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Volume - 7

Numerical Ability and Data Interpretation

SIERRA INNOVATIONS

Numerical Ability and Data Interpretation

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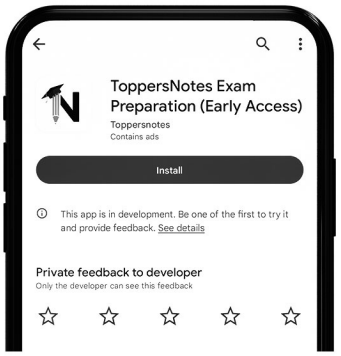

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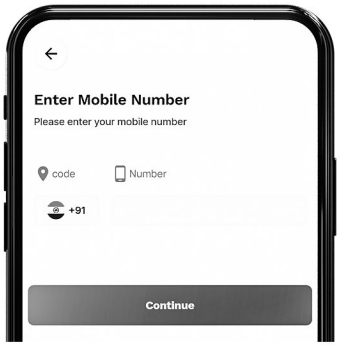

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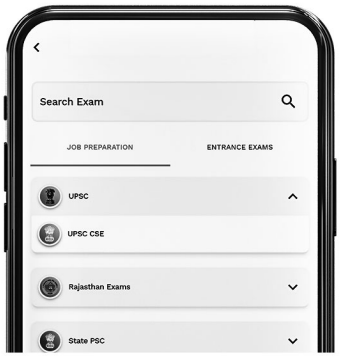

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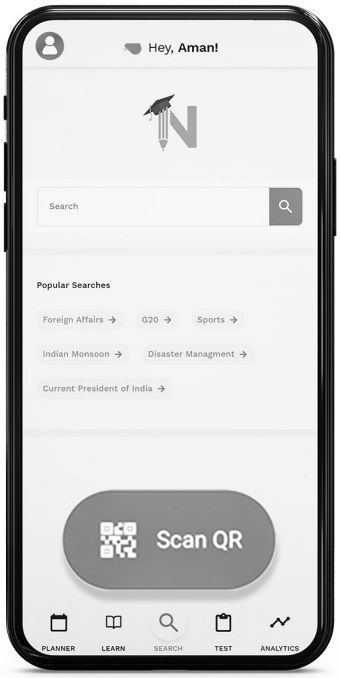

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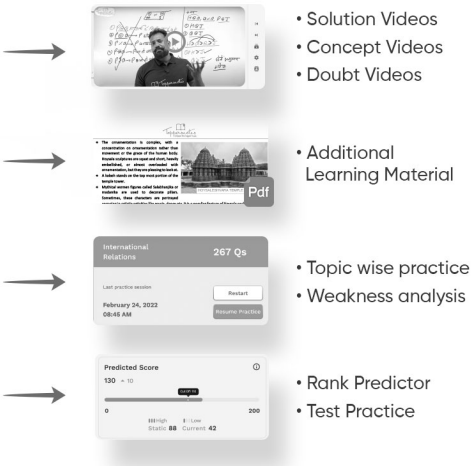

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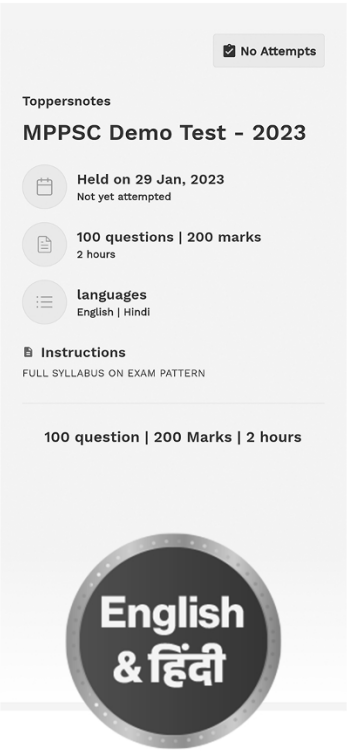

