INTEREST
[Simple and Compound]

11.1 REVIEW

1. **Principal (P)**	It is the money (sum) borrowed or the sum lent.
2. **Interest (I)**	(i) It is the money paid by the borrower to the money lender, for the use of money borrowed.
	(ii) **The simple interest** (S.I.) and **the interest** mean the same.
3. **Rate (R)**	(i) It is the interest on every ₹ 100.
	(ii) If rate is 12% per year; it means, ₹ 12 is the interest of one year on ₹ 100.
	(iii) If rate is 2% per month; it means; ₹ 2 is the interest of one month on ₹ 100.
4. **Time (T)**	(i) It is the time for which the money is lent or is borrowed.
	(ii) If the rate of interest is per year, say 8% per year; the time (T) must be taken in years.
	(iii) If the rate of interest is per month, say 1·5% per month; the time (T) must be taken in months.
5. **Amount (A)**	It is the total of the sum borrowed and the interest on it.
	i.e. Amount = Sum borrowed + Interest
	⇒ Amount = Principal + Interest *i.e.* **A = P + I**

The interest (I) depends on :

1. Principal (P)   2. Rate or rate percent (R)   3. The time (T).

The formula for calculating interest $I = \dfrac{P \times R \times T}{100}$

Since,   Amount = Principal + Interest

⇒   **A = P + I**

⇒ $A = P + \dfrac{P \times R \times T}{100}$ *i.e.* $A = P\left(1 + \dfrac{RT}{100}\right)$

Example 1 :

Find the simple interest on ₹ 1,300 from December 23, 2002 to May 18, 2003 at $7\frac{1}{2}$ % per annum.

Solution :

(i) **Given :** P = ₹ 1,300 and R = $\dfrac{15}{2}$ %

Also,   T = 146 days

$= \dfrac{146}{365}$ years $= \dfrac{2}{5}$ years

∴   S.I. = ₹ $\dfrac{1,300 \times 15 \times 2}{100 \times 2 \times 5}$

$= ₹ 39$ (Ans.)

To calculate time (T) :

Dec.	=	8 days (31 − 23)
Jan.	=	31 days
Feb.	=	28 days
March	=	31 days
April	=	30 days
May	=	18 days
Total	**=**	**146 days**

1. The day on which the money is borrowed is not included in the time.
2. The day on which the money is paid back to the money lender is included in the time.

11.2 TO FIND THE PRINCIPAL (P) ; The Rate Per cent (R) and The Time (T)

The formula for interest, $I = \dfrac{P \times R \times T}{100}$ can be re-written as :

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

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

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

TEST YOURSELF

1. If interest (I) = ₹ 318·50, time (T) = $3\dfrac{1}{2}$ years and rate (R) = 2·6 %

   Principal (P) = ... = ...

2. If P = ₹ 6,000, I = ₹ 2,100 and T= 5 years.

   Rate (R) = ...% = ...%

3. If P = ₹ 650, I = ₹ 312 and R = 6 %

   Time (T) = ... = ...

EXERCISE 11 (A)

1. Find the interest and the amount on :
   (i) ₹ 750 in 3 years 4 months at 10% per annum.
   (ii) ₹ 5,000 at 8% per year from 23rd December 2011 to 29th July 2012.
   (iii) ₹ 2,600 in 2 years 3 months at 1% per month.
   (iv) ₹ 4,000 in $1\dfrac{1}{3}$ years at 2 paise per rupee per month.
2. Rohit borrowed ₹ 24,000 at 7·5 per cent per year. How much money will he pay at the end of 4 years to clear his debt ?
3. The interest on a certain sum of money is ₹ 1,480 in 2 years and at 10 per cent per year. Find the sum of money.
4. On what principal will the simple interest be ₹ 7,008 in 6 years 3 months at 5% per year ?
5. Find the principal which will amount to ₹ 4,000 in 4 years at 6.25% per annum.
6. (i) At what rate per cent per annum will ₹ 630 produce an interest of ₹ 126 in 4 years ?

