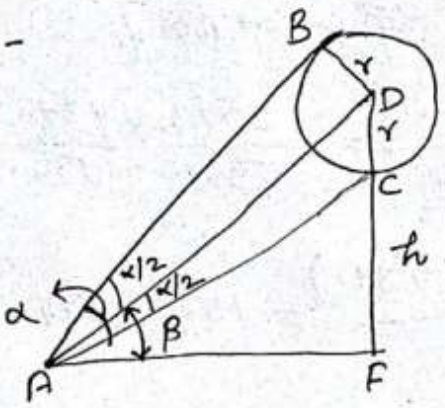
Height and Distance

Question1:- A round ballon 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 ballon is —

Sol^n:-



$$\sin\frac{\alpha}{2} = \frac{BD}{AD} = \frac{r}{AD}$$

$$AD = r\,\text{cosec}\frac{\alpha}{2} \quad —(1)$$

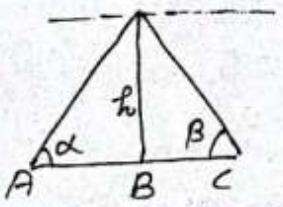
$$\sin\beta = \frac{h}{AD} \qquad h \to DF$$

$$h = AD\sin\beta \quad —(2)$$

So, $\boxed{h = r\,\text{cosec}\frac{\alpha}{2}\cdot\sin\beta}$

Question2:- From an aeroplane just above a straight plane rodd, the depression angle of 2 consecutive milestone are α and β. If the plane stay between 2 milestones, then prove that height of the areoplane is — $\dfrac{\tan\alpha \times \tan\beta}{\tan\alpha + \tan\beta}$ $(AC = 1)$

Sol^n:-



$$\tan\alpha = \frac{h}{AB}, \quad \tan\beta = \frac{h}{BC}$$

$$\frac{\tan\alpha \times \tan\beta}{\tan\alpha + \tan\beta} = \frac{\frac{h}{AB} \times \frac{h}{BC}}{h\left[\frac{1}{AB} + \frac{1}{BC}\right]} = \frac{\frac{h}{AB \times BC}}{\frac{AB + BC}{AB \times BC}}$$

$$\boxed{\frac{\tan\alpha \times \tan\beta}{\tan\alpha + \tan\beta} = h}$$

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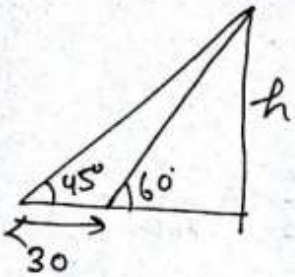
Question3:- The shadow of tower standing on a level plane is found to be 30m longer when the sun's altitude changes from 60° to 45°. The height of the tower is -

Soln:-

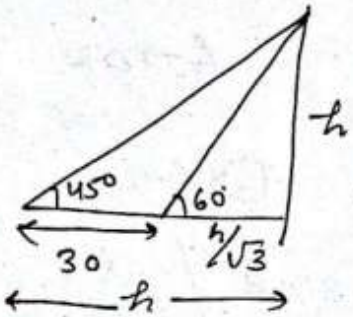


$$30 = h\left[\cot 45^\circ - \cot 60^\circ\right]$$

$$h = \frac{30}{1-\frac{1}{\sqrt{3}}} = \frac{30\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

$$= \frac{\overset{15}{\cancel{30}}\sqrt{3}(\sqrt{3}+1)}{\cancel{2}} = 15\sqrt{3}(\sqrt{3}+1)$$

or



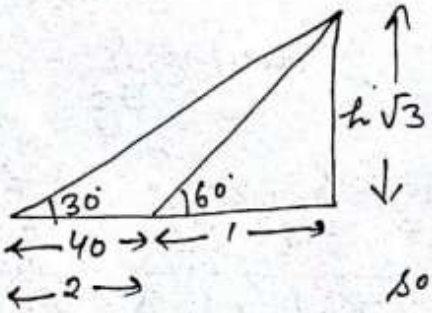
$$h - \frac{h}{\sqrt{3}} \rightarrow 30$$

$$h\left(\frac{\sqrt{3}-1}{\sqrt{3}}\right) \rightarrow 30$$

$$h \rightarrow \frac{30\sqrt{3}}{\sqrt{3}-1}\,\frac{(\sqrt{3}+1)}{(\sqrt{3}+1)} = 15\sqrt{3}(\sqrt{3}+1)$$

Question4:- 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-

Soln:-



$2 \rightarrow 40$

$\boxed{1 \rightarrow 20m}$

So, Breadth of the River → 20m.

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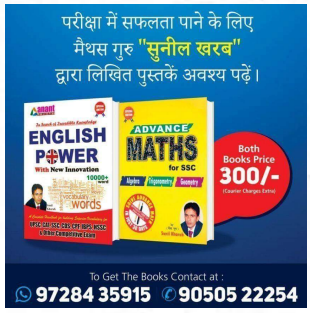
Voters and Election Questions :-

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 –



Solⁿ :-

100

↓ −24%

76

40 | 36% − 150 [150 → were declared invalid]

4% + 150 → 500

4% → 350

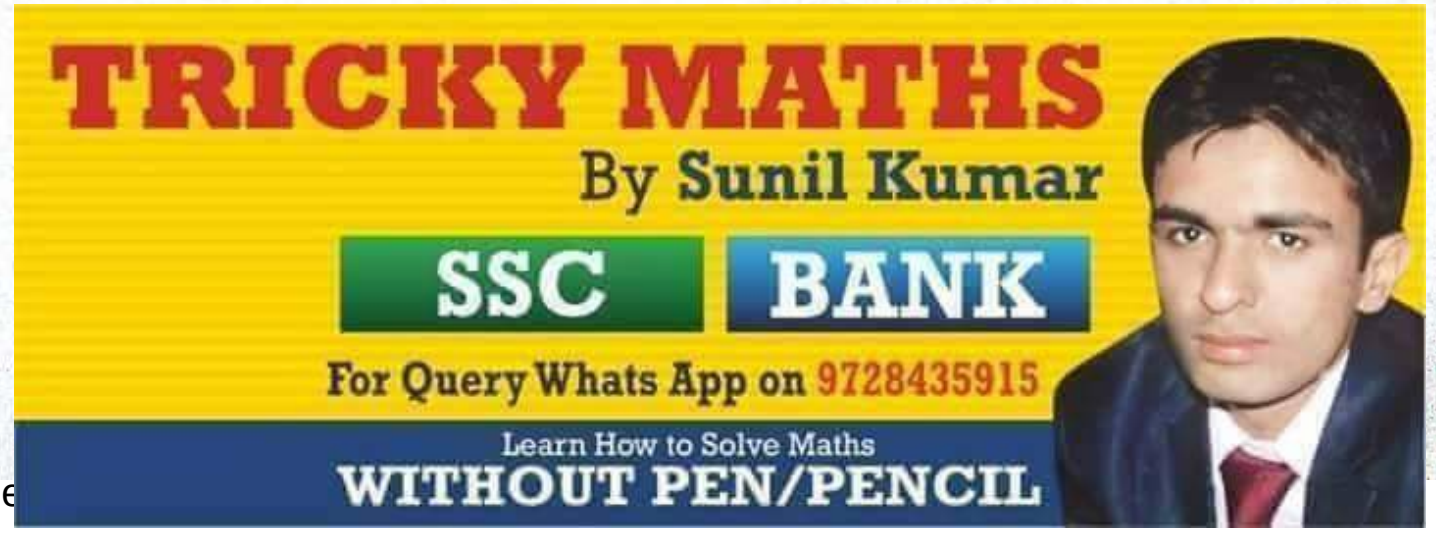
$36\% - 150 \rightarrow \frac{350}{4} \times 36 - 150 = 3150 - 150$

$= 3000$

Defeated candidate secured → 3000 votes.

Total cast vote $76 \rightarrow \frac{350}{4} \times 76 = 6650$

% of the defeated candidate $= \frac{3000}{6650} \times 100 = 45.11\%$



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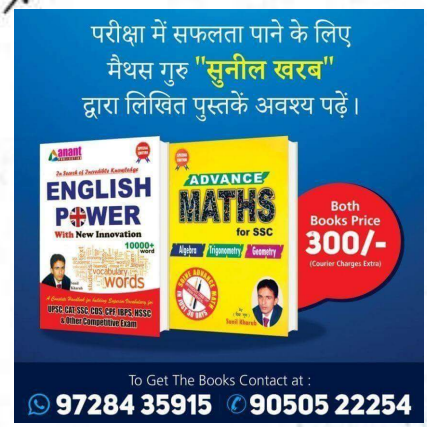
Question 2:- In an election, the total turout was 80% out of which 16% of the total voters were declared invalid. Find which of the following can be the percentage of the votes got by the winner of the election. If the candidate who came second got 20% of the total voters on the voting list. (There were only three contestents, only one winner, and the total no. of voters on the voter's list = 20,000)

(a) 44% (b) 46% (c) 48% (d) 49%



Sol^n:-

Total voters → 20,000

↓ 80%

16,000

Invalid 16% → 3200

2nd position candidate → 20% → 4000

No. of votes left = 16000 − 4000 − 3200

= 8800

% of votes won by winning candidate

$$= \frac{8800}{20000} \times 100 = 44\%$$

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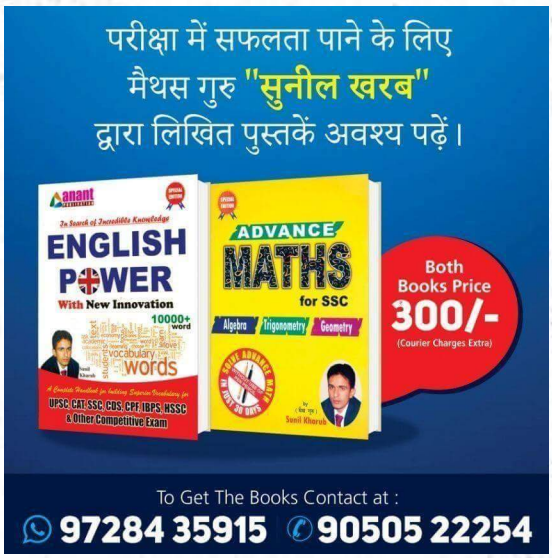
Question3. At an election, the candidate who got 56% of the vote cast won by 144 votes. Find the total no. of voters on the voting list. If 80% people cast their vote and their were no invalid vote?



Sol^n:-

100

↓ −20

80%

56% 44%

12% → 144

12% of 80 → 144

$100 \rightarrow \frac{144}{12 \times 80} \times 160 = 1500$

Question4:- In an election between two candidates, 10% of voters were declare 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^n:-

100

↓

90

54 36

18 → 1800

100 → 10000

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Question5:- 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?

Solⁿ:-

100

↓ −10%

90

↓ −10 (invalid)

81

Total valid

54 46

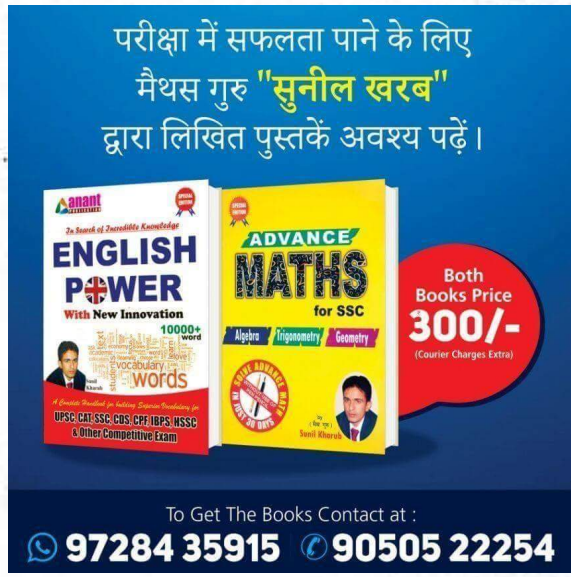
8 → 1620

8% → 8% of 81 → 1620

100% → $\frac{1620}{81 \times 8} \times 100 \times 100$

= 25000

No. of enrolled votes → 25,000



Question6:- In an election b/w 2 candidates, 20% of votes were declares invalid. First candidate got 480 votes more which were 60% of the total valid votes. The total no of votes enrolled in that election was-

Solⁿ:-

100

↓ −20

80

48 32

16 → 480

100 → 30×100

= 3000 Votes

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:-

100

↓ −10

90

60 — 30% − 300

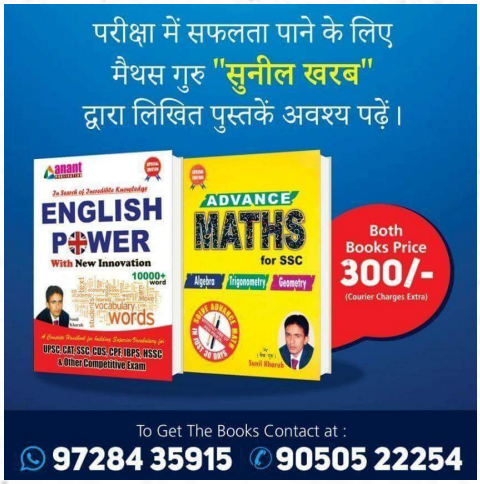
30% + 300 → 900

30% → 600

1 → 20

90 → 1800

Total valid vote 90% − 300 = 1500.



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 successfull candidate got 52% of total votes and won by majority of 640 votes. what was the total number of voters?

Solⁿ:-

100

↓

90

↓

72

52 — 20

32 → 640

1 → 20

100 → 20,000

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

Sol^n:-

100

56 = D — R = 44 → 132,000

12%

$$12 \rightarrow \frac{\cancel{132}^{3},000}{\cancel{44}_{4}} \times 12$$

$= 36,000$

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

Sol^n:-

100

↓

75%

↓ −2%

73.5

75% 25%

$73.5 \times 75\% = 9261$

$$100 \rightarrow \frac{\cancel{9261}^{3087} \times \cancel{100}^{4} \times 100}{73.5 \times \cancel{75}_{3}}$$

$= 16800$

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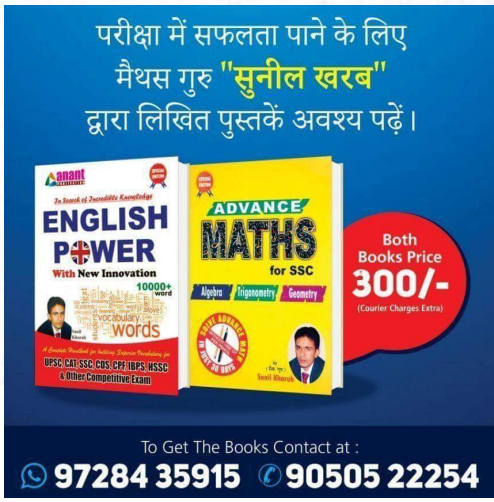
Voters and Elections Questions

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 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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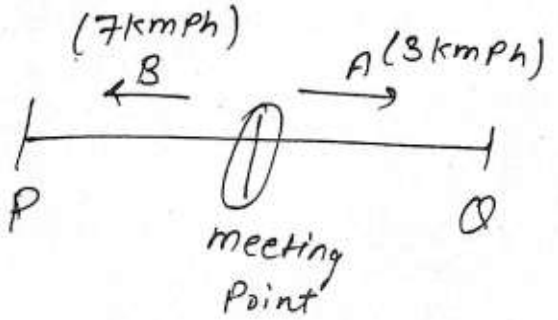
Ans. 4 →



$$\frac{s_1}{s_2} = \sqrt{\frac{t_2}{t_1}} \Rightarrow \frac{3}{7} = \sqrt{\frac{x \times x}{100}} \Rightarrow \frac{3}{7} = \frac{x}{10}$$

$$x = \frac{30}{7} \text{ hours}$$

$$\text{Total Distance} = 7 \times \frac{30}{7} + 3 \times \frac{100 \times 7}{30}$$

$$= 30 + 70 = 100 \text{ km.}$$

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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 contestent by 1100 votes. The total no. of voters in the election was –

