

Chapter - 2 Compound Interest

Interest:-

It is the additional money besides the original money paid by the borrower to the moneylender (bank, financial agency or individual) in lieu of the money used by him.

Principal or sum:-

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

Interest:-

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

Amount:-

The sum of principal and interest after a specified period, is called the amount.

Rate:-

Interest on ₹100 for 1 year is called the rate per cent per annum.

Time:-

The period for which money is borrowed is called the time.

Simple Interest:-

→ When money is borrowed on simple interest, then the interest is calculated uniformly on the original principal throughout the loan period.

$$S.I. = \frac{P \times R \times T}{100}$$

where, P = Principal, R = Rate %, T = Time (years)
So, it is the interest calculated on the original money (principal) for any given time and rate.

Compound Interest:-

→ At the end of the first year (or any other fixed period), if the interest accrued is not paid to the money lender but is added to the principal, then this amount becomes the principal for the next year (or any other fixed period) and so on. The difference between the final amount and the (original) principal is called compound interest.

Note:-

- 1) If the interest is compounded Annually, then the conversion period is 1 year. The amount after 1 year becomes the principal for second year. The amount after 2 years becomes the principal for third year and so on.
- 2) If the interest is compounded Half-Yearly, then the conversion period is Half-Year. The amount after first half-year becomes the principal for second half year. The amount after one year becomes the principal for the third half year and so on.

Example 1:- Find the amount and the compound interest on ₹15000 for 2 years at 8% per annum.

Solution:- Principal for the first year = ₹15000

$$\text{Interest for the first year} = \frac{\text{₹}15000 \times 8 \times 1}{100}$$

$$= \text{₹}1200$$

$$\text{Amount after one year} = \text{₹}15000 + \text{₹}1200 = \text{₹}16200$$

$$\text{Principal for the second year} = \text{₹}16200$$

$$\text{Interest for the second year} = \frac{\text{₹}16200 \times 8 \times 1}{100} = \text{₹}1296$$

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$$\text{Amount after 2 years} = ₹16200 + ₹1296 = ₹17496$$

Compound interest for 2 years

$$= \text{final amount} - (\text{original}) \text{ principal}$$

$$= ₹17496 - ₹15000$$

$$= ₹2496.$$

Example 2:- Find the amount and the compound interest on ₹16000 for $1\frac{1}{2}$ years at 10% p.a., the interest being compounded half-yearly.

Solution:- Since the rate of interest is 10% p.a., therefore, the rate of interest half-yearly
 $= \frac{1}{2}$ of 10% = 5%.

$$\text{Principal for the first half-year} = ₹16000$$

$$\text{Interest for the first half-year} = ₹ \frac{16000 \times 5 \times 1}{100}$$

$$= ₹800$$

$$\text{Amount after the first half-year} = ₹16000 + ₹800$$

$$= ₹16800$$

$$\text{Principal for the second half-year} = ₹16800$$

$$\text{Interest for the second half-year} = ₹ \frac{16800 \times 5 \times 1}{100}$$

$$= ₹840$$

$$\text{Amount after one year} = ₹16800 + ₹840$$

$$= ₹17640$$

$$\text{Principal for the third half-year} = ₹17640$$

$$\text{Interest for the third half-year} = ₹ \frac{17640 \times 5 \times 1}{100}$$

$$= ₹882$$

$$\text{Amount after } 1\frac{1}{2} \text{ years} = ₹17640 + ₹882$$

$$= ₹18522$$

$$\therefore \text{Compound interest for } 1\frac{1}{2} = 18522 - 16000$$

$$= ₹2522$$

Compound Interest by Using Formulae

I When Interest is Compounded Annually

(i) Let Principal = ₹P, Rate = R% p.a.

Time = n years. Then,

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

$$\begin{aligned} \text{C.I.} &= \text{Amount} - \text{Principal} \\ &= \left[P \times \left\{ \left(1 + \frac{R}{100} \right)^n - 1 \right\} \right] \end{aligned}$$

(ii) When rates are different for different years:-

→ Let the rates of interest for three successive years be $R_1\%$, $R_2\%$ and $R_3\%$ per annum respectively. Then

$$\text{Amount} = ₹ \left\{ P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right) \left(1 + \frac{R_3}{100} \right) \right\}$$

(iii) When period is not a complete number of years:-

→ Let it be 2 years 8 months. Then,

$$\text{Amount} = ₹ \left\{ P \left(1 + \frac{R}{100} \right)^2 \times \left(1 + \frac{8R/12}{100} \right) \right\}$$

II When Interest is Compounded Half-yearly

→ Let Principal = ₹P, Rate = R% p.a. and

Time = n years

Then, Principal = ₹P, Rate = $\frac{R}{2}\%$ half yearly
and Time = 2n half years

Therefore,

$$\text{Amount} = \left\{ P \times \left(1 + \frac{R}{2 \times 100} \right)^{2n} \right\}$$

1. Let Principal = P, Rate = R% per annum, Time = n years.

2. **When interest is compound Annually:**

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

3. **When interest is compounded Half-yearly:**

$$\text{Amount} = P \left[1 + \frac{(R/2)}{100} \right]^{2n}$$

4. **When interest is compounded Quarterly:**

$$\text{Amount} = P \left[1 + \frac{(R/4)}{100} \right]^{4n}$$

5. **When interest is compounded Annually but time is in fraction, say $3\frac{2}{5}$ years.**

$$\text{Amount} = P \left(1 + \frac{R}{100} \right)^3 \times \left(1 + \frac{\frac{2}{5}R}{100} \right)$$

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Example 1:- Calculate the amount and the compound interest on ₹12500 for 2 years at 12% per annum, compounded annually.

Solution:- Given, $P = ₹12500$, $R = 12\%$ p.a.
and Time i.e. $n = 2$ years

$$\text{Now, Amount} = P \left(1 + \frac{R}{100}\right)^n$$

$$= \left\{12500 \times \left(1 + \frac{12}{100}\right)^2\right\}$$

$$= \left\{12500 \times \frac{28}{25} \times \frac{28}{25}\right\} = ₹15680$$

$$\text{C.I.} = \text{Amount} - \text{Principal}$$

$$= 15680 - 12500 = ₹3180$$

Example 2:- How much will ₹10000 amount to in 2 years at compound interest, compounded annually, the rates of interest for the successive years being 9% and 10% respectively.

Solution:- Given, $P = ₹10000$, $R_1 = 9\%$ p.a.
and $R_2 = 10\%$ p.a.

$$\therefore \text{Amount} = P \left(1 + \frac{R_1}{100}\right) \left(1 + \frac{R_2}{100}\right)$$

$$= \left[10000 \left(1 + \frac{9}{100}\right) \times \left(1 + \frac{10}{100}\right)\right]$$

$$= \left[10000 \times \frac{109}{100} \times \frac{11}{10}\right] = 11990$$

Hence, amount after 2 years will be ₹11990.