CHAPTER – 8

SIMPLE AND COMPOUND INTEREST

Exercise 8.1

1. Find the simple interest on Rs 4000 at 7.5% p.a. for 3 years 3 months. Also, find the amount.

Solution:

Here

Principal (P) = Rs 4000

Rate of interest (R) = 7.5% p.a.

$= \left(\frac{15}{2}\right)$ % p.a.

Time (T) = 3 years 3 months

$= 3\frac{3}{12}$ years

$= 3\frac{1}{4}$ years

$= \frac{13}{4}$ years

Hence,

Simple Interest (I) $= \frac{(P \times R \times T)}{100}$

$= \text{Rs } \frac{\left\{4000 \times \left(\frac{15}{2}\right) \times \left(\frac{13}{4}\right)\right\}}{100}$

$= \text{Rs } \frac{(4000 \times 15 \times 13)}{(100 \times 2 \times 4)}$

On simplification, we get,

= Rs 5 × 15 × 13

= Rs 975

Therefore,

Amount = P + I

= Rs 14000 + Rs 975

= RS 14, 975

2. What sum of money will yield Rs 170.10 as simple interest in 2 years 3 months at 6% per annum?

Solution:

Here

I = Rs 170.10

T = 2 years 3 months

$= 2\frac{3}{12}$ years

$= 2\frac{1}{4}$ years

$= \frac{9}{4}$ years

R = 6%

Hence,

$P = \frac{(I \times 100)}{(R \times T)}$

$= \text{Rs } \frac{(170.10 \times 100)}{\left\{6 \times \left(\frac{9}{4}\right)\right\}}$

On calculating further, we get,

$= \text{Rs } \frac{(170.10 \times 100 \times 4)}{(6 \times 9)}$

$= \text{Rs } \frac{(17010 \times 4)}{(6 \times 9)}$

$= \text{Rs } \frac{(17010 \times 2)}{(3 \times 9)}$

$= \text{Rs } \frac{34020}{27}$

= Rs 1260

3. Find the rate of interest when Rs 800 fetches Rs 130 as a simple interest in 2 years 6 months.

Solution:

Here

P = Rs 800

T = 2 years 6 months

$= 2\frac{6}{12}$ years

$= 2\frac{1}{2}$ years

$= \frac{5}{2}$ years

Hence,

$R = \frac{(I \times 100)}{(P \times T)}$

$= \frac{(130 \times 100)}{\left\{800 \times \left(\frac{5}{2}\right)\right\}}$ % p.a.

On simplification, we get,

$= \frac{(130 \times 100 \times 2)}{(800 \times 5)}$ % p.a.

$= \frac{(130 \times 2)}{40}$ %

$= \frac{130}{20}$ % p.a.

$= \frac{13}{2}$ %

= 6.5% p.a.

Therefore, the required rate of interest is 6.5% p.a.

4. Find the time when simple interest on Rs 3.3 lakhs at 6.5% per annum is Rs 75075.

Solution:

Here,

P = 3.3 lakhs

= Rs 3.3 × 100000

= Rs 330000

R = 6.5% per annum

I = Rs 75075

Hence,

T = $\frac{(I \times 100)}{(P \times R)}$

= $\frac{(75075 \times 100)}{(330000 \times 6.5)}$ years

= $\frac{(75075 \times 100 \times 10)}{(330000 \times 65)}$ years

On further calculation, we get,

= $\frac{(75075)}{(330 \times 65)}$ years

$= \frac{1155}{330}$ years

We get,

$= \frac{7}{2}$ years

$= 3\frac{1}{2}$ years

5. Find the sum of money when

(i) Simple interest at $7\frac{1}{4}$ % p.a. for years is Rs 2356.25

(ii) The final amount is Rs 11300 at 4% p.a. for 3 years 3 months.

Solution:

(i) Here,

I = Rs 2356.25

R = $7\frac{1}{4}$ % p.a.

= $\frac{29}{4}$ % p.a.

T = $2\frac{1}{2}$ years

= $\frac{5}{2}$ years

Hence,

P = (I × 100) / (R × T)

= Rs $\frac{(2356.25 \times 100)}{\left[\left(\frac{29}{4}\right) \times \left(\frac{5}{2}\right)\right]}$

On further calculation, we get,

= Rs $\frac{(2356.25 \times 100 \times 4 \times 2)}{(29 \times 5)}$

= Rs $\frac{(235625 \times 8)}{(29 \times 5)}$

We get,

= Rs $\frac{(47125 \times 8)}{29}$

= Rs 1625 × 8

= Rs 13000

(ii) Amount (A) = Rs 11300

Rate (R) = 4% p.a.

Time (T) = 3 years 3 months

= $3\frac{3}{12}$ years

= $3\frac{1}{4}$ years

= $\frac{13}{4}$ years

Let the principal be Rs x

Hence,

S.I. = $\frac{(P \times R \times T)}{100}$

= Rs $\frac{(x \times 4 \times 13)}{(100 \times 4)}$

We get,

= Rs $\frac{13x}{100}$

Then,

Amount = Principal + Simple Interest

= Rs x + Rs $\frac{13x}{100}$

= Rs $\frac{(x + 13x)}{100}$

We get,

= Rs $\frac{(100x + 13x)}{100}$

= Rs $\left(\frac{113x}{100}\right)$

But, the amount given is Rs 11300

Hence,

$\frac{113x}{100}$ = 11300

x = 11300 × $\frac{100}{113}$

x = 100 × 100

We get,

x = 10000

Therefore, principal (P) = Rs 10000

6. How long will it take a certain sum of money to triple itself at $13\frac{1}{3}$% per annum simple interest?

Solution:

Let the sum of money be x

Amount = 3 × Rs x

= Rs 3x

Interest = Amount – Principal

= Rs 3x – Rs x

= Rs 2x

Rate = $13\frac{1}{3}$% p.a. = $\frac{40}{3}$ % p.a.