(1) 21,000 (2) 23500 (3) 22000 (4) 27500 ✓

Sol^n:-

100

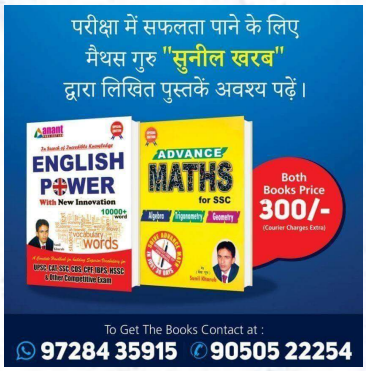
$\downarrow -8$

92

48 44

4 → 1100

$100 \rightarrow \frac{1100 \times 100}{4} = 27500$



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

Sol^n:-

100

$\downarrow$

75 $\xrightarrow{-2\%}$ 73.5%

75% 25%

75% of 73.5 → 9261

$100 \rightarrow \frac{9261 \times 100 \times 100}{73.5 \times 75} = 16,800$

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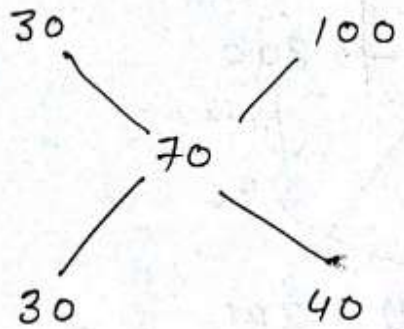
Q.5 :- 75 gm of sugar solution has 30% sugar in it. Then the quantity of sugar that should be added to the solution to make the quantity of the sugar 70% in the solution is -

(1) 125 gm (2) 100 gm (3) 120 gm (4) 130 gm

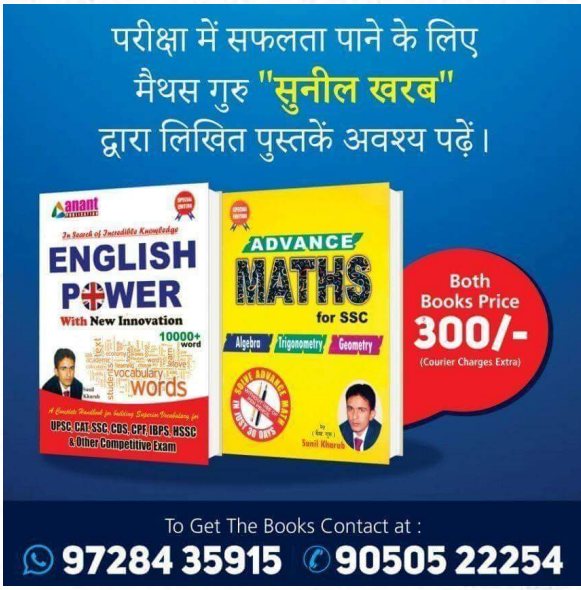
Solⁿ :



3 : 4

↓ ↓

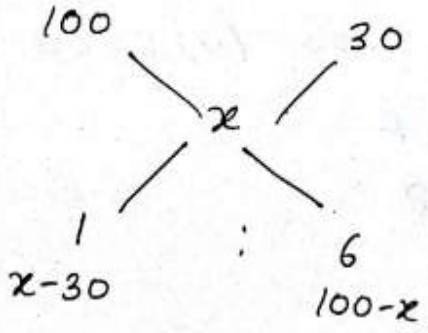
75 100 gm



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 :-



(I) check through option

[or]

$$\frac{x-30}{100-x} = \frac{1}{6}$$

$$7x = 180 + 100 = 280$$

$$x = \frac{280}{7} = 40\%$$

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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^n:-

E	:	S	I
5	:	3	
500	:	300 →	800
↓ +15%			↓ +12%
575			896

Saving = 321

$\% \text{ increase} = \frac{21}{300} \times 100 = 7\%$

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^n:-

M F

10 8

9

1 : 1

2 → 8000 (4000)

M → 4000

F → 4000

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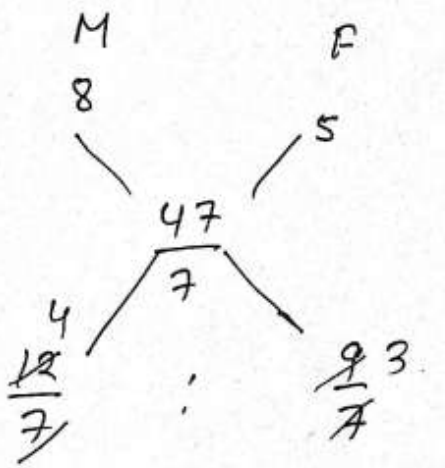
Q.19 :- The population of a village was 9800. In a year, with the increase in population of males by 8% and that of females by 5%, the population of the village became 10458. what was the no. of males in the village before increase?

(1) 4200 (2) 4410 ✓(3) 5600 (4) 6048

Sol^n :-



4 : 3

7 → 9800

1 → 1400

male (4) → 5600

F (3) → 4200

$9800 \xrightarrow{\text{Total}} 10458$

$\% \uparrow \rightarrow \frac{658}{9800} \times 100$

$= \frac{47}{7}\%$

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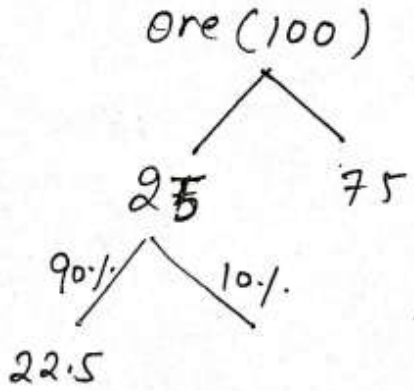
Q.7:- An Ore contains 25% of an alloy that has 90% iron. Other than this, in the remaining 75% of the ore, there is no iron. To obtain 60kg of pure iron, the quantity of the ore needed (in kgs) is approximately -

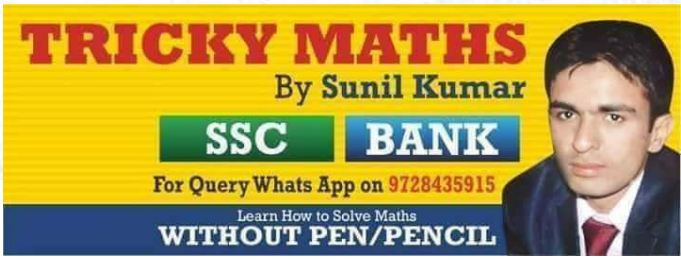
(1) 250.57 (2) 266.67 (3) 275.23 (4) 300

Solⁿ:-



$$x \times \frac{22.5}{100} = 60$$

$$x = \frac{60 \times 100}{22.5} = 266.67$$



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Q →

$$\left.\begin{aligned} A+B+C &= 4\sqrt{3} \\ A^2+B^2+C^2 &= 16 \end{aligned}\right\} \text{ find } A:B:C$$

$= 1:1:1$

Put $A = B = C = \frac{4}{\sqrt{3}}$

[because → $(A+B+C)^2 = A^2+B^2+C^2 + 2(AB+BC+CA)$

$48 = 16 + 2(AB+BC+CA)$

$16\ \cancel{32} = \cancel{2}(AB+BC+CA)$

So, $A^2+B^2+C^2 = AB+BC+CA$

[only when $A=B=C$]

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$\Rightarrow$

$$a^2 + \frac{1}{a^2} = 7$$

max^m

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

$$a^3 + \frac{1}{a^3} = 27 - 9$$

$$v_2 = 18$$

min^m

$$a + \frac{1}{a} = -3$$

$$a^3 + \frac{1}{a^3} = -27 + 9$$

$$v_1 = -18$$

$$v_2 - v_1 = 18 - (-18) = 36$$

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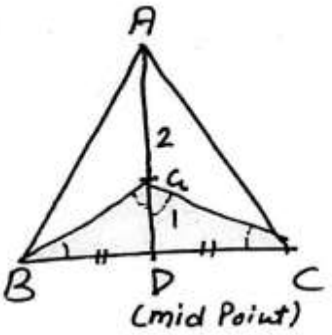
Q.:- यदि G एक ΔABC का ऐसा केंद्रक हो, जिसमें $AG = BC$ हो, तो $\angle BGC$ का मान कितना होगा?

Solⁿ:- (1) 60° (2) 90° (3) 120° (4) 135°



$AG = 2DG$

and $AG = BC$

so, $GD = \frac{1}{2}BC$

so, $[GD = BD = CD]$

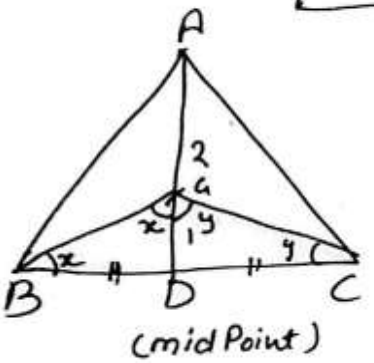
so ΔBGD & ΔDGC [Isosceles Δ]

so, $\angle BGC = \angle BGD + \angle DGC = \angle DBG + \angle DCG$

so, $\cancel{2}\angle BGC = \cancel{180}^{90^\circ}$ (Δ property)

$\boxed{\angle BGC = 90^\circ}$

OR



$AG = 2GD = BC$

$\therefore GD = BD = CD$

ΔBGD & $\Delta DGC \rightarrow$ Isosceles Δ

apply isosceles Δ property.

take $\Delta BGC \Rightarrow$

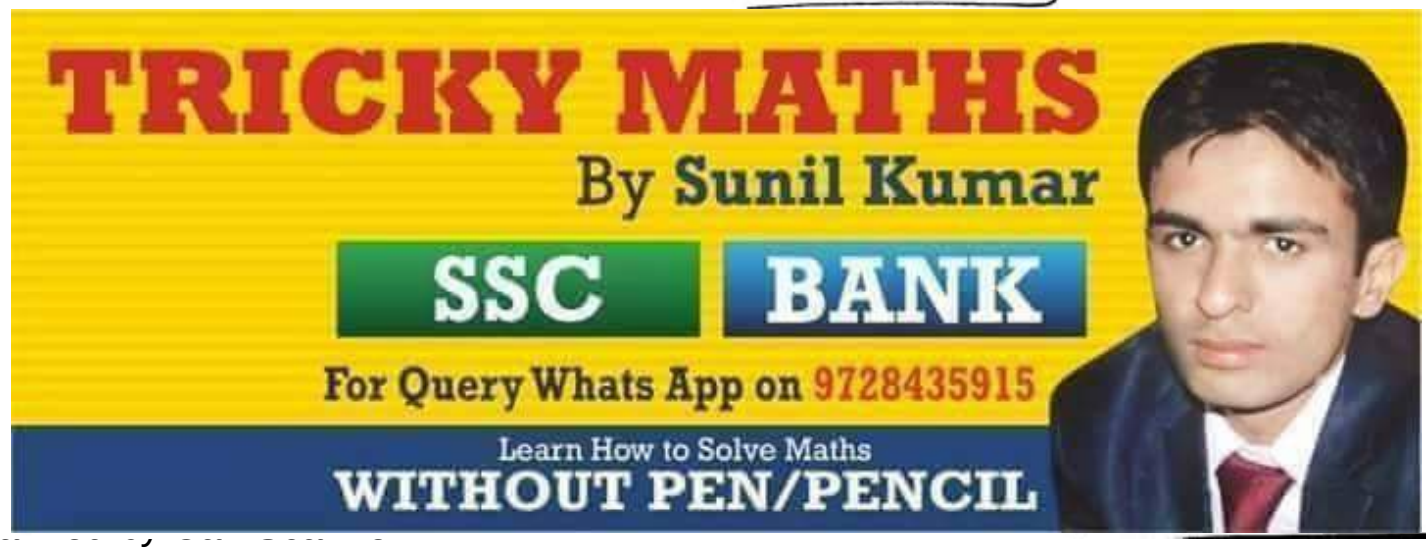
$x + y + (x + y) = 180^\circ$

$\cancel{2}(x+y) = \cancel{180}^{90^\circ}$

$\Downarrow$

$\angle BGC$

$\boxed{\angle BGC = 90^\circ}$



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 2/3 of his amount while B is left with Rs. 145. Then the value of the gift is?

Sol^n:- saving 4:5 → A : B → 4x 5x

Expenditure 3:4 [gift cost 7] → A : B → 3y 4y

$$\frac{(4x)\times\frac{1}{3}}{5x-145} \neq \frac{3}{4} \Rightarrow 16x = 9(5x-145)$$

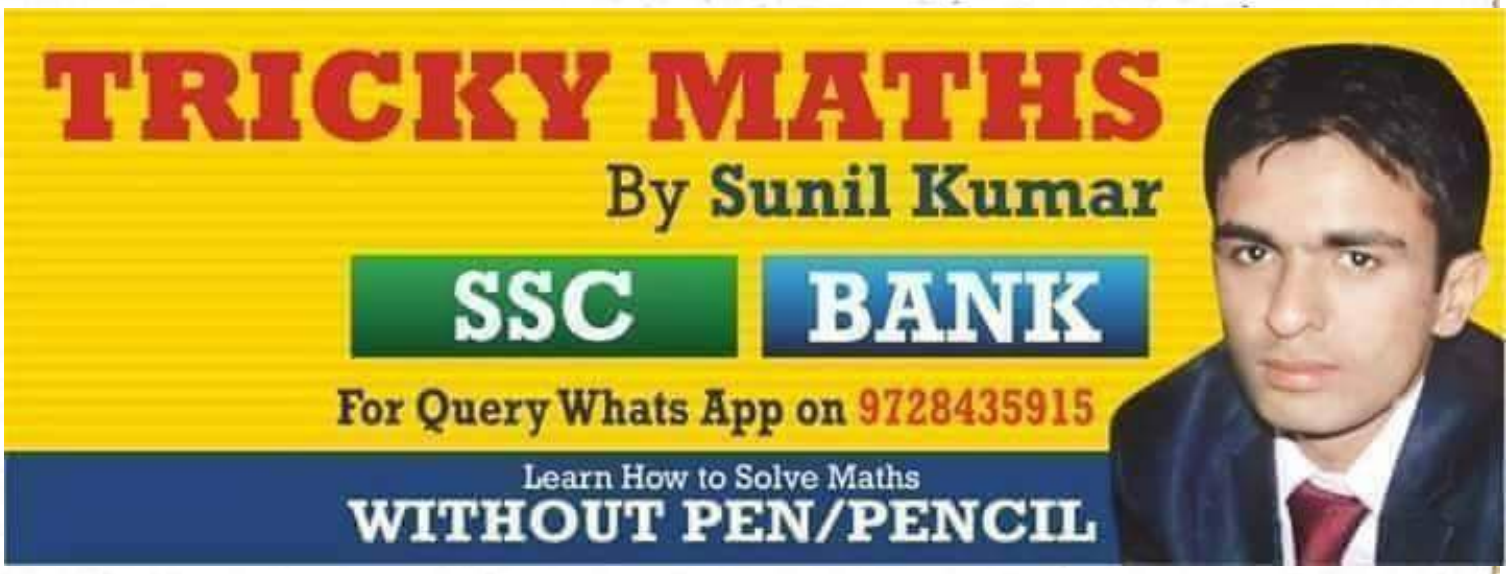
$$29x = 145\times 9$$

$$\boxed{x = 45}$$

so → $5\times 45 - 145 = 4y$

$$\frac{225-145}{4} = y \Rightarrow \boxed{y = \frac{80}{4} = 20}$$

gift cost $= 20\times 7 = 140$ Rs.



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Q:- एक व्यक्ति ने कुछ दूरी किसी चाल से तय की। यदि वह 3 km/h अधिक की चाल से वह दूरी तय करता तो उसे 40 मिनट कम समय लगता। यदि वह 2 km/h कम की चाल से वह दूरी तय करता, तो उसे 40 मिनट अधिक लगेगा। वह दूरी (km) में है?

(1) 20 (3) 35

(2) $36\frac{2}{3}$ (4) 40

Solⁿ:-

$$\begin{array}{ccc} s & & t \\ +3 & \times & -40 \end{array} \Rightarrow -40s + 3t = |-40 \times 3| \quad \text{--- (1)}$$

$$\begin{array}{ccc} s & & t \\ -2 & \times & +40 \end{array} \Rightarrow 40s - 2t = |+40 \times (-2)| \quad \text{--- (2)}$$

$t = 120 + 80 = 200$ minute.

$$s = \frac{80 + 2 \times 200}{40} = \frac{480}{40} = 12 \text{ Km/h}$$

Distance $D = \frac{\overset{2}{\cancel{12}} \times 200}{\cancel{40}} = 40 \text{ km}$

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Q.:- 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.

