CHAPTER 11

INTEREST

(Simple Interest)

11.1 BASIC CONCEPT

Sometimes, when in need, we borrow money. This money could be borrowed from a bank or a money lender. While returning this money after using it for a certain time (period), we pay some additional money with the sum (money) borrowed.

This additional money that is paid for having used the money borrowed is called **Interest.**

The money we borrow is called **Principal** or **Sum** and the total money we return is called **Amount**, such that :

Amount = Principal + Interest i.e. **A = P + I**

Rate Percent (R) :

It is the *interest* on ₹ 100 for a specific period of time (in general, for one year).

Examples:

1. Rate of interest is 6% per annum means ₹ 6 is the interest on ₹ 100 for one year.
2. Rate of interest is 1% per month means ₹ 1 is the interest on ₹ 100 for one month.

   Also, rate of interest = 1% per month
   = 1% × 12 months = 12% per annum (per year)
3. In the same way, if the rate of interest semi-annually is 4%, ₹ 4 is the interest on ₹ 100 for half-a-year, *i.e.* for six months

   Also, rate of interest = 4% semi-annually
   = 2 × 4% annually = 8% per annum

Time (T) :

It is the *period* for which the money is borrowed (taken) or lent (given).

11.2 CALCULATING INTEREST

The value of interest depends on three factors :

(i) Principal (P) (ii) Rate of Interest (R) (iii) Time (T)

And it is calculated by using the formula :

$$\text{Interest} = \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100} \quad \textit{i.e.} \quad I = \frac{P \times R \times T}{100}$$

Interest and simple interest mean the same.

Example 1 :

Find the interest on ₹ 800 for 3 years at 9% per annum.

Solution :

Here, Principal (P) = ₹ 800, Rate (R) = 9% and Time (T) = 3 years.

$\therefore$ **Interest** $= \dfrac{P \times R \times T}{100} = \dfrac{₹800 \times 9 \times 3}{100} =$ **₹ 216** **(Ans.)**

Example 2 :

Find the simple interest on ₹ 2,500 at 1·5% per month for $1\frac{1}{2}$ years.

Solution :

Given $P = ₹ 2,500$ and $R = 1.5\%$ per month,

and time $(T) = 1\frac{1}{2}$ years $= \frac{3}{2} \times 12$ months $= 18$ months,

$\therefore$ **Interest** $= \dfrac{P \times R \times T}{100} = \dfrac{₹2,500 \times 1.5 \times 18}{100} =$ **₹ 675** **(Ans.)**

When the rate of interest is taken per month, the time must also be in months.

Alternative method :

Given $P = ₹ 2,500$ and $R = 1·5\%$ per month,

$= 1·5 \times 12\%$ per year $= 18\%$ per year,

and time $T = 1\frac{1}{2}$ years $= \frac{3}{2}$ years

$\therefore$ **Interest I** $= \dfrac{P \times R \times T}{100} = \dfrac{₹2,500 \times 18 \times 3}{100 \times 2} =$ **₹ 675** **(Ans.)**

When the rate of interest is taken per year, the time must also be in years.

EXERCISE 11 (A)

1. Find the interest (simple interest) on :
   (i) ₹ 200 for 3 years at 6% per annum (p.a.).
   (ii) ₹ 800 for 9 months at 1·5 percent per month.
   (iii) ₹ 2,000 for 10 months at 12% per year.
   (iv) ₹ 460 for 8 months at 5 paise per rupee per month. 5 paise per rupee = 5%
   (v) ₹ 2,450 for 3 years at 12 paise per rupee per year.
2. Rohit borrowed ₹ 4,000 from his friend and agreed to pay him interest at the rate of 15% per year. Find :
   (i) the interest to be paid by Rohit in 2 years
   (ii) the amount that Rohit must pay at the end of the 2nd year in order to clear his debt.
3. Sheela deposited ₹ 3,600 in a bank for 3 years. If the bank pays interest on this deposit at the rate of 10 percent per annum, find how much money will Sheela get from the bank at the end of 3 years.
4. John lends ₹ 15,000 for 3 years at 8% per annum, and Rahul lends ₹ 25,000 for the same time at 5% per annum. Find :
   (i) the interest earned by John in 3 years. (ii) the interest earned by Rahul in 3 years
   (iii) the amount each gets in 3 years. (iv) the difference of their interests.
   (v) the difference of amounts they finally get.
5. A man borrows ₹ 750 at 10% per annum, ₹ 1,200 at 8% per annum, and ₹ 2,000 at 6% per annum. Find the total interest paid by him in 4 years.
   Also, find (i) the total sum borrowed and (ii) the total amount the man has to pay at the end of 4 years to clear his debt.

