

Introduction

In general Compound interest means 'Interest on Interest' The Interest earned on principal plus the interest that was earned earlier.

It is the method that enables banks to issue loans and for depositors to keep money at banks.

When we need to find CI for interest compounded half-yearly: Rate of interest(R) becomes $\frac{R}{2}\%$ and time doubles.

Examples:

Example 1 – Find the compound interest on Rs 25000 for 3 years at 10% per annum, compounded annually.

Solution - Principal for first year = Rs 25000

Total Time = 3 years

Rate of interest = 10%

Then interest for first year = $P \times R \times T$

$$= \frac{25000 \times 1 \times 10}{100} = \text{Rs}2500$$

Amount at the end of first year = $25000 + 2500 = \text{Rs}27500$

Principal for second year = Rs27500

$$\text{Interest for second year} = \frac{27500 \times 1 \times 10}{100} = \text{Rs} 2750$$

Amount at the end of second year = $27500 + 2750 = \text{Rs}30250$

Principal for third year = Rs30250

$$\text{Interest for third year} = \frac{30250 \times 1 \times 10}{100} = \text{Rs} 3025$$

Amount at the end of third year = $30250 + 3025 = \text{Rs}33275$

Thus, compound interest = $33275 - 25000 = \text{Rs} 8275$

Example 2 – Find the compound interest on Rs 5000 for 1 year at 8% per annum, compounded half-yearly.

Solution - Original principal = Rs 5000

Rate of Interest = 8% per annum = 4% per half-year

Time = 1 year = 2 half-years

Then, interest for first half year = $P \times R \times T$

$$= \frac{5000 \times 1 \times 4}{100} = Rs200$$

Amount at the end of first half year = $5000 + 200 = Rs5200$

Principal for second half year = Rs5200

$$\text{Interest for second half year} = \frac{5200 \times 1 \times 4}{100} = Rs 208$$

Amount at the end of second half year = $5200 + 208 = Rs5408$

Thus, compound interest = $5408 - 5000 = Rs408$

Exercise 11A

Question 1 – Find the amount and the compound interest on Rs 2500 for 2 years at 10% per annum, compounded annually.

Solution - Principal for first year = Rs 2500

Total Time = 2 years

Rate of interest = 10% per annum

Then, interest for first year = $P \times R \times T$

$$= \frac{2500 \times 1 \times 10}{100} = Rs250$$

Amount at the end of first year = $2500 + 250 = Rs2750$

Principal for second year = Rs2750

$$\text{Interest for second year} = \frac{2750 \times 1 \times 10}{100} = Rs 275$$

Amount at the end of second year = $2750 + 275 = Rs3025$

Thus, compound interest = $3025 - 2500 = \text{Rs } 525$

Question 2 – Find the amount and the compound interest on Rs 15625 for 3 years at 12% per annum, compounded annually.

Solution - Principal for first year = Rs 15625

Total Time = 3 years

Rate of interest = 12% per annum

Then, interest for first year = $P \times R \times T$

$$= \frac{15625 \times 1 \times 12}{100} = \text{Rs } 1875$$

Amount at the end of first year = $15625 + 1875 = \text{Rs } 17500$

Principal for second year = Rs 17500

$$\text{Interest for second year} = \frac{17500 \times 1 \times 12}{100} = \text{Rs } 2100$$

Amount at the end of second year = $17500 + 2100 = \text{Rs } 19600$

Principal for third year = Rs 19600

$$\text{Interest for third year} = \frac{19600 \times 1 \times 12}{100} = \text{Rs } 2352$$

Amount at the end of third year = $19600 + 2352 = \text{Rs } 21952$

Thus, compound interest = $21952 - 15625 = \text{Rs } 6327$

Question 3 – Find the difference between the simple interest and the compound interest on Rs 5000 for 2 years at 9% per annum.

Solution - Principal for first year = Rs 5000

Total Time = 2 years

Rate of interest = 9% per annum

$$\text{SI} = P \times R \times T = \frac{5000 \times 9 \times 2}{100} = \text{Rs } 900$$

Then, interest for first year = $P \times R \times T$

$$= \frac{5000 \times 1 \times 9}{100} = \text{Rs } 450$$

Amount at the end of first year = $5000 + 450 = Rs5450$

Principal for second year = $Rs5450$

Interest for second year = $\frac{5450 \times 1 \times 9}{100} = Rs 490.5$

Amount at the end of second year = $5450 + 490.5 = Rs5940.5$

Thus, compound interest = $5940.5 - 5000 = Rs 940.5$

Therefore, difference between SI and CI = $940.5 - 900 = Rs40.5$

Question 4 – Ratna obtained a loan of Rs 25000 from the syndicate bank to renovate her house. If the rate of interest is 8% per annum, what amount will she have to pay to the bank after 2 years to discharge her debt?

Solution - Principal for first year = $Rs 2500$

Total Time = 2 years

Rate of interest = 8% per annum

Then, interest for first year = $P \times R \times T$

$$= \frac{25000 \times 1 \times 8}{100} = Rs2000$$

Amount at the end of first year = $25000 + 2000 = Rs27000$

Principal for second year = $Rs27000$

Interest for second year = $\frac{27000 \times 1 \times 8}{100} = Rs 2160$

Amount at the end of second year = $27000 + 2160 = Rs29160$

Therefore, Ratna have to pay $Rs 29160$ to bank after 2 years to discharge her debt

Question 5 – Harpreet borrowed Rs 20000 from her friend at 12% per annum simple interest. She lent it to Alam at the same rate but compounded annually. Find her gain after 2 years.