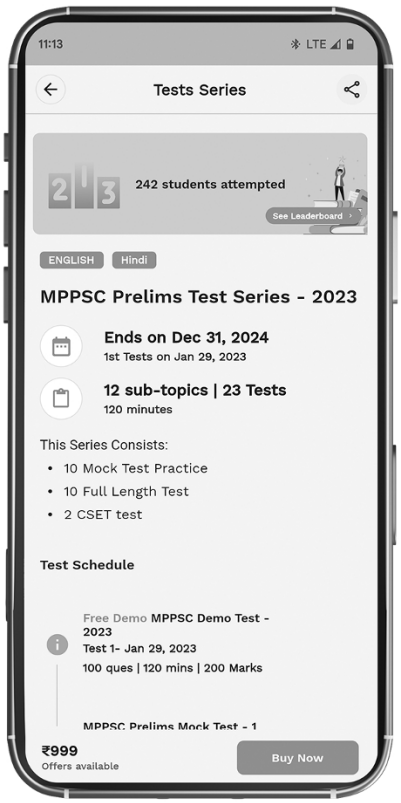

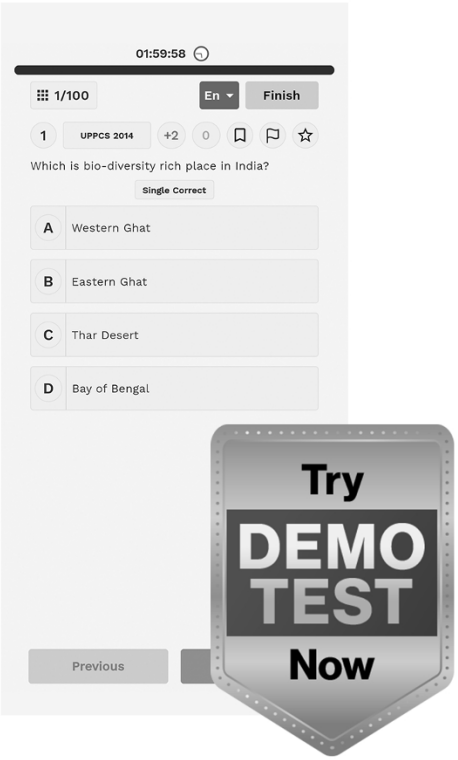

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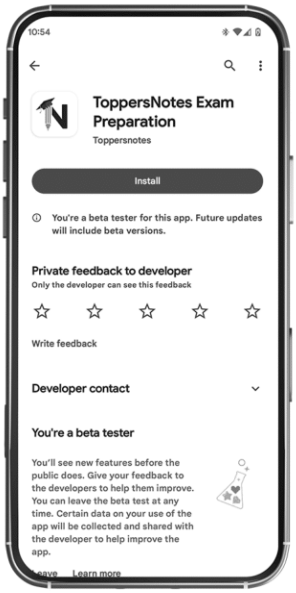

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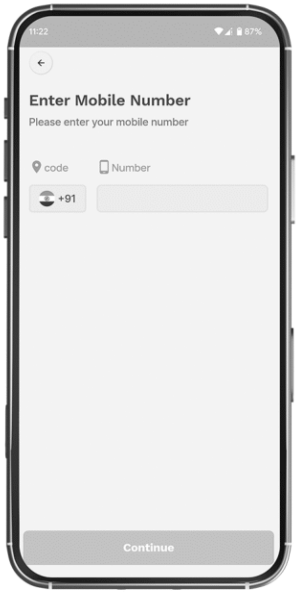

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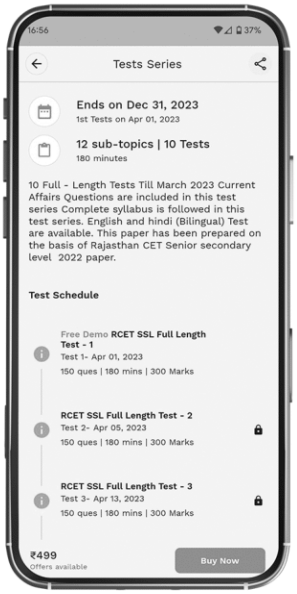