Time (T) = $\frac{(\mathrm{I} \times 100)}{(\mathrm{P} \times \mathrm{R})}$

= $\frac{(2x \times 100)}{x} \times \left(\frac{40}{3}\right)$ years

On further calculation, we get,

= $\frac{(2 \times 100 \times 3)}{40}$ years

= $\frac{(100 \times 3)}{20}$ years

We get,

= 5 × 3 years

= 15 years

7. At a certain rate of simple interest Rs 4050 amounts to Rs 4576.50 in 2 years. At the same rate of simple interest, how much would Rs 1 lakh amount to in 3 years?

Solution:

Here,

P = Rs 40000

A = Rs 4576.50

T = 2 years

Interest = Amount – Principal

= Rs 4576.50 – Rs 4050

= Rs 526.50

Let the rate of simple interest = R% per annum

Then,

$R = \frac{(I \times 100)}{(P \times T)} = \frac{(526.50 \times 100)}{(4050 \times 2)}$ % p.a.

On further calculation, we get,

$= \frac{(526.5 \times 100)}{(405 \times 2)}$ % p.a.

$= \frac{5265}{810}$ % p.a.

We get,

= 6.5% p.a.

Now,

P = Rs 1 lakh

= Rs 100000

R = 6.5% p.a.

T = 3 years

$I = \frac{(P \times R \times T)}{100}$

$= Rs \frac{(100000 \times 6.5 \times 3)}{100}$

We get,

= RS 1000 × 6.5 × 3

= Rs 19500

Amount = Principal + Interest

= Rs 100000 + Rs 19500

= Rs 119500

8. What sum of money invested at 7.5% p.a. simple interest for 2 years produces twice as much interest as Rs 9600 in 3 years 6 months at 10% p.a. simple interest?

Solution:

First Case:

Principal (P_1) = Rs 9600

Rate (R_1) = 10%

Period = (T) = 3 years 6 months

$= 3\frac{1}{2}$ years $= \frac{7}{2}$ years

Simple interest $= \frac{(P \times R \times T)}{100} = \frac{9600 \times 10 \times 7}{100 \times 2}$

We get,

= Rs 3360

Second case:

Simple interest = Rs 3360 × 2

= Rs 6720

Rate (R) = 7.5% p.a. and

Period (T) = 2 years

Therefore,

Principal $= \frac{S.I \times 100}{R \times T} = \frac{6720 \times 100}{7.5 \times 2}$

$= \text{Rs } \frac{6720 \times 100 \times 10}{75 \times 2} = \frac{6720000}{150}$

We get,

= Rs 44800

Exercise 8.2

1. Calculate the compound interest on Rs 6000 at 10% per annum for two years.

Solution:

Given

Rate of interest = 10% per annum

Principal for the first year = Rs 6000

Interest for the first year = Rs $\frac{(6000 \times 10 \times 1)}{100}$

= Rs 600

Amount at the end of first year = Rs 6000 + Rs 600

= Rs 6600

Principal for the second year = Rs 6600

Interest for the second year = Rs $\frac{(6600 \times 10 \times 1)}{100}$

= Rs 660

Amount for the second year = Rs 6600 + Rs 660

= Rs 7260

Therefore, compound interest for 2 years = final amount – (original) Principal

= Rs 7260 – Rs 6000

We get,

= Rs 1260

2. Salma borrowed from Mahila Samiti a sum of Rs 1875 to purchase a sewing machine. If the rate of interest is 4% per annum, what is the compound interest that she has to pay after 2 years?

Solution:

Principal for the first year = Rs 1875

Rate of interest = 4% p.a.

Interest for the first year = Rs $\frac{(1875 \times 4 \times 1)}{100}$

= 75

Amount at the end of first year = Rs 1875 + Rs 75

= Rs 1950

Principal for the second year = Rs 1950

Interest for the second year = Rs $\frac{(1950 \times 4 \times 1)}{100}$

= 78

Amount at the end of second year = Rs 1950 + Rs 78

= Rs 2028

Hence,

Compound interest paid by Salma = Final amount – (original) Principal

= Rs 2028 – Rs 1875

= Rs 153

3. Jacob invests Rs 12000 for 3 years at 10% per annum. Calculate the amount and the compound interest that Jacob will get after 3 years.

Solution:

Principal for the first year = Rs 12000

Rate of interest = 10% p.a.