Solution - Principal for first year = $Rs 20000$

Total Time = 2 years

Rate of interest = 12% per annum

$$SI = P \times R \times T = \frac{20000 \times 12 \times 2}{100} = Rs\ 4800$$

Then, interest for first year = $P \times R \times T$

$$= \frac{20000 \times 1 \times 12}{100} = Rs\ 2400$$

Amount at the end of first year = $20000 + 2400 = Rs\ 22400$

Principal for second year = $Rs\ 22400$

$$\text{Interest for second year} = \frac{22400 \times 1 \times 12}{100} = Rs\ 2688$$

Amount at the end of second year = $22400 + 2688 = Rs\ 25088$

Thus, compound interest = $25088 - 20000 = Rs\ 5088$

Therefore, gain after 2 years = $CI - SI = 5088 - 4800 = Rs\ 288$

Question 6 – Manoj deposited a sum of Rs 64000 in a post office for 3 years, compounded annually at $7\frac{1}{2}$ per annum. What amount will he get on maturity?

Solution - Principal for first year = $Rs\ 64000$

Total Time = 3 years

Rate of interest = $7\frac{1}{2}\% = \frac{15}{2}\%$ per annum

Then, interest for first year = $P \times R \times T$

$$= \frac{64000 \times 1 \times 15}{200} = Rs\ 4800$$

Amount at the end of first year = $64000 + 4800 = Rs\ 68800$

Principal for second year = $Rs\ 68800$

$$\text{Interest for second year} = \frac{68800 \times 1 \times 15}{200} = Rs\ 5160$$

Amount at the end of second year = $68800 + 5160 = Rs\ 73960$

Principal for third year = $Rs\ 73960$

$$\text{Interest for third year} = \frac{73960 \times 1 \times 15}{200} = Rs\ 5547$$

Amount at the end of third year = $73960 + 5547 = Rs\ 79507$

Therefore, amount on maturity = Rs 79507

Question 7 – Divakaran deposited a sum of Rs 6250 in the Allahabad Bank for 1 year, compounded half-yearly at 8% per annum. Find the compound interest he gets.

Solution - Original principal = Rs 6250

Rate of Interest = 8% per annum = 4% per half-year

Time = 1 year = 2 half-years

Then, interest for first half year = $P \times R \times T$

$$= \frac{6250 \times 1 \times 4}{100} = \text{Rs}250$$

Amount at the end of first half year = $6250 + 250 = \text{Rs}6500$

Principal for second half year = Rs6500

$$\text{Interest for second half year} = \frac{6500 \times 1 \times 4}{100} = \text{Rs} 260$$

Amount at the end of second half year = $6500 + 260 = \text{Rs}6760$

Thus, compound interest = $6760 - 6250 = \text{Rs}510$

Question 8 – Michael borrowed Rs 16000 from a finance company at 10% per annum, compounded half-yearly. What amount of money will discharge his debt after $1\frac{1}{2}$ years?

Solution - Original principal = Rs 16000

Rate of Interest = 10% per annum = 5% per half-year

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

Then, interest for first half year = $P \times R \times T$

$$= \frac{16000 \times 1 \times 5}{100} = \text{Rs}800$$

Amount at the end of first half year = $16000 + 800 = \text{Rs}16800$

Principal for second half year = Rs16800

$$\text{Interest for second half year} = \frac{16800 \times 1 \times 5}{100} = \text{Rs} 840$$

Amount at the end of second half year = $16800 + 840 = \text{Rs}17640$

$$\text{Interest for third half year} = \frac{17640 \times 1 \times 5}{100} = \text{Rs } 882$$

$$\text{Amount at the end of third half year} = 17640 + 882 = \text{Rs } 18522$$

$$\text{Thus, amount that will discharge debt after } 1\frac{1}{2} \text{ years} = \text{Rs } 18522$$

Calculating Compound Interest by using formula:

1) When interest is compounded annually:

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

Where P = Principal

R% = Rate per annum

A = Amount

n = number of years

2) When interest is compounded annually but rates are different for different years:

Suppose Principal = Rs P, time = 2 years So R = p% for first year and R = q% for second year

$$\text{Thus, amount after 2 years} = P \left(1 + \frac{p}{100}\right) \left(1 + \frac{q}{100}\right)$$

3) When interest is compounded annually but time is a fraction:

For ex, time = $2\frac{3}{5}$ years

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

Applications of CI formula: we will use CI formula in below cases

- Increase or decrease in population
- The growth of bacteria when the rate of growth is known
- Depreciation in the values of machines at the given rate.

Examples

Example 1 – Find the amount of Rs 8000 for 3 years, compounded annually at 10% per annum. Also, find the compound interest.

Solution - Given that $P = \text{Rs } 8000$

$$R = 10\%$$

$$n = 3 \text{ years}$$

Amount after 3 years:

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

$$A = 8000\left(1 + \frac{10}{100}\right)^3$$

$$A = 8000\left(\frac{110}{100}\right)^3$$

$$A = 8000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} = \text{Rs } 10648$$

Therefore, compound Interest = $10648 - 8000 = \text{Rs } 2648$

Example 2 – Find the compound interest on Rs 6400 for 2 years, compounded annually at $7\frac{1}{2}\%$ per annum.

