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12		36	48

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QUANT

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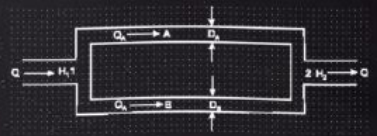

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Introduction To Percentages

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Trusted for Success

Percentages

Introduction to Percentages

Percentage to Fraction

$$20\% = \frac{20}{100} = \frac{1}{5}$$

$$35\% = \frac{35}{100} = \frac{7}{20}$$

Fraction to Percentage

$$\frac{1}{4} = \frac{1}{4} \times 100 = 25\%$$

$$\frac{7}{8} = \frac{7}{8} \times 100 = 87.5\%$$

Percentages

Percentage Increase and Decrease

Fraction for Percentage Increase

Increase of 20%

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

$$\therefore \text{New value} = \left(1 + \frac{1}{5}\right) \times \text{Original Value}$$

$$= \frac{6}{5} \times \text{Original Value}$$

Percentages

Percentage Increase and Decrease

Fraction for Percentage Decrease

Decrease of 14.28%

$$14.28\% = \frac{1}{7}$$

$$\therefore \text{New value} = \left(1 - \frac{1}{7}\right) \times \text{Original Value}$$

$$= \frac{6}{7} \times \text{Original Value}$$

Percentages

Example 1

The price of a mobile phone was Rs. 9624. If it increases by 8.33%, what will be the new price?

Increase of 8.33% = $\frac{1}{12}$

$\therefore$ New Price = $\frac{13}{12} \times$ Original Price

$\therefore$ New Price = $\frac{13}{12} \times 9624$ = Rs. 10426

Percentages

Example 2

The number of students in a college is 36996. There was a decrease of 7.69% over the previous year, how many students were there last year?

Decrease of 7.69% = $\frac{1}{13}$

$\therefore$ New No. of Students = $\frac{12}{13} \times$ Original No. of Students

$\Longrightarrow$ Original No. of Students = $\frac{36996 \times 13}{12}$

$\therefore$ Original No. of Students = 40079

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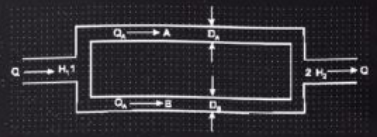

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Percentage Offset

Percentages

Percentage Change

Percentage Offset

If the price of the petrol is increased by 14.28%, by how much should you reduce your consumption to keep the expenses constant?

Let Price = 1, Consumption = 1 $\Longrightarrow$ Expenses = 1 × 1 = 1

$$P \times C = P' \times C' \Longrightarrow 1 \times 1 = \frac{8}{7} \times C'$$

$$\therefore C' = \frac{7}{8}$$

Consumption to be reduced = $\left(1 - \frac{7}{8}\right)$ = 12.5%

Percentages

Percentage Change

Percentage Offset

If the price of the petrol is increased by 14.28%. By how much should you reduce your consumption to keep the expenses constant?

Smart Cut

Price ↑ 14.28% = $\frac{1}{7}$

∴ Consumption ↓ $\frac{1}{8}$ = 12.5%

Percentages

Percentage Change

If A is 20% less than B, then B is _____% more than A.

$A = \frac{4}{5}B \quad \Rightarrow \quad B = \frac{5}{4}A$

$\therefore$ B is $\left(1 + \frac{1}{4}\right) \times A$

$\therefore$ B is $\frac{1}{4}$ more than A.

$\therefore$ B is 25% more than A.

Smart Cut $\downarrow$ by 20% $= \frac{1}{5}$ $\quad \therefore \uparrow$ by $\frac{1}{4} = 25\%$

Percentages

Percentage Change

The government has increased the price of petrol by 16.67%. However, due to widespread opposition, it had to revert back to the original price. By what percentage should they reduce the price now?

Let original price be Re.1.

New Price = $\left(1 + \frac{1}{6}\right) \times 1 = \frac{7}{6}$

$\Rightarrow$ Original price = $\frac{7}{6} \times \frac{6}{7} = 1$ $\therefore$ Reduced by $\frac{1}{7}$ = 14.28%

Smart Cut $\uparrow$ by 16.67% = $\frac{1}{6}$ $\therefore \downarrow$ by $\frac{1}{7}$ = 14.28%

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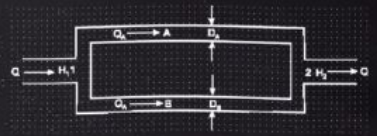

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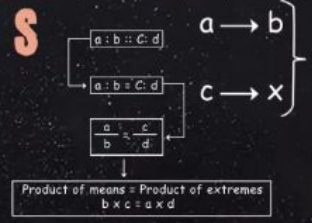

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Successive Percentage Change

Percentages

Successive Percentage Change

If change of a% is followed by another change of b%, then

Net Change = a% + b% + $\left(\frac{ab}{100}\right)$%

20% increase followed by a 30% increase

Net % Change = 20% + 30% + 6% = 56%

20% decrease followed by a 30% decrease

Net % Change = –20% – 30% + 6% = –44%

Percentages

Successive Percentage Change

14.28% increase followed by a 12.5% increase

New Value = $1 \times \frac{8}{7} \times \frac{9}{8} = \frac{9}{7}$

$\therefore$ Net Change = $\frac{2}{7}$ = 28.56%

16.67% decrease followed by a 25% increase

New Value = $1 \times \frac{5}{6} \times \frac{5}{4} = \frac{25}{24}$

$\therefore$ Net Increase of $\frac{1}{24}$ = 4.16%

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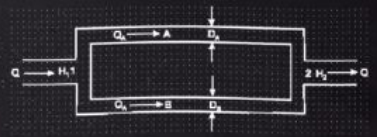

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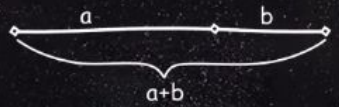

a+b is to a as a is to b

Ratio

Ratio Proportion

Introduction to Ratios

Ratios and Fractions

A vessel contains 12 litres of wine and 52 litre of water.

Ratios: Wine : Water = 12 : 52 = 3 : 13

Fraction of wine : $= \frac{12}{64} = \frac{3}{16}$ of the total quantity

Ratio Proportion

Properties of Ratios

1. If $\frac{A}{9} = \frac{B}{7} = \frac{C}{4}$, then A : B : C = ?

$\frac{A}{9} = \frac{B}{7} = \frac{C}{4} = k$

$\therefore A = 9k$

$B = 7k$

$C = 4k$

$\therefore A : B : C = 9 : 7 : 4$

Ratio Proportion

Properties of Ratios

2. If $A : B : C = \frac{1}{9} : \frac{1}{7} : \frac{1}{4}$, then A : B : C is also = ?

   A : B : C = 28 : 36 : 63

3. If 7A = 5B = 4C, then A : B : C = ?

   A : B : C = 20 : 28 : 35

4. If A : B = 3 : 5 and B : C = 4 : 9, then A : B : C = ?

   $\frac{A}{B} = \frac{3}{5} = \frac{12}{20}$

   $\frac{B}{C} = \frac{4}{9} = \frac{20}{45}$

   $\therefore A : B : C = 12 : 20 : 45$

Ratio Proportion

Properties of Ratios

5. $\frac{a}{b} = \frac{c}{d}$, then $\frac{a+b}{b} = \frac{c+d}{d}$ …(by Componendo)

6. $\frac{a}{b} = \frac{c}{d}$, then $\frac{a-b}{b} = \frac{c-d}{d}$ …(by Dividendo)

7. $\frac{a}{b} = \frac{c}{d}$, then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ …(by Componendo – Dividendo)

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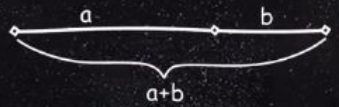

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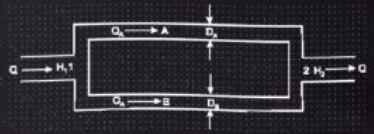

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Proportion

Trusted for Success

Ratio Proportion

Proportion

Proportion

If $\frac{a}{b} = \frac{c}{d}$ then a, b, c, d are in proportion.

Hence, ad = bc

Continued Proportion

If $\frac{a}{b} = \frac{b}{c} = \frac{c}{d}$ then a, b, c, d are in continued proportion.

Hence, If $\frac{a}{b} = \frac{b}{c} = \frac{c}{d} = k$

Then $c = dk$, $b = dk^2$ and $a = dk^3$

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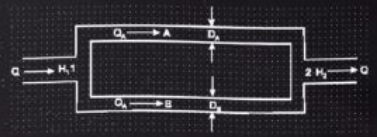

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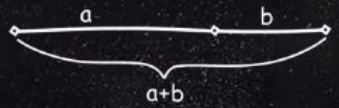

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Variation

Ratio Proportion

Variation

Direct Variation

If $a \alpha b$ then $a = bk$

or $\frac{a_1}{a_2} = \frac{b_1}{b_2}$

Example

If 2 men can make 100 toys in a day, How many toys will 20 men make in a day?