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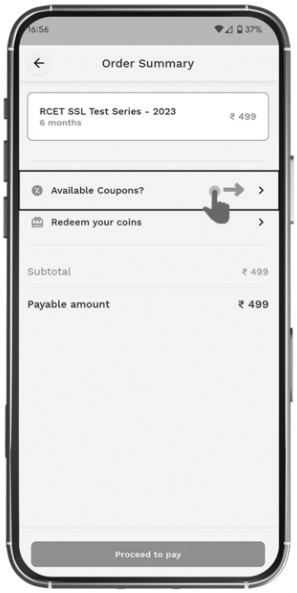

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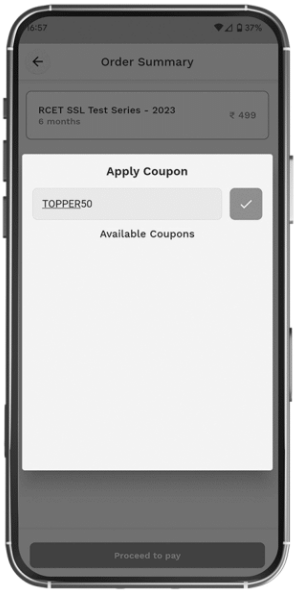

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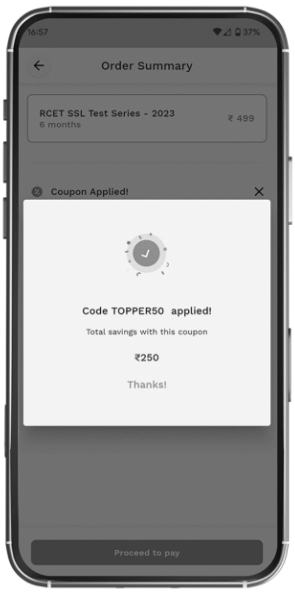

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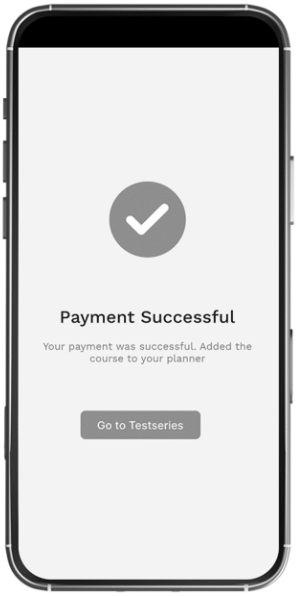

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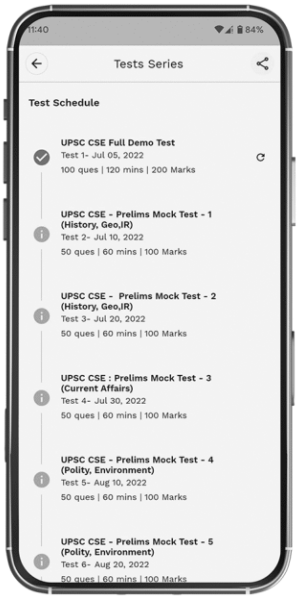

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Percentage

- Percentage means 'Per hundred'.
- The fraction whose denominator is 100**,** is called percentage and the numerator of that fraction is called percentage rate.
- 5 out of 100 $= \frac{5}{100} = 5\%$
- 10 out of 100 $= \frac{10}{100} = 10\%$
- That is, when an amount is compared with 100**,** it is called percentage. The basis with which the comparison is made. In the fraction, the base will be called the denominator.

