14. Compound Interest

- Interest is the extra money paid by institutions such as banks or post offices on money deposited with them.
  It is also paid by people when they borrow money from these institutions.

  $$\text{Simple Interest} = \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$$

  Amount = Principal + Interest

- The interest calculated on the amount of the previous year (or duration at which interest is compounded) is known as **compound interest**. Compound interest allows the principal to grow faster than simple interest.

- Amount (A) when interest is compounded annually is $A = P\left(1 + \frac{R}{100}\right)^n$ here, P = Principal, R = Rate of interest, n = Time period. w

  For example, if Supriya invested Rs 75000 in a bank at the rate of 10% per annum for 2 years then the amount received by her can be calculated as follows:

  Here, P = Rs 75000, R = 10%, n = 2 years

  $$A = P\left(1 + \frac{R}{100}\right)^n$$
  $$= 75000\left(1 + \frac{10}{100}\right)^2$$
  $$= 75000 \times \frac{121}{100}$$

  = Rs 90750

  Thus, Supriya received Rs 90750 after 2 years.

- The growth per unit time is called the **rate of growth**.

  If V_0 is the current measure of quantity and V is the measure of quantity after n years, r is the rate of growth per year, then $V = V_0\left(1 + \frac{r}{100}\right)^n$.

- The decrease in value per unit time is called the **rate of depreciation**.

  If r is the rate of depreciation per year; V_0 is the current value and V is the value after n years, then $V = V_0\left(1 - \frac{r}{100}\right)^n$.

- When a quantity increases in the first year at the rate of $r_1\%$, then decreases at the rate of $r_2\%$ in the second year and then increases at the rate of $r_3\%$ in the third year, then the formula is $V = V_0\left(1 + \frac{r_1}{100}\right)\left(1 - \frac{r_2}{100}\right)\left(1 + \frac{r_3}{100}\right)$.

Here, V_0 is the initial measure and V is the quantity after 3 years.

Example:

Priya bought a diamond necklace worth Rs 300000. The value of the necklace appreciates by 6% every year. What will be the value of the necklace after 3 years?

Solution:

P = Rs 300000

Rate of appreciation, R = 6% p.a.

Therefore, the value of the necklace after 3 years

$$= \text{Rs } 300000\left(1+\frac{6}{100}\right)^3$$

$$= \text{Rs } 300000\times\left(\frac{53}{50}\right)^3$$

$$= \text{Rs } 300000\times\frac{53\times53\times53}{50\times50\times50}$$

$$= \text{Rs } 357304.80$$