11.3 INVERSE PROBLEMS ON SIMPLE INTEREST

The formula $\text{Interest} = \dfrac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$

can be re-written as (i) $\text{Principal} = \dfrac{100 \times \text{Interest}}{\text{Rate} \times \text{Time}}$, *i.e.* $P = \dfrac{100 \times I}{R \times T}$

(ii) $\text{Rate\%} = \dfrac{100 \times \text{Interest}}{\text{Principal} \times \text{Time}}\%$, *i.e.* $R\% = \dfrac{100 \times I}{P \times T}\%$

and (iii) $\text{Time} = \dfrac{100 \times \text{Interest}}{\text{Principal} \times \text{Rate}}$, *i.e.* $T = \dfrac{100 \times I}{P \times T}$

11.4 WHEN PRINCIPAL IS REQUIRED

Example 3 :

The interest on a certain loan for 5 years at 6% was ₹ 120. What was the loan ?

Solution :

Given Rate = 6%, Time = 5 years and Interest = ₹ 120

$\therefore$ **Principal (Loan)** $= \dfrac{100 \times \text{Interest}}{\text{Rate} \times \text{Time}} = \dfrac{100 \times ₹\,120}{6 \times 5} =$ **₹ 400** **(Ans.)**

Example 4 :

Find the principal that will amount to ₹ 1,300 in $2\frac{1}{2}$ years at 12% per annum.

Solution :

Let the principal be ₹ 100.

$\therefore$ Interest $I = \dfrac{P \times R \times T}{100} = \dfrac{₹100 \times 12 \times 5}{100 \times 2} = ₹\,30$

$\Rightarrow$ Amount = ₹ 100 + ₹ 30 = ₹ 130

Amount = Principal + Interest

Applying unitary method, we get :

When amount = ₹ 130, principal = ₹ 100

$\Rightarrow$ When amount = ₹ 1, principal = $₹\,\dfrac{100}{130}$

$\Rightarrow$ When amount = ₹ 1,300, **principal** $= ₹\,\dfrac{100}{130} \times 1{,}300 =$ **₹ 1,000** **(Ans.)**

Alternative (algebraic) method :

Let the principal be ₹ x

$\therefore$ Interest $I = \dfrac{P \times R \times T}{100} = \dfrac{₹x \times 12 \times 5}{100 \times 2} = ₹\,\dfrac{3x}{10}$

Since Principal + Interest = Amount

$\Rightarrow$ $x + \dfrac{3x}{10} = 1300$, i.e. $\dfrac{10x + 3x}{10} = 1300$

$\Rightarrow$ $\dfrac{13x}{10} = 1300$ and $x = 1300 \times \dfrac{10}{13}$, i.e. $x = 1000$

$\therefore$ **Principal = ₹ 1,000** **(Ans.)**

11.5 WHEN RATE IS REQUIRED

Example 5 :

If the interest on ₹ 600 for 5 years is ₹ 60, find the rate of interest.

Solution :

Given Principal (P) = ₹ 600, Interest (I) = ₹ 60 and Time (T) = 5 years,

$$\therefore \quad \textbf{Rate} = \frac{100 \times I}{P \times T}\% = \frac{100 \times 60}{600 \times 5}\% = \textbf{2\%} \qquad \textbf{(Ans.)}$$

11.6 WHEN TIME IS REQUIRED

Example 6 :

In how much time will the interest on ₹ 800 amount to ₹ 100 at 5% p.a. ?

Solution :

Given Principal (P) = ₹ 800, Interest (I) = ₹ 100 and Rate (R) = 5%

$$\therefore \quad \textbf{Time} = \frac{100 \times I}{P \times R} = \frac{100 \times 100}{800 \times 5} \text{ years} = \textbf{2}\frac{\textbf{1}}{\textbf{2}} \textbf{ years} \qquad \textbf{(Ans.)}$$

Example 7 :

In how many years will a sum of money triple itself, the rate of interest being 5 percent per annum ?