Solution - Given that $P = \text{Rs } 6400$

$$R = 7\frac{1}{2}\% = \frac{15}{2}\%$$

$$n = 2 \text{ years}$$

Amount after 2 years = $A = P\left(1 + \frac{R}{100}\right)^n$

$$A = 6400\left(1 + \frac{15}{200}\right)^2$$

$$A = 6400\left(\frac{215}{200}\right)^2$$

$$A = 6400 \times \frac{43}{40} \times \frac{43}{40} = \text{Rs } 7396$$

Therefore, compound Interest = $7396 - 6400 = \text{Rs } 996$

Example 3 – Find the amount of Rs 50000 after 2 years, compounded annually: the rate of interest being 8% p.a. during the first year and 9% p.a. during the second year. Also, find the compound interest.

Solution - Given that P = Rs 50000

Time = 2 years

Rate of interest during first year (p) = 8%

Rate of interest during second year (q) = 9%

Thus, amount after 2 years = $P(1 + \frac{p}{100})(1 + \frac{q}{100})$

$$= 50000(1 + \frac{8}{100})(1 + \frac{9}{100})$$

$$= 50000 \left(\frac{108}{100}\right) \left(\frac{109}{100}\right) = Rs 58860$$

Compound interest = 58860 – 50000 = Rs8860

Example 4 – Find the compound interest on Rs 31250 at 8% per annum for $2\frac{3}{4}$ years.

Solution - Given that P = Rs 31250

Rate = 8%

Time = $2\frac{3}{4}$ years

Since time is in fraction, we will solve by using formula

$$\text{Amount} = P(1 + \frac{R}{100})^2(1 + \frac{\frac{3}{4}R}{100})$$

$$\text{Amount} = 31250(1 + \frac{8}{100})^2(1 + \frac{\frac{3}{4} \times 8}{100})$$

$$\text{Amount} = 31250 \left(\frac{108}{100}\right)^2 \left(1 + \frac{6}{100}\right)$$

$$\text{Amount} = 31250 \times \frac{27}{25} \times \frac{27}{25} \times \frac{106}{100}$$

= Rs 38637

Thus, compound interest = 38637 – 31250 = Rs 7387

Example 5 – The simple interest on a sum of money for 3 years at 12% per annum is Rs 6750. What will be the compound interest on the same sum at the same rate for the same period, compounded annually?

Solution - Given that SI = Rs 6750

Time = 3 years, R = 12% pa

Since $SI = P \times R \times T$

$$6750 = \frac{P \times 12 \times 3}{100}$$

$$P = \frac{6750 \times 100}{36} = Rs\ 18750$$

$$\text{Amount after 3 years} = P \left(1 + \frac{R}{100}\right)^n$$

$$= 18750 \left(1 + \frac{12}{100}\right)^3 = 18750 \left(\frac{112}{100}\right)^3$$

$$= 18750 \times \frac{28}{25} \times \frac{28}{25} \times \frac{28}{25} = Rs\ 26342.4$$

Thus, compound interest = $26342.4 - 18750 = Rs\ 7592.4$

Example 6 – The difference between the compound interest, compounded annually and the simple interest on a certain sum for 2 years at 15% per annum is Rs 180. Find the sum.

Solution - Let Principal sum be Rs x

Time = 2 years, R = 15%

Then, $SI = P \times R \times T$

$$= \frac{x \times 15 \times 2}{100} = \frac{3x}{10}$$

$$\text{Also, amount after 2 years} = P \left(1 + \frac{R}{100}\right)^n = x \left(1 + \frac{15}{100}\right)^2 = x \left(\frac{115}{100}\right)^2 = x \times \frac{23}{20} \times \frac{23}{20} = \frac{529x}{400}$$

$$CI = \frac{529x}{400} - x$$

$$CI = \frac{129x}{400}$$

Given that $CI - SI = Rs\ 180$

$$\Rightarrow \frac{129x}{400} - \frac{3x}{10} = 180$$

$$\Rightarrow \frac{129x - 120x}{400} = 180$$

$$\Rightarrow \frac{9x}{400} = 180$$

$$\Rightarrow x = \frac{180 \times 400}{9} = \text{Rs } 8000$$

Thus, principal sum is Rs 8000

Example 7 – A certain sum amounts to Rs 72900 in 2 years at 8% per annum compound interest, compounded annually. Find the sum.

Solution - Given that amount = Rs 72900

Time = 2 years

R = 8% pa

Sum = ?

Let the principal sum be Rs x

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

$$\Rightarrow 72900 = P \left(1 + \frac{8}{100}\right)^2$$

$$\Rightarrow 72900 = P \left(\frac{108}{100}\right)^2$$

$$\Rightarrow 72900 = P \times \frac{27}{25} \times \frac{27}{25}$$

$$\Rightarrow P = 72900 \times \frac{25}{27} \times \frac{25}{27}$$

$$\Rightarrow P = \text{Rs } 62500$$

Example 8 – At what rate per cent per annum will a sum of Rs 6250 amount to Rs 7840 in 2 years, compounded annually?

