Government of Tamilnadu

Department of Employment and Training

Course : TNPSC Group I Mains Material

Subject : General Aptitude & Mental Ability

Topic : **Simple Interest & Compound Interest**

Commissioner,
Department of Employment and Training.

Simple Interest and Compound Interest

Simple Interest

The loan money that he/she borrowed from the bank is known as Sum or Principal. The borrower takes some time period to return the money to the bank. To use the money during a particular period of time, the borrower has to pay an additional amount to the bank. This is known as Interest. So to repay the money borrowed, the borrower has to add the principal and the interest.

That is, Amount = Principal + Interest

Interest is generally given in per cent for a period of 1 year per annum. Suppose the bank gives an amount of ₹ 100 at an interest rate of ₹ 8.

It means on every ₹ 100 borrowed, ₹ 8 is the required interest, to be paid for every one year. To understand this let us consider an example. Selvam takes a loan of ₹ 10000 at 15% per year as rate of interest.

Let us find the interest he has to pay at the end of 1 year.

Sum borrowed = ₹ 10000

Rate of interest = 15 % per year

This means if ₹ 100 is borrowed he has to pay ₹ 15 as interest.

So, for the borrowed amount of ₹ 10000, the interest for one year would be

$15/100 \times 10000$ = ₹ 1500

So at the end of 1 year, he has to give an amount of = 10000 + 1500 = ₹ 11500.

Now we can write a general relation to find interest for one year. Take P as the principal or sum and r % as Rate per cent per annum. On every ₹ 100 borrowed the interest paid is ₹ r. Therefore, on ₹ P borrowed the interest paid for 1 year would be $P \times r / 100$

If the amount is borrowed for more than 1 year then the interest is calculated for the total period during which the money is kept. This way of calculating interest for the total time period for the same Principal is known as simple interest.

We know that on a Principal of ₹ P at r % rate of interest per year, the interest paid for 1 year is $\frac{P \times r}{100}$. Hence the interest 'I' paid for 'n' years would be $\frac{P \times n \times r}{100}$ or $\frac{Pnr}{100}$

The amount we have to pay at the end of 'n' years is A = P + I .

Simple Interest

Calculated on principal (or) amount of a loan.

It is quick and easy method.

$$SI = \frac{PNR}{100}$$

P - Principle

N - Number of year's

R - Rate of Interest

1. Kamal invested ₹ 3,000 for 1 year at 7% per annum. Find the simple interest and amount received by him at the end of one year.

Solution:

Principal (P) = ₹ 3,000; Number of years (N) = 1; Rate of interest (r) = 7%

Formula,

$$SI = \frac{Pnr}{100}$$

$$= \frac{3000 \times 1 \times 7}{100}$$

SI = ₹ 210.

Amount = P + I $\Rightarrow$ = 3000 + 210

Amount = ₹ 3,210.

2. Find the amount when ₹ 2,500 is invested for 146 days at 13% per annum.

Solution:

P = 2500; r = 13%; n = 146 days $= \frac{146}{365} = \frac{2}{5}$ *[Like 4th Sum]*

Method I

$$SI = \frac{Pnr}{100}$$

$$= \frac{2500 \times 2 \times 13}{5 \times 100}$$

SI = 130.

A = P + I

= 2500 + 130

A = ₹ 2,630.

Method II

$$A = P\left(1 + \frac{nr}{100}\right)$$

$$= 2500\left(1 + \frac{2 \times 13}{5 \times 100}\right)$$

$$= 2500 + 2500\left(\frac{2 \times 13}{500}\right)$$

$$= 2500 + (5 \times 2 \times 13)$$

= 2500 + 130

A = ₹ 2,630.

73 Multiples

$73 \times 2 = 146 = \frac{2}{5}$

$73 \times 3 = 219 = \frac{3}{5}$

$73 \times 4 = 292 = \frac{4}{5}$

$73 \times 5 = 365 = 1$ year

3. Find the SI and amount on ₹ 12,000 from May 21st 1999 to Aug. 2nd 1999 at 9% per annum.

Solution:

P = 12000; r = 9%;

n = May = 11 days (31 − 20)

June = 30 days

July = 31 days

August = 1 day

Total = 73 days

30 days: April, June, Sep, Nov.
Remaining all: 31 days except Feb.

$$n = \frac{73}{365} = \frac{1}{5}$$

$$SI = \frac{Pnr}{100}$$

$$= \frac{12000 \times 9 \times 1}{5 \times 100}$$

SI = ₹ 216.

A = P + I $\Rightarrow$ = 12000 + 216

A = ₹ 12,216.

4. A sum of money triples itself at 8% per annum over a certain time find the number of years.

Solution:

Let principal be P, Amount = 3P; r = 8%;

$$\text{Amount} = P + SI$$

$$SI = A - P \Rightarrow = 3P - P$$

$$SI = 2P$$

$$n = \frac{S.I \times 100}{P \times r} \Rightarrow = \frac{2P \times 100}{P \times 8}$$

n = 25 years.