$\frac{2}{20} = \frac{100}{x}$ $\therefore x = 1000$

Ratio Proportion

Indirect Variation

If $a \alpha \frac{1}{b}$ then $a = \frac{k}{b}$

or $\frac{a_1}{a_2} = \frac{b_2}{b_1}$

Example

When I travel to work at my normal speed, I take 3 hours. How much time will I take if I double my speed?

$\frac{s_1}{s_2} = \frac{t_2}{t_1}$ $\therefore \frac{1}{2} = \frac{t_2}{3}$

Hence, time taken will be 1.5 hours

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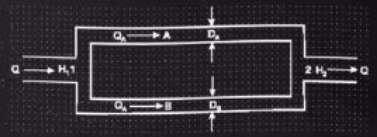

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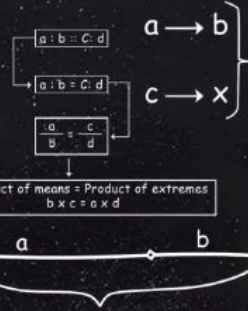

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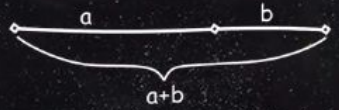

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Introduction To Profit and Loss

Profit and Loss

Profit, Loss and Discount

Profit = Selling Price – Cost Price

$$\text{Profit\%} = \frac{\text{Profit}}{\text{Cost Price}} \times 100$$

Loss = Cost Price – Selling Price

$$\text{Loss\%} = \frac{\text{Loss}}{\text{Cost Price}} \times 100$$

Discount = Marked Price – Selling Price

$$\text{Discount Percentage} = \frac{\text{Discount}}{\text{Marked Price}} \times 100$$

Mark up = Marked Price – Cost Price

$$\text{Mark up Percentage} = \frac{\text{Mark up}}{\text{Cost Price}} \times 100$$

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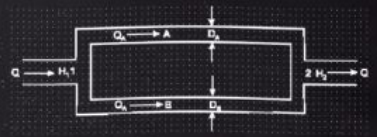

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Relationship between SP and CP

Profit and Loss

Relationship between Cost Price and Selling Price given a Percentage Profit or Loss

Profit

$$SP = \left(\frac{100 + P\%}{100}\right) \times CP$$

Loss

$$SP = \left(\frac{100 - L\%}{100}\right) \times CP$$

Profit and Loss

Relationship between Cost Price and Selling Price given a Percentage Profit or Loss

The cost price of a product is Rs. 14749. If the shopkeeper intends to make a 14.28% profit, what should be the selling price of the product?

$P\% = 14.28\% = \frac{1}{7}$

$\Rightarrow SP = \frac{8}{7} CP$

$\therefore SP = \frac{8}{7} \times 14749 =$ Rs. 16856

Profit and Loss

Relationship between Cost Price and Selling Price given a Percentage Profit or Loss

By selling an article at Rs. 36,000, a shop keeper makes a 9.09% loss. What is the cost price of the article?

$$L\% = 9.09\% = \frac{1}{11}$$

$$\therefore SP = \frac{10}{11} CP$$

$$\therefore \frac{36000 \times 11}{10} = CP$$

$$\therefore CP = \text{Rs. } 39600$$

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

$$\text{Whole} = \frac{\text{Part}}{\text{Percent}} \times 100$$

$$\begin{array}{r} 34 \\ 2\overline{)68} \\ -6 \\ \hline 08 \\ 8 \end{array}$$

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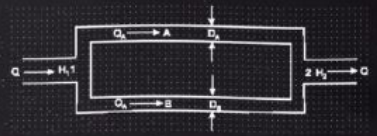

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Concept of MP and Freebies

Profit and Loss

Concept of Marked Price

A dealer makes a profit of 10% after selling an item at a discount of 10%. What percent above the cost price has he marked the item?

P% = 10 D% = 10

$\Rightarrow SP = \frac{11}{10} CP$ $\Rightarrow SP = \frac{9}{10} MP$

$\frac{11}{\cancel{10}} CP = \frac{9}{\cancel{10}} MP$

$\Rightarrow 11\ CP = 9\ MP$

$\Rightarrow \frac{MP}{CP} = \frac{11}{9}$

$\therefore$ Mark up % $= \frac{2}{9} \times 100 = 22.22\%$

Profit and Loss

Freebies

A retail store has an offer where if you buy 5 T-shirts you get 2 free. Calculate the discount percent offered.

$$\text{Discount\%} = \frac{\text{No. of free articles}}{\text{Total no. of articles taken}} \times 100$$

$$= \frac{2}{7} \times 100$$

$$= 28.56\%$$

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2	:	6	8
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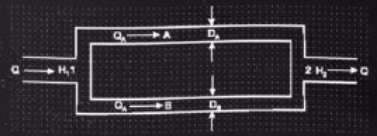

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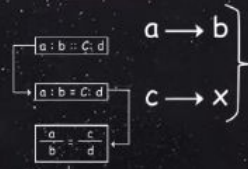

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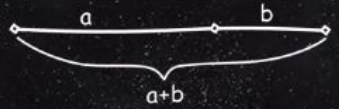

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Items Sold at same SP

Profit and Loss

Items sold at same Selling Price

If two items are sold at Rs. 600 each, one at a profit of 20% and the other at a loss of 20%, then find overall absolute and percentage profit or loss.

Item I

SP = 600

P = 20%

$\Rightarrow SP = \frac{6}{5} CP$

$\therefore CP = \frac{5}{6} \times 600 = \text{Rs. } 500$

Item II

SP = 600

L = 20%

$\Rightarrow SP = \frac{4}{5} CP$

$\therefore CP = \frac{5}{4} \times 600 = \text{Rs. } 750$

Profit and Loss

Items sold at same Selling Price

If two items are sold at Rs. 600 each, one at a profit of 20% and the other at a loss of 20%, then find overall absolute and percentage profit or loss.

Total CP = Rs. 1250; Total SP = Rs. 1200

∴ Loss = 1250 – 1200 = Rs. 50

$$\text{Loss\%} = \frac{50}{1250} \times 100 = 4\%$$

Profit and Loss

Items sold at same Selling Price

If two items are sold at Rs. 600 each, one at a profit of 20% and the other at a loss of 20%, then find overall absolute and percentage profit or loss.

Total CP = Rs. 1250; Total SP = Rs. 1200

∴ Loss = 1250 – 1200 = Rs. 50

$$\text{Loss\%} = \frac{50}{1250} \times 100 = 4\%$$

$$\text{Net Loss \%} = \frac{P^2}{100}$$

$$\text{Absolute (rupee value) Loss} = \frac{2P^2 \times SP}{100^2 - P^2}$$

Profit and Loss

Items sold at same Selling Price

The cost price of 7 articles is equal to the selling price of 9 articles. Find profit or loss percentage.

$CP \times 7 = SP \times 9$

$\Rightarrow \frac{SP}{CP} = \frac{7}{9}$

$\therefore$ Loss $= \frac{2}{9} \times 100 = 22.22\%$

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×6 ↓		×6 ↓	×6 ↓
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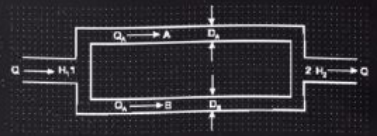

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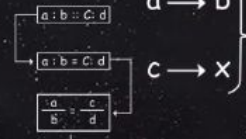

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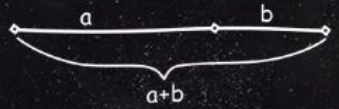

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Dishonest Sellers

Profit and Loss

Cheating

Adulteration

A dairy mixes 1 litre water in 3 litres milk and sells the mixture at cost price of milk. Find their percentage profit or loss.

Let CP of 1 litre milk be Rs. 10.

$\Rightarrow$ CP of 3 litres = Rs. 30

Total quantity to be sold = 4 litres

$\Rightarrow$ SP = Rs. 40

$$\text{Profit\%} = \frac{10}{30} \times 100 = 33.33\%$$

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$$\text{Profit\%} = \frac{10}{30} \times 100 = 33.33\%$$

Smart Cut $\dfrac{\text{Free Quantity}}{\text{Original Quantity}} \times 100 = \dfrac{1}{3} \times 100 = 33.33\%$

Profit and Loss

Cheating

Faulty Weights

A grocer claims to sell his goods at cost price. However, he uses 950 grams weight instead of 1 kg weight. Find the percentage profit.