   (ii) At what rate per cent per year will a sum double itself in $6\dfrac{1}{4}$ years ?
7. (i) In how many years will ₹ 950 produce ₹ 399 as simple interest at 7% ?

   (ii) Find the time in which ₹ 1,200 will amount to ₹ 1,536 at 3·5% per year.
8. The simple interest on a certain sum of money is $\dfrac{3}{8}$ of the sum in $6\dfrac{1}{4}$ years. Find the rate per cent charged.
9. What sum of money borrowed on 24th May will amount to ₹ 10,210·20 on 17th October of the same year at 5 per cent per annum simple interest.
10. In what time will the interest on a certain sum of money at 6% be $\dfrac{5}{8}$ of itself ?
11. Ashok lent out ₹ 7,000 at 6% and ₹ 9,500 at 5%. Find his total income from the interest in 3 years.

12. Raj borrows ₹ 8,000; out of which ₹ 4,500 at 5% and remaining at 6%. Find the total interest paid by him in 4 years.

13. Mohan lends ₹ 4,800 to John for $4\frac{1}{2}$ years and ₹ 2,500 to Shyam for 6 years and receives a total sum of ₹ 2,196 as interest.

Find the rate per cent per annum, it being the same in both the cases.

14. John lent ₹ 2,550 to Mohan at 7·5 per cent per annum. If Mohan discharges the debt after 8 months by giving an old black and white television and ₹ 1,422·50. Find the price of the television.

Example 2 :

Find the rate of interest per year, if the interest charged for 8 months be 0·06 times of the money borrowed.

Solution :

Let the money borrowed be ₹ 100 i.e. P = ₹ 100

Given : Interest (I) charged = 0·06 × ₹ 100 = ₹ 6 and T = $\frac{8}{12}$ years = $\frac{2}{3}$ years

$$\therefore \qquad \textbf{Rate} = \frac{I \times 100}{P \times T}\% = \frac{6 \times 100}{100 \times \frac{2}{3}}\% = \textbf{9\%} \qquad \text{(Ans.)}$$

Example 3 :

A sum of money lent out at 9 per cent for 5 years produces twice as much interest as ₹ 4,800 in $4\frac{1}{2}$ years at 10 per cent. Find the sum.

Solution :

Let the required sum be ₹ x. According to the given statement :

$$₹ \frac{x \times 9 \times 5}{100} = 2 \times ₹ \frac{4,800 \times 10 \times 9}{100 \times 2}$$

On solving, we get : $\qquad$ x = ₹ 9,600

$$\therefore \qquad \textbf{The required sum = ₹ 9,600} \qquad \text{(Ans.)}$$

Example 4 :

A certain sum amounts to ₹ 9,440 in 3 years and to ₹ 10,400 in 5 years. Find the sum and the rate per cent.

Solution :

Amount in 3 years = ₹ 9,440 $\qquad \Rightarrow \qquad$ P + I of 3 years = ₹ 9,440 $\qquad$..........I

Amount in 5 years = ₹ 10,400 $\qquad \Rightarrow \qquad$ P + I of 5 years = ₹ 10,400 $\qquad$.........II

$\therefore \qquad$ Eq. II – Eq. I $\Rightarrow$ Interest of 2 years = ₹ 10,400 – ₹ 9,440 = ₹ 960

$$\Rightarrow \text{Interest of 1 year} = ₹ \frac{960}{2} = ₹ 480$$

And, $\qquad$ Interest of 3 years = ₹ 480 × 3 = ₹ 1,440

From equation I, we get :

$$P + ₹ 1,440 = ₹ 9,440 \qquad \Rightarrow \qquad P = ₹ 8,000$$

Taking P = ₹ 8,000, I = ₹ 480 and T = 1 year

We get, $\qquad$ rate $= \frac{I \times 100}{P \times T}\% = \frac{480 \times 100}{8000 \times 1}\% = 6\%$

$$\therefore \qquad \textbf{The sum = ₹ 8,000 and rate per cent = 6\%} \qquad \text{(Ans.)}$$

TEST YOURSELF

4. If interest of 7 years on a certain sum is ₹ 2,100; the interest of 1 year on same sum and at the same rate = ... , interest of 3 years under the similar conditions = ...