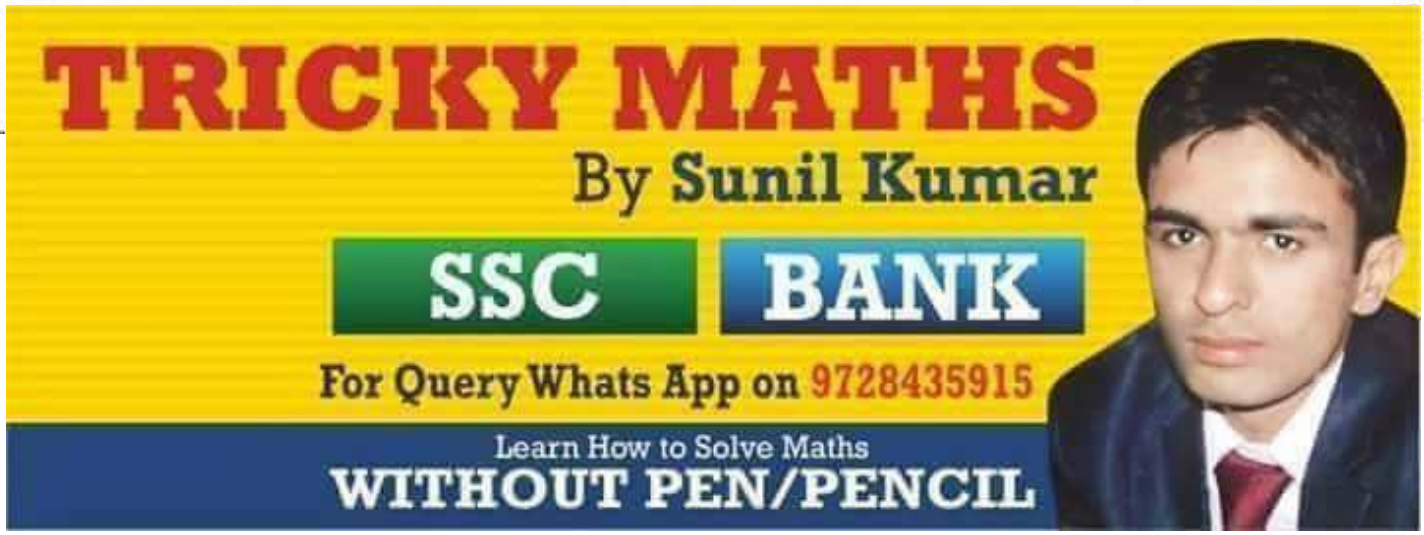
(A) 40% (B) 39% (C) 50% (D) 20%.

Solⁿ:-

$$16 \times \frac{138}{100} = \left(\cancel{15} \times \frac{x}{100}\right) \times \frac{96}{100}$$

$$x = \frac{144}{96} \times 100 = 150 \text{ (MRP)}$$

So, MRP ↑ed 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 :-

$$150(n-8) = \frac{n}{2}\left[2\times150+(n-1)(-4)\right]$$

$$150(n-8) = n[150-2(n-1)]$$

either satisfy by option [This would be easy]

OR solve the quadratic eqn

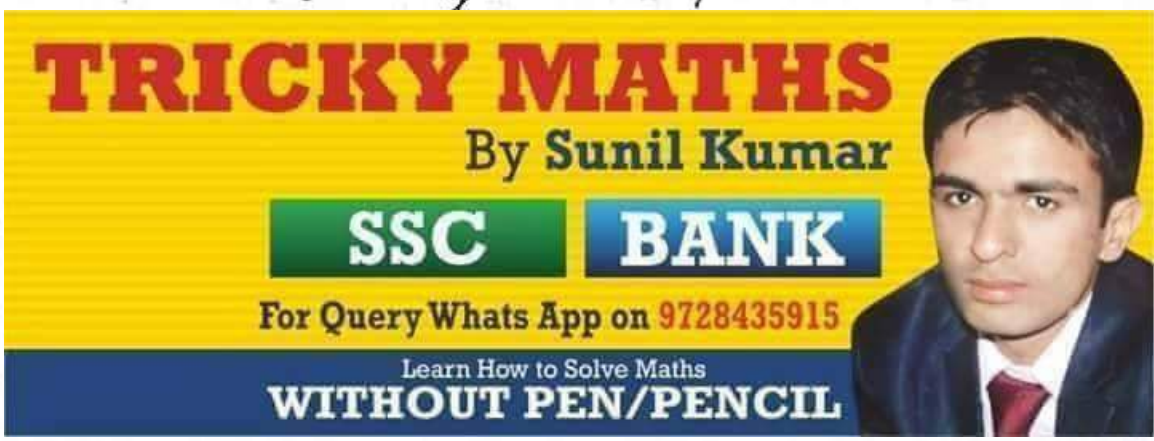
$$150n - 150\times8 = 150\times n - 2n^2 + 2n$$

$$2n^2 - 2n - 1200 = 0$$

$$n^2 - n - 600 = 0$$

$$-25 \quad 24 \Rightarrow \text{factor } +25 \ \& \ \cancel{-24}$$

So It takes 25 days to complete the work.



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 → 4 5

(consumption) C → 5 : 4 → 2kg

$\frac{5}{2}$ kg 1 → 500gm or $\frac{1}{2}$ kg

original Price $= \frac{36}{2} = 18$ Rs./kg

Reduced Price $= \frac{36 \times 2}{5} = \frac{72}{5} = 14.4$ 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.

Solⁿ.:- $10\% \rightarrow \frac{1}{10}$

P → 9 10

C → 10 : 9 → 6.2×9

6.2×10 1 → 6.2kg

Reduced Price $= \frac{1116}{62.0} =$ ₹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

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

$P \rightarrow 6 \quad 5$

$C \rightarrow 5 : 6 \rightarrow 12$ eggs

10 eggs $\quad 1 \rightarrow 2$ eggs

$$\text{Present Rate} = \frac{24}{10} = 2.4 \text{ /egg}$$

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:-

$25\% \downarrow = 1/4$

$P \rightarrow 3 \quad 4$

$C \rightarrow 4 : 3 \rightarrow 30$kg

40kg. $\quad 1 \rightarrow 10$kg

$$\text{Reduced Price per kg} = \frac{600}{40} = 15 \text{ Rs.}$$

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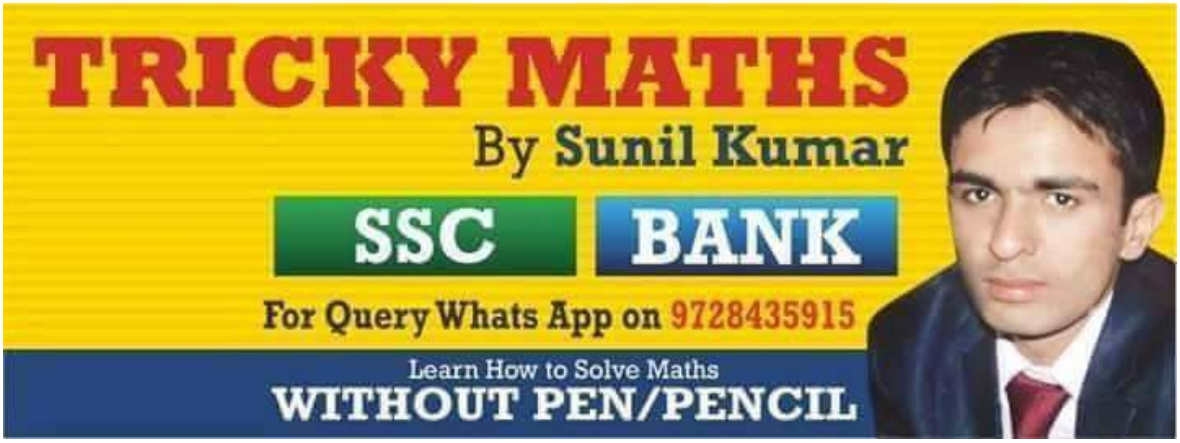
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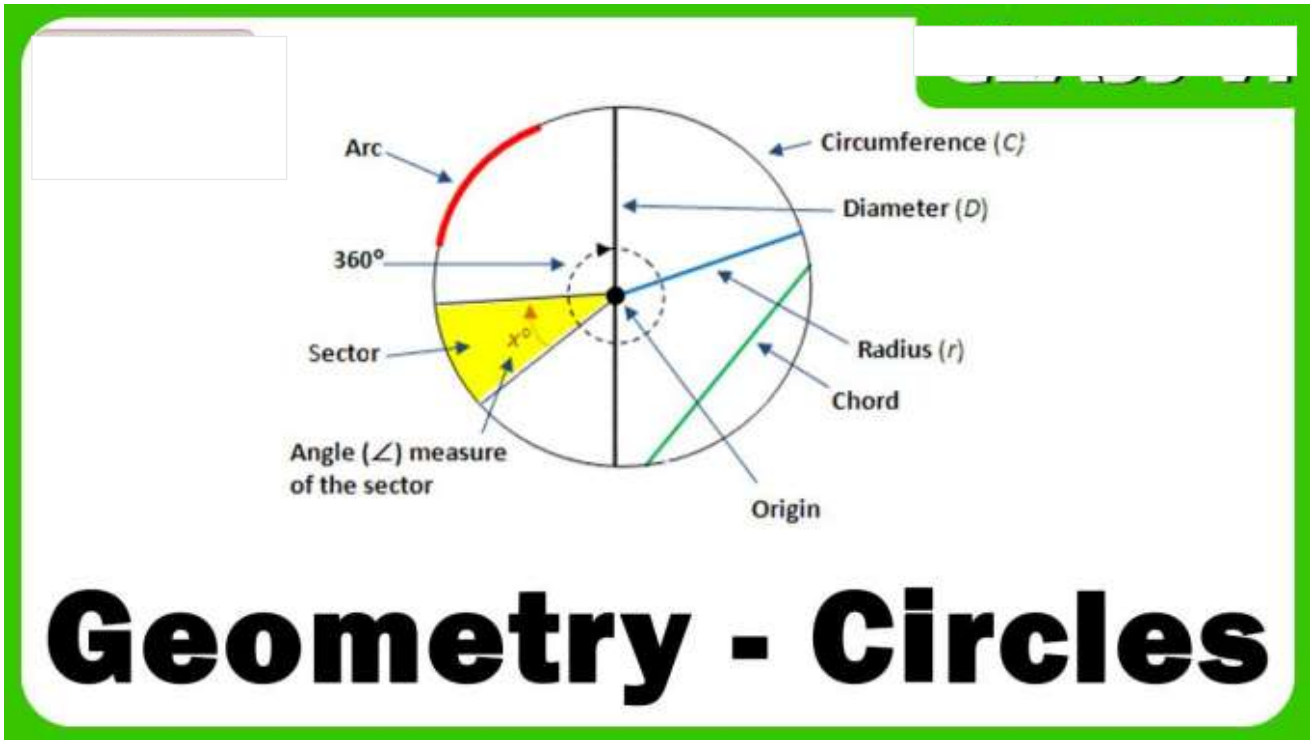
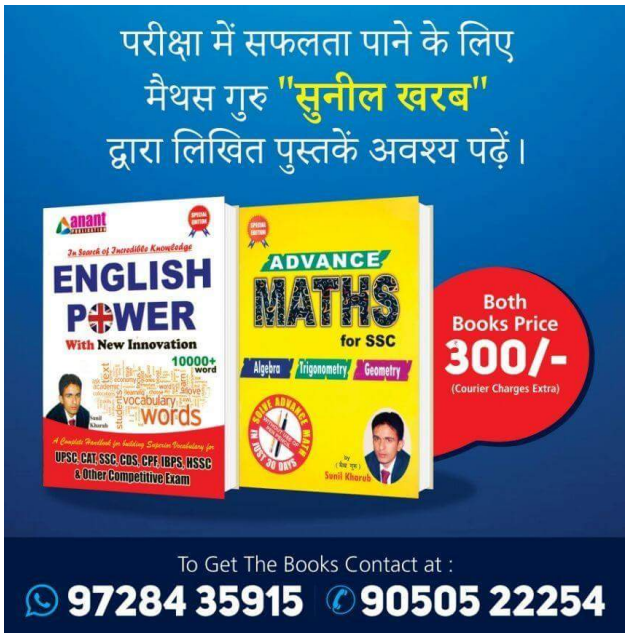

Arc
Circumference (C)
Diameter (D)
360°
Sector
Radius (r)
Chord
Angle (∠) measure
of the sector
Origin
Geometry - Circles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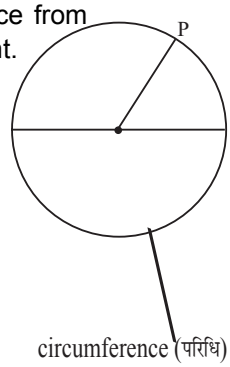
CIRCLE (वृत्त)

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 flxed point always remains constant.

In fgure, '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.



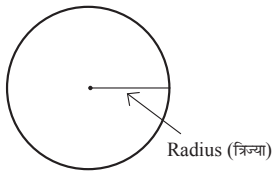
OR A circle is a simple closed curve, all the points of which are at the same distance from a given flxed point.

Circumference

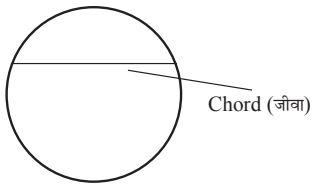
Length of a complete circle is called its circumference.

Terminology Related to CIRCLES

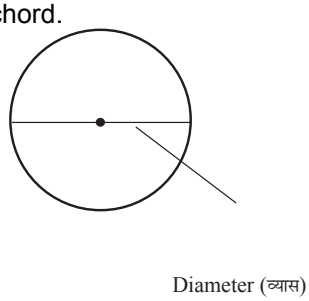
1) Radius (त्रिज्या) : Line segment joining centre and any point of circle.



2) Chord (जीवा) : A line segment joining any two points on a circle is called chord of the circle.



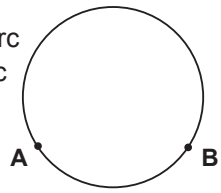
3) Diameter (व्यास) : A chord passing through the centre of a circle is known as its diameter. Diameter is longest chord.



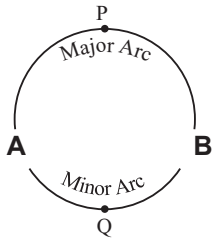
4) Arc of a circle (चाप) :

A piece of a circle between two points is called an arc. Consider two points M and N on the circle. We fnd 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.



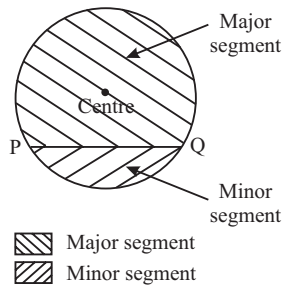
Major arc is denoted by $\overset{\frown}{APB}$ and minor arc is denoted by $\overset{\frown}{AQN}$

Note:-When M and N are ends of a diameter then both the arcs are equal and both are called semicircle.

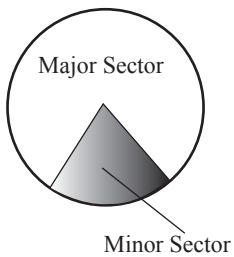
5) Segment of a circle (वृत्तखण्ड) :

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.

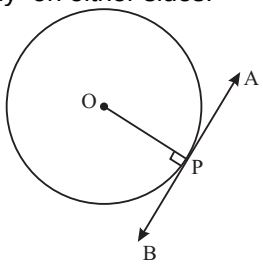


6) Sector of a circle (त्रिज्यखण्ड) : The part of a circle enclosed by an arc and two radii is called a sector.

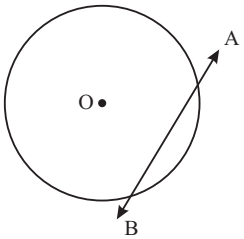


7) **Semicircle (अर्द्धवृत्त) :** A diameter of a circle divides the circumference of the circle into two equal arcs and each of these arcs is known as a semicircle.

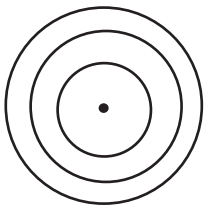
8) **Tangent of a circle (स्पर्शरेखा) :**
A tangent is a straight line which touches the circumference of a circle at only one point. A tangent does not intersect the circumference, if produced infinitely on either sides.



9) **Secant of a circle (प्रतिच्छेदीरेखा) :** A straight line intersecting the circle at two points, is called a secant.

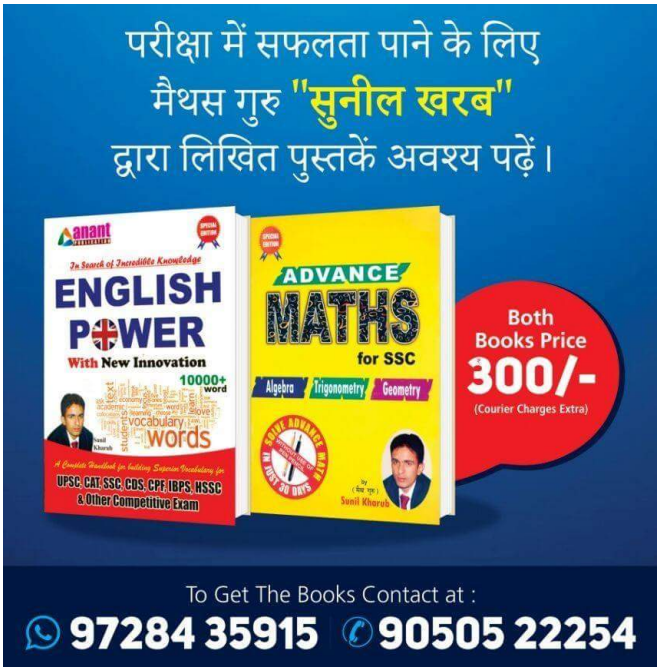


10) **Concentric Circles (सकेन्द्रियवृत्त) :** Circles having the same centre are said to be concentric circles.