Smart Cut

$$\text{Profit Percent} = \frac{\text{Weight not given}}{\text{Actual weight given}} \times 100$$

$$\therefore \frac{50}{950} \times 100 = 5.26\%$$

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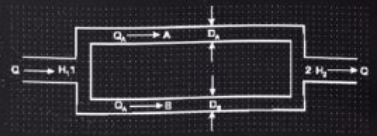

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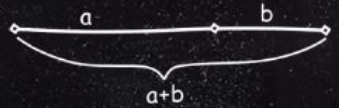

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Introduction To Interest

Simple Interest and Compound Interest

Introduction to Interest

Simple Interest

$$S.I. = \frac{PNR}{100}$$

Compound Interest

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

$$C.I. = A - P$$

Common Terms

I → Interest

A → Amount

P → Principal

N → Number of Years

R → Rate of Interest

Simple Interest and Compound Interest

Example

A sum of Rs. 1000 is kept at 10% p.a. Rate of Interest

Year	Simple Interest		Compound Interest	
	Principal	Interest	Principal	Interest
1	Rs. 1000	100	Rs. 1000	100
2	Rs. 1000	100	Rs. 1100	110
3	Rs. 1000	100	Rs. 1210	121
4	Rs. 1000	100	Rs. 1331	133.1

CI follows same pattern as Amount. Can hence be directly calculated.

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2	:	6	8
×6 ↓		×6 ↓	×6 ↓
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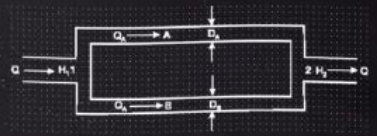

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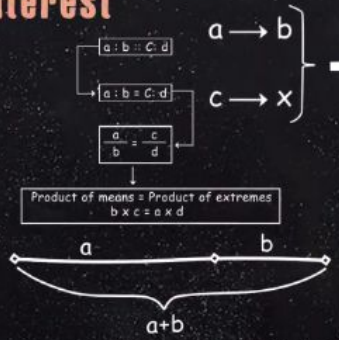

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Difference in SI and CI

Simple Interest and Compound Interest

Difference in the SI and CI for a given Time Period

First Two Time Periods

The difference between S.I. and C.I. for the first two years is Rs. 34 and the total S.I. earned in this period is Rs. 1360. Find:
(i) Rate of Interest (ii) Principal

	Year 1	Year 2
SI	680	680
CI	680	680 + 34

$$\therefore R = \frac{34}{680} \times 100 = 5\%$$

$$I = \frac{PNR}{100}$$

$$\therefore 680 = \frac{P \times 1 \times 5}{100}$$

$$\therefore P = 13600$$

Simple Interest and Compound Interest

Difference in the SI and CI for a given Time Period

The difference between S.I. and C.I. for the first two years at 20% p.a. is Rs. 32.

Find: (i) Principal (ii) Total S.I. earned (iii) Total C.I. earned

	Year 1	Year 2
SI	x	x
CI	x	x + 0.2x

$0.2x = 32$

$\therefore x = 160$

$\therefore$ Total S.I. = 320

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

$$\therefore 160 = \frac{P \times 1 \times 20}{100}$$

$\therefore P = 800$

Total CI = 320 + 32

$\therefore$ Total C.I. = 352

Simple Interest and Compound Interest

Difference in the SI and CI for a given Time Period

The difference between S.I. and C.I. for the first two years at 20% p.a. is Rs. 32.

Find: (i) Principal (ii) Total S.I. earned (iii) Total C.I. earned

Difference between S.I. and C.I. for 2 years = $\frac{PR^2}{100^2}$

$\therefore 32 = \frac{P(20)^2}{100^2}$

$\therefore P = 800$

$\therefore SI = 320$ & $CI = 352$

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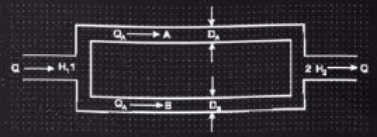

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Different Time Periods of Compounding

Simple Interest and Compound Interest

Different Time Periods for Compounding

A sum of Rs. 10000 is kept at 40% p.a. compound interest. Find the total interest and amount at the end of one year if the compounding happens (i) annually (ii) half yearly (iii) quarterly.

	Annual	Half Yearly	Quarterly
Number of Time Periods of Compounding (N)	1	2	4
ROI for the period of compounding (R)	40%	20%	10%

Simple Interest and Compound Interest

Different Time Periods for Compounding

A sum of Rs. 10000 is kept at 40% p.a. compound interest. Find the total interest and amount at the end of one year if the compounding happens (i) annually (ii) half yearly (iii) quarterly.

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

Annual Compounding:

$$\therefore A = 10000\left(1 + \frac{40}{100}\right)^1$$

Half Yearly Compounding:

$$A = 10000\left(1 + \frac{20}{100}\right)^2$$

Quarterly Compounding:

$$A = 10000\left(1 + \frac{10}{100}\right)^4$$

Simple Interest and Compound Interest

Different Time Periods for Compounding

Total	Annual Compounding	Half Yearly Compounding	Quarterly Compounding
Interest	4000	4400	4641
Amount	14000	14400	14641

If nothing is mentioned about the time period of compounding:
Assume annual

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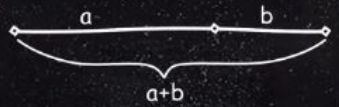

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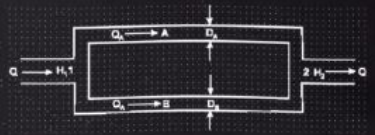

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Installments

Installments

EMI

Example 1

John borrowed Rs. 2,10,000 from a bank at an interest rate of 10% per annum, compounded annually. The loan was repaid in two equal instalments, the first after one year and the second after another year. The first instalment was interest of one year plus part of the principal amount, while the second was the rest of the principal amount plus due interest thereon. Then each installment, in Rs., is:

$$\left[2,10,000\left(1+\frac{10}{100}\right)^2\right] = \left[x\left(1+\frac{10}{100}\right)^1 + x\right]$$

$$2,10,000\,(1.21) = 2.1x$$

$$x = \frac{\cancel{2,10,000}^{1000} \times 1.21}{\cancel{2.1}_{1}} = \boxed{1,21,000}$$

Installments

Example 2

The compound interest offered on the sum of Rs. 5000 is 8% p.a. for a period of three years. The borrower keeps paying back the sum of Rs. 1000 at the end of every year. What is the amount that has to be paid at the end of third year so as to clear all dues?

$$5000(1.08)^3 = 1000(1.08)^2 + 1000(1.08)^1 + x$$

$$5000 \times \frac{126}{100} = 1000(1.17) + 1000(1.08) + x$$

$$50 \times 126 = 1170 + 1080 + x$$

$$6300 = 2250 + x$$

$$\boxed{x = 4050}$$

108 +8
108 +8
116 a

6300
2250
4050

Installments

Example 3

A sum of Rs 25220 is to be paid back in three equal annual installments. How much is each installment if the interest is compounded annually at 5% p.a.?

$$25220\left(1+\frac{5}{100}\right)^3 = x\left(1+\frac{1}{20}\right)^2 + x\left(1+\frac{1}{20}\right)^1 + x$$

$$25220\left(\frac{21}{20}\right)^3 = x \times \frac{441}{400} + \frac{21x}{20} + x$$

$$25220 \times \left(\frac{21}{20}\right)^3 = \frac{441x + 420x + 400x}{400}$$

$$\frac{25220 \times 21 \times 21 \times 21}{20 \times 20 \times 20} = \frac{1261x}{400}$$

$$x = 9261$$

Installments

Example 4

What annual installment will discharge a debt of Rs 2300 due in 4 years, the rate of interest being 10% per annum at S.I.?

Amount

Installment = 100

100 + 30 = 130

100 + 20 = 120

100 + 10 = 110

100 + 0 = 100

460

100 ⇒ Rs. 460

? Rs. 2300

$\frac{2300 \times 100}{460} = 500$

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

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$$\begin{array}{r} 34 \\ 2\overline{)68} \\ -6 \\ \hline 08 \\ 8 \end{array}$$

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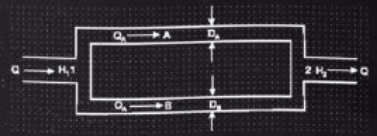

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Averages

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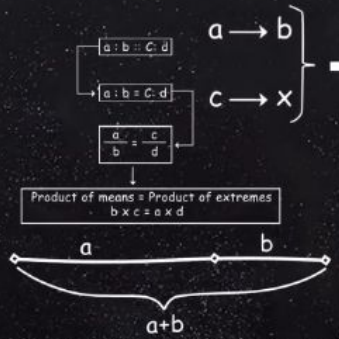

a+b is to a as a is to b

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Average or Mean

Averages

Average / Mean

Simple Average / Arithmetic Mean

$$= \frac{\text{Sum of all values}}{\text{Number of values}}$$

Geometric Mean

$$GM(a, b) = \sqrt[2]{ab}$$

$$GM(a, b, c) = \sqrt[3]{abc}$$

Averages

Harmonic Mean

$$HM(a, b) = \frac{2}{\frac{1}{a} + \frac{1}{b}} = \frac{2ab}{a + b}$$

$$HM(a, b, c) = \frac{3}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c}} = \frac{3abc}{ab + bc + ac}$$