Solution - Given that P = Rs 6250

Amount = Rs 7840

Time = 2 Years

Let Rate be R%

We know that,

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

$$\Rightarrow 7840 = 6250 \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \frac{7840}{6250} = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(\frac{28}{25}\right)^2 = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(1 + \frac{R}{100}\right) = \frac{28}{25}$$

$$\Rightarrow \frac{R}{100} = \frac{28}{25} - 1 = \frac{3}{25}$$

$$\Rightarrow R = \frac{3}{25} \times 100 = 12$$

Thus, rate of interest is 12%

Example 9 – In what time will Rs 1000 amount to Rs 1331 at 10% per annum, compounded annually?

Solution - Given that P = Rs 1000

Amount = Rs 1331

Rate = 10%

Time = ?

Let time be n years

We know that,

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

$$\Rightarrow 1331 = 1000 \left(1 + \frac{10}{100}\right)^n$$

$$\Rightarrow \frac{1331}{1000} = \left(\frac{110}{100}\right)^n$$

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

Since, base is same so we can equate powers

$\Rightarrow n = 3$ years

Example 10 – The population of a town was 176400 in the year 2015. It increases at the rate of 5% per annum.

(a) What would be its population in the year 2017?

(b) What was its population in the year 2013?

Solution - Given that Population in the year 2015 = 176400

Rate of increase = 5% pa

(a) Population in the year 2017 =?

We need to find population after 2 years

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

$$\Rightarrow A = 176400 \left(1 + \frac{5}{100}\right)^2$$

$$\Rightarrow A = 176400 \left(\frac{105}{100}\right)^2$$

$$\Rightarrow A = 176400 \times \frac{21}{20} \times \frac{21}{20}$$

$$\Rightarrow A = 194481$$

Thus, population in 2017 = 194481

(b) Population in 2013 =?

Let population in 2013 be x

Now, we treat population in 2015 as amount

Thus, by using formula, $A = P \left(1 + \frac{R}{100}\right)^n$

$$\Rightarrow 176400 = x \left(1 + \frac{5}{100}\right)^2$$

$$\Rightarrow 176400 = x \left(\frac{105}{100}\right)^2$$

$$\Rightarrow 176400 \times \frac{20}{21} \times \frac{20}{21} = x$$

$$\Rightarrow x = 160000$$

Thus, population in 2013 = 160000

Example 11 – In a certain experiment the count of bacteria was increasing at the rate of 2.5% per hour. Initially, the count was 512000. Find the bacteria at the end of 2 hours.

Solution - Given that $P = 512000$

$$R = 2.5\%$$

$$T = 2 \text{ hours}$$

We need to find bacteria at the end of 2 hours

$$\text{We know that, } A = P \left(1 + \frac{R}{100}\right)^n$$

$$\Rightarrow A = 512000 \left(1 + \frac{2.5}{100}\right)^2$$

$$\Rightarrow A = 512000 \left(\frac{41}{40}\right)^2$$

$$\Rightarrow A = 512000 \times \frac{41}{40} \times \frac{41}{40} = 537920$$

Thus, bacteria at end of 2 hours = 537920

Example 12 – The population of a town 2 years ago was 62500. Due to migration to cities it decreases every year at the rate of 4% per annum. Find its present population.

Solution - Given that population of town 2 years ago = 62500

Rate of decrease = 4% pa

We need to find the present population

$$\text{We know that, } A = P \left(1 - \frac{R}{100}\right)^n$$

$$\Rightarrow A = 62500 \left(1 - \frac{4}{100}\right)^2$$

$$\Rightarrow A = 62500 \left(\frac{24}{25}\right)^2$$

$$\Rightarrow A = 62500 \times \frac{24}{25} \times \frac{24}{25} = 57600$$

Example 13 – A motorcycle is bought at Rs 160000. Its value depreciates at the rate of 10% per annum. Find its value after (a) 1 year (b) 2 years

Solution - Given that Price of motorcycle = Rs 160000

Rate of decrease = 10% pa

(a) Value after 1 year =?

$$\text{We know that, } A = P \left(1 - \frac{R}{100}\right)^n$$

$$\Rightarrow A = 160000 \left(1 - \frac{10}{100}\right)^1$$

$$\Rightarrow A = 160000 \left(\frac{9}{10}\right) = 144000$$

(b) Value after 2 years =?

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

$$\Rightarrow A = 160000 \left(1 - \frac{10}{100}\right)^2$$

$$\Rightarrow A = 160000 \left(\frac{9}{10}\right)^2 = 160000 \times \frac{9}{10} \times \frac{9}{10} = 129600$$

Exercise 11B

By using the formula, find the amount and compound interest on:

Question 1 – Rs 6000 for 2 years at 9% per annum compounded annually.

Solution - Given that P = Rs 6000

T = 2 years

R = 9%

$$\text{We know that, } A = P \left(1 + \frac{R}{100}\right)^n$$

$$\Rightarrow A = 6000 \left(1 + \frac{9}{100}\right)^2$$

$$\Rightarrow A = 6000 \left(\frac{109}{100}\right)^2$$

$$\Rightarrow A = 6000 \times \frac{109}{100} \times \frac{109}{100} = Rs\ 7128.6$$

Thus, compound interest = $7128.6 - 6000 = Rs\ 1128.6$

Question 2 – Rs 10000 for 2 years at 11% per annum compounded annually.