Solution :

Let sum (Principal) = ₹ 100

$\therefore$ Amount = 3 × ₹ 100 = ₹ 300

and Interest = A – P

= ₹ 300 – ₹ 100 = ₹ 200

So we have : P = ₹ 100, I = ₹ 200 and R = 5%

$$\therefore \quad \textbf{Time} = \frac{100 \times I}{P \times R} = \frac{100 \times 200}{100 \times 5} \text{ years} = \textbf{40 years} \qquad \textbf{(Ans.)}$$

EXERCISE 11 (B)

1. Find the principal that will yield an interest of :
   (i) ₹ 60 in 5 years at the rate of 4% per annum.
   (ii) ₹ 680 in 4 years at 8% per annum.
2. Find the principal that will amount to :
   (i) ₹ 729·60 at 7% per annum in 4 years.
   (ii) ₹ 2,240 at 4% per annum simple interest in 3 years.
3. At what percent rate per annum will the simple interest be :
   (i) ₹ 85.50 on ₹ 570 in 5 years ? (ii) ₹ 720 on ₹ 960 in 15 years ?
4. At what percent rate per annum of simple interest will :
   (i) ₹ 1,000 amount to ₹ 1,400 in 4 years ?
   (ii) a sum of money double in 5 years ?

5. Find the time in which the simple interest on :
   (i) ₹ 5,000 at 5% p.a. will be ₹ 750.
   (ii) ₹ 154 at 6% p.a. will be ₹ 92·40.
6. In what time will :
   (i) ₹ 3,200 amount to ₹ 4,224 at 8% per annum ?
   (ii) ₹ 2,500 amount to ₹ 4,375 at 5% per annum ?
7. At what percent rate per annum will a sum of money be five times itself in 10 years ?
8. In what time will a sum of money double itself, the rate of interest per annum being 20% ?

REVISION EXERCISE (Chapter 11)

1. Find the principal on which the interest in 5 years at 11% per year is ₹ 8,800.
2. Find the principal that amounts to ₹ 9,750 in 3 years at 10% per annum.
3. At what rate per annum will ₹ 8,000 earn an interest of ₹ 3,240 in $4\frac{1}{2}$ years ?
4. At what rate per annum will ₹ 37,500 amount to ₹ 45,000 in $2\frac{1}{2}$ years ?
5. Find the time in which the simple interest on ₹ 14,000 at 10% per annum is ₹ 5,600. Also, find the amount at the end of this time.
6. Find the time in which a sum of ₹ 3,500 amounts to ₹ 5,460 at 8% per annum.
7. At what percent rate per annum will a sum of money be four times itself in 12 years ?
8. Rajiv lent ₹ 8,000 at 10% per annum S.I. for 4 years and ₹ 10,000 at 5% per annum for 7 years. Find the total interest earned by Rajiv.
9. Equal sums of ₹ 18,000 were lent to Manoj and John at 10% per year for a period of 3 years and 5 years, respectively. Find the difference of the two interests received.
10. Prem and Geeta each took a loan of ₹ 12,000 from a bank at the same rate of interest. If Geeta cleared her loan by paying ₹ 16,320 at the end of 3 years; find the :
    (i) interest paid by Geeta,
    (ii) rate of interest paid by Geeta
    (iii) rate of interest paid by Prem
    (iv) interest paid by Prem in 5 years
    (v) total money paid by Prem to clear his loan at the end of 5 years.
11. A sum of ₹ 7,000 will amount to ₹ 8,120 in 2 years at a certain rate of interest. Calculate :
    (i) the interest earned.
    (ii) the rate of interest.
    (iii) the amount for ₹ 8,000 in 5 years at the rate of interest as obtained above.
12. A sum of ₹ 21,000 amounts to ₹ 24,780 in 3 years. Find :
    (i) the interest (simple interest).
    (ii) the rate of interest.
    (iii) the time in which ₹ 15,000 will earn ₹ 3,000 as simple interest at the rate obtained above.
13. Geeta borrowed a certain sum from a money lender at 10% simple interest for 6 years. If, by paying ₹ 32,000 at the end of this period, she cleared her debt, find the sum borrowed by her.

14. The simple interest on a certain sum of money is three-fifths of itself in 3 years. Calculate the rate of interest charged.

Let P = ₹ 100 $\Rightarrow$ I = $\frac{3}{5}$ × ₹ 100 = ₹ 60

$\therefore$ R% = $\frac{I \times 100}{P \times T}$% = $\frac{60 \times 100}{100 \times 3}$% = **20%**

15. The simple interest on a certain sum is three-fourths of itself. If the rate of interest is 10%, find the time.