5. A certain sum is invested for 2 years at 20% p.a. simple interest. The interest earned is .... times the sum invested.

6. By investing at simple interest at 5% per annum more, a man will get ₹ .... more on every investment of ₹ 100. On investing ₹ 4,000; the man gets .... more.

7. A certain sum, invested at a certain rate, amounts to ₹ x in 23 years and to ₹ y in 35 years, then interest earned in last 12 years = ... and interest earned in one year = ...

EXERCISE 11 (B)

1. The interest on a certain sum of money is 0·24 times of itself in 3 years. Find the rate of interest.

2. If ₹ 3,750 amount to ₹ 4,620 in 3 years at simple interest. Find :
   (i) the rate of interest.
   (ii) the amount of ₹ 7,500 in $5\frac{1}{2}$ years at the same rate of interest.

3. A sum of money, lent out at simple interest, doubles itself in 8 years. Find :
   (i) the rate of interest.
   (ii) in how many years will the sum become triple (three times) of itself at the same rate per cent ?

4. Rupees 4,000 amount to ₹ 5,000 in 8 years; in what time will ₹ 2,100 amount to ₹ 2,800 at the same rate ?

5. What sum of money lent at 6·5% per annum will produce the same interest in 4 years as ₹ 7,500 produce in 6 years at 5% per annum ?

6. A certain sum amounts to ₹ 3,825 in 4 years and to ₹ 4,050 in 6 years. Find the rate percent and the sum.

7. At what rate per cent of simple interest will the interest on ₹ 3,750 be one-fifth of itself in 4 years? To what will it amount in 15 years?

8. On what date will ₹ 1,950 lent on 5th January, 2011 amount to ₹ 2,125·50 at 5 per cent per annum simple interest ?

9. If the interest on ₹ 2,400 be more than the interest on ₹ 2,000 by ₹ 60 in 3 years at the same rate per cent; find the rate.

10. Divide ₹ 15,600 into two parts such that the interest on one at 5 percent for 5 years may be equal to that on the other at $4\frac{1}{2}$ per cent for 6 years.

11.3 COMPOUND INTEREST (By simple interest method)

Money is said to be lent at **compound Interest,** when at the end of a year (or, some other fixed period) the interest is not paid to the money lender, but is added to the sum lent, and the amount thus obtained becomes the principal for the next period. This process is repeated until the amount for the last period has been found. The difference between the original sum and the final amount is the compound interest.

i.e.   Compound Interest = Final amount – Original principal

= Amount – Principal

⇒   C.I. = A – P

Example 5 :

Calculate the compound interest on ₹ 6,000 for 2 years at 10% per year.

Solution :

For 1st year :   Principal (P) = ₹ 6,000,   Rate (R) = 10%   and Time (T) = 1 year

∴   Interest = $\dfrac{P \times R \times T}{100}$ = $\dfrac{₹\,6,000 \times 10 \times 1}{100}$ = ₹ 600

And,   amount = principal + interest accrued

                 = ₹ 6,000 + ₹ 600 = ₹ 6,600

For 2nd year :   P = ₹ 6,600,   R = 10%   and   T = 1 year

∴   Interest = $\dfrac{P \times R \times T}{100}$ = $\dfrac{₹\,6,600 \times 10 \times 1}{100}$ = ₹ 660

And,   final amount = principal + interest

                     = ₹ 6,600 + ₹ 660 = ₹ 7,260

∴   **Compound interest** = Final amount – Original principal

                     = ₹ 7,260 – ₹ 6,000 = **₹ 1,260**   **(Ans.)**

Example 6 :

Calculate the amount and the compound interest on ₹ 8,000 for 3 years at 5% per annum.