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 = $\frac{\theta}{360^\circ}\times 2\pi r$

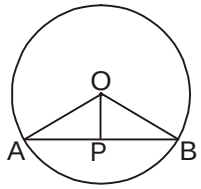


Properties related to Circle

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.

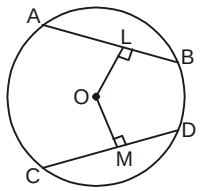


If $OP \perp AB$ then AP = PB

Conversely, the line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord.

If AP = PB then $OP \perp AB$.

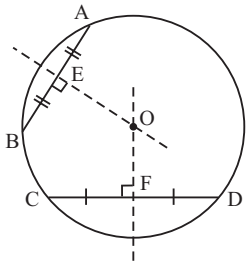
3).Equal chords of a circle are equidistant from the centre.



Chords AB and CD are equidistant from the centre O, ie OL = OM if AB = CD.

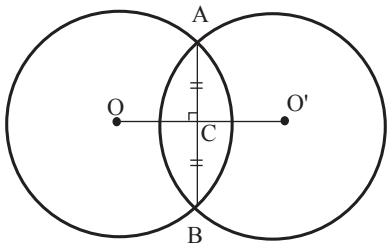
Conversely, chords of a circle which are equidistant from the centre are equal.

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.

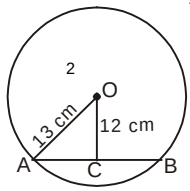
5). If two circles intersect at two points then the line seg- ment joining their centre is perpendicular bisector of common chord.



AC = BC and OC ⊥ 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,

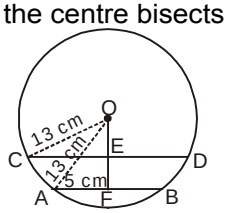
$OC^2 + AC^2 = OA^2 \Rightarrow (12)^2 + (AC)^2 = 13$

$\therefore$ Length of the chord = AC + CB = 2AC = 10 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:

$OF = \sqrt{13^2 - 5^2} = \sqrt{144} = 12$ cm

$OE = \sqrt{13^2 - 12^2} = 5$ cm

$\therefore$ EF is the distance between the chords

and EF = OF – OE = 12 cm – 5 cm = 7 cm

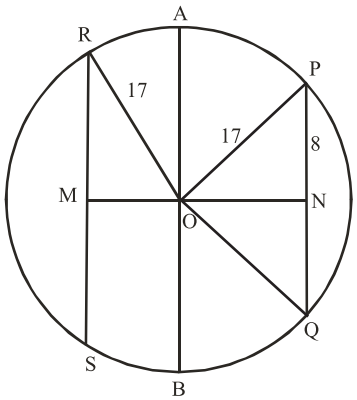
TRICK:- **CE will become OF &**
AF will become OE
OF=CE=12 cm
OE=AF=5 cm

and EF = OF – OE = 12 cm – 5 cm = 7 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 :

(a) 15 cm **(b) 23 cm**
(c) 30 cm **(d) 34 cm**

Solution: (c) Let PQ and RS be two parallel chords of the circle on the opposite sides of the diameter AB = 16 cm



Now, $PN = 8$ (Since ON is the perpendicular bisector)
In ΔPON

$ON^2 = OP^2 - PN^2$
$= (17)^2 - (8)^2 = 289 - 64 = 225$

or $ON = 15 \Rightarrow \therefore OM = 23 - 15 = 8$

In ΔORM,

$RM^2 = OR^2 - OM^2$
$17^2 - 8^2 = 289 - 64 = 225$

or $RM = 15 \Rightarrow RS = 15 \times 2 = 30$ cm

TRICK:-
NP becomes OM =8

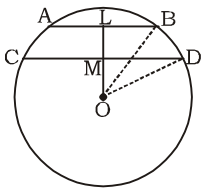
In ΔORM,

$RM^2 = OR^2 - OM^2$
$17^2 - 8^2 = 289 - 64 = 225$

or $RM = 15 \Rightarrow RS = 15 \times 2 = 30$ 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 || CD.
Let OM = x cm and radius of the circle be r cm.



Then, from ΔOMD

$$x^2 + \left(\frac{11}{2}\right)^2 = r^2 \Rightarrow x^2 + \frac{121}{4} = r^2 \quad .... (1)$$

From ΔOLB,

$$(x+3)^2 + \left(\frac{5}{2}\right)^2 = r^2 \Rightarrow x^2 + 6x + \frac{61}{4} = r^2 \quad .... (2)$$

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:-

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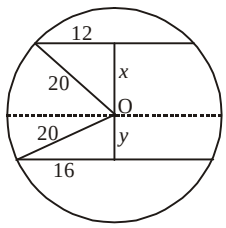
 # What is the distance in cm between two parallel chords of lengths 32 cm and 24 cm in a circle of radius 20 cm?

1) 1 or 7 **2) 2 or 14**
3) 3 or 21 **4) 4 or 28**

Solution:-The two parallel chords lie either on the same side of the diameter or on the oppo- site sides of the diameter. If we find the distance between parallel chords of any one of the above two cases, then it serves our purpose.



Distance between chords

$= x + y = \sqrt{20^2 - 12^2} + \sqrt{20^2 - 16^2} = 16 + 12 = 28$ cm

Only one option contains 28. Hence they will definitely be 4 cm apart in the other case.

TRICK:- 16 will become x & 12 will become y

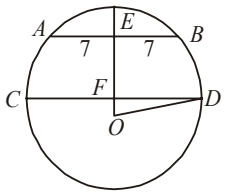
Distance between chords

x+y=28 or x-y=4 cm

 # A chord of length 14 cm is at a distance of 6 cm from the centre of a circle. Find the length of another chord at a distance of 2 cm from the centre of the circle.

(a) 18 cm **(b) 16 cm**
(c) 10 cm **(d) 12cm**

Solution:- (a) Let AB be the chord of length 14 cm. at a distance of 6 cm from the centre O.
Draw $OE \perp AB$. Then, $BE = 7$ cm and $OE = 6$ cm.
$\therefore OB^2 = OE^2 + BE^2 = (6^2 + 7^2) = 85$.
Let CD be the chord at a distance of 2 cm from O.
Now, $OF = 2$ cm, $OD^2 = OB^2 = 85$.

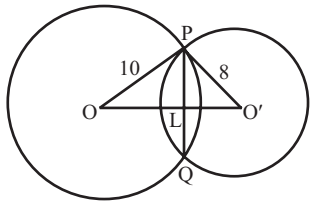


$\therefore FD = 9$ cm.
$\therefore CD = 2 \times FD = 18$ cm.

 # Two circles of radii 10 cm and 8 cm intersect each other and length of the common chord is 12 cm. Find the distance between their centres.

(a) 13.8 cm **(b) 13.29 cm**
(c) 13.2 cm **(d) 12.19 cm**

Solution: (b) Here, $OP = 10$ cm; $O'P = 8$ cm



$PQ = 12$ cm

$\therefore \quad PL = 1/2\ PQ \Rightarrow PL = \frac{1}{2} \times 12 \Rightarrow PL = 6$ cm

In rt. ΔOLP, $OP^2 = OL^2 + LP^2$

(using Pythagoras theorem)

$\Rightarrow \quad (10)^2 = OL^2 + (6)^2 \Rightarrow OL^2 = 64;\ OL = 8$

In $\Delta O'LP$, $(O'L)^2 = O'P^2 - LP^2 = 64 - 36 = 28$

$O'L^2 = 28 \Rightarrow O'L = \sqrt{28}$

$O'L = 5.29$ cm

$\therefore \quad OO' = OL + O'L = 8 + 5.29$

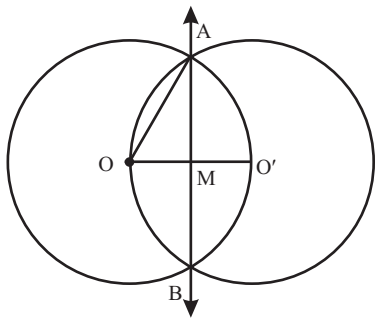
$OO' = 13.29$ cm

 # Two equal circles pass through each other's centre. If the radius of each circle is 5 cm, what is the length of the common chord?

(a) $5\sqrt{3}$ **(b)** $10\sqrt{3}$

(c) $\frac{5\sqrt{3}}{2}$ **(d) 5**

Solution: (a)



Given, distance between the centres of two circle = 5 cm

$OO' = 5$ cm

$\therefore \quad OM = \frac{5}{2}$ cm

$\therefore$ The length of common chord, $AB = 2 \times AM$

In ΔOAM,

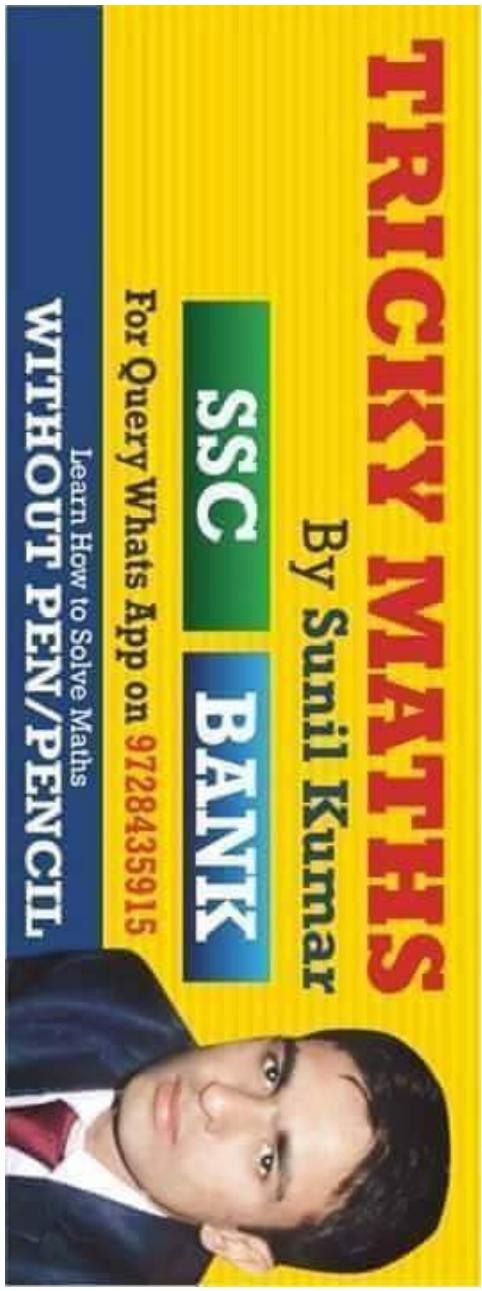
$$OA^2 = OM^2 + AM^2$$

$$(5)^2 = \left(\frac{5}{2}\right)^2 + AM^2$$

$$AM = \sqrt{25 - \frac{25}{4}} = \frac{5\sqrt{3}}{2} \text{ cm}$$

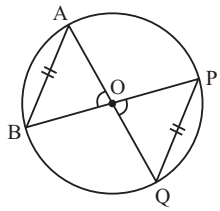
$\therefore$ The length of common chord, $AB = 2 \times AM$

$$= 2 \times \frac{5\sqrt{3}}{2} = 5\sqrt{3} \text{ cm}$$



Properties based on ANGLES of a Circle

1. Equal chord of a circle subtend equal angles at the centre.

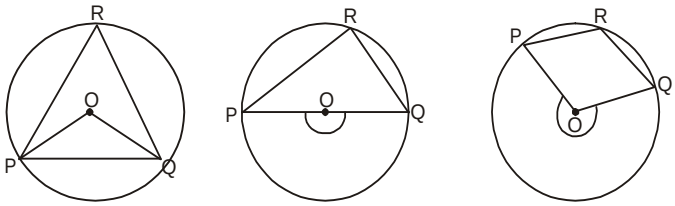


If $AB = PQ$, then $\angle AOB = \angle POQ$

The converse is also true.

If the angles subtended by two chords of a circle at the centre are equal, the chords are equal.

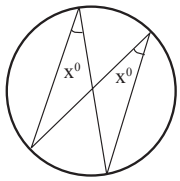
2. The angle subtended by an arc of a circle at the centre is double the angle subtended by it at any point on the remaining part of the circle.

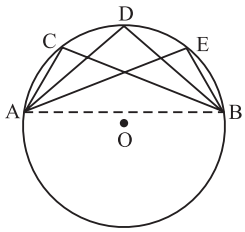


In each of the above figures,

$\angle POQ = 2\angle PRQ$

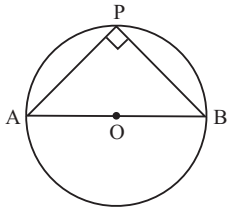
3. Angles in the same segment of a circle are equal.





$\therefore \quad \angle ACB = \angle ADB = \angle AEB.$

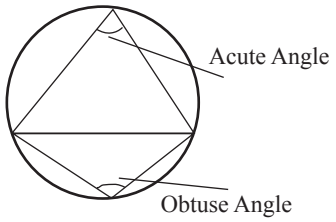
4. Angle in a semicircle is a right angle.



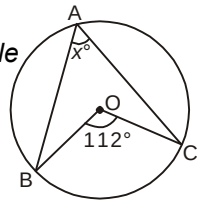
In figure, AOB is a diameter, hence $AOBPA$ is a semicircle, therefore $\angle APB = 90°$.

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.*

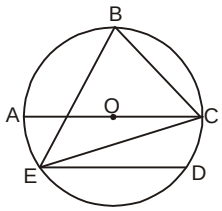
$\therefore 2x = 112°$

$\Rightarrow x = 56°$

*In the given figure, chord ED is parallel to the diameter AC of the circle. If* $\angle CBE = 65°$ *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°

Also, $\angle AEC = 90°$ (Angle made by diameter on the circumference)

$\Rightarrow \angle ACE = 180° - (90° + 65°) = 25°$

And $\angle ACE = \angle DEC = 25°$ (***Alternate*** angles)

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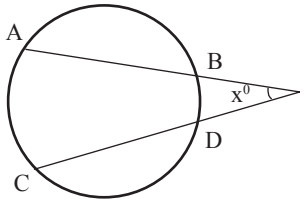
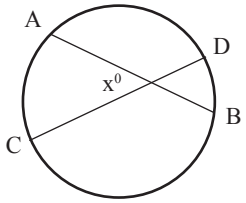
MATH GURU
97284-35915

TRICK:- If two chords intersect each other then angle made by them on point of intersection –



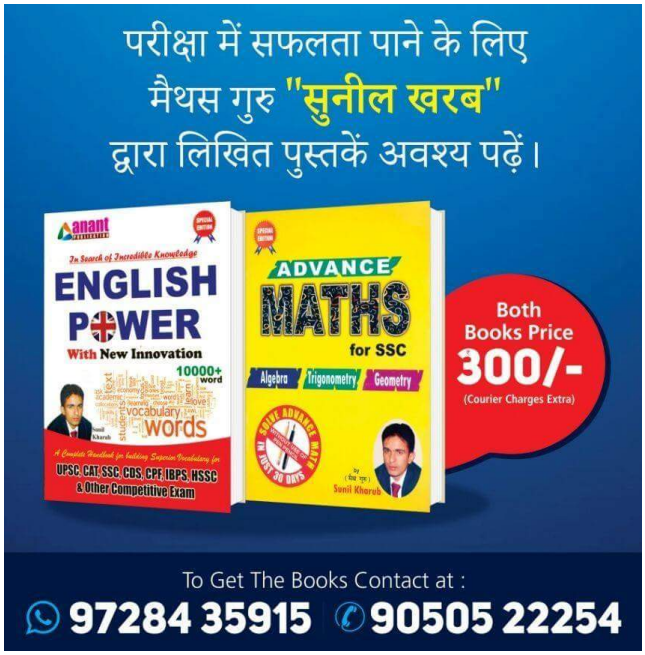
$$x = \frac{1}{2} \times \text{angle by}$$

(arc AC – arc BD) at the centre



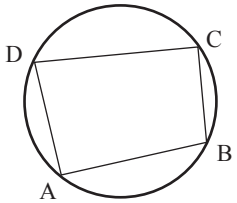
$$x = \frac{1}{2} \times \text{angle by}$$

(arc AC + arc BD) at centre

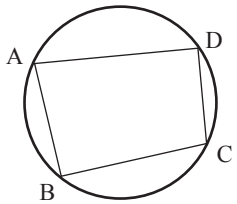


Cyclic Quadrilateral Properties

Cyclic quadrilateral (चक्रियचतुर्भुज) : A cyclic quadrilateral is called cyclic quadrilateral if its all vertices lie on a circle.



