Chapter 1

SIMPLE AND COMPOUND INTEREST

Introduction :

When a person is in need of money, he borrows it from a bank, a financial institution or from another person. He has to pay a charge on the sum of money he borrows. This charge is called the Interest. The sum that is borrowed is the principal. In this Chapter, we shall discuss the concepts of Simple Interest and Compound Interest and the methods of calculating them.

Notations used :

P   -   Principal
A   -   Amount
N   –   No. of years
R   -   Rate of interest
SI   -   Simple interest
CI   -   Compound interest

Important Formulae :

1. $SI = \dfrac{PNR}{100}$

2. $P = \dfrac{100 \times SI}{N \times R}$

3. $N = \dfrac{100 \times SI}{P \times R}$

4. $R = \dfrac{100 \times SI}{P \times N}$

5. $A = P + SI$

6. $CI = P\left(1 + \dfrac{R}{100}\right)^{N} - P$

Where $P\left(1 + \dfrac{R}{100}\right)^{N}$ is the amount on CI, where interest is compounded annually.

Note : a) When interest is compounded half-yearly

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

b) When interest is compounded quarterly

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

EXAMPLE PROBLEMS

1. **A construction company borrowed Rs. 8,50,000 for 5 years at interest rate $1\frac{1}{2}$% p.a. How much annual interest, the company had to pay?**
   a) Rs.63,750
   b) Rs.1,27,500
   c) Rs.12,750
   d) Rs.25,000

   Ans : a

   Solution :

   $$\text{S.I.} = \frac{8,50,000 \times 3}{2 \times 100} = 4250 \times 15 = \textbf{Rs. 63,750}$$

2. **A sum of Rs. 20,000 is to be divided between two brothers aged 15 years and 13 years, so that at the age of 18 they get equal amount, while the compound rate of interest is 5% per annum. What is the amount received by the younger brother?**
   a) Rs.8,125.50
   b) Rs.1,213.50
   c) Rs.9,512.50
   d) Rs.1,000.50

   Ans : c

   Solution :

   Let the sum received by younger brother be Rs. x
   ∴ Sum received by elder brother = 20000 − x

   $$\text{Given, } x\left(1 + \frac{5}{100}\right)^5 = (20,000 - x)\left(1 + \frac{5}{100}\right)^3$$

   $$x\left(1 + \frac{5}{100}\right)^2 = 20,000 - x$$

   $$\frac{441}{400}x = 20,000 - x \Rightarrow 841x = 80,00,000$$

   $$x = \frac{80,00,000}{841} = \textbf{Rs.9,512.50}$$

3. **A money-lender borrows money at 4% per annum and pays the interest at the end of the year. He lends it at 6% per annum compound interest compounded half yearly and receives the interest at the end of the year. In this way, he gains Rs.104.50 a year. The amount of money he borrows, is**
   a) Rs.6,000
   b) Rs.5,500
   c) Rs.5,000
   d) Rs.4,500

   Ans : c

   Solution :

   Let the borrowed amount be Rs. x

   $$\text{Given, } x\left[\left(1 + \frac{3}{100}\right)^2 - 1\right] - \frac{x \times 4 \times 1}{100} = 104.50$$

   Interest is compounded half yearly

   $$R = \frac{6}{2} = 3, \quad N = 1 \times 2 = 2$$

   $$x[(1.03)^2 - 1] - 0.04x = 104.50 \Rightarrow 0.0609x - 0.04x = 104.5$$

   $$0.209x = 104.50 \quad \therefore x = \frac{104.5}{0.0209} = \textbf{Rs.5000}$$

4. **Rs.6,000 becomes Rs.7,200 in 4 years at a certain rate of simple interest. If the rate becomes 1.5 times of itself, the amount of the same principal in 5 years will be**
   a) Rs.8,000
   b) Rs.8,250
   c) Rs.9,250
   d) Rs.9,000

   Ans : b

   Solution :

   S.I. = Rs. (7200 − 6000) = Rs. 1200

   $$\text{SI} = \frac{\text{PNR}}{100} \Rightarrow 1200 = \frac{6000 \times 4 \times R}{100} \Rightarrow R = \frac{1200 \times 100}{6000 \times 4} = 5\%$$

   New rate percent = 5 × 1.5 = 7.5%

   $$\text{S.I.} = \frac{6000 \times 7.5 \times 5}{100} = 2250$$

   ∴ Amount = 6000 + 2250 = **Rs. 8250**

5. **Simple interest on Rs. 500 for 4 years at 6.25% per annum is equal to the simple interest on Rs. 400 at 5% per annum for a certain period of time. The period of time is**

a) 4 years   b) 5 years   c) $8\frac{2}{3}$ years   d) $6\frac{1}{4}$ years

Ans : d

Solution :

