

Compound Interest

- 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

$$\begin{aligned}
&= \text{Rs } 300000 \left(1 + \frac{6}{100}\right)^3 \\
&= \text{Rs } 300000 \times \left(\frac{53}{50}\right)^3 \\
&= \text{Rs } 300000 \times \frac{53 \times 53 \times 53}{50 \times 50 \times 50} \\
&= \text{Rs } 357304.80
\end{aligned}$$

- 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.

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, $P = \text{Rs } 75000$, $R = 10\%$, $n = 2$ years

$$\begin{aligned}
A &= P \left(1 + \frac{R}{100}\right)^n \\
&= 75000 \left(1 + \frac{10}{100}\right)^2 \\
&= 75000 \times \frac{121}{100} \\
&= \text{Rs } 90750
\end{aligned}$$

Thus, Supriya received Rs 90750 after 2 years.

- Amount when interest is compounded half yearly is given by, $A = P \left(1 + \frac{R}{200}\right)^{2n}$

Where, $\frac{R}{2}$ = Half-yearly rate and $2n$ = Number of half years

- Amount when interest is compounded quarterly is given by, $A = P \left(1 + \frac{R}{400}\right)^{4n}$

Where, $\frac{R}{4}$ = Quarterly rate and $4n$ = Number of quarters