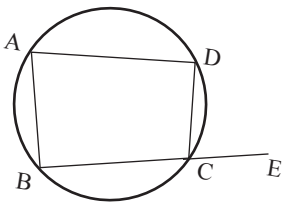
1. The sum of either pair or opposite angles of a cyclic quadrilateral is 180^0.



$\angle A + \angle C = 180^0$ and $\angle B + \angle D = 180^0$

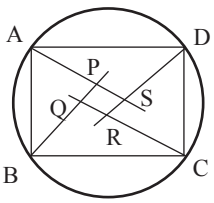
2. If the sum of any pair of opposite angles of a quadrilateral is 180^0, then the quadrilateral is cyclic.

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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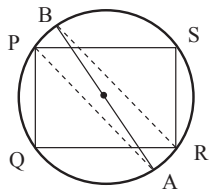
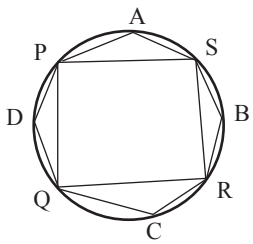
5. If two sides of a cyclic quadrilateral are parallel then the remaining two sides are equal and diagonal are also equal.

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.

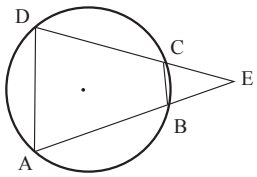


8. The sum of the angles in the four segments exterior to a cyclic quadrilateral is equal to 6 right angles.

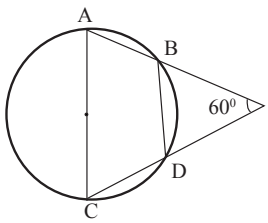


$\angle A + \angle B + \angle C + \angle D = 90^0 \times 6 = 540^0$

9. ABCD is a cyclic quadrilateral. AB and DC are produced to meet in E, then Δ EBC $\sim$ Δ EDA .

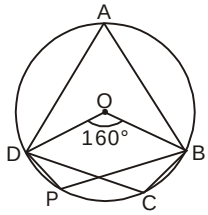


10. AB is diameter of a circle. Chord CD is equal to radius. If AC and BD when produced intersect at P, then $\angle$ APB = 60^0



In the given figure, ABCD is a cyclic quadrilateral; O is the centre of the circle. If $\angle BOD = 160°$, ***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 ***m***ake angle $\angle BOD = 160°$ at the centre of the circle and $\angle BAD$ at a point A on the circumference.

$\therefore \angle BAD = \frac{1}{2}\angle BOD = 80°$

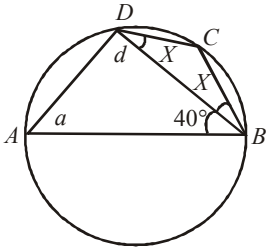
Now, ABPD is a cyclic quadrilateral.

$\therefore \angle BAD + \angle BPD = 180°$

$\Rightarrow 80° + \angle BPD = 180°$

$\Rightarrow \angle BPD = 180° - 80° = 100°$

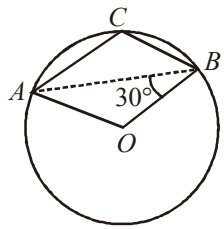
In the adjoining figure, $ABCD$ is a cyclic quadrilateral. If AB is a diameter, $BC = CD$ and $\angle ABD = 40°$, find the measure of $\angle DBC$.



(a) 65 (b) 25
(c) 45 (d) 60

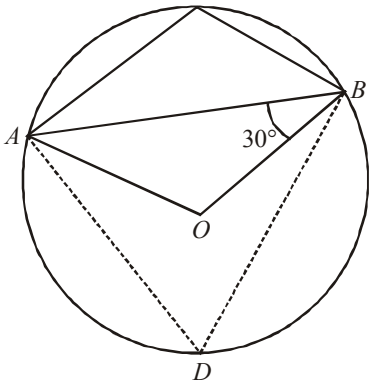
SOLUTION:- **(b)** In ΔBCD, $BC = CD$, $\angle BDC = \angle CBD = x$
In cyclic quadrilateral $ABCD$, $\angle ABC + \angle ADC = 180° 40° + x + 90° + x = 180° \Rightarrow x = 25°$.

In the following figure, O is the centre of the circle and $\angle ABO = 30°$, find $\angle ACB$.



(a) 60° (b) 120°
(c) 75° (c) 90°

C



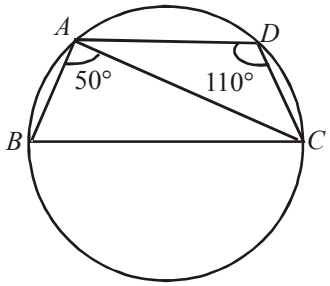
$OB = OA$ = radius of the circle
$\angle AOB = 180 - (30 + 30)$
{Sum of angles of triangle = 180°)
$\Rightarrow 120°$

Then $\angle ADB = \frac{120}{2} = 60°$, 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 $\angle ACB = 180° - 60° = 120°$ (because opposite angles of cyclic quadrilateral are supplementary).

$ABCD$ is a cyclic quadrilateral in which $BC \parallel AD$, $\angle ADC = 110°$ and $\angle BAC = 50°$ find $\angle DAC$

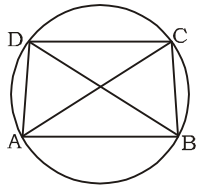
(a) 60° (b) 45°
(c) 90° (d) 120°

SOLUTION:-**(a)** $\angle ABC + \angle ADC = 180°$ (sum of opposites angles of cyclic quadrilateral is 180°)



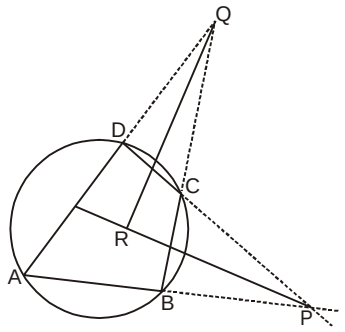
$\Rightarrow \angle ABC + 110° = 180°$
($ABCD$ is a cyclic quadrilateral)
$\Rightarrow \angle ABC = 180 - 110 \Rightarrow \angle ABC = 70°$
$\because AD \parallel BC$
$\therefore \angle ABC + \angle BAD = 180°$ (Sum of the interior angles on the same side of transversal is 180°)
$70° + \angle BAD = 180°$
$\Rightarrow \angle BAD = 180° - 70° = 110°$
$\Rightarrow \angle BAC + \angle DAC = 110° \Rightarrow 50° + \angle DAC = 110°$
$\Rightarrow \angle DAC = 110° - 50° = 60°$

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 || CD then
(i) AD = BC (ii) AC = DB

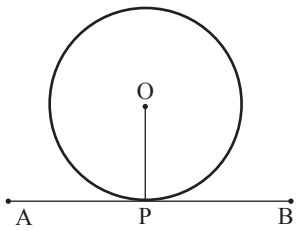
 # The bisectors of the angles formed by producing the opposite sides of a cyclic quadrilateral (provided that they are not parallel), intersect at right angle.



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 $\angle PRQ = 90°$.

TANGENT AND ITS PROPERTIES

1) A tangent to a circle is perpendicular to the radius through the point of contact.



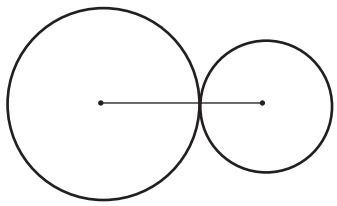
$OP \perp AB$

2) A line drawn through the end point of a radius and perpendicular to it is a tangent to the circle.

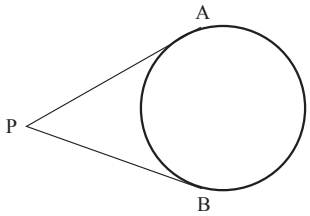
3) One and only one tangent can be drawn to a circle at a given point on the circumference.

4) The perpendicular to a tangent through its point of a contact passes through the centre of the circle.

5) If two circles touches each-other, the point of contact lies on the straight line joining their centers.

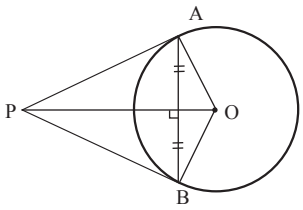


6) From any point outside a circle two tangents can be drawn to it and they are equal in length.



PA = PB

7)



(i) PA = PB

(ii) $\Delta PAO \cong \Delta PBO$

(iii) $\angle P + \angle O = 180^0$

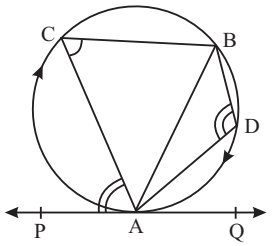
(iv) PO is a angle bisector of $\angle P$ & $\angle O$

(v) OP is perpendicular bisector of AB

(vi) $\overset{\frown}{AB} < \overset{\frown}{BA}$

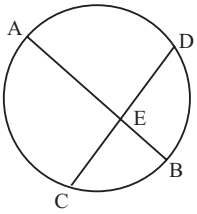
8.ALternate segment THEOREM

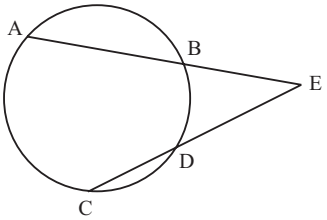
If a chord is drawn through the point of contact of a tangent to a circle, then the angle which this chord makes with the given tangent is equal to the angle formed in the alternate segment.

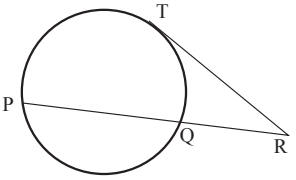


In the figure, AB is a chord of a circle. PQ is a tangent at an end point A of the chord to the circle. C is any point on arc AB and D is any point on arc BA.
$\angle BAQ$ and $\angle ACB$ are angles in the alternate segments
$\angle BAP$ and $\angle ADB$ are angles in the alternate segments.
Angles 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 × EB = CE × ED.

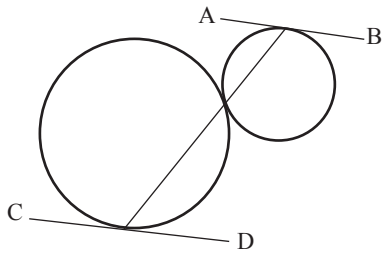






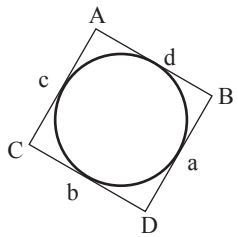
PR x RQ = TR^2

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 | | CD

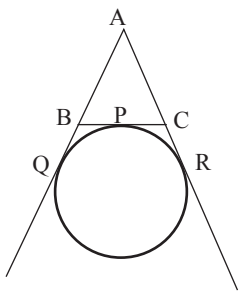
11) If a circle touches all the four sides of a quadrilateral then the sum of opposite pair of sides are equal.



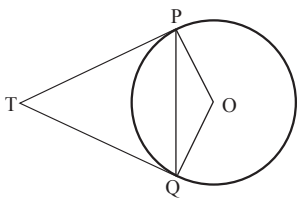
AB + DC = BC + DA

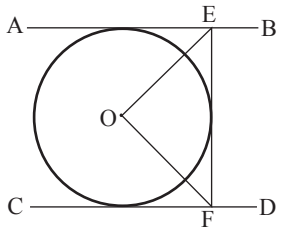
Area = $\sqrt{s(s-a)(s-b)(s-c)(s-d)}$

12) A circle touching the side BC of ΔABC at P and touching AB and AC produced at Q and R respectively then AQ = $\frac{1}{2}$ (perimeter of ΔABC)



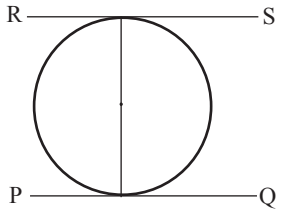
13) Two tangents TP and TQ are drawn to a circle with centre O from an external point T, then ∠PTQ = 2 ∠OPQ .





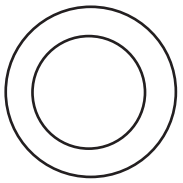
If AB | | CD than ∠EOF = 90^0

15) Tangents at the end point of a diameter of a circle are parallel.

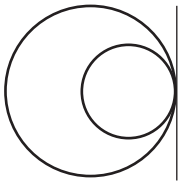


PQ | | RS

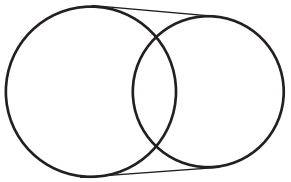
16) Common tangents to two circle



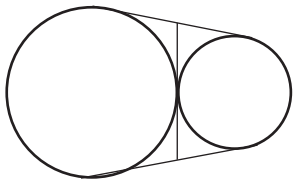
No common tangent



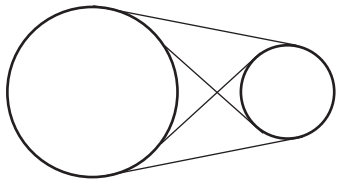
One common tangent



Two common tangent

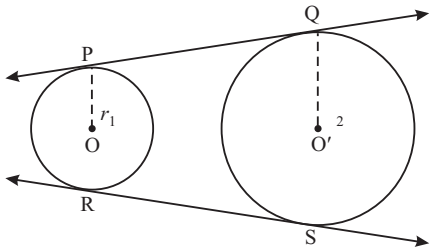


Three common tangent



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.

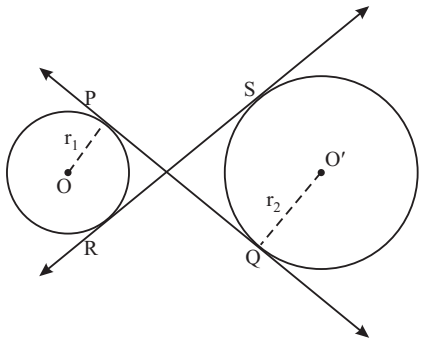
i.e. $PQ = RS$

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.



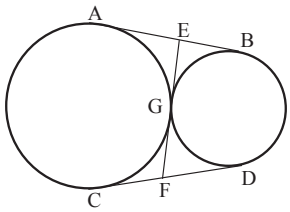
In the figure, PQ and RS are two indirect common tangents to the same two circles.

$\therefore$ $PQ = RS$

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.

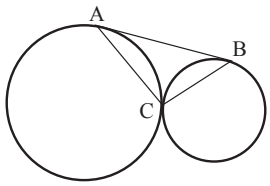
IMPORTANT RESULT



(i) AB = CD = EF

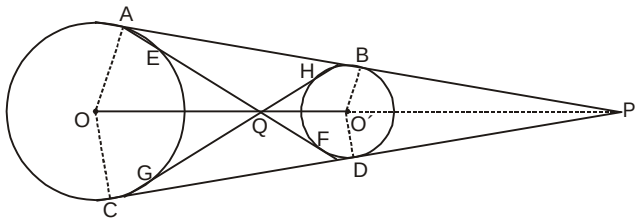
(ii) AE = EB = EG = GF = CF = FD

IMPORTANT RESULT



$\angle ACB = 90^0$

 # The point of intersection of direct common tangents and indirect (transverse) common tan-gents 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 commontangents, which when produced meet at P. Also, EF and GH are the transverse common tan-gents intersecting at Q. r is the radius of the circle having centre O and s is the radius of circle having centre O´.Then

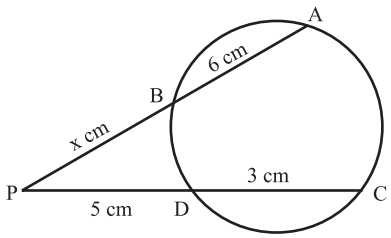
(i) P divides OO´ externally in the ratio r : s.

ie $\frac{OP}{O'P} = \frac{r}{s}$

(ii) Q divides OO´ internally in the ratio $r : s$

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 cm, *CD* = 3 cm and *PD* = 5 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)

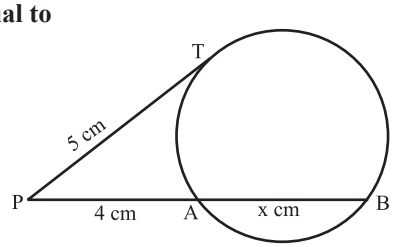
$\Rightarrow$ $(x + 6) \times x = 8 \times 5$

$\Rightarrow$ $x^2 + 6x - 40 = 0$

$\Rightarrow$ $(x + 10)(x - 4) = 0 \Rightarrow x = 4$

$\therefore$ $PB = 4$ cm

 # In the given figure, *PAB* is a secant and *PT* is a tangent to the circle from *P*. If *PT* = 5 cm, *PA* = 4 cm and *AB* = *x* cm, then *x* is equal to



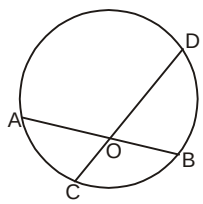
(a) 2.5 cm **(b) 2.6 cm**
(c) 2.25 cm **(d) 2.75 cm**

Solution: (c) $PA \times PB = PT^2 \Rightarrow 4 \times (4 + x) = 25$

$\Rightarrow$ $4 + x = \frac{25}{4} = 6.25 \Rightarrow x = 2.25$ cm

 # In the given figure, two chords AB and CD intersect each other at O. If AO = 8 cm, CO = 6 cm and OD = 4 cm, find OB.

1) 3 cm 2) 4 cm
3) 5 cm 4) 6 cm

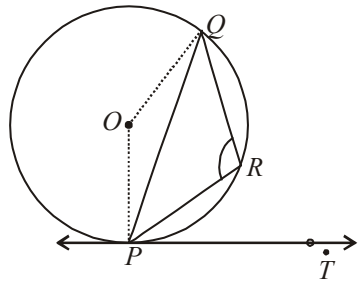


We know that, OA × OB = OC × OD

$\Rightarrow 8 \times OB = 6 \times 4$

OB=3 CM

#In the given fig. *PQ* is a chord of a circle and *PT* is the tangent at *P* such that $\angle QPT = 60°$. Then $\angle PRQ$ is equal to



(a) 135° (b) 150°
(c) 120° (d) 110°

$\angle QPT = 60°$

$\Rightarrow \angle PSQ = 60°$

[Alternate segment theorem]

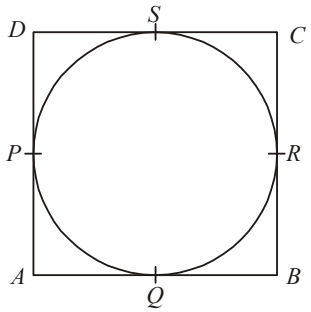
Now SQRP is cyclic quadrilateral

$\Rightarrow \angle S + \angle R = 180° \Rightarrow \angle R = 180° - 60°$
$= 120°$

If four sides of a quadrilateral *ABCD* are tangential to a circle, then.