Interest for the first year = Rs $\frac{(12000 \times 10 \times 1)}{100}$

= Rs 1200

Amount at the end of first year = Rs 12000 + Rs 1200

= 13200

Principal for the second year = Rs 13200

Interest for the second year = Rs $\frac{(13200 \times 10 \times 1)}{100}$

= Rs 1320

Amount at the end of second year = Rs 13200 + Rs 1320

= Rs 14520

Principal for the third year = Rs 14520

Interest for the third year = Rs $\frac{(14520 \times 10 \times 1)}{100}$

= Rs 1452

Amount at the end of third year = Rs 14520 + Rs 1452

= Rs 15972

Hence,

Compound interest for 3 year = Final amount – (original) Principal

= Rs 15972 – Rs 12000

= Rs 3972

4. A man invests Rs 46875 at 4% per annum compound interest for 3 years.

Calculate:

(i) the interest for the first year

(ii) the amount standing to his credit at the end of second year

(iii) the interest for the third year

Solution:

(i) Principal for the first year = Rs 46875

Rate of interest = 4% per annum

Therefore,

Interest for the first year = Rs $\frac{(46875 \times 4 \times 1)}{100}$

We get,

= Rs $\frac{46875}{25}$

= Rs 1875

Hence, interest for the first year is Rs 1875

(ii) Amount at the end of first year

= Rs 46875 + Rs 1875

We get,

= Rs 48750

Principal for the second year = Rs 48750

Interest for the second year = Rs $\frac{(48750 \times 4 \times 1)}{100}$

= Rs $\frac{48750}{25}$

We get,

= Rs 1950

Amount at the end of second year = Rs 48750 + Rs 1950

We get,

= Rs 50700

Hence, the amount at the end of second year is Rs 50700

(iii) Principal for the third year = Rs 50700

Interest for the third year = Rs $\frac{(50700 \times 4 \times 1)}{100}$

We get,

= Rs 507 × 4

= Rs 2028

Hence, the interest for the third year is Rs 2028

5. Calculate the compound interest for the second year on Rs 6000 invested for 3 years at 10% p.a. Also find the sum due at the end of third year.

Solution:

Principal for the first year = Rs 6000

Rate of interest = 10% p.a.

Interest for the first year = Rs $\frac{(6000 \times 10 \times 1)}{100}$

= Rs 600

Amount at the end of first year = Rs 6000 + Rs 600

= Rs 6600

Principal for the second year = Rs 6600

Interest for the second year = Rs $\frac{6600 \times 10 \times 1}{100}$

We get,

= Rs 660

Amount at the end of second year = Rs 6600 + Rs 660 = Rs 7260

Compound interest for the second year = Final amount – (original) Principal

= Rs 7260 – Rs 6000

= Rs 1260

Principal for the third year = Rs 7260

Interest for the third year = Rs $\frac{(7260 \times 10 \times 1)}{100}$

We get,

= Rs 726

Amount at the end of third year = Rs 7260 + Rs 726

= Rs 7986

6. Calculate the amount and the compound interest on Rs 5000 in 2 years when the rate of interest for successive years is 6% and 8% respectively.

Solution:

Principal for the first year = Rs 5000

Rate of interest = 6% p.a.

Interest for the first year = Rs $\frac{(5000 \times 6 \times 1)}{100}$

= Rs 50 × 6

= Rs 300

Amount at the end of first year = Rs 5000 + Rs 300

= Rs 5300

Principal for the second year = Rs 5300

Rate of interest = 8% p.a.

Interest for the second year = Rs $\frac{(5300 \times 8 \times 1)}{100}$ = Rs 53 × 8

We get,

= Rs 424

Amount for the second year = Rs 5300 + Rs 424 = Rs 5724

Compound interest for two years = Final amount – (original) Principal

= Rs 5724 – Rs 5000

We get,

= Rs 724

7. Calculate the difference between the compound interest and the simple interest on Rs 20000 in 2 years at 8% per annum.

Solution:

Principal (P) = Rs 20000

Rate (R) = 8% p.a.

Period (T) = 2 years

Hence,

Simple interest (S.I.) = $\frac{PRT}{100}$

= Rs $\frac{(20000 \times 8 \times 2)}{100}$

We get,

= Rs 3200

Now,

Amount on compound interest

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

= RS 20000 $\left\{1 + \left(\frac{8}{100}\right)\right\}^{2}$

On further calculation,

We get,

= Rs 20000 $\times \left(\frac{27}{25}\right) \times \left(\frac{27}{25}\right)$

= Rs 32 × 729

= Rs 23328

Therefore,

Compound interest = Final amount – (original) Principal

= Rs 23328 – Rs 20000

We get,

= Rs 3328

Hence,

Difference in compound interest – simple interest

= Rs 3328 – Rs 3200

= Rs 128

Exercise 8.3

1. Calculate the amount and compound interest on

(i) Rs 15000 for 2 years at 10% per annum compounded annually.

(ii) Rs 156250 for $1\frac{1}{2}$ years at 8% per annum compounded half-yearly.

(iii) Rs 100000 for 9 months at 4% per annum compounded quarterly.

Solution:

(i) Given

Principal (P) = Rs 15000

Rate (R) = 10% p.a.