Solution - Given that $P = Rs\ 10000$

$T = 2$ years

$R = 11\%$

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

$$\Rightarrow A = 10000 \left(1 + \frac{11}{100}\right)^2$$

$$\Rightarrow A = 10000 \left(\frac{111}{100}\right)^2$$

$$\Rightarrow A = 10000 \times \frac{111}{100} \times \frac{111}{100} = Rs\ 12321$$

Thus, compound interest = $12321 - 10000 = Rs\ 2321$

Question 3 – Rs 31250 for 3 years at 8% per annum compounded annually.

Solution - Given that $P = Rs\ 31250$

$T = 3$ years

$R = 8\%$

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

$$\Rightarrow A = 31250 \left(1 + \frac{8}{100}\right)^3$$

$$\Rightarrow A = 31250 \left(\frac{108}{100}\right)^3$$

$$\Rightarrow A = 31250 \times \frac{27}{25} \times \frac{27}{25} \times \frac{27}{25} = Rs\ 39366$$

Thus, compound interest = $39366 - 31250 = Rs\ 8116$

Question 4 – Rs 10240 for 3 years at $12\frac{1}{2}\%$ per annum compounded annually.

Solution - Given that $P = \text{Rs}10240$

$T = 3$ years

$$R = 12\frac{1}{2}\% = \frac{25}{2}\%$$

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

$$\Rightarrow A = 10240 \left(1 + \frac{25}{200}\right)^3$$

$$\Rightarrow A = 10240 \left(\frac{225}{200}\right)^3$$

$$\Rightarrow A = 10240 \times \frac{9}{8} \times \frac{9}{8} \times \frac{9}{8} = \text{Rs } 14580$$

Thus, compound interest = $14580 - 10240 = \text{Rs } 4340$

Question 5 – Rs 62500 for 2 years 6 months at 12% per annum compounded annually.

Solution - Given that $P = \text{Rs } 62500$

$$T = 2 \text{ years } 6 \text{ months} = 2 + \frac{6}{12} = \frac{30}{12} = \frac{5}{2} = 2\frac{1}{2} \text{ years}$$

$R = 12\%$

When time is in fraction,

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

$$A = 62500 \left(1 + \frac{12}{100}\right)^2 \left(1 + \frac{\frac{1}{2} \times 12}{100}\right)$$

$$A = 62500 \left(\frac{112}{100}\right)^2 \left(1 + \frac{6}{100}\right)$$

$$A = 62500 \times \frac{28}{25} \times \frac{28}{25} \times \frac{106}{100}$$

$$A = \text{Rs } 83104$$

Thus, compound interest = $83104 - 62500 = \text{Rs } 20604$

Question 6 – Rs 9000 for 2 years 4 months at 10% per annum compounded annually.

Solution - Given that P = Rs 9000

$$T = 2 \text{ years } 4 \text{ months} = 2 + \frac{4}{12} = \frac{28}{12} = \frac{7}{3} = 2\frac{1}{3} \text{ years}$$

$$R = 10\%$$

When time is in fraction,

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

$$A = 9000\left(1 + \frac{10}{100}\right)^2 \left(1 + \frac{\frac{1}{3} \times 10}{100}\right)$$

$$A = 9000 \left(\frac{110}{100}\right)^2 \left(1 + \frac{10}{300}\right)$$

$$A = 9000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{31}{30}$$

$$A = \text{Rs } 11253$$

Thus, compound interest = 11253 – 9000 = Rs 2253

Question 7 – Find the amount of Rs 8000 for 2 years compounded annually and the rates being 9% per annum during the first year and 10% per annum during the second year.

Solution - Given that P = Rs 8000

Time = 2 years

Rate of interest during first year (p) = 9%

Rate of interest during second year (q) = 10%

$$\text{Thus, amount after 2 years} = P\left(1 + \frac{p}{100}\right)\left(1 + \frac{q}{100}\right)$$

$$= 8000\left(1 + \frac{9}{100}\right)\left(1 + \frac{10}{100}\right)$$

$$= 8000 \left(\frac{109}{100}\right) \left(\frac{110}{100}\right) = \text{Rs } 9592$$

Question 8 – Anand obtained a loan of Rs 125000 from the Allahabad bank for buying computers. The bank charges compound interest at 8% per annum, compounded annually. What amount will he have to pay after 3 years to clear the debt?

Solution - Given that P = Rs 125000

R = 8% pa

T = 3 years

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

$$\Rightarrow A = 125000 \left(1 + \frac{8}{100}\right)^3$$

$$\Rightarrow A = 125000 \left(\frac{108}{100}\right)^3$$

$$\Rightarrow A = 125000 \times \frac{27}{25} \times \frac{27}{25} \times \frac{27}{25} = Rs\ 157464$$

Thus, Anand had to pay Rs 157464 after 3 years to clear the debt.

Question 9 – Three years ago, Beeru purchased a buffalo from surjeet for Rs 11000. What payment will discharge his debt now, the rate of interest being 10% per annum compounded annually?