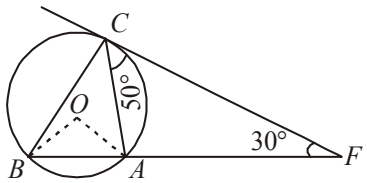
(a) AC + AD = BD + CD (b) AD + BC = AB + CD
(c) AB + CD = AC + BC (d) AC + AD = BC + DB

(b) Since *ABCD* is a quadrilateral
Again *AP*, *AQ* are tangents to the circle from the point *A*.



$\therefore$ $AP = AQ$
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 $\angle BOA$.

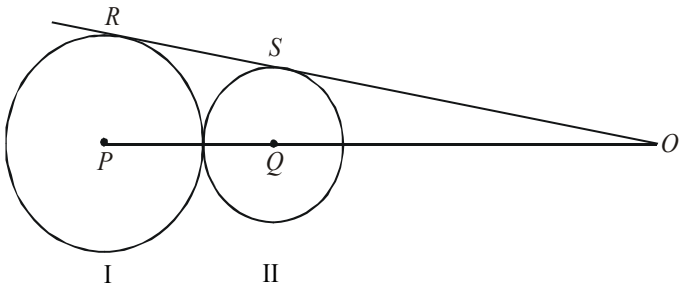


(a) 100° (b) 150°
(c) 80° (d) Indeterminate

(a) $\angle CAF = 100°$. Hence $\angle BAC = 80°$
Also, $\angle OCA = (90 - ACF) = 90 - 50 = 40° = \angle OAC$ (Since the triangle OCA is isosceles)
Hence $\angle OAB = 40°$
In isosceles ΔOAB, $\angle OBA$ will also be 40°
Hence, $\angle BOA = 180 - 40 - 40 = 100°$

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 circle 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 rartio 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?

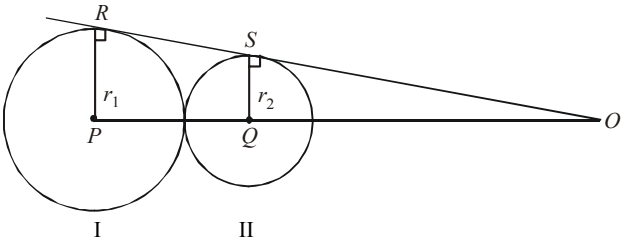
(a) 1 : 4 (b) 1 : 3
(d) 3 : 8 (d) 3 : 4

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 ΔSOQ and ΔROP
$\angle O$ is common
$\angle S = \angle R = 90°$ (tangent at circle)

$\therefore \Delta SOQ \sim \Delta ROP$

$$\Rightarrow \frac{RP}{SQ} = \frac{OP}{OQ} = \frac{PQ+OQ}{OQ} = \frac{PQ}{OQ} + 1$$

$$\Rightarrow \frac{4}{3} = \frac{PQ}{OQ} + 1 \text{ or } \frac{PQ}{OQ} = \frac{4}{3} - 1 = \frac{1}{3}$$

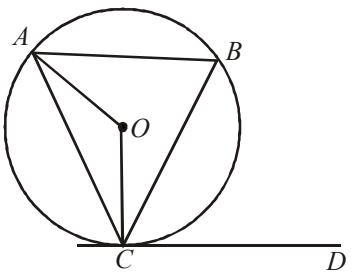
$\Rightarrow PQ = 7$ and $OQ = 21$

$$\therefore \text{Required ratio } = \frac{7}{21} = \frac{1}{3}$$

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 ΔSOQ,
$\Rightarrow SO^2 + SQ^2 = OQ^2$
$\Rightarrow SO^2 = 21^2 - 3^2 = (21 - 3)(21 + 3) = 18 \times 24 = 432$
$\Rightarrow SO = 12\sqrt{3}$

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°. Find the value of $\angle OCB$:



(a) 30° (b) 20°
(c) 60° (d) None of these

(a) $\angle OCD = 90°$
$\angle OAC = \angle OCA = 30°$
$\angle ACD = \angle ACO + \angle OCD = 30° + 90° = 120°$
$\therefore \quad \angle BAC = 180° - 120° = 60°$
$\Rightarrow \quad \angle BCD = 60°$ $\quad (\angle BCD = \angle BAC)$
$\Rightarrow \quad \angle OCB = \angle OCB - \angle BCD$
$= 90° - 60° = 30°$

#. 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

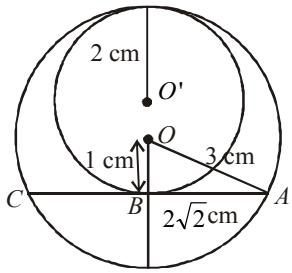
(a) $2\sqrt{2}$ cm (b) $3\sqrt{2}$ cm

(c) $2\sqrt{3}$ cm (d) $4\sqrt{2}$ cm

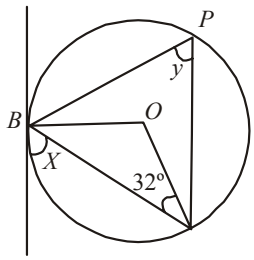
(d)

$AB = \sqrt{3^2 - 1^2} = 2\sqrt{2}$ cm

$\therefore \quad AC = 4\sqrt{2}$ 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°, 52° (b) 58°, 52°

(c) 58°, 58° (d) 60°, 64°

(c) Given AB is a circle and BT is a tangent, $\angle BAO = 32°$

Here, $\angle OBT = 90°$

[$\because$ Tangent is $\perp$ to the radius at the point of contact]

$OA = OB$ [Radii of the same circle]

$\therefore \angle OBA = \angle OAB = 32°$

[Angles opposite to equal side are equal]

$\therefore \angle OBT = \angle OBA + \angle ABT = 90°$ or $32° + x = 90°$.

$\angle x = 90° - 32° = 58°$.

Also, $\angle AOB = 180° - \angle OAB - \angle OBA$

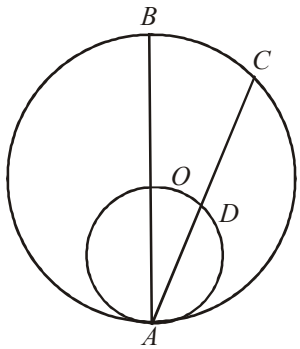
$= 180° - 32° - 32° = 116°$

Now $Y = \frac{1}{2} AOB$

[Angle formed at the center of a circle is double the angle formed in the remaining part of the circle]

$= \frac{1}{2} \times 116° = 58°$.

#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 of the diameters of the larger and smaller circles respectively. Chord AC intersects the smaller circle at a point D. If $AC = 12$ cm, then AD is:



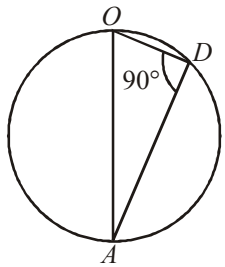
(a) 4 cm (b) 6 cm

(c) 5.6 cm (d) Data insufficient

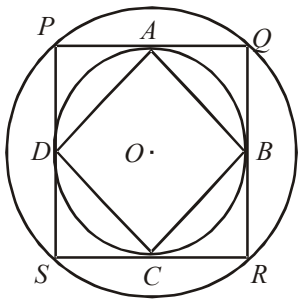
(b) $\angle ADO$ is a right angle (angle of semicircle)

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.

$\therefore \quad AD = CD = 6$ 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 $= r\sqrt{2}$.

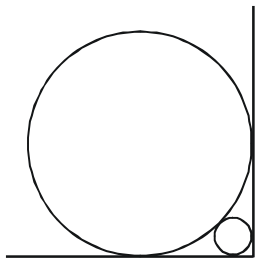
Now, $ABCD$ is a square. And side $\frac{r\sqrt{2}}{2} \times \sqrt{2} = r$.

Perimeter of $ABCD = 4r$.

Circumference of bigger circle $= 2\pi r$.

Therefore, required ratio $= \frac{\pi}{2}$

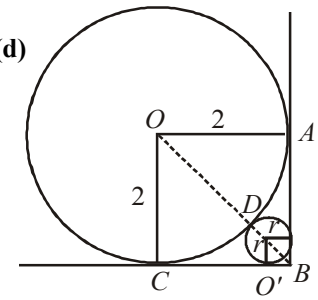
A circle with radius 2 is placed against a right angle. Another smaller circle is also placed as shown in the adjoining figure. What is the radius of the smaller circle?



(a) $3-2\sqrt{2}$ (b) $4-2\sqrt{2}$

(c) $7-4\sqrt{2}$ (d) $6-4\sqrt{2}$

***SOL:-.* (d)**



$OABC$ is square with side = 2

$\therefore OB = \sqrt{2^2+2^2} = 2\sqrt{2}$

$OB = 2\sqrt{2} = OD + r + O'B = 2 + r + r\sqrt{2}$

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

$\Rightarrow r = \frac{2(\sqrt{2}-1)}{(\sqrt{2}+1)} = \frac{2(\sqrt{2}-1)^2}{2-1} = 2(2+1-2\sqrt{2})$

$= 6-4\sqrt{2}$

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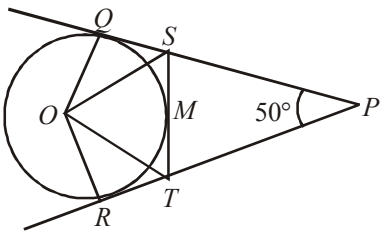
MATH GURU
97284-35915

In the adjoining figure 'O' is the centre of the circle and PQ, PR and ST are the three tangents. $\angle QPR = 50°$, then the value of $\angle SOT$ is:



(a) 30° (b) 75°

(c) 65° (d) can't be determined

(c) $\angle ROQ = 180° - 50 = 130°$

$\left(\because \angle OQP + \angle ORP + \angle QOR + \angle QPR = 360° \text{ and } \angle OQP = ORP = 90°\right)$

Now, since $RT = TM$ and $QS = SM$

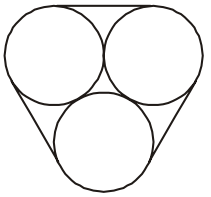
$\therefore$ also $OR = OM = OQ$

$\therefore \angle ROT = \angle TOM$ and $\angle MOS = \angle SOQ$

$\therefore \angle SOT = \frac{1}{2}\angle ROQ$

$\therefore \angle SOT = \frac{130}{2} = 65°$

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) $2\pi + 6$ (b) $3\pi + 4$

(c) $4\pi + 6$ (d) $6\pi + 6$

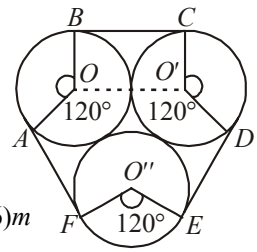
(a) $\angle AOB = \angle CO'D = \angle FO''E = 120°$

Distance between 2 centres = 2 m

$\therefore$ $BC = DE = FA = 2\ m$

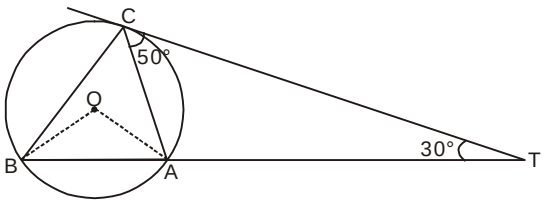
Perimeter of the figure = $BC + DE + FA$ + circumference of sectors AOB, $CO'D$ and $FO''E$.

But three equal sectors of 120° = 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 $\angle ATC = 30°$ *and* $\angle ACT = 50°$ *then* $\angle BOA$ *is*



1) 100° 2) 80°
3) 40 4) 65°

1; From the alternate segment theorem

$\angle ABC = \angle ACT \Rightarrow \angle ABC = 50°$

Also, $\angle CAB = \angle ACT + \angle ATC = 50° + 30° = 80°$

$\therefore \angle BCA = 180° - (\angle ABC + \angle CAB) = 180° - (50° + 80°)$

$= 50°$ Now, $\angle BOA = 2.\angle BCA = 2 \times 50° = 100°$

[Angle made by chord at the centre is double that at the circumference]

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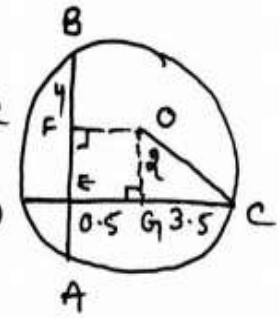
Chords AB and CD of a circle intersect at E and are perpendicular to each other. Segments AE, EB and ED are of lengths 2 cm, 6 cm and 3 cm re spectively. Then the length of the diameter of the circle (in cm) is

(a) $\sqrt{65}$ (b) $\frac{1}{2}\sqrt{65}$

(c) 65 (d) $\frac{65}{2}$

6. (a)



$AE \times EB = DE \times EC$

$2 \times 6 = 3 \times CE$

$\Rightarrow CE = 4$ cm

Draw $OF \perp AB$ & $OG \perp$ To DC

$\Rightarrow$ F is mid point as $\perp$ from Centre O is drawn.

$FB = AF = 4$

$\Rightarrow EF = EB - FB = 6 - 4 = 2$

Also $DG = GC = \frac{7}{2} = 3.5$ cm

ΔOGC $EG = 3.5 - 3 = .5$ cm

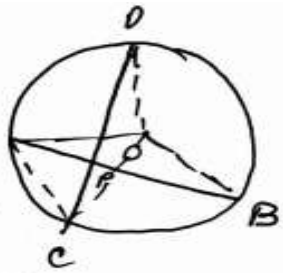
$OC = \sqrt{(3.5)^2 + (2)^2} = \frac{\sqrt{65}}{2} \Rightarrow D = \sqrt{65}$

Two chords AB and CD of a circle with centre O, intersect each other at P. If $\angle AOD = 100^0$ and $\angle BOC = 70^0$, then the value of $\angle APC$ is

(a) 80^0 (b) 75^0

(c) 85^0 (d) 95^0

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 $\triangle APC$

$\angle APC = 180^\circ - (35^\circ + 50^\circ)$

$= 95^\circ$ ANS.