5. Find SI and amount on ₹ 5000 at 10% per annum for 5 years.

Solution:

P = 5000; r = 10%; n = 5

$$SI = \frac{5000 \times 5 \times 10}{100} \Rightarrow SI = 2500$$

$$A = P + I \Rightarrow = ₹\ 7,500.$$

6. Find principal that earns ₹ 250 as SI in 2½ years at 10% per annum.

Solution:

SI = 250; r = 10%; $n = \frac{5}{2}$

$$P = \frac{S.I \times 100}{n \times r} = \frac{250 \times 100 \times 2}{10 \times 5}$$

P = ₹ 1,000.

7. In how many years will a sum of ₹ 5,000 amount to ₹ 5,800 at the rate of 8% per annum.

Solution:

P = 5000; A = 5800%; r = 8%;

$$SI = A - P \Rightarrow = 5800 - 5000$$

SI = 800

$$n = \frac{S.I \times 100}{P \times r} = \frac{800 \times 100}{5000 \times 8}$$

n = 2 years.

8. A certain sum of money amounts to ₹ 6500 in 3 years and ₹ 5,750 in 1½ years respectively. Find principal and rate percent.

Solution:

Amount at the end of 3 years = P + Interest for 3 years

$6500 = P + I_3 \quad \rightarrow (1)$

Amount at the end of 1½ years = P + Interest for 1½ years

$5750 = P + I_{3/2} \quad \rightarrow (2)$

(1) − (2)

Interest at end of 1½ years $I_{3/2} = 6500 - 5750$

$I_{3/2} = 750.$

Interest at end of 1st year $= 750 \times \frac{2}{3} = 500$

$I = 500. \qquad (I_3 = 500 \times 3 = 1500)$

$P + I_3 = 6500$

$P = 6500 - 1500$

P = ₹ 5,000.

$r = \frac{S.I \times 100}{P \times n} \Rightarrow = \frac{1500 \times 100}{5000 \times 3}$

r = 10%.

9. A certain sum of money amounts to ₹ 6, 372 in 3 years at 6%. Find the principal.

Solution:

A = 6372; r = 6%; n = 3

$$A = P\left(1 + \frac{nr}{100}\right)$$

$$6372 = P\left(1 + \frac{18}{100}\right) = P\left(1 + \frac{9}{50}\right)$$

$$6372 = P\left(\frac{59}{50}\right)$$

$$P = \frac{6372 \times 50}{59} \qquad \textbf{P = ₹ 5400.}$$

10. A sum of money doubles itself in 10 yea₹ find the rate of interest.

Solution:

Let principal be P, Amount = 2P; n = 8 years

$$SI = P \Rightarrow A - P \Rightarrow 2P - P = P$$

$$r = \frac{S.I \times 100}{P \times n}$$

$$= \frac{P \times 100}{P \times 10} \qquad \therefore \mathbf{r = 10\%.}$$

11. A sum of money doubles itself at 12½% per annum over a certain period of time. Find the number of years.

Solution:

Let principal be P, Amount = 2P; $r = \frac{25}{2}\%$;

$$SI = P \Rightarrow A - P \Rightarrow 2P - P = P$$

$$n = \frac{S.I \times 100}{P \times r} = \frac{P \times 100 \times 2}{P \times 25}$$

n = 8 years.

12. Find SI and amount on ₹ 3600 at 15% p.a. for 3 years and 9 months.

Solution:

P = 3600; r = 15%; $n = 3 \text{ years } \frac{9}{12} \text{ month}, = 3\frac{3}{4} = \frac{15}{4}$

$$SI = \frac{3600 \times 15 \times 15}{4 \times 100}$$

$$SI = 2025.$$

$A = P + I \Rightarrow$ $= 3600 + 2025$ **= ₹ 5,625.**

13. Find the principal that earns ₹ 2080 as SI in 3¼ years at 16% per annum.

Solution:

SI = 2080; r = 16%; $n = \frac{13}{4}$

$$P = \frac{S.I \times 100 \times 4}{16 \times 13}$$

$$= \frac{2080 \times 100}{4 \times 13}$$

P = ₹ 4,000.