Solution - It is given that P = Rs 11000

Time = 3 years

R = 10%

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

$$\Rightarrow A = 11000 \left(1 + \frac{10}{100}\right)^3$$

$$\Rightarrow A = 11000 \left(\frac{110}{100}\right)^3$$

$$\Rightarrow A = 11000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} = Rs\ 14641$$

Question 10 – Shubhalaxmi took a loan of Rs 18000 from Surya Finance to purchase a TV set. If the company charges compound interest at 12% per annum during the first year and $12\frac{1}{2}\%$ per annum during the second year, how much will she have to pay after 2 years?

Solution - Given that P = Rs 18000

Time = 2 years

Rate of interest during first year (p) = 12%

Rate of interest during second year (q) = $12\frac{1}{2}\% = \frac{25}{2}\%$

Thus, amount after 2 years = $P(1 + \frac{p}{100})(1 + \frac{q}{100})$

$$= 18000(1 + \frac{12}{100})(1 + \frac{25}{200})$$

$$= 18000 \left(\frac{112}{100}\right) \left(\frac{225}{200}\right) = Rs 22680$$

Question 11 – Neha borrowed Rs 24000 from the State Bank of India to buy a scooter. If the rate of interest be 10% per annum compounded annually, what payment will she have to make after 2 years 3 months?

Solution - Given that P = Rs 24000

T = 2 years 3 months = $2 + \frac{3}{12} = \frac{27}{12} = \frac{9}{4} = 2\frac{1}{4}$ years

R = 10%

When time is in fraction,

$$\text{Amount} = P(1 + \frac{R}{100})^2(1 + \frac{\frac{3}{4}R}{100})$$

$$A = 24000(1 + \frac{10}{100})^2(1 + \frac{\frac{1}{4} \times 10}{100})$$

$$A = 24000 \left(\frac{110}{100}\right)^2 \left(1 + \frac{5}{200}\right)$$

$$A = 24000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{41}{40}$$

$$A = Rs 29766$$

Question 12 – Abhay borrowed Rs 16000 at $7\frac{1}{2}\%$ per annum simple interest. On the same day, he lent it to Gurmeet at the same rate but compounded annually. What does he gain at the end of 2 years?

Solution - It is given that $P = \text{Rs } 16000$

$$R = 7\frac{1}{2}\% = \frac{15}{2}\%$$

$$T = 2 \text{ years}$$

$$SI = P \times R \times T$$

$$= \frac{16000 \times 2 \times 15}{2 \times 100} = \text{Rs } 2400$$

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

$$\Rightarrow A = 16000 \left(1 + \frac{15}{200}\right)^2$$

$$\Rightarrow A = 16000 \left(\frac{215}{200}\right)^2$$

$$\Rightarrow A = 16000 \times \frac{43}{40} \times \frac{43}{40} = \text{Rs } 18490$$

$$CI = 18490 - 16000 = \text{Rs } 2490$$

$$\text{Thus, gain at the end of 2 years} = CI - SI$$

$$= 2490 - 2400 = \text{Rs } 90$$

Question 13 – The simple interest on a sum of money for 2 years at 8% per annum is Rs 2400. What will be the compound interest on that sum at the same rate and for the same period?

Solution - It is given that $SI = \text{Rs } 2400$

$$\text{Time} = 2 \text{ years}$$

$$R = 8\%$$

Let the principal sum be Rs x

$$\text{Since, } SI = P \times R \times T$$

$$\Rightarrow 2400 = \frac{x \times 2 \times 8}{100}$$

$$\Rightarrow x = \frac{2400 \times 100}{2 \times 8} = \text{Rs } 15000$$

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

$$\Rightarrow A = 15000 \left(1 + \frac{8}{100}\right)^2$$

$$\Rightarrow A = 15000 \left(\frac{108}{100}\right)^2$$

$$\Rightarrow A = 15000 \times \frac{27}{25} \times \frac{27}{25} = \text{Rs } 17496$$

$$\text{CI} = 17496 - 15000 = \text{Rs } 2496$$

Question 14 – The difference between the compound interest and the simple interest on a certain sum for 2 years at 6% per annum is Rs 90. Find the sum.

Solution - Let Principal sum be Rs x

Time = 2 years, $R = 6\%$

Then, $\text{SI} = P \times R \times T$

$$= \frac{x \times 6 \times 2}{100} = \frac{3x}{25}$$

$$\text{Also, amount after 2 years} = P \left(1 + \frac{R}{100}\right)^n = x \left(1 + \frac{6}{100}\right)^2 = x \left(\frac{106}{100}\right)^2 = x \times \frac{53}{50} \times \frac{53}{50} = \frac{2809x}{2500}$$

$$\text{CI} = \frac{2809x}{2500} - x$$

$$\text{CI} = \frac{309x}{2500}$$

Given that $\text{CI} - \text{SI} = \text{Rs } 90$

$$\Rightarrow \frac{309x}{2500} - \frac{3x}{25} = 90$$

$$\Rightarrow \frac{309x - 300x}{2500} = 90$$

$$\Rightarrow \frac{9x}{2500} = 90$$

$$\Rightarrow x = \frac{90 \times 2500}{9} = \text{Rs } 25000$$

Thus, principal sum is Rs 25000

Question 15 – The difference between the compound interest and the simple interest on a certain sum for 3 years at 10% per annum is Rs 93. Find the sum.