Period (n) = 2 years

Hence,

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

= Rs 15000 $\left\{1+\left(\frac{10}{100}\right)\right\}^{2}$

On further calculation, we get,

= Rs 15000 $\times \left(\frac{11}{10}\right) \times \left(\frac{11}{10}\right)$

We get,

= Rs 18150

Therefore,

Compound interest = Amount – Principal

= Rs 18150 – 15000

We get,

= Rs 3150

(ii) Principal (P) = Rs 156250

Rate (R) = 8% p.a. or 4% half-yearly

Period (n) = $1\frac{1}{2}$ years

= 3 half-year

Therefore,

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

= Rs 156250 $\left\{1+\left(\frac{4}{100}\right)\right\}^{3}$

On further calculation, we get,

= Rs 156250 × $\left(\frac{26}{25}\right)^{3}$

= Rs 156250 × $\left(\frac{26}{25}\right)\times\left(\frac{26}{25}\right)\times\left(\frac{26}{25}\right)$

We get,

= Rs 175760

Hence,

Compound interest = Amount – Principal

= Rs 175760 – Rs 156250

= Rs 19510

2. Find the difference between the simple interest and compound interest on Rs 4800 for 2 years at 5% per annum, compound interest being reckoned annually.

Solution:

Given

Principal (P) = Rs 4800

Rate (R) = 5% p.a.

Period (n) = 2 years

Therefore,

S.I. = $\frac{PRT}{100} = \frac{4800 \times 5 \times 2}{100}$

We get,

= Rs 480

And when interest is compounded annually

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

= Rs 4800 $\left\{1 + \left(\frac{5}{100}\right)\right\}^2$

= Rs 4800 $\times \left(\frac{21}{20}\right) \times \left(\frac{21}{20}\right)$

We get,

= Rs 5292

Hence,

Compound interest = Amount – Principal

= Rs 5292 – Rs 4800

= Rs 492

Now,

Difference in compound interest and simple interest = Rs 492 – Rs 480 = Rs 12

3. Find the compound interest on Rs 3125 for 3 years if the rates of interest for the first, second and third year are respectively 4%, 5% and 6% per annum.

Solution:

Given

Principal (P) = Rs 3125

Rate of interest for continuous 3 years = 4%, 5%, 6%

Period (n) = 3 years

Therefore,

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

$= 3125\left\{1+\left(\frac{4}{100}\right)\right\}\left\{1+\left(\frac{5}{100}\right)\right\}\left\{1+\left(\frac{6}{100}\right)\right\}$

On further calculation, we get,

$= 3125 \times \left(\frac{26}{25}\right) \times \left(\frac{21}{20}\right) \times \left(\frac{53}{50}\right)$

We get,

= Rs $\frac{14469}{4}$

= Rs 3617.25

Hence,

Compound interest = Amount – Principal

= Rs 3617. 25 – Rs 3125

= Rs 492. 25

4. Kamla borrowed Rs 26400 from a Bank to buy a scooter at a rate of 15% p.a. compounded yearly. What amount will she pay at the end of 2 years and 4 months to clear the loan?

Solution:

Given

Money borrowed (P) = Rs 26400

Rate (R) = 15% p.a.

Period (n) = 2 years 4 months

$= 2\frac{4}{12}$

$= 2\frac{1}{3}$ years

Therefore,

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

= Rs 26400 $\left\{1+\left(\frac{5}{100}\right)^{2}\right\}\times\left[1+\left\{\frac{15}{3\times 100}\right\}\right]^{1}$

On further calculation, we get,

= Rs 26400 $\times\left(\frac{23}{20}\right)\times\left(\frac{23}{20}\right)\times\left(\frac{21}{20}\right)$

We get,

= Rs $\frac{366597}{10}$

= Rs 36659.70

5. Anil borrowed Rs 18000 from Rakesh at 8% per annum simple interest for 2 years. If Anil had borrowed this sum at 8% per annum compound interest, what extra amount would he has to pay?

Solution:

Given

Money borrowed (P) = Rs 18000

Rate (R) = 8% p.a.

Time (n) = 2 years

Simple Interest = $\frac{PRT}{100}$

= Rs $\frac{(18000 \times 8 \times 2)}{100}$

= Rs 2880

In case of compound interest

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

= Rs 18000 $\left\{1 + \left(\frac{8}{100}\right)\right\}^2$

= Rs 18000 $\times \left(\frac{27}{25}\right)^2$

= Rs 18000 $\times \left(\frac{27}{25}\right) \times \left(\frac{27}{25}\right)$

We get,

= Rs $\frac{104976}{5}$

= Rs 20995.20

Hence,

Compound interest = Amount – Principal

= Rs 20995.20 – Rs 18000

= Rs 2995.20

Now,

Difference between compound interest and simple interest

= Rs 2995.20 – Rs 2880

= Rs 115.20

6. Mukesh borrowed 75000 from a bank. If the rate of interest is 12% per annum, find the amount he would be paying after $1\frac{1}{2}$ years if the interest is

(i) Compounded annually

(ii) Compounded half-yearly

Solution:

Given

Money borrowed (P) = Rs 75000

Rate (R) = 12% p.a. or 6% half- yearly

Period (n) = $1\frac{1}{2}$ years or 3 half-years

(i) When the interest compounded yearly

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

= Rs 75000 $\left\{1+\left(\frac{12}{100}\right)\right\}\left\{1+\left(\frac{6}{100}\right)\right\}$

= Rs 75000 $\times \left(\frac{28}{25}\right) \times \left(\frac{53}{50}\right)$

On simplification, we get,

= Rs 89040

(ii) When the interest compounded half-yearly

Then,

Amount = Rs 75000 $\left\{1 + \left(\frac{6}{100}\right)\right\}^3$

= Rs 75000 × $\left(\frac{53}{50}\right)^3$

= Rs 75000 × $\left(\frac{53}{50}\right) \times \left(\frac{53}{50}\right) \times \left(\frac{53}{50}\right)$

We get,

= Rs $\frac{446631}{5}$ = Rs 89326.20

7. Aryaman invested Rs 10000 in a company, he would be paid interest at 7% per annum compounded annually. Find

(i) The amount received by him at the end of 2 years

(ii) The interest for the 3rd year

Solution:

(i) Given

Investment to a company (P) = Rs 10000

Rate of interest (R) = 7% p.a.

