1. **km/hr to m/s conversion:**

$a$ km/hr = $\left(a \times \frac{5}{18}\right)$ m/s.

2. **m/s to km/hr conversion:**

$a$ m/s = $\left(a \times \frac{18}{5}\right)$ km/hr.

3. **Formulas for finding Speed, Time and Distance**

4. Time taken by a train of length $l$ metres to pass a pole or standing man or a signal post is equal to the time taken by the train to cover $l$ metres.

5. Time taken by a train of length $l$ metres to pass a stationery object of length $b$ metres is the time taken by the train to cover ($l$ + $b$) metres.

6. Suppose two trains or two objects bodies are moving in the same direction at $u$ m/s and $v$ m/s, where $u > v$, then their relative speed is = ($u - v$) m/s.

7. Suppose two trains or two objects bodies are moving in opposite directions at $u$ m/s and $v$ m/s, then their relative speed is = ($u + v$) m/s.

8. If two trains of length $a$ metres and $b$ metres are moving in opposite directions at $u$ m/s and $v$ m/s, then:

The time taken by the trains to cross each other = $\frac{(a+b)}{(u+v)}$ sec.

9. If two trains of length $a$ metres and $b$ metres are moving in the same direction at $u$ m/s and $v$ m/s, then:

The time taken by the faster train to cross the slower train = $\frac{(a+b)}{(u-v)}$ sec.

10. If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take $a$ and $b$ sec in reaching B and A respectively, then:

(A's speed) : (B's speed) = ($\sqrt{b}$ : $\sqrt{a}$)

**Exercise : Time and Distance - Formulas**

- Time and Distance - Formulas
- Time and Distance - General Questions
- Time and Distance - Data Sufficiency 1

1. **Speed, Time and Distance:**

Speed = $\left(\frac{\text{Distance}}{\text{Time}}\right)$, Time = $\left(\frac{\text{Distance}}{\text{Speed}}\right)$, Distance = (Speed x Time).

2. **km/hr to m/sec conversion:**

$x$ km/hr = $\left(x \times \frac{5}{18}\right)$ m/sec.

3. **m/sec to km/hr conversion:**

$x$ m/sec = $\left(x \times \frac{18}{5}\right)$ km/hr.

4. If the ratio of the speeds of A and B is $a : b$, then the ratio of

the times taken by them to cover the same distance is $\frac{1}{a} : \frac{1}{b}$ or $b : a$.

5. Suppose a man covers a certain distance at $x$ km/hr and an equal distance at $y$ km/hr. Then,

the average speed during the whole journey is $\left(\frac{2xy}{x+y}\right)$ km/hr.

Exercise : Time and Work - Formulas



1. **Work from Days:**

   If A can do a piece of work in $n$ days, then A's 1 day's work = $\frac{1}{n}$.

2. **Days from Work:**

   If A's 1 day's work = $\frac{1}{n}$, then A can finish the work in $n$ days.

3. **Ratio:**

   If A is thrice as good a workman as B, then:

   Ratio of work done by A and B = 3 : 1.

   Ratio of times taken by A and B to finish a work = 1 : 3.

Exercise : Simple Interest - Formulas



1. **Principal:**

   The money borrowed or lent out for a certain period is called the **principal** or the **sum**.

2. **Interest:**

   Extra money paid for using other's money is called **interest**.

3. Simple Interest (S.I.):

   If the interest on a sum borrowed for certain period is reckoned uniformly, then it is called **simple interest**.

   Let Principal = P, Rate = R% per annum (p.a.) and Time = T years. Then

   (i). Simple Intereest = $\left(\frac{P \times R \times T}{100}\right)$

   (ii). P = $\left(\frac{100 \times S.I.}{R \times T}\right)$ ; R = $\left(\frac{100 \times S.I.}{P \times T}\right)$ and T = $\left(\frac{100 \times S.I.}{P \times R}\right)$.

1. **Concept of Percentage:**

By a certain **percent**, we mean that many hundredths.

Thus, $x$ percent means $x$ hundredths, written as $x$ %.

To express $x$ % as a fraction: We have, $x\ \% = \frac{x}{100}$.

Thus, $20\% = \frac{20}{100} = \frac{1}{5}$.

To express $\frac{a}{b}$ as a percent: We have, $\frac{a}{b} = \left(\frac{a}{b} \times 100\right)\%$.

Thus, $\frac{1}{4} = \left(\frac{1}{4} \times 100\right)\% = 25\%$.

2. **Percentage Increase/Decrease:**

If the price of a commodity increases by R%, then the reduction in consumption so as not to increase the expenditure is:

$$\left[\frac{R}{(100 + R)} \times 100\right]\%$$

If the price of a commodity decreases by R%, then the increase in consumption so as not to decrease the expenditure is:

$$\left[\frac{R}{(100 - R)} \times 100\right]\%$$

3. **Results on Population:**

Let the population of a town be P now and suppose it increases at the rate of R% per annum, then:

1. Population after $n$ years $= P\left(1 + \frac{R}{100}\right)^n$

2. Population $n$ years ago $= \dfrac{P}{\left(1 + \frac{R}{100}\right)^n}$

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Exercise : Average - Formulas

- Average - Formulas
- Average - General Questions
- Average - Data Sufficiency 1
- Average - Data Sufficiency 2

1. **Average:**

$$\text{Average} = \left(\frac{\text{Sum of observations}}{\text{Number of observations}}\right)$$

2. **Average Speed:**

Suppose a man covers a certain distance at $x$ kmph and an equal distance at $y$ kmph.

Then, the average speed during the whole journey is $\left(\frac{2xy}{x + y}\right)$ kmph.