Conversion From Percentage to Fraction

$100\% = 1$	$10\% = \frac{1}{10}$	$5\frac{5}{19}\% = \frac{1}{19}$
$50\% = \frac{1}{2}$	$9\frac{1}{11}\% = \frac{1}{11}$	$5\% = \frac{1}{20}$
$33\frac{1}{3}\% = \frac{1}{3}$	$8\frac{1}{3}\% = \frac{1}{12}$	$4\frac{1}{6}\% = \frac{1}{24}$
$25\% = \frac{1}{4}$	$7\frac{9}{13}\% = \frac{1}{13}$	$4\% = \frac{1}{25}$
$20\% = \frac{1}{5}$	$7\frac{1}{7}\% = \frac{1}{14}$	$2\frac{1}{2}\% = \frac{1}{40}$
$16\frac{2}{3}\% = \frac{1}{6}$	$6\frac{2}{3}\% = \frac{1}{15}$	$37\frac{1}{2}\% = \frac{3}{8}$
$14\frac{2}{7}\% = \frac{1}{7}$	$6\frac{1}{4}\% = \frac{1}{16}$	$62\frac{1}{2}\% = \frac{5}{8}$
$12\frac{1}{2}\% = \frac{1}{8}$	$5\frac{15}{17}\% = \frac{1}{17}$	$57\frac{1}{7}\% = \frac{4}{7}$
$11\frac{1}{9}\% = \frac{1}{9}$	$5\frac{5}{9}\% = \frac{1}{18}$	$66\frac{2}{3}\% = \frac{2}{3}$
$80\% = \frac{4}{5}$	$75\% = \frac{3}{4}$	

Note -

(i) To convert a fraction or a decimal fraction or an integer into a percentage, multiply it by 100.

(ii) To convert a percentage to a fraction, divide it by 100.

- One number is what percent of another number –

$$\% \text{ Quantity} = \frac{\text{Given number}}{\text{Basic (another number)}} \times 100$$

Ex.1 What percent of 48 is 6 ?

Sol. Let x % of 48 = 6

Now, $48 \times \frac{x}{100} = 6$

$\frac{12x}{25} = 6$

$x = \frac{6 \times 25}{12} = 12\frac{1}{2}$

The percent $12\frac{1}{2}\%$ of 48 is 6.

Ex.2 Convert $\frac{9}{16}$ into percentage.

Sol. $\frac{9}{16} = \left(\frac{9}{16} \times 100\right)\% = \frac{225}{4}\% = 56\frac{1}{4}\%$

Ex.3 When 60 is subtracted from 60% of a number, the result is 60. The number is-
(a) 120 (b) 150 (c) 180 (d) 200

Sol. **(b)**

Let the number be x, then –

$X \times 60\% - 60 = 60$

$\Rightarrow 0.60x - 60 = 60$

$\Rightarrow 0.60x = 120$

$\Rightarrow x = \frac{120}{0.60}$

$X = 200$

$\therefore$ The number is 200.

If there is a percentage change

Case I – If there is increase of x_1 % & x_2 % then –

Percentage increase = $x_1 + x_2 + \frac{x_1 . x_2}{100}$

Case II – If there is decrease of x_1 % & x_2 % then –

Percent decrease = $x_1 + x_2 - \frac{x_1 . x_2}{100}$

Case III – If there is increase of x_1 % and decrease of x_2 % then –

$$\text{Percentage change} = x_1 - x_2 - \frac{x_1.x_2}{100}\left[\begin{matrix} x_1 = \text{ Always percentage increase} \\ x_2 = \text{ Always percentage decrease.}\end{matrix}\right]$$

Note- If you want to calculate the percentage change in expenses, sales income, revenue, area, etc., then the same rule will be used.

Ex.1 Two successive price increases of 10% and 10% of an article are equal to which one single price increase?

(a) 19% (b) 20% (c) 21% (d) 22%

Sol. (c)

Let the initial price of any item = 100

New price = 110 % of 100 of 110%.

$\left(100 \times \frac{110}{100} \times \frac{110}{100}\right) = 121 = 21\%$

Hence, the single price increase is equal to 21 percent.

Ex.2 The price of laptop is increased by 25%. Now by what percent is the price increased for the second time so that the total increase becomes 35%?

(a) 7.5 (b) 9 (c) 8 (d) 10

Sol. (c)

Given that –

Price increased by 25% = x

The overall increase was 35%.