Let the period of time be N

Given, $\dfrac{400 \times 5 \times N}{100} = \dfrac{500 \times 4 \times 6.25}{100}$

$N = \dfrac{500}{400} \times \dfrac{6.25 \times 4}{5} = 6.25 = \dfrac{625}{100} = \dfrac{25}{4} = \mathbf{6\frac{1}{4}}$ **years**

6. **With a given rate of simple interest, the ratio of principal and amount for a certain period of time is 4 : 5. After 3 years, with the same rate of interest, the ratio of the principal and amount becomes 5 : 7. The rate of interest is**

a) 4%   b) 6%   c) 5%   d) 7%

Ans : c

Solution :

Case I :

Interest = 5x − 4x = x

$\therefore$ x $= \dfrac{4x \times R \times N}{100} \Rightarrow N = \dfrac{25}{R}$ years

Case II :

$N = \dfrac{25}{R} + 3 = \dfrac{25 + 3R}{R}$ years

S.I. = 7y − 5y = 2y $\Rightarrow$ 2y $= \dfrac{5y \times R \times (25 + 3R)}{R \times 100}$

$40 = 25 + 3R \Rightarrow 3R = 15 \Rightarrow R = \mathbf{5\%}$

7. **Rs.1000 is invested at 5% per annum simple interest. If the interest is added to the principal after every 10 years, the amount will become Rs.2,000 after**

a) 15 years   b) 18 years   c) 20 years   d) $16\frac{2}{3}$ years

Ans : d

Solution :

After 10 years, S.I. $= \dfrac{1000 \times 5 \times 10}{100} = $ Rs.500

Principal for 11th year = 1000 + 500 = 1500

S.I. = 2000 − 1500 = Rs. 500

$N = \dfrac{100 \times SI}{P \times R} = \dfrac{500 \times 100}{1500 \times 5} = \dfrac{20}{3} = 6\frac{2}{3}$ years

Total time = 10 + $6\frac{2}{3}$ = $\mathbf{16\frac{2}{3}}$ **years**

8. **A sum of money amounts to Rs. 5,200 in 5 years and to Rs. 5,680 in 7 years at simple interest. The rate of interest per annum is**

a) 3%   b) 4%   c) 5%   d) 6%

Ans : d

Solution :

P + S.I. for 5 years = 5,200 ----------- (1)

P + S.I. for 7 years = 56,800 ---------- (2)

$\therefore$ (2) − (1) $\Rightarrow$ S.I. for 2 years = 480

$\therefore$ S.I. for 1 year = 240

From equation (1)

$P + 5 \times 240 = 5200 \Rightarrow P = 5200 - 1200 = $ Rs. 4000

$R = \dfrac{100 \times SI}{P \times N} = \dfrac{100 \times 240}{1 \times 4000} = \mathbf{6\%}$

9. **A borrows Rs.800 at the rate of 12% per annum simple interest and B borrows Rs.910 at the rate of 10% per annum simple interest. In how many years will their amount of debt be equal?**

a) 18   b) 20   c) 22   d) 24

Ans : c

Solution :

Let the period of time be N years

Given, $800 + \dfrac{800 \times 12 \times N}{100} = \dfrac{910 + 910 \times 10 \times N}{100}$

$800 + 96N = 91N + 910 \Rightarrow 5N = 110 \Rightarrow N = \dfrac{110}{5} = \mathbf{22 \ years}$

10. **A person deposited Rs.400 for 2 years, Rs.550 for 4 years and Rs.1,200 for 6 years. He received the total simple interest of Rs.1020. The rate of interest per annum is**
    a) 10%   b) 5%   c) 15%   d) 20%

    Ans : a

Solution :

Let the rate of interest be R% per annum.

Given, $\dfrac{400 \times 2 \times R}{100} + \dfrac{550 \times 4 \times R}{100} + \dfrac{1200 \times 6 \times R}{100} = 1020$

$8R + 22R + 72R = 1020 \Rightarrow 102R = 1020 \Rightarrow R = \mathbf{10\%}$

11. **A certain sum of money becomes three times of itself in 20 years at simple interest. In how many years does it become double of itself at the same rate of simple interest ?**
    a) 8 years   b) 10 years   c) 12 years   d) 14 years

    Ans : b

Solution :

Let P = Rs. x, A = 3x, I = Rs.2x

$SI = \dfrac{PNR}{100} \Rightarrow 2x = \dfrac{x \times R \times 20}{100} \Rightarrow R = 10\%$

In second case :

P = Rs. x, A = Rs. 2x, I = Rs. x, N = ?

