Ratio, Proportion and Percentages Formulas and Tricks

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Ratio & Proportion

- The equality of two ratios is called a proportion. If $a : b = c : d$, we write $a : b :: c : d$ and we say that a, b, c, d are in proportion. In a proportion, the first and fourth terms are known as extremes, while the second and third are known as means.

- Product of extremes = Product of means

- Mean proportion between a and b is

- The compounded ratio of the ratios $(a : b), (c : d), (e : f)$ is $(ace : bdf)$

- $a^2 : b^2$ is a duplicate ratio of $a : b$

- $\sqrt{a} : \sqrt{b}$ is a sub-duplicate ration of $a : b$

- $a^3 : b^3$ is a triplicate ratio of $a : b$

- $a^{1/3} : b^{1/3}$ is a sub-triplicate ratio of $a : b$

- If $\dfrac{a}{b} = \dfrac{c}{d}$, then, $\dfrac{a + b}{b} = \dfrac{c + d}{d}$, which is called the Componendo.

- If $\dfrac{a}{b} = \dfrac{c}{d}$, then, $\dfrac{a - b}{b} = \dfrac{c - d}{d}$, which is called the dividendo

- If $\dfrac{a}{b} = \dfrac{c}{d}$, then, $\dfrac{a + b}{a - b} = \dfrac{c + d}{c - d}$, which is called the Componendo & Dividendo.

- Variation: We say that x is directly proportional to y if $x = ky$ for some constant k and we write, $x \propto y.$

- Also, we say that x is inversely proportional to y $if x = \dfrac{k}{y}$ for some constant k and we write $x \propto \dfrac{1}{y}$

Ratios

- If $a : b = c : d$, then $a : b = c : d = (a + c) : (b + d)$

- If $a < b$, then for a positive quantity x,

$\dfrac{a + x}{b + x} > \dfrac{a}{b}$ and $\dfrac{a - x}{b - x} < \dfrac{a}{b}$. If $a > b$, then for a positive quantity x,

- $\dfrac{a + x}{b + x} < \dfrac{a}{b}$ and $\dfrac{a - x}{b - x} > \dfrac{a}{b}$

Proportions

If $a : b :: c : d$ or $\dfrac{a}{b} = \dfrac{c}{d}$, then

- $\dfrac{a}{c} = \dfrac{b}{d}$ …Alternendo Law

- $\dfrac{b}{a} = \dfrac{d}{c}$ …Invertendo Law

- $\dfrac{a + b}{b} = \dfrac{c + d}{d}$ …Componendo Law

- $\dfrac{a - b}{b} = \dfrac{c - d}{d}$ …Dividendo Law

- $\dfrac{a + b}{a - b} = \dfrac{c + d}{c - d}$ …Componendo and Dividendo Law

- If $\dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} = \ldots k$, then $\dfrac{a + c + e + \ldots}{b + d + f + \ldots} = k$

- If $\dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} = \ldots k$, then p, q, r are real numbers, then $\dfrac{pa^n + qc^n + re^n + \ldots}{pb^n + qd^n + rf^n + \ldots} = k^n$

Percentage

- To express x % as a fraction, we have $x\% = \dfrac{x}{100}$

- To express $\dfrac{a}{b}$ as a percent, we have $\dfrac{a}{b} = \left(\dfrac{a}{b} \times 100 \right) \%$

- If 'A' is R % more than 'B' , then 'B' is less than 'A' by

OR

If the price of a commodity increases by R % , then the reduction in consumption, not to increase the expenditure is $\left(\dfrac{100R}{[100 + R]} \right) \%$

- If 'A' is R % less than 'B' , then 'B' is more than 'A' by

OR

If the price of a commodity decreases by R % , then the increase in consumption, not to increase the expenditure is $\left\{ \dfrac{100R}{[100 - R]} \right\} \%$

- If the population of a town is 'P' in a year, then its population after 'N' years is $P \cdot \left(1 + \left(\dfrac{R}{100} \right) \right)^N$

- If the population of a town is 'P' in a year, then its population 'N' years ago is $\dfrac{P}{\left(1 + \left(\frac{R}{100} \right) \right)^N}$

Percentage Change

- Percentage Change $= \dfrac{\text{Final Value} - \text{Initial Value}}{\text{Initial Value}} \times 100$

- For two successive changes of $a\%$ and $b\%,$ Total Percentage Change $= (a + b + \dfrac{ab}{100})\%$