For a set of numbers

$AM \geq GM \geq HM$

The average for a set of numbers is always larger than the lowest and smaller than the highest numbers of the set

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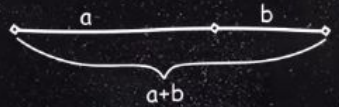

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Weighted Average

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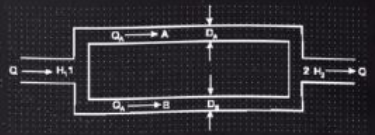

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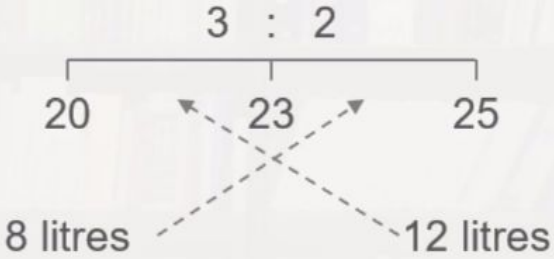
Averages

Weighted Average

$$\text{Weighted Average} = \frac{w_1 \times x_1 + w_2 \times x_2 + \ldots + w_n \times x_n}{w_1 + w_2 + \ldots + w_n}$$

A milkman mixes 12 litres of milk at Rs. 25 per litre, with 8 litres of milk at Rs. 20 per litre. What would be the average price of the resulting mixture?

$$\frac{12 \times 25 + 8 \times 20}{12 + 8} = 23$$



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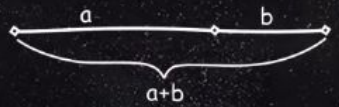

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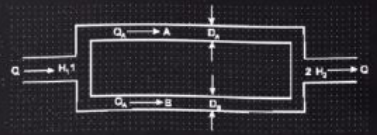

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Behavior of Averages

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Averages

Behavior of Averages

There are 19 students in a class having an average of 18 chocolates. If a new student having 58 chocolates joins in, What would be the new average?

Average = $\frac{(19 * 18) + 58}{20}$

$= \frac{342 + 58}{20}$

$= 20$

Averages

Behavior of Averages

There are 19 students in a class having an average of 18 chocolates. If a new student having 58 chocolates joins in, What would be the new average?

The new student has 58 chocolates, i.e. 40 extra than the current average.

The additional 40 chocolates would get distributed to 20 children.

So each child would get 2 extra

So the new average would be 18 + 2 = 20

Averages

Behavior of Averages

Dhoni's Average in the first 23 innings is 56. If in the 24th inning, he scores 8 runs, What would be his new average?

$$\text{Average} = \frac{(23 * 56) + 8}{24}$$

$$= \frac{1288 + 8}{24}$$

$$= 54$$

Averages

Behavior of Averages

Dhoni's Average in the first 23 innings is 56. If in the 24th inning, he scores 8 runs, What would be his new average?

He has scored 48 runs less than his current average

The deficit of 48 runs would get distributed to 24 innings

So each inning would reduce by 2

So the new average would be 56 - 2 = 54

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2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

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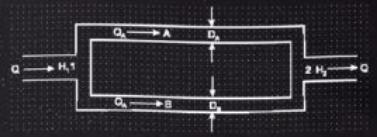

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a+b is to a as a is to b

Mixtures: Addition and Replacement

Mixtures and Alligations

Mixtures

Simple Addition

A vessel contains Milk and Water in the ratio 3 : 5. When 6 litres of Water is added to this solution, the ratio of Milk and Water becomes 5 : 9. How many litres of the solution was present in the vessel originally?

$$\frac{3x}{5x + 6} = \frac{5}{9}$$

$\therefore x = 15$

$\therefore$ Total = 8x = 120 litre

Mixtures and Alligations

Mixtures

Simple Replacement

A vessel contains Milk and Water in the ratio 3 : 5. When 6 litres of this solution is removed and replaced by Water, the ratio of Milk and Water becomes 5 : 9. How many litres of the solution was present in the vessel originally?

∴ Total = 120 + 6 = 126 litre

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

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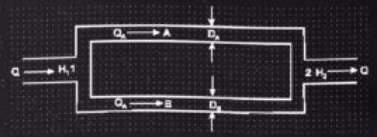

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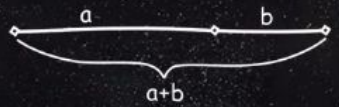


a+b is to a as a is to b

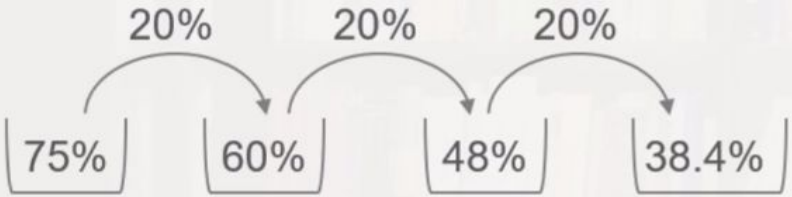
Mixtures: Percentage Replacement

Mixtures and Alligations

Mixtures

Simple Percentage Replacement

A vessel contains 75% Milk solution. 20% of this solution is removed and replaced by Water. This process is repeated two more times. Find the percentage of Milk in the solution after the three operations.



Mixtures and Alligations

Mixtures

Simple Percentage Replacement

A vessel contains 75% Milk solution. 20% of this solution is removed and replaced by Water. This process is repeated two more times. Find the percentage of Milk in the solution after the three operations.

$$75\% \xrightarrow{20\%} 60\% \xrightarrow{20\%} 48\% \xrightarrow{20\%} 38.4\%$$

$$75 \times \frac{80}{100} \times \frac{80}{100} \times \frac{80}{100} = 75 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}$$

$\therefore$ Percentage of Milk = 38.4%

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×6 ↓		×6 ↓	×6 ↓
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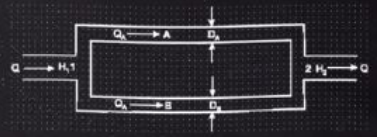

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Wine Left Formula

Mixtures and Alligations

Wine left Formula

Consider a vessel containing ‘x’ litres of liquid A.

If we withdraw ‘y’ litres of liquid A and replace the same quantity with another liquid B,

Volume of liquids A left = ‘x – y’ litres

Volume of liquids B left = ‘y’ litres.

If this operation is performed n times in all, then:

$$\frac{\text{Liquid A left in the vessel after nth operation}}{\text{Initial quantity of liquid A in the vessel}} = \left(\frac{x-y}{x}\right)^n$$

$$\frac{\text{Liquid A left after nth operation}}{\text{Liquid B left after nth operation}} = \frac{\left(\frac{x-y}{x}\right)^n}{1-\left(\frac{x-y}{x}\right)^n}$$

Mixtures and Alligations

Wine left Formula

Example 1

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

Let the original quantity of wine in the cask be x

$$\frac{\text{Wine left in the cask after fourth operation}}{\text{Initial quantity of wine in the vessel}} = \frac{16}{16 + 65}$$

$$\left(\frac{x - 8}{x}\right)^4 = \frac{16}{81}$$

Mixtures and Alligations

Wine left Formula

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$$\left(\frac{x-8}{x}\right) = \frac{2}{3}$$

$$3x - 24 = 2x$$

$$x = 24$$

$\therefore$ Volume of wine originally in the cask is 24 litres

Mixtures and Alligations

Wine left Formula

Example 2

A cistern contains 100 litres of pure acid. A 20 litre jug is used to remove the cistern mixture, replacing it with water. After how many such processes will the concentration of acid drop below 50% ?

$$\frac{\text{Acid left in the cistern after } n^{th} \text{ operation}}{\text{Initial quantity of acid in the cistern}} = \left(\frac{100-20}{100}\right)^n$$

n	Concentration of acid
1	0.8 or 80%
2	0.64 or 64%
3	0.512 or 51.2%
4	0.4096 or 40.96%

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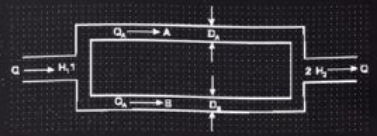

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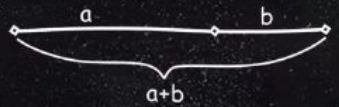


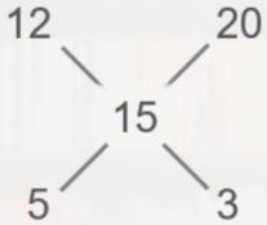
a+b is to a as a is to b

Alligation

Mixtures and Alligations

Alligation

In what ratio should you mix two varieties of sugar, one costing Rs. 12 per kg and the other costing Rs. 20 per kg, so as get a mixture at an average price of Rs. 15 per kg?