Formula:

Total Increment = x + y +xy/100

Calculation:

$\Rightarrow$ 35 = 25 + y + (25 × y/100)

$\Rightarrow$ 35 = 25 + y + y/4

$\Rightarrow$ 140 = 100 + 4y + y

$\Rightarrow$ 140 – 100 = 5y

$\Rightarrow$ 40 = 5y

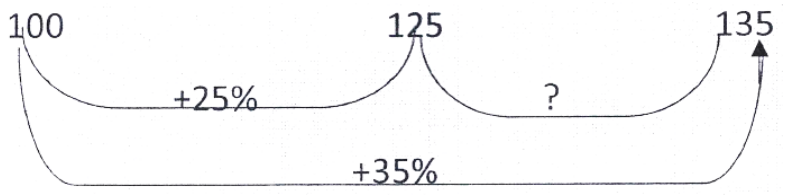
$\Rightarrow$ y = 8

Hence, the second time increase is 8%.

Method II

Let the price of laptop = 100

Price First Increase Second Increase



Percent increase $= \frac{135-125}{125} \times 100$

$= \frac{10}{125} \times 100 = 8\%$

Ex.3 The value of a tool decreases by 20% every year. What will be the cost of that tool after 3 years?

(a) 48.8% (b) 51.2% (c) 54% (d) 60%

Sol. **(a)**

20% = 1/5

Initial	Final
5	4
5	4
5	4
125	64

Required Percentage = $\frac{61}{125} \times 100 = 48.8\%$

Method II

Let the price of tool = x

According to question,

Price after 8 years $= x \times \frac{80}{100} \times \frac{80}{100} \times \frac{80}{100}$

$= \frac{64}{125}x$

Decrease in price $= x - \frac{64}{125}x = \frac{61}{125}x$

Percentage decrease $= \frac{\frac{61}{125}x}{x} \times 100 = 48.8\%$

Formula Related to Population

- If the population of a city is P and it is increasing at the rate of x% per annum, then the population after n years –

$$= P\left(1+\frac{x}{100}\right)^n$$

- If it is decreasing, then the population $= P\left(1-\frac{x}{100}\right)^n$

Ex.1 If the population of a city is increasing at the rate of 4% per annum and the present number of people is 15625, then what will be the population after 3 years?

Sol. Required Population = $15625\left(1+\frac{4}{100}\right)^3$

$$= 15625\times\frac{26}{25}\times\frac{26}{25}\times\frac{26}{25} = 17576$$

Ex.2 The population of a city is 8000. If the number of males increases at the rate of 6 percent and the rate of increase in the number of females is 10 percent, then the population will become 8600. Find the number of females in the city.

Sol. Let the number of females = x

Then, 110 % of x + 106% of (8000 + x) = 8600

$$\frac{110x}{100}+\frac{106(8000-x)}{100} = 8600$$

$x(110 - 106) = 8600 \times 100 - 8000 \times 106$

$$\therefore x = \frac{8600\times100-8000\times106}{110-106} = \frac{12000}{4} = 3000$$

Ex.3 In 1988 the population of a city decreased by 12%. In 1989 it increased by 15%. What was the overall impact on the city's population in the early 1990s?

Sol. % Impact = % Increase – % Decrease – $\frac{(\%\,\text{Increase})(\%\,\text{Decrease})}{100}$

$$= 15 - 12 - \frac{15\times12}{100} = 15 - 13.8 = 12$$

$\therefore$ The population increased by 1.2%.

- If x percent of any amount is taken by the first person, y percent of the balance is taken by the second person and after taking z percent of the remaining amount by the third person, if A is left, then the total amount initially –

$$= \frac{A \times 100 \times 100 \times 100}{(100-x)(100-y)(100-z)}$$

- An increase or decrease in the price of a commodity, a decrease or increase in it consumption –

  (a) % Increase in consumption $= \frac{100 \times \text{decrease}}{100 - \text{decrease}}$

  (b) % Decrease in consumption $= \frac{100 \times \text{increase}}{100 + \text{increase}}$

Ex.1 If the price of sugar is increased by 40%, by what percent should a family reduce it annual consumption of sugar so that the expenditure of the family does not increase?