Compound Interest

- The most powerful force in this universe is_____. How would you finish this quote? The world renowned physicist Albert Einstein completed this quote with the word Compound Interest. When money is borrowed or deposited on simple interest, then the interest is calculated evenly on the principal throughout the loan or deposit period. In post offices, banks, insurance companies and other financial institutions, they also offer another type of interest calculation. Here, the interest accrued during the first time period (say, 6 months) is added to the original principal and the amount so obtained is taken as the principal for the second time period (say, next 6 months) and this keeps going on, up to the fixed time agreement between the lender and the borrower.
- After a certain period, the difference between the amount and the money borrowed or deposited is called the compound interest which is abbreviated as C.I. Clearly, compound interest will be more than the simple interest just because the principal keeps on changing for every time period.
- We call the time period after which the interest is added to the principal, as the 'conversion period'. For example, if the interest is compounded say, quarterly, there will be four conversion periods in a year each after 3 months. In such cases, the interest rate will be one fourth of the annual rate and the number of times that interest will be compounded is four times the number of years.
- In case of simple interest, the principal remains the same for the whole duration where as in case of compound interest, the principal keeps on changing as per the conversion period. Simple interest and Compound interest remains the same for the first conversion period.

Applications of Compound Interest formula:

The compound interest formula is used in the following situations.

- To find the increase or decrease in population.
- To find the growth of cells when the rate of growth is given.
- To find the depreciation in the values of machines, vehicles, utility appliances etc.,

Difference between S.I and C.I

- There is no difference in S.I and C.I for the first conversion period.
- For 2 years, the difference in S.I and C.I is

$$C.I - S.I = P\left(\frac{r}{100}\right)^2$$

- For 3 years, the difference in S.I and C.I is

$$C.I - S.I = P\left(\frac{r}{100}\right)^2\left(3+\frac{r}{100}\right)$$

1. Compound interest

Based on principal amount and interest

$$CI = A - P$$

$$A = \left(1+\frac{r}{100}\right)^n$$

P - Principal

A - Total Amount

Interest is added to the principal at the end of each year [Compounded Annually]

Compounded half-yearly:

$$A = P\left[1+\frac{1}{2}\left(\frac{r}{100}\right)\right]^{2n}$$

Compounded quarterly:

$$A = P\left[1+\frac{1}{4}\left(\frac{r}{100}\right)\right]^{4n}$$

2. Difference between CI and SI $= \frac{PR^2}{100^2}$

1. Find amount and CI

P = 1000; r = 5%; n = 3

Solution:

$$A = P\left(1+\frac{r}{100}\right)^n \Rightarrow = 1000\left(1+\frac{5}{100}\right)^3$$

$$= 1000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$$

$$A = 1157.63$$

$CI = A - P \Rightarrow$ $CI = 1157.63 - 1000$

CI = ₹ 157.63.

2. Find the principal that will yield a CI of ₹ 1,632 in 2 years at 4% rate per annum

Solution:

$CI = 1632;\quad r = 4\%;\quad n = 2;\quad P = ?$

$$CI = A - P$$

$$= P\left(1+\frac{r}{100}\right)^n - P$$

$$1632 = P\left[\left(1+\frac{r}{100}\right)^n - 1\right]$$

$$1632 = P\left[\left(1+\frac{4}{100}\right)^2 - 1\right]$$

$$= P\left[\frac{26\times 26}{625} - 1\right]$$

$$= P\left[\frac{676-625}{625}\right] \Rightarrow = P\left[\frac{51}{625}\right]$$

$$P = \frac{1632\times 625}{51}$$

P = ₹ 20,000.

3. At what rate percent CI per annum will ₹ 640 amount to ₹ 774.40 in 2 years.

Solution:

P = 640; n = 2; A = 774.40; r = ?

$$A = P\left(1+\frac{r}{100}\right)^n$$

$$\frac{774.40}{640} = \left(1+\frac{r}{100}\right)^2$$

$$\frac{77440}{64000} = \left(1+\frac{r}{100}\right)^2$$

$$\frac{121}{100} = \left(1+\frac{r}{100}\right)^2 \Rightarrow \left(\frac{11}{10}\right)^2 = \left(1+\frac{r}{100}\right)^2$$

$$\frac{11}{10} = 1+\frac{r}{100}$$

$$\frac{r}{100} = \frac{11}{10} - 1 \Rightarrow = \frac{1}{10}$$

$$r = \frac{1}{10} \times 100 \qquad \therefore r = \mathbf{10\%.}$$

4. Ramlal deposited ₹ 8,000 with a finance company for 3 years at an interest of 15% per annum. What is the compound interest that Rahul gets after 3 years.

Solution:

P = 8000; n = 3; r = 15%

$$CI = A - P$$

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

$$= 8000\left(1+\frac{15}{100}\right)^3 = 8000\left(1+\frac{3}{20}\right)^3$$

$$= 8000\left(\frac{23}{20}\right)^3$$

$$= 8000 \times \frac{23}{20} \times \frac{23}{20} \times \frac{23}{20} \qquad A = 12167$$

$$CI = 12167 - 8000 = \mathbf{₹\ 4{,}167.}$$

5. Find the CI on ₹ 1,000 at a rate of 10% per annum for 18 months when interest is compounded half yearly.

Solution:

P = 1000; r = 10%; n = 18 month, $\frac{18}{12}=\frac{3}{2}$ years.