$SI = \dfrac{PNR}{100} \Rightarrow x = \dfrac{x \times N \times 10}{100} \Rightarrow N = \mathbf{10\ years}$

12. **The compound interest on a certain sum of money at 5% for 2 years is Rs. 328. The simple interest on that sum at the same rate and for the same period of time will be**
    a) Rs. 320   b) Rs. 322   c) Rs. 325   d) Rs. 326

    Ans : a

Solution :

$C.I. = P\left[\left(1 + \dfrac{R}{100}\right)^{T} - 1\right] \Rightarrow 328 = P\left\{\left(1 + \dfrac{5}{100}\right)^{2} - 1\right\}$

$328 = P\left\{\dfrac{441}{400} - 1\right\} \Rightarrow 328 = P\left(\dfrac{41}{400}\right) \Rightarrow P = \dfrac{328 \times 400}{441} = 3200$

$SI = \dfrac{PRT}{100} = \dfrac{3200 \times 5 \times 2}{100} = \mathbf{Rs.\ 320}$

13. **If the difference between the simple and compound interest on a sum of money for 2 years at 4% per annum is Rs.80, the sum is**
    a) Rs. 5000   b) Rs. 50000   c) Rs. 10000   d) Rs. 1000

    Ans : b

Solution :

When difference between the compound interest and simple interest on a certain sum of money for 2 years at R% rate is Rs. x, then the sum is given by

$x\left(\dfrac{100}{R}\right)^{2}$ Given, x = Rs.80 and R = 4%

Required sum $= 80\left(\dfrac{100}{4}\right)^{2} = \mathbf{Rs.50,000}$

14. **A sum of money on compound interest amounts to Rs.10,648 in 3 years and Rs.9680 in 2 years. The rate of interest per annum is**

    a) 5%   b) 10%   c) 15%   d) 20%

    Ans : b

Solution :

Let the sum be Rs. P and rate of interest be R% per annum.

Then, $P\left(1 + \dfrac{R}{100}\right)^{2} = 9680$ ------- (1)

$P\left(1 + \dfrac{R}{100}\right)^{3} = 10648$ ------- (2)

$(2) \div (1) \Rightarrow 1 + \dfrac{R}{100} = \dfrac{10648}{9680}$

$\dfrac{R}{100} = \dfrac{10648}{9680} - 1 = \dfrac{10648 - 9680}{9680} = \dfrac{968}{9680}$

$\dfrac{R}{100} = \dfrac{1}{10} \Rightarrow R = \mathbf{10\%}$

15. If the simple interest on a certain sum of money for 15 months at $7\frac{1}{2}$% per annum exceeds the simple interest on the same sum for 8 months at $12\frac{1}{2}$% per annum by Rs.32.50, then the sum of money (in Rs.) is

a) 312 b) 312.50 c) 3120 d) 3120.50

Ans : c

Solution :

Let sum = Rs. x; $SI = \dfrac{PNR}{100}$

Given, $\dfrac{x \times \frac{15}{2} \times \frac{15}{2}}{100} - \dfrac{x \times \frac{8}{12} \times \frac{25}{2}}{100} = 32.50 \Rightarrow \dfrac{25x}{2400} = 32.50$

$x = \dfrac{32.50 \times 2400}{25} = \textbf{Rs.3120}$

16. Mr. Sharma takes loan of Rs.25,000 and repays an amount of Rs.31,000 at the end of 2 years. What is the rate of simple interest at which he repays the loan?

a) 8% b) 6% c) 12% d) 9%

Ans : c

Solution :

S.I. = A − P = 31,000 − 25,000 = 6,000

$R = \dfrac{100 \times SI}{P \times N} = \dfrac{100 \times 6000}{25000 \times 2} = \textbf{12\%}$

17. Govardhan deposited Rs.7,500 in a bank for 6 months at the rate of 8% per annum, interest compounded quarterly. Find the amount he received after 6 months.

a) 7,800 b) 7,803 c) 7,850 d) 7,750

Ans : b

Solution :

P = Rs.7,500, T = 6 months = 2 quarters

R = 8% per annum = 2% per quarter

$A = P\left(1 + \dfrac{R}{100}\right)^{T} = 7500\left\{\left(1 + \dfrac{2}{100}\right)^{2}\right\}$

$= 7500 \times \dfrac{51}{50} \times \dfrac{51}{50} = 51 \times 51 \times 3 = \textbf{Rs. 7803}$

18. A sum of money becomes $\dfrac{41}{40}$ of itself in $\dfrac{1}{4}$ years at a certain rate of simple interest. The rate of interest per annum is

a) 10% b) 1% c) 2.5% d) 5%

Ans : a

Solution :

Let the principal be Re. 1. Hence, $S.I. = \dfrac{41}{40} - 1 = \dfrac{1}{40}$

Rate % $= \dfrac{100 \times S.I.}{P \times N} = \dfrac{\frac{1}{40} \times 100}{1 \times \frac{1}{4}} = \textbf{10\%}$