Period (n) = 2 years

Hence,

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

= Rs 10000 $\left\{1 + \left(\frac{7}{100}\right)\right\}^2$

= Rs 10000 × $\left(\frac{107}{100}\right) \times \left(\frac{107}{100}\right)$

On simplification, we get,

= Rs 11449

(ii) Amount after 3rd year = Rs 11449 × $\left(\frac{107}{100}\right)$

We get,

= Rs 12250.43

Therefore,

Interest on the 3rd year = Rs 12250.43 – 11449 = Rs 801.43

8. What sum of money will amount to Rs 9261 in 3 years at 5% per annum compound interest?

Solution:

Given

Amount (A) = Rs 9261

Rate of interest = 5% p.a.

Time (T) = 3 years

Principal (P) =?

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

$9261 = P\left\{1 + \left(\frac{5}{100}\right)\right\}^3$

We get,

$9261 = P\left(\frac{21}{20}\right)^3$

$P = \frac{9261 \times 20 \times 20 \times 20}{21 \times 21 \times 21}$

On simplification, we get,

= Rs 8000

Therefore, the sum of money = Rs 8000

9. What sum invested for $1\frac{1}{2}$ years compounded half-yearly at the rate of 8% p.a. will amount to Rs 140608?

Solution:

Given

Amount (A) = Rs 140608

Rate (R) = 8% p.a. = 4% half-yearly

Period (n) = $1\frac{1}{2}$ years = 3 half-year

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

140608 = P $\left\{1+\left(\frac{4}{100}\right)\right\}^{3}$

140608 = P $\left(\frac{26}{25}\right)^{3}$

Therefore,

P = 140608 × $\left(\frac{25}{26}\right) \times \left(\frac{25}{26}\right) \times \left(\frac{25}{26}\right)$

On further calculation, we get,

P = Rs 125000

Hence,

Principal = Rs 125000

10. At what rate percent will Rs 2000 amount to Rs 2315.25 in 3 years at compound interest?

Solution:

Given

Principal (P) = Rs 2000

Amount (A) = Rs 2315.25

Period (n) = 3 years

Let the rate of interest be r% p.a.

WKT

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

$$\frac{2315.25}{2000} = \left\{1 + \left(\frac{r}{100}\right)\right\}^{3}$$

$$\left\{1 + \left(\frac{r}{100}\right)\right\}^{3} = \frac{(231525)}{(100 \times 2000)}$$

On calculating, we get,

$$\left\{1 + \left(\frac{r}{100}\right)\right\}^{3} = \frac{9261}{8000}$$

$$\left\{1 + \left(\frac{r}{100}\right)\right\}^{3} = \left(\frac{21}{20}\right)^{3}$$

We get,

$$1 + \left(\frac{r}{100}\right) = \frac{21}{20}$$

$$\frac{r}{100} = \left(\frac{21}{20}\right) - 1$$

$$\frac{r}{100} = \frac{1}{20}$$

We get,

$r = \frac{100}{20} = 5$

Therefore, rate of interest = 5% p.a.

11. If Rs 40000 amounts to Rs 46305 in $1\frac{1}{2}$ years, compound interest payable half-yearly, find the rate of interest per annum.

Solution:

Given

Principal (P) = Rs 40000

Amount (A) = Rs 46305

Period (n) = $1\frac{1}{2}$ years = $\frac{3}{2}$ years

So half yearly, $2n = 2 \times \left(\frac{3}{2}\right) = 3$ years.

Let the rate of interest be r% p.a.

WKT

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

$\frac{46305}{40000} = \left(1 + \frac{r}{100}\right)^3$

$\left(1 + \frac{r}{100}\right)^3 = \frac{46305}{40000}$

On further calculation, we get,

$\left(1 + \frac{r}{100}\right)^3 = \frac{9261}{8000}$

$\left(1 + \frac{r}{100}\right)^3 = \left(\frac{21}{20}\right)^3$

We get,

$\left(1+\frac{r}{100}\right)=\left(\frac{21}{20}\right)$

$\frac{r}{100}=\left(\frac{21}{20}\right)-1$

$\frac{r}{100}=\frac{1}{20}$

$r=\frac{100}{20}=5$

Therefore, rate of interest = 5% for half year.

So, 2 × 5 = 10% per annum.

12. in what time will Rs 15625 amount to Rs 17576 at 4% per annum compound interest?

Solution:

Given

Amount (A) = Rs 17576

Principal (P) = Rs 15625

Rate (R) = 4% p.a.