(a) $24\frac{4}{7}\%$ (b) $28\frac{4}{7}\%$ (c) $29\frac{4}{7}\%$ (d) $30\frac{4}{7}\%$

Sol. **(b)**

Let , the consumption initially was = 100 units and price per unit = ₹100.

Initially total expenditure = ₹ (100 × 100) = ₹ 10000

New price = 140 per units and let the new consumption ¾ (100 – X) units.

Now, expenditure = 140 × (100 – x) × (14000 – 140 x)

14000 – 140x = 10000

$\Rightarrow$ 140x = 4000

$\Rightarrow x = \frac{4000}{140} = \frac{200}{7}\% = 28\frac{4}{7}\%$

Decrease in consumption = $28\frac{4}{7}\%$

Method II

Decrease in comsumption $\%\text{Decrease} = \frac{100 \times \text{Increase}}{100 + \text{Increase}}$

$$\% \text{ Decrease } = \frac{100 \times 40}{100 + 40}$$

$$= \frac{4000}{140} = \frac{200}{7}$$

$$= 28\frac{4}{7}\%$$

Ex.2 A 10% reduction in the price of sugar allows a housewife to buy 6.2 kg more sugar for ₹ 1116. What is the reduced price of sugar per kg?

(a) ₹ 12 (b) ₹ 14 (c) ₹ 16 (d) ₹ 18

Sol. **(d)**

Let the price initially = X per kg.

New price $= \frac{90x}{100}$ Rs./kg. $= \frac{9x}{10} =$ Per kg.

$$\frac{116}{(9x/10)} - \frac{1116}{x} = 6.2$$

$$\Rightarrow \frac{1240}{x} - \frac{1116}{x} = 6.2$$

$$6.2x = (1240 - 1116) = 124$$

$$\Rightarrow x = \frac{124}{6.2} = \frac{1240}{62} = 20$$

Reduced price $= \left(\frac{90}{100} \times 20\right)$ per kg. = ₹ 18 per kg.

Method II

For the current price –

Rs. × % change = Weight (Less/More)

$$1116 \times \frac{10}{100} = 6.2$$

$$\Rightarrow \frac{1162}{62} = 18 ₹ \Rightarrow \text{Current price.}$$

Ex.3 If the price of petrol is reduced by 10%, by how much will a consumer have to increase the consumption of petrol so that his expenditure on petrol does not decrease?

(a) $11\frac{1}{9}\%$ (b) $12\frac{1}{3}\%$ (c) $10\frac{1}{2}\%$ (d) 14%

Sol. (a)

Let the initial consumption of petrol = 100 Units and it's price = ₹100 per unit.

Total price = ₹ (100 x 100) =₹ 10000

New price = ₹90 per unit.

Let, new consumption = (100 + X) units.

Now, the total price = (₹100 + x) × 90] = ₹ (9000 + 90x)

$\therefore$ 9000 + 90x = 10000 = 90x = 1000

$$\Rightarrow x = \frac{1000}{90} = \frac{100}{9} = 11\frac{1}{9}$$

Increase in consumption = $11\frac{1}{9}\%$

Method II

Increase in consumption $= \frac{100 \times \text{Decrease}}{100 - \text{Decrease}}$

% Increase $= \frac{100 \times 10}{100 - 10}$

$$= \frac{1000}{90} = \frac{100}{9}$$

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

- If each side or vertices of an equilateral triangle, each side or diagonal or perimeter of a square, the radius, diameter or circumference of a circle, each side of a cube or a cuboid, the radius or diameter of a sphere or a hemisphere, etc., increase or decrease by x percent then the percentage decrease or increase in it's area is –

$$= 2x \pm \frac{x^2}{100} \qquad \begin{bmatrix} +\text{Increase} \\ -\text{Decrease} \end{bmatrix}$$

Ex.1 When the radius is increased by 25%, then find the percentage increase in the area of the circle.