Amount after 18 month $= P\left[1+\frac{1}{2}\left(\frac{r}{100}\right)\right]^{2n}$

$= 1000\left[1+\frac{1}{2}\left(\frac{10}{100}\right)\right]^{2\times\frac{3}{2}} = 1000\left(1+\frac{1}{20}\right)^{3}$

$= 1000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20}$

$A = 1157.63$

$CI = A - P \Rightarrow$ $CI = 1157.63 - 1000$

CI = ₹ 157.63.

6. Find the compound interest on ₹ 20,000 at 15% per annum for $2\frac{1}{3}$ years.

Solution:

P = 20000; r = 15%; n = $2\frac{1}{3}$ years.

Amount after $2\frac{1}{3}$ years, $A = P\left(1+\frac{r}{100}\right)^{2}\left[1+\frac{1}{3}\left(\frac{r}{100}\right)\right]$

Note: (Like, fraction of years 1st. Solve whole years (in power) fraction of years - multiply with rate percent).

$A = 20000\left(1+\frac{15}{100}\right)^{2}\left[1+\frac{1}{3}\left(\frac{15}{100}\right)\right]$

$= 20000\left(1+\frac{3}{20}\right)^{2}\left(1+\frac{1}{20}\right)$

$= 20000\times\frac{23}{20}\times\frac{23}{20}\times\frac{21}{20}$

$A = 27772.50$

$CI = A - P \Rightarrow$ $CI = 27772.50 - 20000$

CI = ₹ 7,772.50.

7. At what rate percent per annum will ₹ 640 amount to ₹ 774.40 in 2 years, when interest is being compounded annually.

Solution:

P = 640; A = 774.40; n = 2 years; r = ?

$$A = P\left(1+\frac{r}{100}\right)^n$$

$$774.40 = 640\left(1+\frac{r}{100}\right)^2$$

$$\frac{774.40}{640} = \left(1+\frac{r}{100}\right)^2 \Rightarrow \frac{77440}{64000} = \left(1+\frac{r}{100}\right)^2$$

$$\frac{121}{100} = \left(1+\frac{r}{100}\right)^2 \Rightarrow \left(\frac{11}{10}\right)^2 = \left(1+\frac{r}{100}\right)^2$$

$$\frac{11}{10} = 1+\frac{r}{100}$$

$$\frac{r}{100} = \frac{11}{10} - 1, \Rightarrow \frac{1}{10}$$

$$r = \frac{100}{10} \qquad \therefore \mathbf{r = 10\%.}$$

8. Find the difference between SI and CI for a sum of ₹ 8,000 at 10% in 2 years.

Solution:

P = 8000; r = 10%; n = 2

Difference between CI and SI for 2 years = $P\left(\frac{r}{100}\right)^2$

$$= 8000\left(\frac{10}{100}\right)^2$$

$$= 8000 \times \frac{1}{10} \times \frac{1}{10}$$

Difference = ₹ 80.

9. Sujatha borrows ₹ 12,500 at 12% per annum for 3 years at SI and Radhika borrows the same amount for same period at 10% per annum compounded annually who pays more interest and by how much?

Solution:

i) Sujatha - SI $\Rightarrow$ P = 12500; r = 12; n = 3

$$SI = \frac{Pnr}{100}$$

$$= \frac{12500 \times 3 \times 12}{100}$$

SI = ₹ 4,500.

ii) Radhika - CI $\Rightarrow$ r = 10; n = 3

$$A = P\left(1 + \frac{r}{100}\right)^n$$

$$= 12500\left(1 + \frac{10}{100}\right)^3$$

$$= 12500\left(\frac{11}{100}\right)^3$$

$$= 12500 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}$$

A = 16637.5

CI = A − P $\Rightarrow$ CI = 16637.5 − 12500

CI = ₹ 4,137.

Sujatha pays more interest = 4500 − 4137 = ₹ **363**.

10. Find the difference between simple interest and compound interest on ₹ 2,400 at 2 years at 5% per annum compounded annually.

Solution:

P = 2400; r = 5%; n = 2

Difference between SI and CI $= P\left(\frac{r}{100}\right)^2$

$$= 2400\left(\frac{5}{100}\right)\left(\frac{5}{100}\right)$$

$$= 2400 \times \frac{1}{20} \times \frac{1}{20}$$

Difference = ₹ 6.

11. Find the difference b/w SI and CI on ₹ 6,400 for 2 years at 6¼% per annum compounded annually.

Solution:

P = 6400; $r = \frac{25}{4}\%$; n = 2

Difference $= P\left(\frac{r}{100}\right)^2$

$$= 6400\left(\frac{25}{4(100)}\right)^2$$

$$= 6400 \times \frac{1}{16} \times \frac{1}{16}$$

Difference = ₹ 25.