Let period be n years

WKT

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

$\frac{17576}{15625}=\left\{1+\left(\frac{4}{100}\right)\right\}^{n}$

We get,

$\left(\frac{26}{25}\right)^{3}=\left(\frac{26}{25}\right)^{n}$

n = 3

Therefore, time = 3 years

13. Rs 16000 invested at 10% p.a. compounded semi-annually, amounts to Rs 18522. Find the time period of investment.

Solution:

Given

Principal (P) = Rs 16000

Amount (A) = Rs 18522

Rate (R) = 10% p.a. or 5% semi-annually

Let period be n half-years

WKT

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

$\frac{18522}{16000} = \left\{1 + \left(\frac{5}{100}\right)\right\}^n$

On further calculation, we get,

$\frac{9261}{8000} = \left(\frac{21}{20}\right)^n$

$\left(\frac{21}{20}\right)^3 = \left(\frac{21}{20}\right)^n$

So,

n = 3 half years

Therefore,

Time = $\frac{3}{2} = 1\frac{1}{2}$ years

Mental Maths

Question 1: Fill in the blanks:

(i) The money borrowed (lent or invested) is called ……
(ii) The additional money paid by the borrower to the moneylender in lieu of the money used is called ……
(iii) In simple interest, the principal …… for the whole loan period.
(iv) In compound interest the …… goes on changing every conversion period.
(v) The time after which the interest is added each time to form a new principal is called ……
(vi) If the interest is compounded semi-annually then semi-annually rate is …… of annual rate.

Solution:

(i) The money borrowed (lent or invested) is called principal.
(ii) the additional money paid by the borrower to the moneylender in lieu of the money used is called interest.
(iii) In simple interest, the principal remains constant for the whole loan period.
(iv) In compound interest the principal goes on changing every conversion period.
(v) The time after which the interest is added each time to form a new principal is called conversion period.
(vi) If the interest is compounded semi-annually then semi-annually rate is half of annual rate.

Question 2: State whether the following statements are true (T) or false (F):

(i) The interest paid by the banks, post offices, insurance companies is simple interest.
(ii) Compound interest is calculated on the amount of the previous year.

(iii) In compound interest, the principal remains constant for the whole period.
(iv) The time from one specified interest period to the next period is called conversion period.
(v) If the interest is compounded quarterly then there are 2 conversion periods in a year.
Solution:
(i) The interest paid by the banks, post offices, insurance companies is simple interest. False
Correct:
It is compound interest.
(ii) Compound interest is calculated on the amount of the previous year. True.
(iii) In compound interest, the principal remains constant for the whole period. False
Correct:
It goes on changing every conversion period,
(iv) The time from one specified interest period to the next period is called conversion period. True.
(v) If the interest is compounded quarterly then there are 2 conversion periods in a year. False
Correct:
There are 4 conversion period not two.

Multiple Choice Questions

Choose the correct answer from the given four options (3 to 9):

Question 3: The compound interest on ₹ 1000 at 10% p.a. for 2 years is

(a) ₹190
(b) ₹210

(c) ₹1210
(d) ₹200
Solution:
Principal (P) = ₹1000
Rate (R) = 10% p.a.
Period (n) = 2 years

$$A = P\left(1 + \frac{R}{100}\right)^2 = ₹1000\left(1 + \frac{10}{100}\right)^2$$

$$= ₹1000 \times \frac{11}{10} \times \frac{11}{10} = ₹1210$$

And C.I. = A – P
= ₹1210 – ₹1000 = ₹210 (b)

Question 4: The compound interest on ₹5000 at 20% per annum for $\frac{1}{2}$ years compounded half yearly is
(a) ₹6655
(b) ₹1655
(c) ₹50
(d) ₹1000
Solution:
Principal (P) = ₹5000
Rate (R) = 20% p.a. or 10% half-yearly
Period (n) = $\frac{1}{2}$ years or 3 half-years

$$\therefore A = P\left(1 + \frac{R}{100}\right)^n = ₹5000\left(1 + \frac{10}{100}\right)^3$$

$$= ₹5000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} = ₹6655$$

∴ C.I. = A – P = ₹6655 – ₹5000 = ₹1655 (b)

Question 5: The compound interest on ₹10000 at 8% per annum for 6 months compounded quarterly is
a) ₹408
(b) ₹10404
(c) ₹404
(d) ₹400
Solution:
Principal (P) = ₹ 10000
Rate (R) = 8% p.a. or 2% quarterly
Period (n) = 6 months = 2 quarters

$$\therefore A = R\left(1 + \frac{R}{100}\right)^n = 10000 \times \left(1 + \frac{10}{100}\right)^3$$

$$= 10000 \times \frac{51}{50} \times \frac{51}{50} = ₹10404$$

∴ C.I. = A – P = ₹10404 – ₹10000 = ₹404 (b)

Question 6: The time periods and rate for a sum taken at 8% p.a. for $1\frac{1}{2}$ years compounded half yearly are
(a) n = 3, R = 4%
(b) n = 6, R = 2%
(c) n = 3, R = 2%
(d) n = 6, R = 4%
Solution:
Rate (R) = 8% p.a. = 4% half-yearly
Time (n) = $1\frac{1}{2}$ years = 3 half-year (a)

Question 7: If ₹12000 taken for 2 years at 4% per annum compounded quarterly, then time period and rate is
(a) n = 2, R = 16%

(b) n = 4, R = 1 %
(c) n = 8, R = 1%
(d) n = 8, R = 16%
Solution:
Principal (P) = ₹ 12000
Rate (R) = 4% p.a. or 1% quarterly
Time (n) = 2 years or 8 quarter (c)

Question 8: If the number of conversion periods ≥ 2, then compound interest is
(a) less than or equal to simple interest
(b) greater than or equal to simple interest
(c) less than simple interest
(d) greater than simple interest
Solution:
Number of conversion period ≥ 2
The C.I. is greater than simple interest (S.I.) (d)

Question 9: The time in which ₹6000 amounts to ₹7986 at 10% p.a. compounded annually is
(a) 2 years
(b) 3 years
(c) 4 years
(d) 5 years
Solution:
Amount (A) = ₹7986
Principal (P) = ₹6000
Rate (R) = 10% p.a.