1. **Factorial Notation:**

   Let $n$ be a positive integer. Then, factorial $n$, denoted $n!$ is defined as:

   $$n! = n(n - 1)(n - 2) \ldots 3.2.1.$$

   **Examples:**

   1. We define $0! = 1$.
   2. $4! = (4 \times 3 \times 2 \times 1) = 24$.
   3. $5! = (5 \times 4 \times 3 \times 2 \times 1) = 120$.

2. **Permutations:**

   The different arrangements of a given number of things by taking some or all at a time, are called permutations.

   **Examples:**

   1. All permutations (or arrangements) made with the letters $a$, $b$, $c$ by taking two at a time are ($ab$, $ba$, $ac$, $ca$, $bc$, $cb$).
   2. All permutations made with the letters $a$, $b$, $c$ taking all at a time are:
      ($abc$, $acb$, $bac$, $bca$, $cab$, $cba$)

3. **Number of Permutations:**

   Number of all permutations of $n$ things, taken $r$ at a time, is given by:

   $${}^nP_r = n(n - 1)(n - 2) \ldots (n - r + 1) = \frac{n!}{(n - r)!}$$

   **Examples:**

   1. ${}^6P_2 = (6 \times 5) = 30$.
   2. ${}^7P_3 = (7 \times 6 \times 5) = 210$.
   3. **Cor. number of all permutations of $n$ things, taken all at a time = $n!$.**

4. **An Important Result:**

   If there are $n$ subjects of which $p_1$ are alike of one kind; $p_2$ are alike of another kind; $p_3$ are alike of third kind and so on and $p_r$ are alike of $r^{th}$ kind,
   such that $(p_1 + p_2 + \ldots p_r) = n$.

   Then, number of permutations of these $n$ objects is = $\frac{n!}{(p_1!).(p_2)!.....(p_r!)}$

5. **Combinations:**

   Each of the different groups or selections which can be formed by taking some or all of a number of objects is called a **combination**.

   **Examples:**

   1. Suppose we want to select two out of three boys A, B, C. Then, possible selections are AB, BC and CA.

      Note: AB and BA represent the same selection.
   2. All the combinations formed by $a$, $b$, $c$ taking $ab$, $bc$, $ca$.
   3. The only combination that can be formed of three letters $a$, $b$, $c$ taken all at a time is $abc$.
   4. Various groups of 2 out of four persons A, B, C, D are:

      AB, AC, AD, BC, BD, CD.
   5. Note that $ab$ $ba$ are two different permutations but they represent the same combination.

6. **Number of Combinations:**

   The number of all combinations of $n$ things, taken $r$ at a time is:

   $${}^nC_r = \frac{n!}{(r!)(n - r)!} = \frac{n(n - 1)(n - 2) \ldots \text{to } r \text{ factors}}{r!}.$$

   **Note:**

   1. ${}^nC_n = 1$ and ${}^nC_0 = 1$.
   2. ${}^nC_r = {}^nC_{(n - r)}$

1. **Factors and Multiples:**

   If number $a$ divided another number $b$ exactly, we say that $a$ is a **factor** of $b$.

   In this case, $b$ is called a **multiple** of $a$.

2. **Highest Common Factor (H.C.F.) or Greatest Common Measure (G.C.M.) or Greatest Common Divisor (G.C.D.):**

   The H.C.F. of two or more than two numbers is the greatest number that divides each of them exactly.

   There are two methods of finding the H.C.F. of a given set of numbers:

   1. **Factorization Method:** Express the each one of the given numbers as the product of prime factors. The product of least powers of common prime factors gives H.C.F.

   2. **Division Method:** Suppose we have to find the H.C.F. of two given numbers, divide the larger by the smaller one. Now, divide the divisor by the remainder. Repeat the process of dividing the preceding number by the remainder last obtained till zero is obtained as remainder. The last divisor is required H.C.F.

      **Finding the H.C.F. of more than two numbers:** Suppose we have to find the H.C.F. of three numbers, then, H.C.F. of [(H.C.F. of any two) and (the third number)] gives the H.C.F. of three given number.

      Similarly, the H.C.F. of more than three numbers may be obtained.

3. **Least Common Multiple (L.C.M.):**

   The least number which is exactly divisible by each one of the given numbers is called their L.C.M.

   There are two methods of finding the L.C.M. of a given set of numbers:

   1. **Factorization Method:** Resolve each one of the given numbers into a product of prime factors. Then, L.C.M. is the product of highest powers of all the factors.

   2. **Division Method (short-cut):** Arrange the given numbers in a rwo in any order. Divide by a number which divided exactly at least two of the given numbers and carry forward the numbers which are not divisible. Repeat the above process till no two of the numbers are divisible by the same number except 1. The product of the divisors and the undivided numbers is the required L.C.M. of the given numbers.

4. **Product of two numbers = Product of their H.C.F. and L.C.M.**

5. **Co-primes:** Two numbers are said to be co-primes if their H.C.F. is 1.

6. **H.C.F. and L.C.M. of Fractions:**

   1. $\text{H.C.F.} = \dfrac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}}$

   2. $\text{L.C.M.} = \dfrac{\text{L.C.M. of Numerators}}{\text{H.C.F. of Denominators}}$

7. **H.C.F. and L.C.M. of Decimal Fractions:**

   In a given numbers, make the same number of decimal places by annexing zeros in some numbers, if necessary. Considering these numbers without decimal point, find H.C.F. or L.C.M. as the case may be. Now, in the result, mark off as many decimal places as are there in each of the given numbers.

8. **Comparison of Fractions:**

   Find the L.C.M. of the denominators of the given fractions. Convert each of the fractions into an equivalent fraction with L.C.M as the denominator, by multiplying both the numerator and denominator by the same number. The resultant fraction with the greatest numerator is the greatest.