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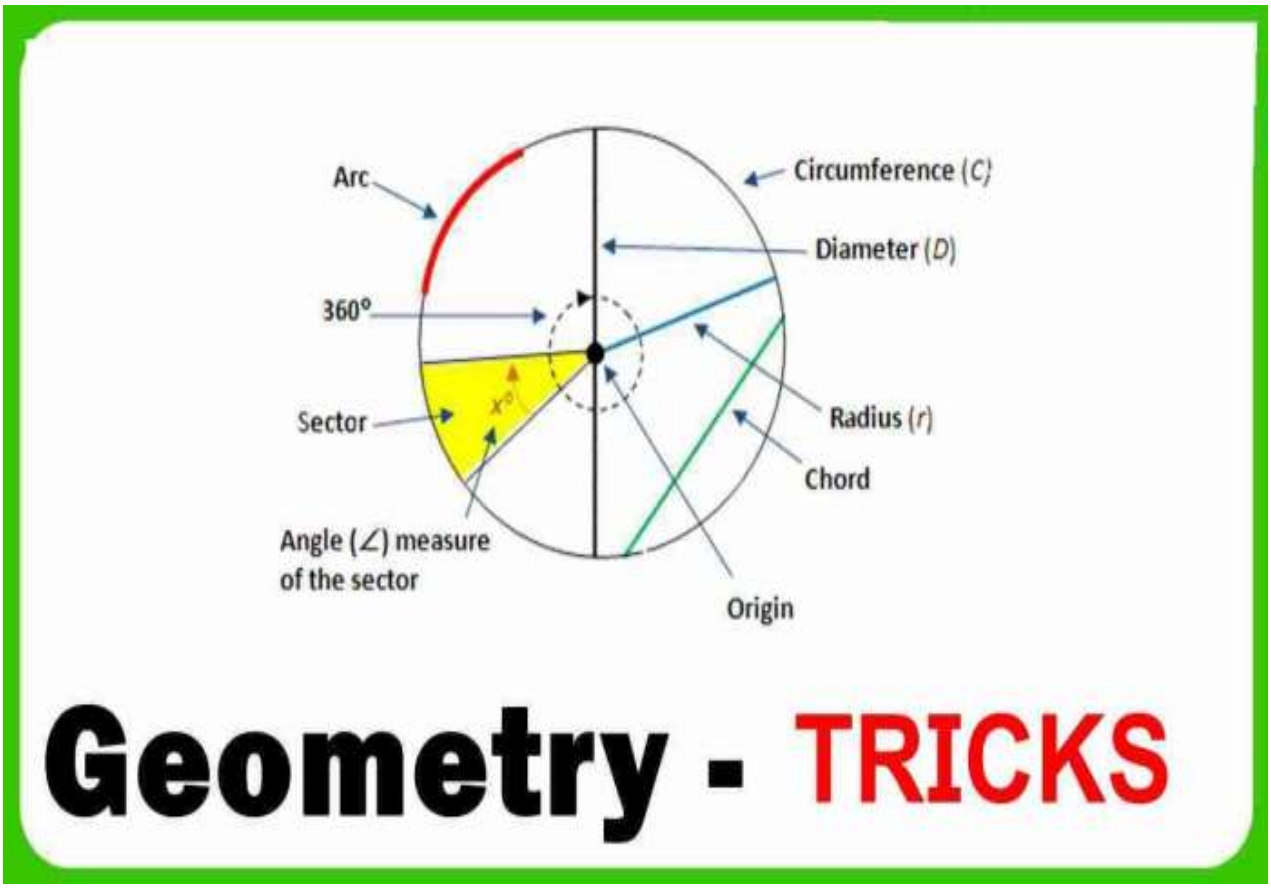

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GEOMETRY

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 triangled, 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 Δ ABC such that DE = 18 cm, CE = 5 cm

DE PERPENDICULAR TO BC

TAN$\angle$ ABC = 3.6, then AC : CD =

(a) BC : 2 CE (b) 2CE : BC

(c) 2BC : CE (d) CE : 2BC

4. BL and CM are medians of Δ 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 1440^0. 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 re spectively. 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) 45^0 (b) 90^0

(c) 30^0 (d) 60^0

8. I and O are respectively the incentre and circumcenter of a triangle ABC. the line AI produced intersects the circumcircle of Δ ABC at the point D. If $\angle$ ABC = x^0, $\angle$ BID = y^0 and $\angle$ BOD = z^0, then $\frac{z+x}{y}$

(a) 3 (b) 1

(c) 2 (d) 4

9. If the Δ ABC is right angled at B, find its circumradius if the sides AB and

BC are 15 cm and 20 cm respectively.

(a) 25 cm (b) 20 cm

(c) 15 cm (d) 12.5 cm

10. If the circumradius of an equilateral triangle ABC be 8 cm, then the height of the triangle is

(a) 16 cm (b) 6 cm

(c) 8 cm (d) 12 cm

11. If AD, BE and CF are medians of ΔABC, then which one of the following statements is correct

(a) (AD +BE+CF) <AB +BC +CA

(b) AD +BE+CF >AB +BC +CA

(c) AD +BE+CF=AB +BC +CA

(d) AD +BE+CF= $\sqrt{2}$ (AB +BC +CA)

12. In a triangle, if orthocentre, circumcentre, incentre and centroid coincide, then the triangle must be

(a) obtuse angled (b) isosceles

(c) equilateral (d) right angled

13. Two chords AB and CD of a circle with centre O, intersect each other at P. If $\angle$AOD = 100^0 and $\angle$BOC = 70^0, then the value of $\angle$APC is

(a) 80^0 (b) 75^0

(c) 85^0 (d) 95^0

14. In ΔABC, a line through A cuts the side BC at D such that BD : DC = 4 : 5. If the area of ΔABD = 60 cm^2, then the area of Δ ABC is:

(a) 50 cm^2 (b) 60 cm^2

(c) 75 cm^2 (d) 90 cm^2

15. The measure of an angle whose supplement is three times as large as its complement, is

(a) 30^0 (b) 45^0

(c) 60^0 (d) 75^0

16. If PQRS is a rhombus and $\angle$SPQ = 50^0, then $\angle$RSQ is

(a) 75^0 (b) 45^0

(c) 55^0 (d) 65^0

17. 'O' is the circumcentre of triangle ABC. If $\angle$BAC = 50^0 then $\angle$OBC is

(a) 100^0 (b) 130^0

(c) 40^0 (d) 50^0

18. In a rhombus ABCD, $\angle$A = 60^0 and AB = 12 cm. Then the diagonal BD is:

(a) $2\sqrt{3}$ cm (b) 6 cm

(c) 12 cm (d) 10 cm

19. The chord of a circle is equal to its radius. The angle subtended by this chord at the minor are of the circle is

(a) 150^0 (b) 60^0

(c) 75^0 (d) 120^0

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 108^0. 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 meets AB produced at Q. If $\angle CAB = 34^0$, then measure of $\angle CBA$ is

(a) 56^0 (b) 68^0

(c) 34^0 (d) 124^0

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 $\angle ACD = 50^0$, the measure of $\angle BAD$ is

(a) 130^0 (b) 40^0

(c) 50^0 (d)140|

25. BE, CF are the two medians of ΔABC 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 ΔABC, the external bisectors of the angles $\angle B$ and $\angle C$ meet at the point O. If $\angle A = 70^0$, then the measure of $\angle BOC$ is

(a) 75^0 (b) 50^0

(c) 55^0 (d) 60_0

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) 12cm

(c) $6\sqrt{6}$ cm (d) 18 cm

28. In ΔABC, the internal bisectors of $\angle B$ and $\angle C$ meet at point O. If $\angle A = 80^0$ then $\angle$ BOC is of:

(a) 120^0 (b) 140^0

(c) 130^0 (d) 100^0

29. In ΔABC, $\angle B = 60^0$, and $\angle C = 40^0$, AD and AE are respectively the bisector of $\angle A$ and perpendicular on BC. The measure of $\angle EAD$ is:

(a) 9^0 (b) 11^0

(c) 10^0 (d) 12^0

30. In ΔABC, O is the orthocentre and $\angle BOC = 80^0$, the measure of $\angle A$ is

(a) 120^0 (b) 90^0
(c) 80^0 (d) 100^0

31. The medians CD and BE of a triangle ABC intersect each other at O. The ratio of ΔODE : ΔABC 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 increament 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) $3a^3$ cm^3 (b) $3\sqrt{2}\,a^2$ cm^3
(c) $3\sqrt{3}\,a^3$ cm^3 (d) $6a^3$ cm^3

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 cm^3, 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 voume (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 $\frac{3\sqrt{3}}{2}p^2$ cm^2, $10\sqrt{3}$ cm and 700 cm^3 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 pyra mid is 12 cm, then its total surface area is
(a) 360 cm^2 (b) 400 cm^2
(c) 460 cm^2 (d) 260 cm^2

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 cm^2 (b) $16\sqrt{3}$ cm^2
(c) $16\sqrt{2}$ cm^2 (d) 27 cm^2

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 anypoint 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 $\angle BAN = 38^0$ and $\angle ACM = 20^0$ then $\angle$ MBN

(a) 38^0 (b) 42^0

(c) 28^0 (d) 32^0

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 orhtocentre 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 $\angle QCR = 130^0$, then $\angle RPS =$

PQS=60

(a) 30^0 (b) 35^0

(c) 100^0 (d) 60^0

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 Δ 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 Δ ABC. If AP = a cm, AQ = b cm and $\angle BAD = 15^0$, $\sin 75^0 = ?$

(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 $\angle QPR = 40^0$, then $\angle ACD$ is equal to:

(a) 140^0 (b) 40^0

(c) 70^0 (d) 100^0

50. D is any point on side AC of Δ 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)

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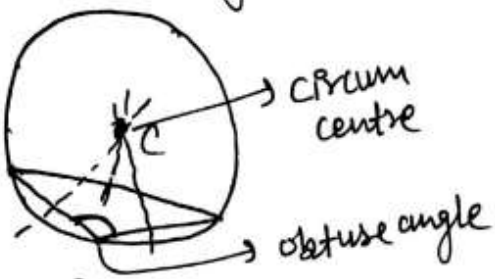
GEOMETRY SOLUTION · By SUNIL SIR

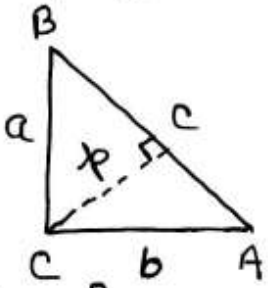
1. a) obtuse angled △



Note :→ Circumcentre & orthocentre of obtuse angled △ always lies outside.

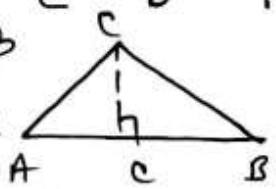
2. (b.)

$\Delta = \frac{1}{2} \times a \times b$



also $\Delta = \frac{1}{2} \times AB \times p$

$= \frac{1}{2} \times p \times c$



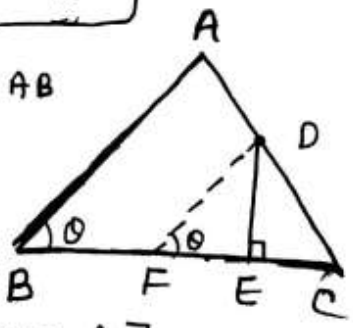
but $c = \sqrt{a^2+b^2}$

$\Rightarrow \frac{1}{2} \times a \times b = \frac{1}{2} \times p \times \sqrt{a^2+b^2}$

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

$\Rightarrow \boxed{\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}}$

3. (a) draw DF ∥ AB



∠ABC = ∠DFC

tan ∠ABC = tan ∠DFC

$3.6 = \frac{DE}{FE}$ $\left[\tan\theta = \frac{P}{B}\right]$

$\Rightarrow FE = \frac{18}{3.6} = 5$ [∵ DE = 18]

Also FE = CE = 5 [∵ CE = 5 given]

= CF/2

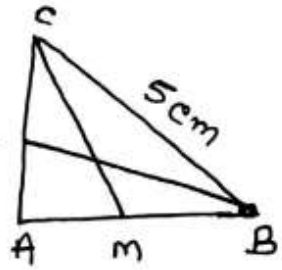
△ABC ~ △DFC

$\frac{AC}{CD} = \frac{BC}{FC} = \frac{BC}{2CE}$

$\Rightarrow \boxed{AC : CD = BC : 2CE}$

4. use (a).

$4(BL^2 + CM^2) = 5BC^2$



$4\left(\frac{45}{4} + CM^2\right) = 5 \times 25$

$CM^2 = \frac{125}{4} - \frac{45}{4} = \frac{80}{4} = 20$

$\Rightarrow CM = \sqrt{20} = 2\sqrt{5}$ cm

5. sum of interior angle of regular polygon $= (n-2) \times 180°$

$\therefore (n-2) \times 180° = 1440°$

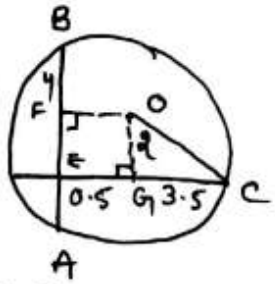
$\Rightarrow n - 2 = 8 \Rightarrow n = 10$ (a).

6. (a)

AE × EB = DE × EC

2 × 6 = 3 × CE

⇒ CE = 4 cm



Draw OF ⊥ AB & OG ⊥ to DC

⇒ F is mid point as ⊥ from centre O is drawn.

FB = AF = 4

⇒ EF = EB − FB = 6 − 4 = 2

Also DG = GC = $\frac{7}{2}$ = 3.5 cm

In △OGC EG = 3.5 − 3 = .5 cm

$OC = \sqrt{(3.5)^2 + (2)^2} = \frac{\sqrt{65}}{2} \Rightarrow D = \sqrt{65}$

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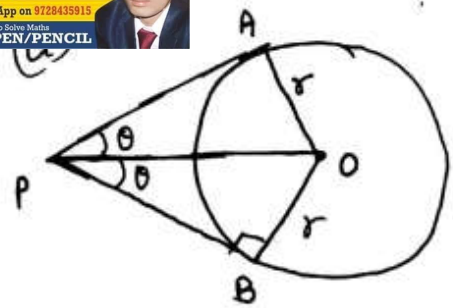
7. (a)

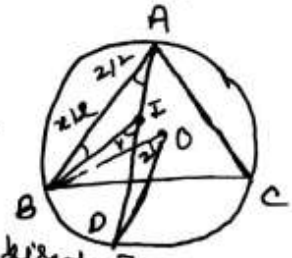


$OP = 2r = D$

IN $\triangle AOP$ $\sin\theta = \frac{AO}{OP} = \frac{r}{2r} = \frac{1}{2}$

$\Rightarrow \theta = 30° \Rightarrow \angle APB = 2\theta = 60°$ (d)

8. (c)



$\angle ABI = \angle IBC = \frac{x}{2}$ [angle bisector]

$\angle BAD = \frac{z}{2}$ [angle at centre is double of arc]

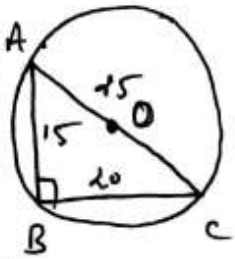
IN $\triangle AIB$

$y = \frac{x}{2} + \frac{z}{2}$ [Exterior Angle]

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

(d)

9. Circum centre of Right angled Triangle lies at mid point of hypotenuse.



$AC = \sqrt{(15)^2 + (20)^2} = 25$

Circum Radius $= \frac{25}{2} = 12.5$

Note → orthocentre of rt angled triangled lies at the right angle.

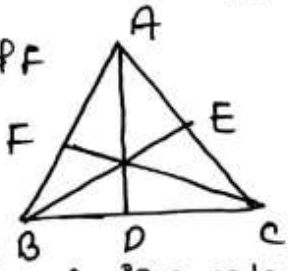
10. $R = \frac{a}{\sqrt{3}} \Rightarrow 8 = \frac{a}{\sqrt{3}} \Rightarrow a = 8\sqrt{3}$

altitude $= \frac{\sqrt{3}}{2} a = \frac{\sqrt{3}}{2} \times 8\sqrt{3}$

$= 12$ cm (d)

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

$2(AB + BC + CA) > 2(AD + BE + CF)$

$\Rightarrow AB + BC + CA > (AD + BE + CF)$

(a)

12. equilateral.

Note :→ Ortho centre, circum centre, incentre, and centroid of any triangle are always collinear. but if they lie at same point ⇒ $\triangle$ is equilateral.

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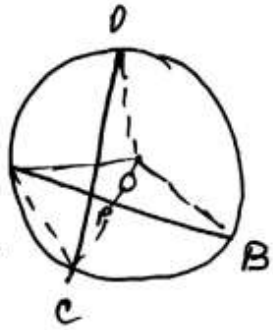
13.



$\angle BAC = \frac{1}{2}\angle BOC$

$= \frac{70^\circ}{2} = 35^\circ$

$\angle ACD = \frac{1}{2}\angle AOD$

$= \frac{1}{2} \times 100^\circ = 50^\circ$

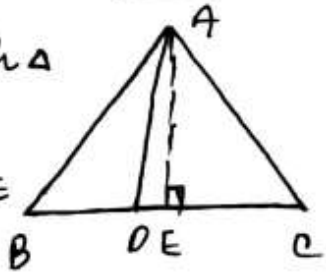
IN $\triangle APC$

$\angle APC = 180^\circ - (35^\circ + 50^\circ)$

$= 95^\circ$ Ans.