$\therefore \frac{A}{P} = \left(1 + \frac{R}{100}\right)^n \Rightarrow \frac{7986}{6000} = \left(1 + \frac{10}{100}\right)^n$

$= \frac{7986}{6000} = \left(\frac{11}{10}\right)^n \Rightarrow \left(\frac{11}{10}\right)^3 = \left(\frac{11}{10}\right)^n$

∴ n = 3

∴ Time = 3 years

Value Based Question

Question 1: A person wants to invest ₹ 100000 in fixed deposit scheme for 2 years. His financial advisor explained him two type of schemes first is yielding 10% p.a. compounded annually, second is yielding 10% p.a. compounded semi-annually. Which scheme is better and why? Why investment is important for future life?

Solution:

Principal (P) = ₹ 100000
Rate = 10% p.a. or 5% per half-yearly
Period (n) = 2 years or 4 half-years

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

$= ₹100000\left(1 + \frac{10}{100}\right)^2$

$= ₹100000 \times \frac{11}{10} \times \frac{11}{10} = ₹121000$

If interest is compounded half-yearly, then

$A = ₹100000\left(1 + \frac{5}{100}\right)^4$

$= ₹100000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$

$= ₹\frac{972405}{8} = ₹121550.60$

It is clear that second scheme is more beneficial.
For our future, we should save some money and
if possible we should invest it in some beneficial schemes.

Higher Order Thinking Skills (Hots)

Question 1: A certain sum of money is invested at the rate of 5% per annum compound interest, the interest compounded annually. If the difference between the interests of third year and first year is ₹102.50. Find the sum.

Solution:
Let sum of money = ₹100
Rate (R) = 5% p.a.

$\therefore$ Interest for the first year = $\frac{PRT}{100}$

$= \frac{100\times5\times1}{100} = ₹5$

Amount after 3 years = $100\left(1+\frac{5}{100}\right)^3$

$= ₹100 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} = ₹\frac{9261}{80}$

C.I. = A – P = $\frac{9261}{80} = 100$

$= \frac{9261-8000}{80} = ₹\frac{1261}{80}$

Difference in the interest for first year and third year = $\frac{1261}{80} - 5$

$= \frac{1261-400}{80} = ₹\frac{861}{80}$

If difference is $₹\frac{861}{80}$, then principal = ₹100

If difference is ₹102.50 then principal

$= \frac{100 \times 80}{861} \times 102.50$

$= \frac{100 \times 80 \times 102.50}{861 \times 100} =$ ₹952.38

Question 2: The difference between the compound interest and the simple interest on ₹42000 for two years is ₹105 at the same rate of interest per annum. Find

(i) The rate of interest

(ii) The compound interest earned in second year.

Solution:

Let P be the interest

Principal = ₹42000

Time 2 years

S.I. $= \frac{P \times r \times t}{100} = \frac{4200 \times 2 \times r}{100} = 840r$

C.I. = Amount – Principal

$= P \times \left(1 + \frac{r}{100}\right)^2 - 42000$

$= 42000 \times \left(1 + \frac{r}{100}\right)^2 - 42000$

It is given that the difference between the compound interest and the simple interest of ₹42000 for two years is ₹105.

$\therefore 42000 \times \left(1 + \frac{r}{100}\right)^2 - 840r = 105$

$\Rightarrow 42000 \times \left[(1)^2 + 2 \times 1 \times \frac{r}{100} + \left(\frac{r}{100}\right)^2\right] - 42000 - 840r = 105$

$\Rightarrow 42000 \times \left[1 + \frac{2r}{100} + \frac{r^2}{10000}\right] - 42000 - 840r = 105$

$\Rightarrow 42000 \times 840r + 4.2r^2 - 42000 - 840r = 105$

$\Rightarrow 4.2r^2 = 105$

$\Rightarrow r^2 = \frac{105}{4.2}$

$\Rightarrow r^2 = 25 \qquad\qquad \Rightarrow r = \sqrt{25} = 5\%$

∴ Rate of interest is 5% p.a.

(ii) P = ₹42000

R = 5%p.a.

T = 1 year

$A_1 = P + \left(1 + \frac{R}{100}\right)^n$

$= 42000 \times \left(1 + \frac{5}{100}\right)^1$

$= 42000 \times \frac{21}{20} = ₹44100$

Now, principal for second year = $P_2 = A_1 = ₹44100$

R = 5% p.a.

