Topic: Simple and Compound Interest

Introduction :

If you have a savings account with a bank and deposit some money, the bank will pay you extra money for saving with them. Similarly if you need to borrow money from a bank the bank will expect you to pay back more than you borrowed from them in the first place! How much extra depends on the interest rate set by the bank. Banks make their money by charging more for their loans than they give for their savings accounts.

Simple interest is where the amount of interest earned is fixed over time. For example, if you saved £1000 at 4% simple interest you would earn £40 per year, every year. The amount of interest earned stays the same when dealing with simple interest.

Compound interest is where interest is paid on the amount already earned leading to greater and greater amounts of interest. For example £1000 at 4% compound interest would earn you £40 in the first year but in the second year you would earn 4% on the new amount of £1040 which would be £41.60.

Compound interest is by far the most common type of interest use in real life. It is the reason why small amounts saved can turn into retirement nest eggs and why small loans taken out can spiral into huge debts very quickly.

Simple Interest :

As the name implies, the calculation of simple interest is pretty simple. Multiply the principal amount with the number of years and the rate of interest.

Formula:
Simple Interest = Principal * Time * Rate of interest / 100
Abbreviated as SI = P*T*R/100

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

2. **Interest:**
   This is the extra money paid for taking the money as loan. This is often expressed as a percentage.Say, the interest is 10% on a loan of Rs. 100. Then the interest in amount is Rs. 10 and at the end of the year, the amount to be paid is Rs. 110.

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

3. **Time**: This is the time period for which the money is lent or the time period in which the money has to be returned with interest.

4. **Simple Interest (S.I.):**
   If the interest on a sum borrowed for certain period is reckoned uniformly, then it is called simple interest.

Topic: Simple and Compound Interest

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

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

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

Compound Interest :

In compound interest, the principal amount with interest after the first unit of time becomes the principal for the next unit.

Say, when compounded annually for 2 years, the principal amount with interest accrued at the end of first year becomes the principal for the second year.

Formula:
Amount = Principal * [1 + Rate of Interest/100]$^{\text{Time period}}$
Abbreviated as Amount = P * [1 + R/100]^{t}, when compounded annually.

Sometimes, the interest is also calculated half-yearly or quarterly.

When compounded semi-annually or half-yearly,

Amount = P[1 + (R/2)/100]^{2t}

When compounded quarterly,

Amount = P[1 + (R/4)/100]^{4t}

Present worth of Principal P due t years hence is given by:

P/[1+ R/100]^{t}

Read More :

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

2. When interest is compound Annually:

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

3. When interest is compounded Half-yearly:

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

4. When interest is compounded Quarterly:

   Amount = P $\left[1 + \dfrac{(R/}{} \right.$ ^{4n}

Topic: Simple and Compound Interest

$$\frac{4)}{100}$$

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

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

6. When Rates are different for different years, say $R_1\%$, $R_2\%$, $R_3\%$ for 1st, 2nd and 3rd year respectively.

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

7. Present worth of Rs. x due n years hence is given by:

$$\text{Present Worth} = \frac{x}{\left(1 + \frac{R}{100}\right)}.$$

Sample problems and solutions :

Let us work on some examples to understand the concepts and the differences.

Problem 1. A sum of Rs. 25000 becomes Rs. 27250 at the end of 3 years when calculated at simple interest. Find the rate of interest.
Solution:
Simple interest = 27250 − 25000 = 2250

Time = 3 years.

SI = PTR / 100 → R = SI * 100 / PT

R = 2250 * 100 / 25000 * 3 → R = 3%.

Problem 2. Find the present worth of Rs. 78000 due in 4 years at 5% interest per year.
Solution:
Amount with interest after 4 years = Rs. 78000

Therefore, simple interest = 78000 − Principal.

Let the principal amount be p.

78000 − p = p*4*5/100 → p=13000

Principal = 78000 − 13000 = Rs. 65000

Problem 3. A certain principal amounts to Rs. 15000 in 2.5 years and to Rs. 16500 in 4 years at the same rate of interest. Find the rate of interest.

Topic: Simple and Compound Interest

Solution:
Amount becomes 15000 in 2.5 years and 16500 in 4 years.

Simple interest for (4-2.5) years = 16500 − 15000

Therefore, SI for 1.5 years = Rs. 1500.

SI for 2.5 years = 1500/1.5 * 2.5 = 2500

Principal amount = 15000 − 2500 = Rs. 12500.

Rate of Interest = 2500 * 100 / 12500 * 2.5 → R = 8%.

Problem 4. Find the compound interest on Rs. 3000 at 5% for 2 years, compounded annually.
Solution:
Amount with CI = $3000 (1+ 5/100)^2$ = Rs. 3307.5

Therefore, CI = 3307.5 − 3000 = Rs. 307.5

Problem 5. Find the compound interest on Rs. 10000 at 12% rate of interest for 1 year, compounded half-yearly.
Solution:
Amount with CI = $10000 [1+ (12/2 * 100)]^2$ = Rs. 11236

Therefore, CI = 11236 − 10000 = Rs. 1236

Problem 6. The difference between SI and CI compounded annually on a certain sum of money for 2 years at 8% per annum is Rs. 12.80. Find the principal.
Solution:
Let the principal amount be x.

SI = x * 2 * 8 / 100 = 4x/25

CI = $x[1+ 8/100]^2$ − x → 104x/625

Therefore, 104x/625 − 4x/25 = 12.80

Solving which gives x, Principal = Rs. 2000.

Problem 7. Find the simple interest on Rs. 5000 at a certain rate if the compound interest on the same amount for 2 years is Rs. 253.125.
Solution:
Let the rate of interest be r.

$5000[1+ r/100]^2$ = 5000+253.125

→ $[1+r/100]^2$ = 5253.125/5000

Topic: Simple and Compound Interest

Solving which gives

$[1+ r/100]^2$ = 1681/1600

→ 1+r/100 = 41/40

→ r = 2.5

Therefore, SI = 5000* 2 * 2.5/ 100 = Rs. 250.

Problem 8. A certain amount becomes Rs. 5760 in 2 years and Rs. 6912 in 3 years. What is the principal amount and the rate of interest?
<u>Solution</u>:
SI on Rs. 5760 for 1 year = 6912 − 5760 = Rs. 1152

Therefore, Rate of interest for 1 year = 100*1152/5760*1 = 20%

Let the principal be p.

Then, Principal = $p[1+ 20/100]^2$ = 5760

Solving which gives Principal = Rs. 4000

Problem 9. How long will it take a certain amount to increase by 30% at the rate of 15% simple interest?
<u>Solution</u>:
Let the principal be Rs. x

Simple interest = x*30/100 = 3x/10

T = 100*SI/PR = 100*3x/10 / x*15 = 2%

Alternatively, this can be solved by considering principal amount to be Rs. 100. Then simple interest becomes Rs. 30.

Then, T = 100*30/100*15 = 2%