(a) 50% (b) 56.25% (c) 56% (d) 56.15%

Sol. Gradual increase = A + B + (AB/100)

= 25 + 25 + (25 × 25/100)

= 50 + 6.25 = 56.25%

∴ % increase in the area = 56.25%

Ex.2 By what percent will the surface area of a cube increase when each of it's time is doubled?

(a) 200% (b) 300% (c) 150% (d) 50%

Sol. **(b)**

We know that -

Total surface area of the cube = $6a^2$

If both the sides are multiplied, then –

$1 \rightarrow 2$

$1 \rightarrow 2$

Total surface area $\rightarrow \underbrace{1}_{3}$ $4 \leftarrow$ New surface area

∴ The surface area of the cube will increase = $\left(\frac{3}{1} \times 100\%\right)$ = 300%

Ex.3 If the radius and height of the base of a right circular cylinder are increased by 20% each, then by how much will the volume of the cylinder increase?

(a) 40% (b) 60% (c) 72.80% (d) 96%

Sol. **(c)**

Let the radius and height of the cylinder be r and h respectively.

It's volume, $v = \pi r^2 h$

New radius = $r + \frac{20}{100}r = \frac{6}{5}r$

New height = $h + \frac{20}{100}h = \frac{6}{5}h$

So, new volume $V_1 = \pi\left(\frac{6}{5}r\right)^2 \times \left(\frac{6}{5}h\right) = \frac{216}{125}\pi r^2 h$

Hence, increase in volume = $\frac{216}{125}\pi r^2 h - \pi r^2 h = \frac{91}{125}\pi r^2 h$

Hence, % increase = $\frac{\frac{91}{125}\pi r^2 h}{\pi r^2 h} \times 100 = \frac{91}{125} \times 100$

$= \frac{364}{5} = 72.8$

Method II

Volume of cylinder $= \pi r^2 h$

$= \pi.r.rh$

Here we will use permutation formula twice

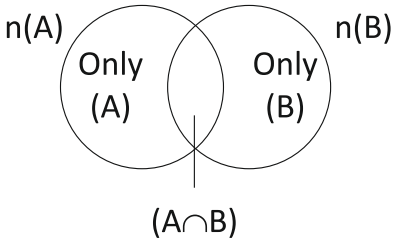
First time $= 20 + 20 + \frac{20 \times 20}{100}$

$= 44\%$

Second time $= 44 + 20 + \frac{44 \times 20}{100} = 64 + 8.8 = 72.8\%$

Question Based On Sets

- $n(A \cup B)$ = A and B together or at least one.
- $n(A \cap B)$ = Includes both.
- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- Only $A = n(A) - n(A \cap B)$
- Only $B = n(B) - n(A \cap B)$

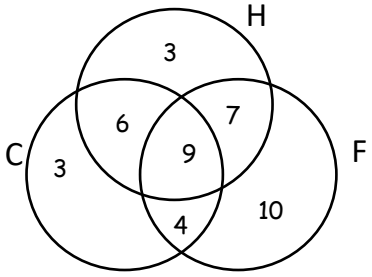


Ex.1 In a school there are 22 boys in cricket team, 25 in hockey team and 30 in football team. Now if 15 boys play hockey and cricket, 16 boys play hockey and football, 13 boys play football and cricket and 9 boys play hockey, football and cricket, then find the total number of boys who play?

Sol. Let C, H and F be the set of boys playing Cricket, Hockey and Football respectively.

Given that = $n(C) = 22$, $n(H) = 25$, $n(F) = 30$, $n(C \cap H \cap F) = 9$

$n(C \cap H) = 15$, $n(H \cap F) = 16$, $n(C \cap F) = 13$



Now, the number of players playing only C and H = $n(C \cap H) - n(C \cap H \cap F)$

$= 15 - 9 = 6$

Number of players playing only H and F = $n(H \cap F) - n(C \cap H \cap F)$

Number of players playing only C and F = $n(C \cap F) - n(C \cap H \cap F)$

$= 13 - 9 = 4$

Number of players playing only C = $22 - 6 - 9 - 4 = 3$

Number of players playing only H = $25 - 6 - 9 - 4 = 6$

And, number of players playing only F = $30 - 7 - 9 - 4 = 10$

Hence, the total number of players = $3 + 6 + 3 + 9 + 7 + 10 + 4 = 42$

Ex.2 In an office 72% of employees like to drink tea and 44% like to drink coffee. If each employee must like one of the two and 40 like both, then what is the total number of employees in the office?