Solution - Let Principal sum be Rs x

Time = 3 years, $R = 10\%$

Then, $SI = P \times R \times T$

$$= \frac{x \times 10 \times 3}{100} = \frac{3x}{10}$$

Also, amount after 3 years $= P \left(1 + \frac{R}{100}\right)^n = x \left(1 + \frac{10}{100}\right)^3 = x \left(\frac{110}{100}\right)^3 = x \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} = \frac{1331x}{1000}$

$$CI = \frac{1331x}{1000} - x$$

$$CI = \frac{331x}{1000}$$

Given that $CI - SI = \text{Rs } 93$

$$\Rightarrow \frac{331x}{1000} - \frac{3x}{10} = 93$$

$$\Rightarrow \frac{331x - 300x}{1000} = 93$$

$$\Rightarrow \frac{31x}{1000} = 93$$

$$\Rightarrow x = \frac{93 \times 1000}{31} = \text{Rs } 3000$$

Thus, principal sum is Rs 3000

Question 16 – A sum of money amounts to Rs 10240 in 2 years at $6\frac{2}{3}\%$ per annum, compounded annually. Find the sum.

Solution - Given that Amount = Rs 10240

Time = 2 years

$$R = 6\frac{2}{3}\% = \frac{20}{3}\% \text{ pa}$$

Let the principal be Rs P

$$\text{We know that, } A = P \left(1 + \frac{R}{100}\right)^n$$

$$\Rightarrow 10240 = P \left(1 + \frac{20}{300}\right)^2$$

$$\Rightarrow 10240 = P \left(\frac{320}{300}\right)^2$$

$$\Rightarrow 10240 = P \times \frac{16}{15} \times \frac{16}{15}$$

$$\Rightarrow P = 10240 \times \frac{15}{16} \times \frac{15}{16}$$

$$\Rightarrow P = \text{Rs } 9000$$

Question 17 – What sum of money will amount to Rs 21296 in 3 years at 10% per annum, compounded annually?

Solution - Given that Amount = Rs 21296

Time = 3 years

R = 10% pa

Let the principal be Rs P

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

$$\Rightarrow 21296 = P \left(1 + \frac{10}{100}\right)^3$$

$$\Rightarrow 21296 = P \left(\frac{110}{100}\right)^3$$

$$\Rightarrow 21296 = P \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}$$

$$\Rightarrow P = 21296 \times \frac{10}{11} \times \frac{10}{11} \times \frac{10}{11}$$

$$\Rightarrow P = \text{Rs } 16000$$

Question 18 – At what rate per cent per annum will Rs 4000 amount to Rs 4410 in 2 years when compounded annually?

Solution - Given that P = Rs 4000

Amount = Rs 4410

Time = 2 Years

Let Rate be R%

We know that,

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

$$\Rightarrow 4410 = 4000 \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \frac{4410}{4000} = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(\frac{21}{20}\right)^2 = \left(1 + \frac{R}{100}\right)^2$$

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

$$\Rightarrow \frac{R}{100} = \frac{21}{20} - 1 = \frac{1}{20}$$

$$\Rightarrow R = \frac{1}{20} \times 100 = 5$$

Thus, rate of interest is 5% pa

Question 19 – At what rate per cent per annum will Rs 640 amount to Rs 774.40 in 2 years when compounded annually?

Solution - Given that P = Rs 640

Amount = Rs 774.40

Time = 2 Years

Let Rate be R%

We know that,

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

$$\Rightarrow 774.40 = 640 \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \frac{774.4}{640} = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(\frac{88}{80}\right)^2 = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(1 + \frac{R}{100}\right) = \frac{88}{80}$$

$$\Rightarrow \frac{R}{100} = \frac{88}{80} - 1 = \frac{8}{80} = \frac{1}{10}$$

$$\Rightarrow R = \frac{1}{10} \times 100 = 10$$

Thus, rate of interest is 10% pa

Question 20 – In how many years will Rs 1800 amount to Rs 2178 at 10% per annum when compounded annually?

Solution - Given that P = Rs 1800

Amount = Rs 2178

Rate = 10%

Time = ?

Let time be n years

We know that,

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

$$\Rightarrow 2178 = 1800 \left(1 + \frac{10}{100}\right)^n$$

$$\Rightarrow \frac{2178}{1800} = \left(\frac{110}{100}\right)^n$$

$$\Rightarrow \frac{121}{100} = \left(\frac{11}{10}\right)^n$$

$$\Rightarrow \left(\frac{11}{10}\right)^2 = \left(\frac{11}{10}\right)^n$$

Since, base is same so we can equate powers

$$\Rightarrow n = 2 \text{ years}$$

Question 21 – In how many years will Rs 6250 amount to Rs 7290 at 8% per annum, compounded annually?

Solution - Given that P = Rs 6250

Amount = Rs 7290

Rate = 8%

Time =?

Let time be n years

We know that,

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

$$\Rightarrow 7290 = 6250 \left(1 + \frac{8}{100} \right)^n$$

$$\Rightarrow \frac{7290}{6250} = \left(\frac{108}{100} \right)^n$$

$$\Rightarrow \frac{729}{625} = \left(\frac{27}{25} \right)^n$$

$$\Rightarrow \left(\frac{27}{25} \right)^2 = \left(\frac{27}{25} \right)^n$$

Since, base is same so we can equate powers

$$\Rightarrow n = 2 \text{ years}$$

Question 22 – The population of a town is 125000. It is increasing at the rate of 2% per annum. What will be its population after 3 years?