T = 1 year

Now, $A_2 = P_2 \left(1 + \frac{R}{100}\right)^n$

$= 44100 \times \left(1 + \frac{5}{100}\right)^1$

$= 44100 \times \frac{21}{20} = ₹46305$

Now, C.I. earned in second year

$= A_2 - P_2$ = ₹46305 – ₹44100 = ₹2205

Check Your Progress

Question 1: Find the amount and the compound interest on ₹5000 for 2 years at 6% per annum interest payable yearly.

Solution:
Principal (P) = ₹5000
Rate of interest (r) = 6% p.a.
Period (n) = 2 years

$$\therefore A = P\left(1+\frac{r}{100}\right)^n = 5000\left(1+\frac{6}{100}\right)^2$$

$$= 5000 \times \frac{53}{50} \times \frac{53}{50} = ₹5618$$

∴ C.I. = A – P = ₹5618 – ₹5000 = ₹618

Question 2: Find the amount and the compounded interest on ₹7400 for 1 year at 5% per annum, interest payable half yearly.
Solution:
Principal (P) = ₹7400
Rate (R) = 5% p.a. or $\frac{5}{2}$% half yearly
Period (n) = 1 year or 2 half years

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

$$= ₹7400\left(1+\frac{5}{2\times100}\right)^2$$

$$= ₹7400 \times \frac{41}{40} \times \frac{41}{40}$$

$$= ₹\frac{62197}{8} = ₹7774.625$$

And C.I. = A – P = ₹7774.625 – ₹7400 = ₹374.625

Question 3: Find the difference between C.I. and S.I. on sum of ₹5000 for 2 years at 8% per annum payable yearly.

Solution:

Principal = ₹5000

Rate (R) = 8% p.a.

Period (n) = 2 years

$\therefore$ S.I. $= \frac{PRT}{100} = \frac{5000 \times 8 \times 2}{100} = ₹800$

And if interest is compounded yearly, then

$$A = P\left(1 + \frac{R}{100}\right)^n = ₹5000\left(1 + \frac{8}{100}\right)^2$$

$$= ₹5000 \times \frac{27}{25} \times \frac{27}{25} = ₹5832$$

$\therefore$ C.I. = A – P = ₹5832 – ₹5000 = ₹832

Now difference between C.I. and S.I. = ₹832 – ₹800 = ₹32

Question 4: Find the amount and compound interest on ₹10000 for $1\frac{1}{2}$ years at 10% per annum, compounded half yearly. Would this interest be more than the interest he would get if it was compounded annually?

Solution:

Principal (P) = ₹10000

Rate (R) = 10% p.a. or 5% half yearly

Period (n) = $1\frac{1}{2}$ years or 3 half years

$$\therefore A = P\left(1 + \frac{R}{100}\right)^n = ₹10000\left(1 + \frac{5}{100}\right)^3$$

$$= ₹10000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$$

$= \frac{92610}{8} = ₹11576.25$

∴ C.I. = A – P = $\frac{92610-10000}{8}$

$= ₹\frac{12610}{8} = ₹1576.25$

If interest is compound yearly, then

$A = ₹10000 \times \left(1 + \frac{10}{100}\right)^1 \left(1 + \frac{5}{100}\right)^1$

$= ₹10000 \times \frac{11}{10} \times \frac{21}{20} = ₹11550$

∴ And C.I. = ₹11550 – 10000 = ₹1550

Yes, the interest compounded half yearly is more than yearly.

Question 5: What sum invested for $1\frac{1}{2}$ years compounded half yearly at the rate of 4% p.a. will amount to ₹ 132651?

Solution:

Amount (A) = ₹ 132651

Rate (R) = 4% p.a. or 2% half yearly

Period (n) = $1\frac{1}{2}$ years or 3 half years

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

$\Rightarrow 132651 = P\left(1 + \frac{2}{100}\right)^3 \Rightarrow P\left(\frac{51}{50}\right)^3$

$P = 132651 \times \left(\frac{51}{50}\right)^3$

$= ₹13261 \times \frac{50}{51} \times \frac{50}{51} \times \frac{50}{51}$

$= ₹125000$

Question 6: Find the time (in years) in which ₹ 12500 will produce ₹3246.40 as compound interest at 8% per annum, compounded annually.

Solution:

Principal (P) = ₹12500
C .I. = ₹3246.40
∴ Amount = P + C.I. = 12500 + 3246.40
= ₹ 5746.40
Rate (R) = 8% p.a.

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

$$= \frac{15746.40}{12500} = \left(1 + \frac{8}{100}\right)^n = \left(1 + \frac{2}{25}\right)^n$$

$$\Rightarrow \left(\frac{27}{25}\right)^n = \frac{15746.40}{12500} = \frac{1574640}{12500 \times 100}$$

$$= \frac{1574640}{1250000} = \frac{19683}{15625} = \left(\frac{27}{25}\right)^3$$

Comparing, we get n = 3

∴ Time = 3 years

Question 7: Find the amount and compound interest on ₹2500 in 2 years if the rate are 5% and 6% for the successive years.

Solution:

Principal (P) = ₹2500
Rate (R) = 5% and 6% for 2 successive years

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

$$= 2500\left(1 + \frac{5}{100}\right)^1\left(1 + \frac{6}{100}\right)$$

$$= 2500 \times \frac{21}{20} \times \frac{53}{20} = \frac{5565}{2} = ₹2782.50$$

And C.I. =A – P = ₹2782.50 – 2500 = ₹282.50