(a) 200 (b) 240 (c) 250 (d) 320

Sol. **(c)**

Let, the total number of employees = x

Now, $n(A) = \left(\frac{72}{100} \times x\right) = \frac{18x}{25}, n(B) = \left(\frac{44}{100} \times x\right) = \frac{11x}{25}$

And, $n(A \cap B) = 40$

$\therefore \quad n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$x = \left(\frac{18x}{25} + \frac{11x}{25} - 40\right) \quad \Rightarrow \left(\frac{29x}{25} - x\right) = 40$

$4x = (40 \times 25) \Rightarrow x = 250$

Hence, the total number of employees in the office = 250

Method II

Tea = 72%

Coffee = 44%

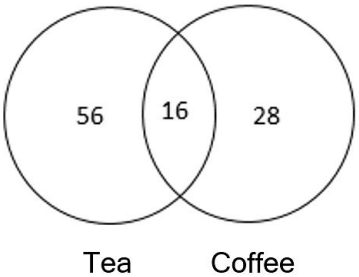
Both (Tea + Coffee) $= 72 + 44 + 100$

$= 116 - 100$

$= 16\%$

Total employees $= \frac{40}{16} \times 100$

$= 250$



Ex.3 In an examination 34% of the students failed in Mathematics and 41% failed in English. If 20% of the students failed in both the subjects, then what is the percentage of students passed in both the subjects?

(a) 44% (b) 50% (c) 54% (d) 56%

Sol. **(a)**

Let A = set of failed students of Mathematics and B = set of failed students of English

Then, $n(A) = 34, n(B) = 42, n(A \cap B) = 20$

$\therefore \; n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= (34 + 42 - 20) = 56$

Hence, the number of people who failed in one or both the subjects = 56

Percentage of students who passed = (100 – 56)% = 44%

Profit and Loss

- **Cost Price –** Purchase price of an item.
- **Selling Price –** The item sold for the rupees.
- **MRP –** The MRP of an item is called the marked price or printed price or list price.
- **Discount –** Always given on the retail price of an item. The MRP of an item is always 100% in

  The case of discount i.e., (SP = MRP)
- There is profit if, S.P. > C. P.

  Profit = Selling Price – Cost Price (Profit = SP – CP)
- There is loss if, S.P. < C.P.

  Loss = Cost Price – Selling Price (Loss = CP – SP)

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

- The profit and loss is always find out at the cost price.

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

$$\text{Selling Price} = \frac{100 - \text{Profit}\,\%}{100} \times \text{Cost Price (CP)}$$

$$\text{Selling Price} = \frac{100 - \text{Loss}\,\%}{100} \times \text{Cost Price (CP)}$$

$$\text{Cost Price} = \frac{100}{100 - \text{Profit}\,\%} \times \text{Selling Price (SP)}$$

$$\text{Cost Price} = \frac{100}{100 - \text{Loss}\,\%} \times \text{Selling Price (SP)}$$

- If the cost price or selling price is given as the number of items, then the cost price of x item is equal to the selling price of y item.

  Selling price = x, Cost price = y

$$\%\text{ profit or loss} = \frac{(x - y) \times 100}{y} \quad \begin{matrix} + = \%\ \text{Profit} \\ - = \%\ \text{Loss} \end{matrix}$$

- If the rate of buying of the item is given, then the rate of selling is given –

  If an article is purchased at the rate of a for rupees n, then the $CP = \frac{n}{a}$

$$SP = \frac{n}{a}\left(\frac{100 \pm r}{100}\right) \qquad \frac{\text{Numerator} - \text{Rupees}}{\text{Denominator} - \text{Articles}}$$

- Finding Buyer Price if Seller Price is given.