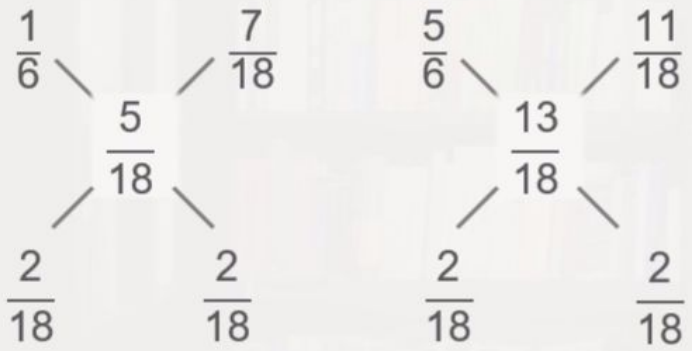


Thus the ratio is 5:3

Mixtures and Alligations

Alligation

A vessel contains wine and water in the ratio 1 : 5. Another vessel contains wine and water in the ratio 7 : 11. In what ratio should the contents of the two vessel be added, so as to get wine and water in the ratio 5 : 13?



Thus the ratio is 1:1

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

$$\text{Whole} = \frac{\text{Part}}{\text{Percent}} \times 100$$

$$\begin{array}{r} 34 \\ 2\overline{)68} \\ -6 \\ \hline 08 \\ 8 \end{array}$$

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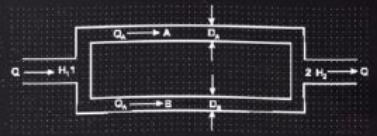

QUANT Concept Videos

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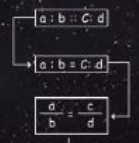

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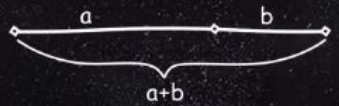

a+b is to a as a is to b

Partnership

Partnership

Concept

In a partnership involving multiple people,

Profit or Loss is divided in the ratio of

'Time period × Investment'

Partnership

Example

3 friends Amar, Bhavin and Chetan enter into a partnership with capitals in the ratio of 2 : 3 : 5. Bhavin leaves the business after 6 months, while Chetan leaves after another 3 months. At the same time when Chetan leaves, Darshan enters the business with investment equal to Bhavin. Find the amount each should get if a profit of Rs. 16000/- was made at the end of the year.

Amar	Bhavin	Chetan	Darshan
$2 \times 12 = 24$	$3 \times 6 = 18$	$5 \times 9 = 45$	$3 \times 3 = 9$

Partnership

Example

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$\therefore$ Ratio = 8 : 6 : 15 : 3

16000 divided in 8 : 6 : 15 : 3 will give

$$\frac{8}{32} \times 16000 = 4000$$

$\therefore$ Amar = 4000, Bhavin = 3000, Chetan = 7500 & Darshan = 1500

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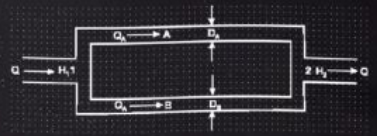

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Introduction

Trusted for Success

Time and Work

Introduction

Work Done = Efficiency (Rate) × Time × Number of People

Rate and Time are: Inversely proportional

(if the work done and number of people are constant)

Number of people and Time are: Inversely proportional

(if the work done and rate are constant)

Time and Work

Work - Introduction

Efficiency

If A is thrice as good a workman as B,

then the ratio of work done by A and B in the same time = 3 : 1

and the ratio of the time taken by A and B for the same work = 1 : 3

If A is 60% more efficient than B,

then the ratio of work done by A and B in the same time = 160 : 100 = 8 : 5

and the ratio of the time taken by A and B for the same work = 5 : 8

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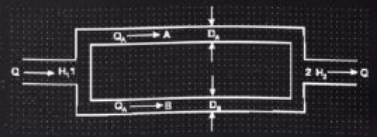

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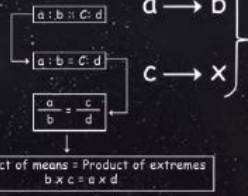

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Different Types of Questions

Time and Work

Different Types of Questions

A. Two or more people working simultaneously:

Adam can do a piece of work in 20 days working alone, Bob can do it in 15 days working alone and Charles can do it in 30 days working alone. How many days will it take to complete the work, if all three of them work together?

∴ Total work = 60 units

∴ Adam = 3 units/day; Bob = 4 units/day;

Charles = 2 units/day

∴ Together = 3 + 4 + 2 = 9 units/day

∴ Time required = $\frac{60}{9}$ = 6.67 days

Time and Work

Different Types of Questions

B. Two people working alternately:

Adam can do a piece of work in 20 days working alone, Charles can do it in 25 days working alone. How many days will it take to complete the work, if the two of them work on alternate days?

Case 1 : If Adam works on the first day:

∴ Total work = 100 units

∴ Adam = 5 units/day; Charles = 4 units/day

∴ 9 units in 2 days

∴ 99 units in 22 days

Time and Work

Different Types of Questions

B. Two people working alternately:

Adam can do a piece of work in 20 days working alone, Charles can do it in 25 days working alone. How many days will it take to complete the work, if the two of them work on alternate days?

$\therefore$ Remaining 1 unit $\rightarrow$ Adam $\rightarrow \frac{1}{5}$th of a day

Hence, work will be completed in $22\frac{1}{5}$ days

Time and Work

Different Types of Questions

B. Two people working alternately:

Adam can do a piece of work in 20 days working alone, Charles can do it in 25 days working alone. How many days will it take to complete the work, if the two of them work on alternate days?

$\therefore$ Remaining 1 unit $\rightarrow$ Adam $\rightarrow \frac{1}{5}$th of a day

Hence, work will be completed in $22\frac{1}{5}$ days

Case 2 : If Charles works on the first day

$\therefore$ Remaining 1 unit $\rightarrow$ Charles $\rightarrow \frac{1}{4}$th of a day

Hence, work will be completed in $22\frac{1}{4}$ days

Time and Work

Different Types of Questions

C. Man-Days extended to output:

25 men working 8 hours a day produce 200 toys in 10 days. In how many days will 1000 toys be produced by 100 men, if they work 10 hours a day?

Input or Effort $\propto$ Output

So, $\frac{(\text{Input})_1}{(\text{Input})_2} = \frac{(\text{Output})_1}{(\text{Output})_2}$

$$\frac{25 \times 8 \times 10}{100 \times 10 \times d} = \frac{200}{1000}$$

Solving: we get d = 10

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×6 ↓		×6 ↓	×6 ↓
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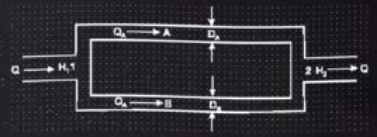

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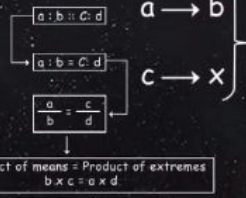

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Pipes and Cisterns

Time and Work

Pipes and Cisterns - Introduction

Efficiency

If the ratio of the radii of taps A and B is 1 : 2,

the ratio of output from taps A and B in the same time = 1 : 4

& the ratio of the time taken by taps A and B to fill a tank = 4 : 1

Time and Work

Different Types of Questions

Tap A can fill a vessel in 15 hours and tap B can fill it in 20 hours. How much time will it take to fill the vessel if both the taps are opened simultaneously?

Tank capacity = 60 litres

∴ Tap A = 4 litres/hour

∴ Tap B = 3 litres/hour

∴ Total = 7 litres/hour

∴ Time taken to fill the vessel completely = $\frac{60}{7}$ hours

Time and Work

Different Types of Questions

Concept of Negative Work

Tap A can fill a vessel in 15 hours, tap B can fill it in 20 hours while a drain pipe C can empty it in 30 hours. How much time will it take to fill the vessel if all three are operating simultaneously?

Tank capacity = 60 litres

∴ Tap A = 4 litres/hour; Tap B = 3 litres/hour;

Tap C = –2 litres/hour

∴ Total = 5 litres/hour

∴ Time taken to fill the vessel completely = $\frac{60}{5}$ = 12 hours

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

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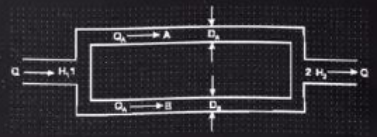

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Introduction to Time, Speed and Distance

ims
Trusted for Success

Time, Speed and Distance

Introduction

Speed is distance covered in unit time.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Speed and Distance are directly proportional (if the Time is constant)

Speed and Time are inversely proportional (if the Distance is constant)

Time, Speed and Distance

Example

Walking at three–fourth of his normal speed, Raj is two hours late to office. What is the normal time it takes for Raj to reach office?