Solution :

For 1st year :   Principal (P) = ₹ 8,000,   Rate (R) = 5%   and Time (T) = 1 year

∴   Interest = $\dfrac{₹\,8,000 \times 5 \times 1}{100}$ = ₹ 400

And,   amount = P + I = ₹ 8,000 + ₹ 400 = ₹ 8,400

For 2nd year :   P = ₹ 8,400; R = 5%   and   T = 1 year

∴   Interest = $\dfrac{₹\,8,400 \times 5 \times 1}{100}$ = ₹ 420

And,   amount = ₹ 8,400 + ₹ 420 = ₹ 8,820

For 3rd year :   P = ₹ 8,820; R = 5%   and   T = 1 year

∴   Interest = $\dfrac{₹\,8,820 \times 5 \times 1}{100}$ = ₹ 441

⇒   **Amount** = ₹ 8,820 + ₹ 441 = **₹ 9,261**   **(Ans.)**

And,   **C.I.** = ₹ 9,261 – ₹ 8,000 = **₹ 1,261.**   **(Ans.)**

In order to understand the difference between simple interest and compound interest, study the following table prepared with a principal of ₹ 8,000 and rate of interest 5% per annum:

		Under Simple Interest	Under Compound Interest
First year	Principal Interest at 5%	₹ 8,000 ₹ 400	₹ 8,000 ₹ 400
	Amount	₹ **8,400**	₹ **8,400**
Second year	Principal Interest at 5%	₹ 8,000 ₹ 400	₹ 8,400 ₹ 420
	Amount	₹ (8,400 + 400) = ₹ **8,800**	₹ **8,820**
Third year	Principal Interest at 5%	₹ 8,000 ₹ 400	₹ 8,820 ₹ 441
	Amount	₹ (8,800 + 400) = ₹ **9,200**	₹ **9,261**

∴   Interest earned by simple Interest
$$= ₹ (9,200 - 8,000) = ₹ 1,200$$

And, interest earned by compound Interest
$$= ₹(9,261 - 8,000) = ₹ 1,261$$

1. In the case of simple interest, the principal remains the same every year for the whole period, whereas in case of compound interest, the principal keeps on increasing every year.
2. Since, in the case of the compound interest, the principal keeps on increasing every year, the interest of every year also keeps on increasing.
3. The compound interest for the certain period can also be obtained by adding the interest of different years.

   For example, in Example 5, the compound interest of two years
   $$= \text{Interest of the first year} + \text{Interest of the second year}$$
   $$= ₹ 600 + ₹ 660 = ₹ \textbf{1,260.}$$

   And, for example 6,
   C.I. in 3 years $= ₹ 400 + ₹ 420 + ₹ 441 = ₹ \textbf{1,261}$

Example 7 :

Calculate the amount and the compound interest on ₹ 5,000 in 2 years, if the rates of interest for the successive years be 8% and 10% respectively.

Solution :

For 1st year :   Principal (P) = ₹ 5,000, Rate (R) = 8% and Time (T) = 1 year

∴   Interest $= \dfrac{₹ 5,000 \times 8 \times 1}{100} = ₹ 400$

And,   amount = ₹ 5,000 + ₹ 400 = ₹ 5,400

For 2nd year :   P = ₹ 5,400; R = 10% and T = 1 year

∴   Interest $= \dfrac{₹ 5,400 \times 10 \times 1}{100} = ₹ 540$

⇒   **Amount = ₹ 5,400 + ₹ 540 = ₹ 5,940**   (Ans.)

And,   **C.I. = ₹ 5,940 − ₹ 5,000 = ₹ 940**   (Ans.)

Example 8 :

Calculate the compound interest for the second year on ₹ 4,000 invested for 3 years at 10% per annum.

Solution :

For 1st year :   Principal (P) = ₹ 4,000, Rate (R) = 10% and Time (T) = 1 year

∴   Interest $= \dfrac{₹ 4,000 \times 10 \times 1}{100} = ₹ 400$

And,   amount = ₹ 4,000 + ₹ 400 = ₹ 4,400   [∵ A = P + I]

For 2nd year :   P = ₹ 4,400; R = 10% and T = 1 year

∴   Interest $= \dfrac{₹ 4,000 \times 10 \times 1}{100} = ₹ 440$

⇒   **Compound interest for second year = ₹ 440**   (Ans.)