14.

height of both $\triangle$ ABD and ADC are equal = AE



$\frac{\text{ar } \triangle ABD}{\text{ar } \triangle ADC} = \frac{BD}{DC} = \frac{4}{5}$ [$\because$ h 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 $\alpha + \beta = 180^\circ$

& complementary if $\alpha + \beta = 90^\circ$

let angle θ

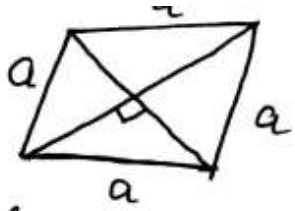
$180 - \theta = 3(90 - \theta)$

$2\theta = 90$

$\theta = 45^\circ$ Ans.

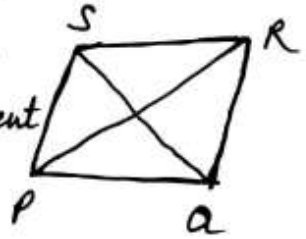
Rhombus

is a llelogram 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



$\Rightarrow \angle RSP = 180^\circ - 50$

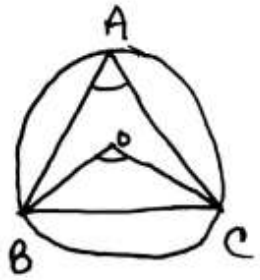
$= 130^\circ$

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 [Radius]

$\therefore \angle OBC = \angle OCB$

$\Rightarrow \theta + \theta + 100^\circ = 180^\circ$

$\Rightarrow \theta = 40^\circ$ Ans

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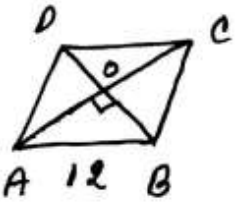
$= \angle A = 60^\circ$

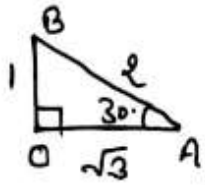


$\angle OAB = 30^\circ$

Now focus on $\triangle OAB$

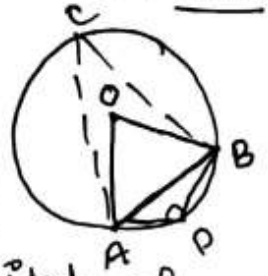
$2 \to 12$

$1 \to OB \to 6$



$BD = 2 \times 6 = 12$ cm Ans.

19.



as $AB = r$

$\Rightarrow OA = OB = AB = r$

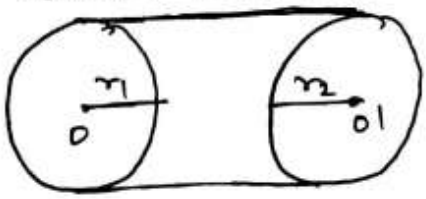
$\triangle OAB$ is equilateral

$\angle AOB = 60^\circ$

$\Rightarrow \angle ACB = 30^\circ \Rightarrow \angle ADB = 180^\circ - 30^\circ$

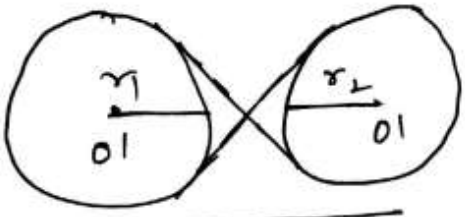
$= 150^\circ$ Ans.

Direct Common Tangent



$= \sqrt{(OO1)^2 - (r_1 - r_2)^2}$

Transverse Common Tangent

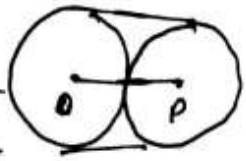


$= \sqrt{(OO1)^2 - (r_1 + r_2)^2}$

20. $OP = 12$

$DCT = \sqrt{(12)^2 - (8-4)^2}$

$= \sqrt{128} = 8\sqrt{2}$



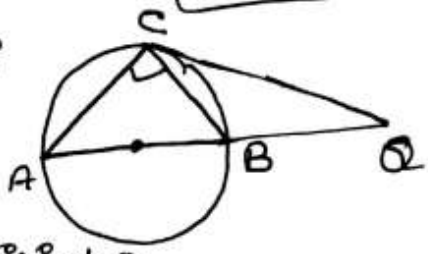
21. $\frac{(n-2) \times 180^\circ}{n} - \frac{360^\circ}{n} = 108^\circ$

$\Rightarrow 72n = 720 \Rightarrow \boxed{n = 10}$

22. $\angle CAB = 34^\circ$

$\angle ACB = 90^\circ$

[angle in semicircle]



$\Rightarrow$ In $\triangle ABC$ $\angle B = 180^\circ - 90^\circ - 34$

$= 56^\circ$ Ans.

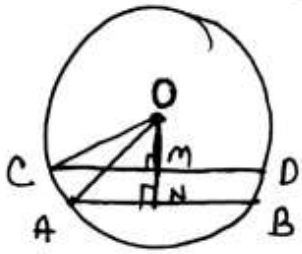
23. Trick

CM become ON

& AN become OM

$\Rightarrow MN = 3 - 2$

$= 1$ cm Ans.



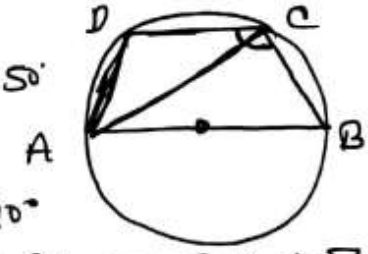
24.

$\angle ACD = 50^\circ$

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 Quadrilateral]

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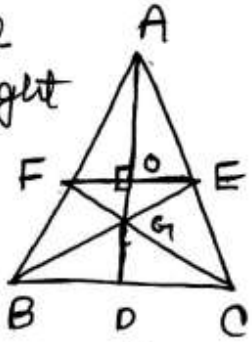
GEOMETRY PART-2

(a)

25. let Δ base is a & height h of ABC.

& Δ as equilateral

$\Rightarrow h = \frac{\sqrt{3}}{2}a$



as F & E are mid points

$\Rightarrow FE \parallel BC \Rightarrow FE = \frac{1}{2}BC$

$\Rightarrow \Delta GFE \sim BGC$

also For equilateral Δ altitude & median are same

$\frac{OG}{GD} = \frac{FE}{BC} = \frac{BC}{BC \times 2} = \frac{1}{2}$

$OG = \frac{1}{2}GD = \frac{1}{2} \times \frac{a}{2\sqrt{3}}$

Also $AO = AG - OG$

$= \frac{a}{\sqrt{3}} - \frac{a}{4\sqrt{3}} = \frac{3a}{4\sqrt{3}}$

$\Rightarrow AO : OG = \frac{3}{2} \times \frac{a}{2\sqrt{3}} : \frac{a}{4\sqrt{3}}$

$= \boxed{3:1}$

(c)

26 $\angle BOC = 90 - \frac{\angle A}{2}$

$= 90 - \frac{70}{2} = 55^\circ$

(b)

27. $= \sqrt{(OO')^2 - (R_1 + R_2)^2}$

$= \sqrt{225 - (6+3)^2}$

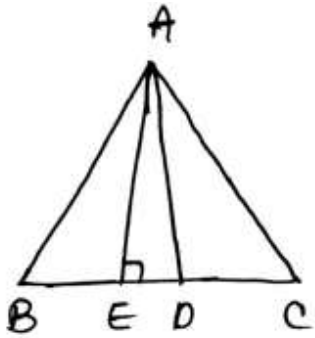
$= \sqrt{144} = 12$ cm

28. $\angle BOC = 90^\circ + \frac{\angle A}{2}$

$= 90^\circ + 40^\circ = 130^\circ$

29. (c)

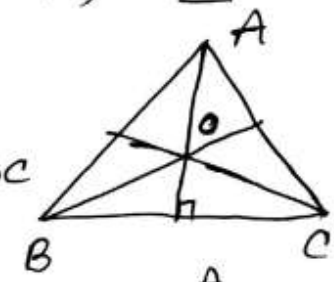
TRICK



$\angle EAD = \frac{1}{2}(B - C)$

$= \frac{1}{2}(60 - 40) = 10^\circ$

30. (d)



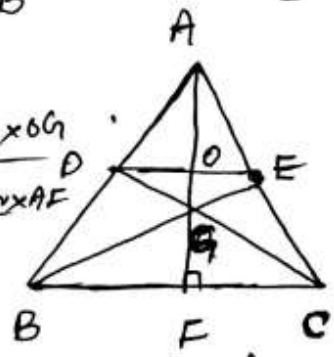
$\angle BAC$

$= 180^\circ - \angle BOC$

$= 180^\circ - 80^\circ$

$= 100^\circ$

31. (a)



$\frac{\Delta ODE}{\Delta ABC} = \frac{\frac{1}{2}DE \times OG}{\frac{1}{2} \times BC \times AF}$

assume Δ as equilateral also as explained in Q.25

$ODG \sim BGC$

$\frac{\Delta ODE}{\Delta ABC} = \frac{\frac{BC}{2} \times \frac{a}{4\sqrt{3}}}{BC \times \frac{\sqrt{3}}{2}a} = \frac{1}{12}$

(a)

32. $5\% = \frac{1}{20}$

$20 \rightarrow 21$

$20 \rightarrow 21$

$400 \rightarrow 441$

$\%$ Increase $= \frac{41}{400} \times 100$

$= 10.25\%$

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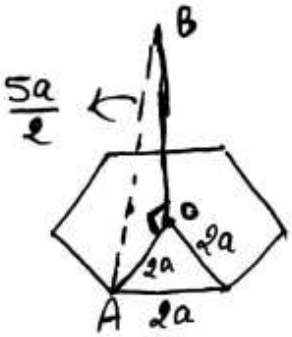
33. (c)



$V_p = \frac{1}{3} \times$ AREA OF base $\times$ height

$= \frac{1}{3} \times \frac{3\sqrt{3}}{2} \times (2a)^2 \times BO$ —(1)

$BO = \sqrt{AB^2 - OA^2} = \sqrt{\frac{25a^2}{4} - 4a^2}$

$= \frac{3a}{2}$

$\Rightarrow V_p = \frac{1}{3} \times \frac{3\sqrt{3}}{2} \times 4a^2 \times \frac{3a}{2}$

$= 3\sqrt{3}\, a^3$ cm^3

34. (c)

V_{prism} = AREA OF base $\times$ height

1056 = AREA OF base $\times h$

$A_{TRAPEZIUM} = \frac{1}{2}(8+14) \times 8$

$= 88$

$\Rightarrow h = \frac{1056}{88} = \frac{96}{8} = 12$ cm

35 (d)

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)

$V_p = A \times h \Rightarrow 366 = A \times h$

$\Delta = r \times s = 4 \times \frac{28}{2} = 56$

$\Rightarrow h = \frac{366}{56} = 6$ cm

37. (c).

$V = \frac{\sqrt{2}}{12} a^3 = \frac{\sqrt{2}}{12} \times 64$

$= \frac{16\sqrt{2}}{3}$ cm^3

38. (a).

$V = A \times h$

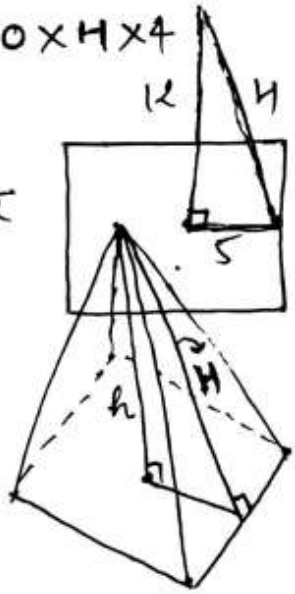
$720 = \frac{3\sqrt{3}}{2} p^2 \times 10\sqrt{3}$

$p = 4$ cm

39. (a)

C.S.A. = AREA OF 4 Δ

$= \frac{1}{2} \times 10 \times H \times 4$



$H = \sqrt{5^2 + 12^2}$

$= 13$

C.S.A $= \frac{1}{2} \times 10 \times 13 \times 4$

$= 260$.

T.S.A $= 260 + 10 \times 10 = 360$

40 (a)

C.S.A $= P \times H$

$= (5 + 12 + 13) \times 10$

$= 300$

T.S.A $= 300 + 2 \times 30$

$= 360$

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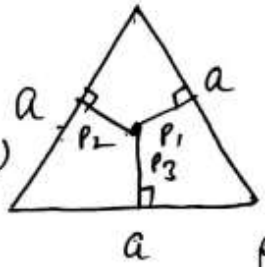
41. max AREA of given perimeter when Δ is equilateral.

$a = \frac{24}{3} = 8$ cm

$\Delta = \frac{\sqrt{3}}{4} \times 8 \times 8 = 16\sqrt{3}$ cm²

42. (d)



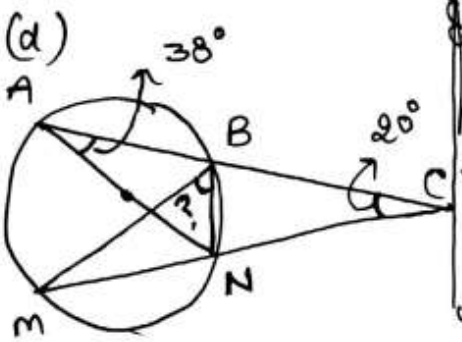
$a = \frac{2}{\sqrt{3}}(p_1+p_2+p_3)$

43. $a = \frac{2}{\sqrt{3}}(6+8+10)$

$= 16\sqrt{3}$ cm

(c).

44. (d)



$\angle ABN = 90°$ [semicircle]

$\angle ANM = 20° + 38°$

$= 58°$ [Exterior angle]

$\angle ABM = \angle ANM$

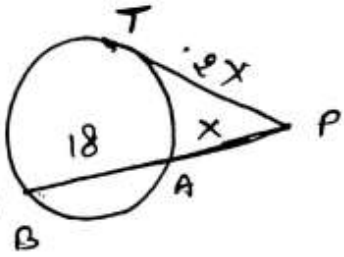
$= 58°$ [angle by same chord AM]

$\Rightarrow \angle MBN = \angle ABN - \angle ABM$

$= 90° - 58°$

$= 32°$

45. (a)



$PT^2 = PA \times PB$

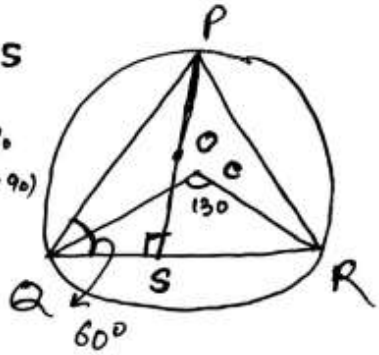
$4x^2 = x[x+18]$

$\Rightarrow 3x^2 - 18x = 0$

$3x[x-6] = 0 \Rightarrow x = 6$

$PT = 2 \times 6 = 12$

46. IN Δ PQS



$\angle QPS = 180° - (60 + 90)$

$= 30°$

$\angle QPR = \frac{130°}{2}$

$= 65°$

$\therefore \angle RPS = 65° - 30° = 35°$

(c)

48. $\angle B = 90°$

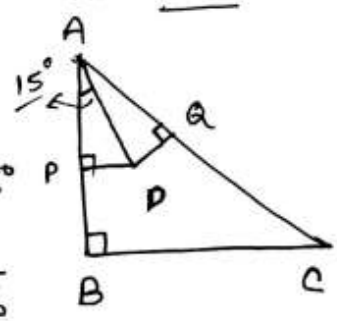
$AB = BC$

$\therefore \angle A = \angle C = 45°$

$\angle BAD = 15°$

$\angle CAD = 45 - 15$

$= 30°$



$\angle APD = 90° \Rightarrow \angle PDA = 90 - 15$

$= 75°$

$\therefore \sin 75° = \frac{AP}{AD} = \frac{a}{x}$

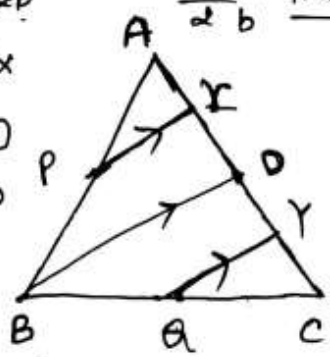
$\Delta AQD \quad \cos 30° = \frac{AQ}{AD} = \frac{b}{x}$

$\Rightarrow x = \frac{2b}{\sqrt{3}}$

$\sin 75° = \frac{a}{2b} \times \sqrt{3} = \frac{\sqrt{3}\,a}{2\,b}$ Ans.

(b)

50. IN Δ APX



$PX = \frac{1}{2} BD$

IN Δ BCD

$QY = \frac{1}{2} BD$

$\Rightarrow PX = PY$ OR $PX : PY = 1:1$

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