Distance is constant

Speed and Time are inversely proportional

$$\frac{S_2}{S_1} = \frac{T_1}{T_2}$$

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

t = 6 hours

Time, Speed and Distance

Example

Raj and Akash start travelling at 9:00 am from Town A and Town B towards each other at speeds of 40 km/hr and 50 km/hr respectively. The distance between these towns is 450 kms. When and where will they meet each other ?

$$\frac{40}{50} = \frac{D_R}{450 - D_R}$$

$D_R = 200$ kms

$\therefore D_A = 250$ kms

$$T_A = \frac{250}{50} = 5 \text{ hrs}$$

Time, Speed and Distance

Introduction

Conversions

1 km = 1000 m

$$1 \text{ km/h} = \frac{1000}{3600} = \frac{5}{18} \text{m/s}$$

$$1 \text{ m/s} = \frac{18}{5} \text{ km/hr}$$

1 Mile ≈ 1.6 kms

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×6 ↓		×6 ↓	×6 ↓
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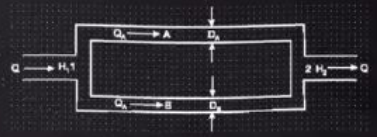

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Average Speed

Time, Speed and Distance

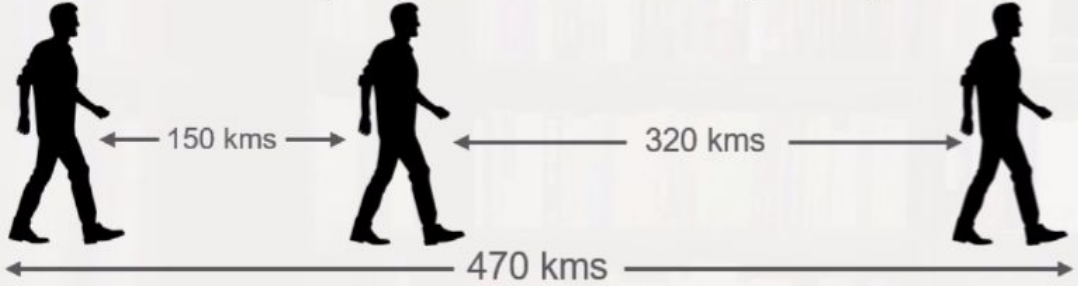
Average Speed

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

Time, Speed and Distance

Average Speed

A man covers the first 150 kms of his journey at a speed of 30 km/hr, the next 320 kms of his journey at a speed of 80 km/hr What is his average speed for the entire journey?



Total distance = 470 kms

Total time = $\frac{150}{30} + \frac{320}{80} = 9$ hrs

$\therefore$ Average speed = $\frac{470}{9} \approx 52.2$ kms/hr

Time, Speed and Distance

Average Speed

Distance Constant

A person covers three different stretches of same lengths at speeds of 30 km/hr, 60 km/hr and 90 km/hr respectively. What is his average speed for the entire journey?

When Distance is constant, Average speed is the Harmonic mean of speeds.

$$\text{Average speed} = HM(30, 60, 90) = \frac{3}{\frac{1}{30}+\frac{1}{60}+\frac{1}{90}} = \frac{540}{11} \approx 49\text{km/hr}$$

Time, Speed and Distance

Average Speed

Time Constant

A person covers a particular journey at three different speeds: 30 km/hr, 60 km/hr and 90 km/hr, each for equal intervals of time. What is his average speed for the entire journey?

When time is constant, Average speed is the Arithmetic Mean of speeds

$$\therefore \text{Average speed} = \frac{30 + 60 + 90}{3} = 60 \text{ km/hr}$$

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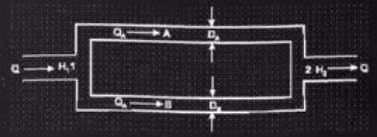

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Relative Speed

Time, Speed and Distance

Relative Speed

Two bodies moving in the same direction:

Relative Speed = Difference of speeds

Two bodies moving in opposite directions:

Relative speed = Sum of speeds

Time, Speed and Distance

Example

Raj and Akash start travelling at 9:00 am from Town A and Town B at speeds of 40 km/hr and 50 km/hr respectively. The distance between these towns is 450 kms. When and where will they meet each other?

$\therefore$ Relative speed = 90 km/hr

Time taken to meet = $\frac{450}{90}$ = 5 hours.

$\therefore$ They meet each other at 2:00 pm.

$D_A = 50 \times 5 = 250$ kms

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

$$\text{Whole} = \frac{\text{Part}}{\text{Percent}} \times 100$$

$$\begin{array}{r} 34 \\ 2\overline{)68} \\ -6 \\ \hline 08 \\ 8 \end{array}$$

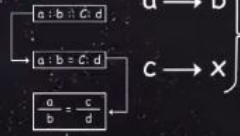
QUANT

Concept Videos

Time, Speed and Distance

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Speed = Distance ÷ Time



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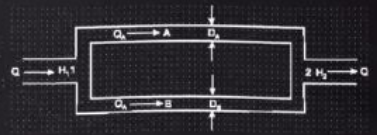

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Trains

ims
Trusted for Success

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will it take to completely pass a lamp-post by the side of the railway track?

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$72 \times \frac{5}{18} = 20\text{m/s}$$

$$\text{Therefore, } t = \frac{600}{20} = 30 \text{ secs}$$

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will it take to completely cross a bridge 900 m long?

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$72 \times \frac{5}{18} = 20\text{m/s}$$

Total Distance = 900 + 600 = 1500m

$$\text{Therefore, } t = \frac{1500}{20} = 75 \text{ secs}$$

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will it take for a car, travelling at 108 kmph on a road parallel to the track in the same direction, to completely overtake the train?

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Relative Speed = 108 - 72 = 36 kmph

$$36 \times \frac{5}{18} = 10\text{m/s}$$

$$\text{Therefore, } t = \frac{600}{10} = 60 \text{ secs}$$

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will the train take to completely pass the Prem Express, 300 m long, stopped at a station?

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Total Distance = 600 + 300 = 900m

$$72 \times \frac{5}{18} = 20\text{m/s}$$

$$\text{Therefore, } t = \frac{900}{20} = 45 \text{ secs}$$

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will it take to completely pass the Prem Express, if the latter is moving in the same direction at 36 kmph?

Total Distance = 600 + 300 = 900 m

Relative Speed = 72 - 36 = 36 kmph

$36 \times \frac{5}{18} = 10$ m/s

Therefore, $t = \frac{900}{10} = 90$ secs

Time, Speed and Distance

Example

The Amar Mail, a newly commissioned train, is 600 m long. It travels at a steady speed of 72 kmph.

How long will it take to completely pass the Prem Express, if the latter is moving in the opposite direction at 36 kmph?

Total Distance = 600 + 300 = 900 m

Relative Speed = 72 + 36 = 108 kmph

$108 \times \frac{5}{18} = 30$ m/s

Therefore, $t = \frac{900}{30} = 30$ secs

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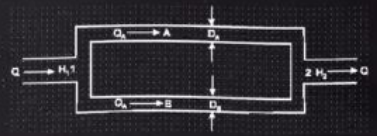

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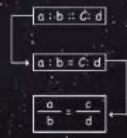

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Boats and Streams

Time, Speed and Distance

Boats & Streams

Speed of boat in still water = a

Speed of stream/current = b

Speed in Upstream (S_u) = a – b

Speed in Downstream (S_d) = a + b

Time, Speed and Distance

Boats & Streams

Bharat, a fisherman of Rampur, has a motorboat which can move at a speed of 20 kmph in still water. Bharat travels from his home jetty at Rampur to a jetty at Sitapur, 75 km downriver, in three hours. Find the speed of the river.

Speed of boat in still water = 20 kmph

Speed of stream/current = b kmph

Speed in Downstream (S_d) = 20 + b kmph

$$20 + b = \frac{75}{3}$$

b = 5 kmph

Time, Speed and Distance

Boats & Streams

Bharat, a fisherman of Rampur, has a motorboat which can move at a speed of 20 kmph in still water. Bharat travels from his home jetty at Rampur to a jetty at Sitapur, 75 km downriver, in three hours.

How long will Bharat take to go back from Sitapur to Rampur?

Speed of boat in still water = 20 kmph

Speed of stream/current = 5 kmph

Speed in Upstream (S_u) = 15 kmph

$$t = \frac{75}{15}$$

Purple		Red	Total
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×6 ↓		×6 ↓	×6 ↓
12		36	48

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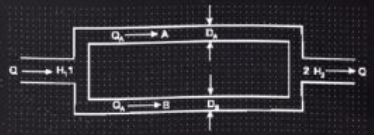

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Escalator

ims
Trusted for Success

Time Speed and Distance

Escalators

Example 1

A man can walk up a moving 'up' escalator in 30 seconds. The same man can walk down this moving 'up' escalator in 90 seconds. Assume that his walking speed is same upwards and downwards. How much time will he take to walk up the escalator which is stationary?