Example 9 :

Calculate the difference between the compound interest and the simple interest on ₹ 10,000 in two years and at 5% per year.

Solution :

For the Compound interest :

Principal for 1st year = ₹ 10,000

Interest of 1st year = $\dfrac{₹ 10,000 \times 5 \times 1}{100}$ = ₹ 500

Amount of 1st year = ₹ 10,500

Principal for 2nd year = ₹ 10,500

Interest of 2nd year = $\dfrac{₹ 10,500 \times 5 \times 1}{100}$ = ₹ 525

Amount of 2nd year = ₹ 11,025

∴ The compound interest in 2 years = ₹ 11,025 – ₹ 10,000 = ₹ 1,025

For the simple interest :

P = ₹ 10,000; R = 5% and T = 2 years

⇒ Interest = $\dfrac{₹ 10,000 \times 5 \times 2}{100}$ = ₹ 1,000

⇒ **The required difference between C.I. and S.I. = C.I. – S.I.**

= ₹ 1,025 – ₹ 1,000 = **₹ 25 (Ans.)**

TEST YOURSELF

8. ₹ 5,000 is lent at 20% p.a. compound interest. The amount at the end of 1st year = ... = ..., and the amount at the end of 2nd year = ...

9. At the rate of 10% p.a. compounded interest, the amount for third year is ₹ 600; then the amount for 4th year = ... = ...

10. At the rate of 10% p.a., the compound interest for third year is ₹ 600; then the C.I. for 4th year = ... = ...

EXERCISE 11 (C)

1. A sum of ₹ 8,000 is invested for 2 years at 10% per annum compound interest. Calculate :
   (i) interest for the first year.
   (ii) principal for the second year.
   (iii) interest for the second year.
   (iv) final amount at the end of the second year.
   (v) compound interest earned in 2 years.

2. A man borrowed ₹ 20,000 for 2 years at 8% per year compound interest. Calculate :
   (i) the interest of the first year.
   (ii) the interest of the second year.

   (iii) the final amount at the end of the second year.
   (iv) the compound interest of two years.

3. Calculate the amount and the compound interest on ₹ 12,000 in 2 years and at 10% per year.

4. Calculate the amount and the compound interest on ₹ 10,000 in 3 years at 8% per annum.

5. Calculate the compound interest on ₹ 5,000 in 2 years; if the rates of interest for successive years be 10% and 12% respectively.

6. Calculate the compound interest on ₹ 15,000 in 3 years; if the rates of interest for

successive years be 6%, 8% and 10% respectively.

7. Mohan borrowed ₹ 16,000 for 3 years at 5% per annum compound interest. Calculate the amount that Mohan will pay at the end of 3 years.

8. Rekha borrowed ₹ 40,000 for 3 years at 10% per annum compound interest. Calculate the interest paid by her for the second year.

9. Calculate the compound interest for the second year on ₹ 15,000 invested for 5 years at 6% per annum.

10. A man invests ₹ 9,600 at 10% per annum compound interest for 3 years. Calculate :
    (i) the interest for the first year.
    (ii) the amount at the end of the first year.
    (iii) the interest for the second year.
    (iv) the interest for the third year.

11. A person invests ₹ 5,000 for two years at a certain rate of interest compounded annually. At the end of one year, this sum amounts to ₹ 5,600. Calculate.
    (i) the rate of interest per year.
    (ii) the amount at the end of the second year.

12. Calculate the difference between the compound interest and the simple interest on ₹ 7,500 in two years and at 8% per annum.

13. Calculate the difference between the compound interest and the simple interest on ₹ 8,000 in three years and at 10% per annum.

14. Rohit borrowed ₹ 40,000 for 2 years at 10% per annum C.I. and Manish borrowed the same sum for the same time at 10·5% per annum simple interest. Which of these two gets less interest and by how much ?

15. Mr. Sharma borrowed ₹ 24,000 at 13% p.a. simple interest and an equal sum at 12% p.a. compound interest. Find the total interest earned by Mr. Sharma in 2 years.