19. A sum of money invested at compound interest amounts in 3 years to Rs.2400 and in 4 years to Rs.2520. The rate of interest is

a) 5% b) 6% c) 10% d) 12%

Ans : a

Solution :

S.I. for 1 year = 2520 − 2400 = 120

P = 2400

Rate % $= \dfrac{120 \times 100}{2400 \times 1} = \textbf{5\%}$

20. If in a certain number of years Rs. 3000 amounts to Rs. 4320 at compound interest, in half that time Rs. 3000 will amount to

a) Rs. 3200 b) Rs. 3560 c) Rs.3600 d) Rs.3800

Ans : c

Solution :

Let rate of interest = R%

Number of years = N

$4320 = 3000\left(1 + \dfrac{R}{100}\right)^{N}$

$\left(1 + \dfrac{R}{100}\right)^{N/2} = \sqrt{1.44} = 1.2$

In n/2 years Rs.3000 will amount to

$3000\left(1 + \dfrac{R}{100}\right)^{N/2} = 3000 \times 1.2 = \textbf{Rs.3600}$

21. If the simple interest on a sum of money for 2 years at 5% per annum is Rs.50. What is the compound interest on the same sum at the same rate and for the same time ?

    a) Rs.60   **b)** Rs.54.25   **c)** Rs.52   **d)** Rs.51.25

                                              Ans : d

Solution :

Difference in C.I. and S.I. $= \dfrac{\text{Rate} \times \text{S.I.}}{2 \times 100} = \dfrac{5 \times 50}{2 \times 100} = 1.25$

C.I. = 50 + 1.25 = **Rs. 51.25**

22. What is the present worth of Rs.132 due in 2 years at 5% simple interest per annum?

    a) Rs.122   **b)** Rs.112   **c)** Rs.118.80   **d)** Rs.120

                                              Ans : c

Solution :

$SI = \dfrac{\text{PNR}}{100} = \dfrac{132 \times 5 \times 2}{100} = \text{Rs.}13.2$

Present worth = 132 − 13.2 = **Rs.118.80**

23. A sum of money is lent out at compound interest for 2 years at 20% per annum. It would fetch Rs.482 more if the interest is compounded half-yearly, than if it were compounded yearly, the sum of money is

    a) Rs.22,000   **b)** Rs.20,000   **c)** Rs.25,000   **d)** Rs.24,000

                                              Ans : b

Solution :

$$P\left\{\left(1+\frac{10}{100}\right)^4 - 1\right\} - P\left\{\left(1+\frac{20}{100}\right)^2 - 1\right\} = 482$$

$$P\left\{\left(1+\frac{10}{100}\right)^4 - \left(1+\frac{20}{100}\right)^2\right\} = 482$$

$$P\left\{\left(\frac{11}{10}\right)^4 - \left(\frac{6}{5}\right)^2\right\} = 482 \Rightarrow P\left\{\frac{14641}{10000} - \frac{36}{25}\right\} = 482$$

$$P\left(\frac{14641 - 14400}{10000}\right) = 482 \Rightarrow P = \frac{482 \times 10000}{241} = \textbf{Rs. 20,000}$$

24. A sum of money invested at compound interest amounts to Rs.5850 at the end of 2 years and to Rs.5908.50 at the end of 3 years. The rate percent per annum is

    a) 1.0%   **b)** 0.9%   **c)** 1.1%   **d)** 1.2%

                                              Ans : a

Solution :

$$\frac{P\left(1+\dfrac{R}{100}\right)^3}{P\left(1+\dfrac{R}{100}\right)^2} = \frac{5908.50}{5850} \Rightarrow 1+\frac{R}{100} = 1.01\%$$

$$\frac{R}{100} = 0.01\% \Rightarrow R = \textbf{1\%}$$

25. A man invested a certain sum of money at 5% per annum simple interest. After 6 months, he invested an equal sum at 6% per annum simple interest. When the amount in each case becomes Rs.2,300, he withdrew the money. The sum invested in each case was

    a) Rs.2,200   **b)** Rs.1,800   **c)** Rs.1,500   **d)** Rs.2,000

                                              Ans : d

Solution :

Let us suppose that after time T the amount in each case becomes Rs.2,300

Given, $P + \dfrac{P \times 5 \times T}{100} = P + P \times \dfrac{6}{100}\left(T - \dfrac{1}{2}\right) = 2300$

On solving, t = 3 years

$\Rightarrow P\left(1 + \dfrac{5}{100} \times 3\right) = 2300 \Rightarrow P = \dfrac{2300 \times 100}{115} = \textbf{Rs.2000}$

26. I borrowed Rs. 7500 from a bank at 10%. At the beginning of every year, I repaid Rs. 2500. After 3 years, how much is the balance payment ?

    a) Rs. 4,000   **b)** Rs. 4,207   **c)** Rs. 4,207.50   **d)** Rs. 4,208

                                              Ans : c