Speed of man = 'x' steps/sec. Speed of Escalator = 'y' steps/sec

$30(x + y) = 90(x - y)$

$x + y = 3x - 3y$

$x = 2y$

Time taken $= \frac{30(x + y)}{x} = \frac{90y}{2y} = 45$ seconds

Time Speed and Distance

Escalators

Example 2

A man can walk up a moving ‘up’ escalator in 40 seconds but takes 30 seconds when he runs. He takes 20 steps when he walks, whereas he takes 40 steps when he is running. What are the total number of steps on the escalator?

Let Speed of Escalator = ‘x’ steps/second.

$40(x) + 20 = 30(x) + 40$

$10x = 20$

$x = 2$

Number of steps $= 40(x) + 20$

$= 100$ steps

Time Speed and Distance

Escalators

Example 3

2 friends A & B can climb up a moving up escalator in 12 seconds and 10 seconds respectively. A takes 4 steps whereas B takes 5 steps per second. What are the total number of steps on the escalator?

Let Speed of Escalator = ‘x’ steps/second.

$10(x + 5) = 12(x + 4)$

$10x + 50 = 12x + 48$

$x = 1$

Number of steps = $10(x + 5)$

= 60 steps

Time Speed and Distance

Escalators

Example 4

A and B walk up on a moving ‘up’ escalator. A takes 40 steps to reach the top whereas B takes 45 steps for the same. B takes 5 steps whereas A can take only 4 steps in one second. How much time would B take to reach the top if the escalator was switched off?

A takes 40 steps @ 4 steps/second.

Time taken by A to reach the top = 10 seconds

B takes 45 steps @ 5 steps/second.

Time taken by B to reach the top = 9 seconds

$(10x + 40) = (9x + 45)$

$x = 5$

Time Speed and Distance

Escalators

Example 4

A and B walk up on a moving 'up' escalator. A takes 40 steps to reach the top whereas B takes 45 steps for the same. B takes 5 steps whereas A can take only 4 steps in one second. How much time would B take to reach the top if the escalator was switched off?

Total number of steps = 90 steps

Time taken by B = $\frac{90}{5}$ = 18 seconds

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
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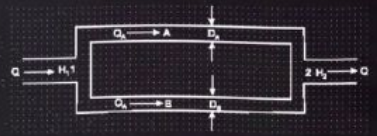

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Linear and Circular Races

Time, Speed and Distance

Linear Races

started together

A gives B a start of 10 metres and the race ends in a dead heat / A beats B by 10 metres (in a race of 100 m.)

Constant Time = 't' A = 100m B = 90m

$\frac{S_A}{S_B} = \frac{100}{90} = 10:9$

A gives B a start of 10 seconds and the race ends in a dead heat / A beats B by 10 seconds (in a race of 100 m.)

A = 't' B = t+10 ⇒ D = 100m

A beats B by 10 metres or 5 seconds: ['i']

'B' covers 10m in '5' secs. ∴ $S_B = 10/5 = 2m/s$

Time, Speed and Distance

Linear Races

A beats B by 20 meters or by 4 seconds in a race of 100 m.

Speed of A = $\frac{d}{t} = \frac{100}{16} = 6.25$ m/s

Time taken by A = $20 - 4 = 16$ secs

Speed of B = 'B' covers 20m in 4 secs $\therefore s_B = \frac{20}{4} = 5$ m/s

Time taken by B = $\frac{d}{s} = \frac{100}{5} = \boxed{20 \text{ secs}}$

Time, Speed and Distance

Circular Races

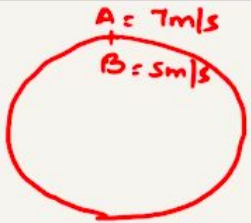
A and B start from the same point at the same time and move along a circular track 420 metres long at speeds of 7 m/s and 5 m/s respectively. → direction

1. When and where will they meet for the first time.

2. Time taken to meet for the first time at the starting point.

Time, Speed and Distance

Case 1



420m

Moving in the same direction

Length of track = 420 m

Speed of A = 7 m/s

Speed of B = 5 m/s

Every second A gains 2 m over B.

$\therefore$ A will take 210 secs to gain 420 m over B.

$\frac{420}{2} = 210$ secs

Distance covered by A = 7 × 210 = 1470 m $\left(3\frac{1}{2} \text{ rounds}\right)$ → 1 round

Distance covered by B = 5 × 210 = 1050 m $\left(2\frac{1}{2} \text{ rounds}\right)$

Time, Speed and Distance

Case 2

Moving in the opposite direction

Every second distance covered by A and B will be 12 m.

∴ To cover 420 m, it will take 35 seconds.

Distance covered by A = 7 × 35 = 245 m

Distance covered by B = 5 × 35 = 175 m

420m

$D_A + D_B = 420$

$7t + 5t = 420$

$12t = 420$

$t = 35$

Time, Speed and Distance

Circular Races

Time taken to meet for 1st time = $\frac{\text{Length of track}}{\text{Relative Speed}}$

Case 1: $\frac{420}{2}$ = 210 secs [same direction] [Rel sp = 7 - 5]

Case 2: $\frac{420}{12}$ = 35 secs [opp "] [Rel sp = 7 + 5]

Time, Speed and Distance

Circular Races

→ direction

Time taken to meet for first time at starting point

T_A to complete 1 lap = $\frac{420}{7}$ = 60 secs ✓

T_B to complete 1 lap = $\frac{420}{5}$ = 84 secs ✓

∴ LCM (60, 84) = 420 secs

A would have completed 7 laps.

B would have completed 5 laps.

Irrelevant of the directions

60, 120, 180, ...

84, 168, ...

L.C.M.

Time, Speed and Distance

Circular Races

V Imp

How may times would they meet before they meet on the starting point?

Same Direction:

Number of times = $\frac{420}{210}$ = 2

Relative Speed = 2 m/s

$S_A = 7$
$S_B = 5$ } 7 : 5 [smallest ratio]

7 + 5 = 12 times

Opposite Direction:

Number of times = $\frac{420}{35}$ = 12

Relative Speed = 12 m/s

Time, Speed and Distance

Circular Races

A, B and C start from the same point at the same time and move along a circular track 420 m long at speeds of 7 m/s, 5 m/s and 3 m/s respectively.

Time taken for them to meet for the 1st time

Case 2: A and C move in the same direction, while B moves in the opposite direction.

Time taken for A and C to meet for the 1st time

$= \frac{420}{4} = 105$ secs

Time taken for A and B to meet for the 1st time

$= \frac{420}{12} = 35$ secs

LCM (105, 35) = 105 secs

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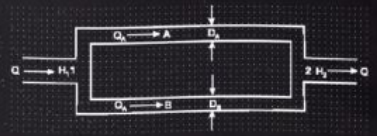

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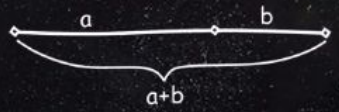

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Clock-I

00:04

CLOCKS

Introduction

Minute hand covers 360° in 1 hour (60 mins)

$\therefore$ It covers 6° in 1 minute.

Hour hand covers 30° in 1 hour (60 mins)

$\therefore$ It covers 0.5° in 1 minute.

$\therefore$ Minute hand gains $\frac{11^{\circ}}{2}$ (5.5°) over the hour hand in 1 minute.

CLOCKS

Introduction

Time taken for the hour hand and minute hand to meet.

$$\text{Time taken} = \frac{360}{11/2} = 360 \times \frac{2}{11} = \frac{720}{11} = 65\frac{5}{11} \text{ mins}$$

$\therefore$ Every 12 hours, the minute and hour hand coincide multiple times.

$$\text{Number of times} = \frac{12 \times 60}{720/11} = \frac{720 \times 11}{720} = 11 \text{ times}$$

$\therefore$ In 24 hours, they will coincide 22 times.

CLOCKS

Example 1

Find the smaller angle between the hour and minute hands of the clock at 7:24am.

At 7:00am, the angle between the two hands is $7 \times 30^\circ = 210^\circ$

The minute hand then moves by 24 min

$1 \text{ min} \rightarrow \frac{11}{2}$

$24 \text{ min} \rightarrow ?$

$24 \times \frac{11}{2} = 132^\circ$

$\therefore$ Smaller angle $= 210^\circ - 132^\circ = 78^\circ$

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×6 ↓		×6 ↓	×6 ↓
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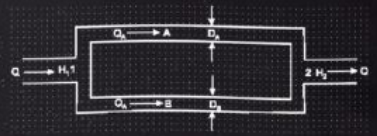

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Clock-II

CLOCKS

Example 2

At what time do the hands of the clocks meet between 7 and 8?