16. Peter borrows ₹ 12,000 for 2 years at 10% p.a. compound interest. He repays ₹ 8,000 at the end of first year. Find :
    (i) the amount at the end of first year, before making the repayment.
    (ii) the amount at the end of first year, after making the repayment.
    (iii) the principal for the second year.
    (iv) the amount to be paid at the end of second year, to make the account clear.

17. Gautam takes a loan of ₹ 16,000 for 2 years at 15% p.a. compound interest. He repays ₹ 9,000 at the end of first year. How much must he pay at the end of second year to clear the debt ?

18. A certain sum of money, invested for 5 years at 8% p.a. simple interest, earns an interset of ₹ 12,000. Find :
    (i) the sum of money.
    (ii) the compound interest earned by this money in two years and at 10% p.a. compound interest.

ANSWERS

TEST YOURSELF

1. ₹ $\frac{100 \times 318·50}{3·5 \times 2·6}$; ₹ 3,500   2. $\frac{100 \times 2,100}{6,000 \times 5}$; 7   3. $\frac{100 \times 312}{650 \times 6}$ years; 8 years   4. ₹ 300; ₹ 900

5. $\frac{2 \times 20}{100} = 0·4$ 6. 5, ₹ $\frac{4000}{100} \times 5 = ₹ 200$ 7. ₹ (y – x); ₹ $\frac{(y-x)}{12}$ 8. ₹ 5,000 + 20% of ₹ 5,000; ₹ 6,000;

₹ 6,000 + 20% of ₹ 6,000 = ₹ 7,200   9. ₹ 600 + 10% of ` 600; ₹ 660   10. ₹ 600 + 10% of ₹ 600; ₹ 660

EXERCISE 11(A)

1. (i) ₹ 250 and ₹ 1,000   (ii) ₹ 240 and ₹ 5,240   (iii) ₹ 702 and ₹ 3,302   (iv) ₹ 1,280 and ₹ 5,280   2. ₹ 31,200   3. ₹ 7,400   4. ₹ 22,425.60   5. ₹ 3,200   6. (i) 5% (ii) 16% 7. (i) 6 years (ii) 8 years   8. 6%   9. ₹ 10,010   10. 10 years and 5 months   11. ₹ 2,685   12. ₹ 1,740 13. 6%   14. ₹ 1,255

EXERCISE 11(B)

1. 8%   **2.** (i) $7\frac{11}{15}$ %   (ii) ₹ 10,690   **3.** (i) 12·5%   (ii) 16 years   **4.** 10 years and 8 months   **5.** ₹ 8,653.85

6. $3\frac{1}{3}$ % and ₹ 3,375   **7.** 5% and ₹ 6,562.50   **8.** 23rd Oct. 1992   **9.** 5%   **10.** ₹ 8,100 and ₹ 7,500

EXERCISE 11(C)

1. (i) ₹ 800   (ii) ₹ 8,800   (iii) ₹ 880   (iv) ₹ 9,680   (v) ₹ 1,680   **2.** (i) ₹ 1,600   (ii) ₹ 1,728

(iii) ₹ 23,328   (iv) ₹ 3,328   **3.** ₹ 14,520 and ₹ 2,520   **4.** ₹ 12,597.12 and ₹ 2,597.12   **5.** ₹ 1,160

6. ₹ 3,889.20   **7.** ₹ 18,522   **8.** ₹ 4,400   **9.** ₹ 954   **10.** (i) ₹ 960   (ii) ₹ 10,560   (iii) ₹ 1,056

(iv) ₹ 1,161.60   **11.** (i) 12%   (ii) ₹ 6,272   **12.** ₹ 48   **13.** ₹ 248   **14.** Both get equal interests   **15.** ₹ 12,345.60

16. (i) ₹ 13,200   (ii) ₹ 5,200   (iii) ₹ 5,200   (iv) ₹ 5,720   **17.** ₹ 10,810   **18.** (i) ₹ 30,000   (ii) ₹ 6,300