$1 \text{ min} \rightarrow \frac{11^{\circ}}{2}$

$? \quad \rightarrow 210^{\circ}$

$$\frac{210 \times 1}{11/2} = \frac{210 \times 2}{11} = \frac{420}{11}$$

$= 38\frac{2}{11}$ mins $\approx$ 38 mins 11 secs

CLOCKS

Example 3

At what time between 4 o'clock and 5 o'clock the two hands of the clocks are 90º apart?

Case 1:

The minute hand is 90º behind the hour hand.

$$1 \text{ min} \rightarrow \frac{11^{\circ}}{2}$$

$$? \rightarrow 30^{\circ}$$

$$\frac{30 \times 1}{11/2} = \frac{60}{11} = 5\frac{5}{11} \text{ mins}$$

CLOCKS

Example 3

At what time between 4 o'clock and 5 o'clock the two hands of the clocks are 90º apart?

Case 2:

The minute hand is 90º ahead of the hour hand

$$1 \text{ min} \rightarrow \frac{11^{\circ}}{2}$$

$$? \rightarrow 210^{\circ}$$

$$\frac{210}{11/2} = 210 \times \frac{2}{11} = \frac{420}{11} = 38\frac{2}{11} \approx 38 \text{ mins } 11 \text{ secs}$$

CLOCKS

Example 4

At what time between 4 o'clock and 5 o'clock the two hands of the clocks are in one straight line?

Straight line = 180º

$1 \text{ min} \rightarrow \frac{11^{\circ}}{2}$

$? \quad \rightarrow 300^{\circ}$

$$\frac{300 \times 1}{11/2} = 300 \times \frac{2}{11} = \frac{600}{11} \text{ mins}$$

$$= 54\frac{6}{11} \text{ mins} \approx 54 \text{ mins } 32 \text{ secs}$$

Purple		Red	Total
2	:	6	8
×6 ↓		×6 ↓	×6 ↓
12		36	48

$$\text{Whole} = \frac{\text{Part}}{\text{Percent}} \times 100$$

$$\begin{array}{r} 34 \\ 2\overline{)68} \\ -6 \\ \hline 08 \\ 8 \end{array}$$

QUANT Concept Videos

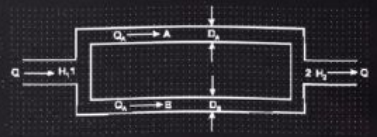
Discount is usually expressed as as certain per cent of the M.P

Discount = M.P. - S.P.

$$\text{Rate of Discount} = \text{Discount \%} = \frac{\text{Discount}}{\text{M.P.}} \times 100$$

$$\text{S.P.} = \text{M.P.} \times \left(\frac{100 - \text{Discount\%}}{100}\right)$$

$$\text{M.P.} = \frac{100 - \text{S.P.}}{100 - \text{Discount\%}}$$



$$\text{Empty time by leak} = T = \frac{\left(\frac{1}{x} + \frac{1}{y}\right) + \frac{1}{p}}{\left(\frac{1}{x} + \frac{1}{y}\right)^2}$$

$$\text{Percent Increase} = \frac{\text{amount of increase}}{\text{original amount}}$$

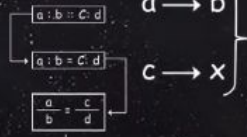
$$\text{Percent Decrease} = \frac{\text{amount of decrease}}{\text{original amount}}$$

27.1 meters travelled before brakes are fully applied

25 meters travelled before brakes are fully applied

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Speed = Distance ÷ Time



Product of means = Product of extremes

b × c = a × d

$$\left.\begin{array}{l} a \longrightarrow b \\ c \longrightarrow x \end{array}\right\} \Rightarrow x = \frac{b \cdot c}{a}$$

a+b is to a as a is to b

Calendars

Calendars

Introduction

Leap Year

A leap year has 366 days.

In a leap year, February has 29 days instead of 28 days.

Every year divisible by 4 is a leap year, if it is not a century.

Leap Years : 2004, 1556, 1280, 860

Every century divisible by 400 is a leap year and no other century is a leap year.

Leap Years : 400, 800, 1600, 2000

Calendars

Introduction

Ordinary Year

An ordinary year has 365 days.

Any year which is not a leap year is a **ordinary year.**

Odd Days

In a given period, number of days more than complete weeks are called odd days.

Number of Odd Days

In an Ordinary Year → **365**(mod 7) ≡ 1 **i.e. 1 odd day**

In a Leap Year → **366**(mod 7) ≡ 2 **i.e. 2 odd days**

Calendars

Same Date & different Year

1st January 2019 – Tuesday

+ 1

1st January 2020 – Wednesday

+ 2

1st January 2021 – Friday

1st January 2022 – Saturday

1st January 2023 – Sunday

1st January 2024 – Monday

1st January 2025 – Wednesday

Calendars

Example 1

If 1st January 1983 was a Saturday, which day of the week is 1st January 2007?

From 1983 – 2007,

24 Years → **24 odd days**

Leap Years: 1984, 1988, 1992, 1996, 2000, 2004

6 Leap Years → **6 additional odd days**

∴ Total Odd Days = 24 + 6 = 30

Remainder ≡ 30(mod 7) ≡ 2

∴ 2 days from Saturday → **Monday**

Calendars

Example 1

If 1st January 1983 was a Saturday, which day of the week is 1st January 2007?

From 1983 – 2007,

24 Years → **24 odd days**

Leap Years: 1984, 1988, 1992, 1996, 2000, 2004

6 Leap Years → **6 additional odd days**

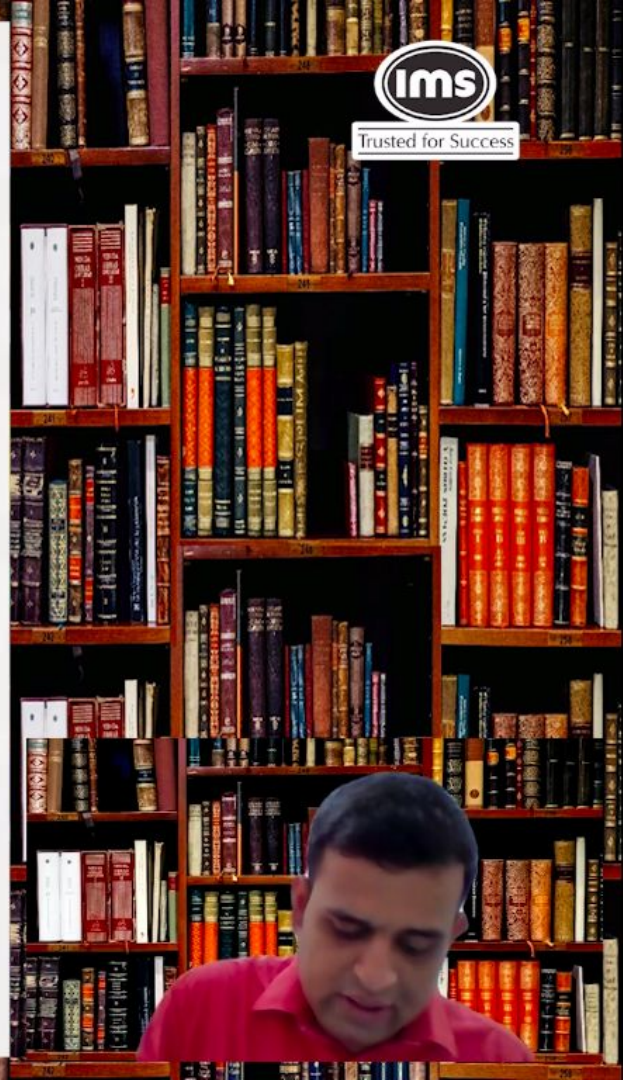
$T_n = a + (n - 1) d$

$\therefore 2004 = 1984 + (n - 1) 4$

$\therefore 20 = (n - 1) 4$

$\therefore (n - 1) = 5$

$\therefore n = 6$



Calendars

Example 2

15th August 1947 → Friday

1st January 2001 → Monday

If 1st January 2020 was a Wednesday, which day of the week will be 15th August 2047?

Till 1st January 2047, number of Odd Days = 27 + 7 = 34

January	(30 days)	→ 2 odd days
February	(28 days)	→ 0 odd days
March	(31 days)	→ 3 odd days
April	(30 days)	→ 2 odd days
May	(31 days)	→ 3 odd days
June	(30 days)	→ 2 odd days
July	(31 days)	→ 3 odd days
August	(15 days)	→ 1 odd day

16 odd days

Calendars

Example 2

If 1st January 2020 was a Wednesday, which day of the week will be 15th August 2047?

Till 1st January 2047, number of Odd Days = 27 + 7 = 34

16 odd days + 34 odd days = 50 odd days

$\because$ 50 (mod 7) = 1

$\therefore$ 1 day after Wednesday → **Thursday**

$\therefore$ 15th August 2047 will be Thursday.