Solution - Given that Population of town = 125000

Rate of increase = 2% pa

We need to find population after 3 years

$$\text{We know that, } A = P \left(1 + \frac{R}{100} \right)^n$$

$$\Rightarrow A = 125000 \left(1 + \frac{2}{100} \right)^3$$

$$\Rightarrow A = 125000 \left(\frac{102}{100} \right)^3$$

$$\Rightarrow A = 125000 \times \frac{51}{50} \times \frac{51}{50} \times \frac{51}{50}$$

$$\Rightarrow A = 132651$$

Thus, population after 3 years = 132651

Question 23 – Three years ago, the population of a town was 50000. If the annual increase during three successive years be at the rate of 5%, 4% and 3% respectively, what is its present population?

Solution - It is given that Population of town = 50000

Time = 3 years

Rate of interest during first year (p) = 5%

Rate of interest during second year (q) = 4%

Rate of interest during third year (r) = 3%

Thus, amount after 3 years = $P\left(1 + \frac{p}{100}\right)\left(1 + \frac{q}{100}\right)$

$$= 50000\left(1 + \frac{5}{100}\right)\left(1 + \frac{4}{100}\right)\left(1 + \frac{3}{100}\right)$$

$$= 50000\left(\frac{105}{100}\right)\left(\frac{104}{100}\right)\left(\frac{103}{100}\right) = \text{Rs } 56238$$

Question 24 – The population of a city was 120000 in the year 2013. During next year it increased by 6% but due to an epidemic it decreased by 5% in the following year. What was its population in the year 2015?

Solution - Given Population in 2013 = 120000

Rate of increase = 6%

Population in 2014 =?

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

$$\Rightarrow A = 120000\left(1 + \frac{6}{100}\right)$$

$$\Rightarrow A = 120000\left(\frac{106}{100}\right)$$

$$\Rightarrow A = 127200$$

Now, Rate of decrease = 5%

Population in 2015 =?

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

$$\Rightarrow A = 127200 \left(1 - \frac{5}{100}\right)$$

$$\Rightarrow A = 127200 \left(\frac{95}{100}\right)$$

$$\Rightarrow A = 120840$$

Question 25 – The count of bacteria in a certain experiment was increasing at the rate of 2% per hour. Find the bacteria at the end of 2 hours if the count was initially 500000.

Solution - Given that $P = 500000$

$$R = 2\%$$

$$T = 2 \text{ hours}$$

We need to find bacteria at the end of 2 hours

$$\text{We know that, } A = P \left(1 + \frac{R}{100}\right)^n$$

$$\Rightarrow A = 500000 \left(1 + \frac{2}{100}\right)^2$$

$$\Rightarrow A = 500000 \left(\frac{102}{100}\right)^2$$

$$\Rightarrow A = 500000 \times \frac{51}{50} \times \frac{51}{50} = 520200$$

Thus, bacteria at end of 2 hours = 520200

Question 26 – The bacteria in a culture grows by 10% in the first hour, decreases by 10% in the second hour and again increases by 10% in the third hour. Find the bacteria at the end of 3 hours if the count was initially 20000.

Solution - It is given that bacteria count = 20000

Time = 3 years

Rate of increase during first year (p) = 10%

Rate of decrease during second year (q) = 10%

Rate of increase during third year (r) = 10%

$$\text{Thus, amount after 3 years} = P \left(1 + \frac{p}{100}\right) \left(1 + \frac{q}{100}\right) \left(1 + \frac{r}{100}\right)$$

$$= 20000 \left(1 + \frac{10}{100}\right) \left(1 - \frac{10}{100}\right) \left(1 + \frac{10}{100}\right)$$

$$= 20000 \left(\frac{110}{100}\right) \left(\frac{90}{100}\right) \left(\frac{110}{100}\right) = 21780$$

Thus, bacteria count at the end of 3 hours = 21780

Question 27 – A machine is purchased for Rs 625000. Its value depreciates at the rate of 8% per annum. What will be its value after 2 years?

Solution - Given that Price of machine = Rs 625000

Rate of decrease = 8% pa

Value after 2 years =?

$$\text{We know that, } A = P \left(1 - \frac{R}{100}\right)^n$$

$$\Rightarrow A = 625000 \left(1 - \frac{8}{100}\right)^2$$

$$\Rightarrow A = 625000 \left(\frac{92}{100}\right)^2$$

$$\Rightarrow A = 625000 \times \frac{92}{100} \times \frac{92}{100} = 529000$$

Thus, value of machine after 2 years = Rs 529000

Question 28 – A scooter is bought at Rs 56000. Its value depreciates at the rate of 10% per annum. What will be its value after 3 years?

Solution - Given that Price of scooter = Rs 56000

Rate of decrease = 10% pa

Value after 3 years =?

$$\text{We know that, } A = P \left(1 - \frac{R}{100}\right)^n$$

$$\Rightarrow A = 56000 \left(1 - \frac{10}{100}\right)^3$$

$$\Rightarrow A = 56000 \left(\frac{90}{100}\right)^3$$

$$\Rightarrow A = 56000 \times \frac{9}{10} \times \frac{9}{10} \times \frac{9}{10} = 40824$$

Thus, value of machine after 2 years = Rs 40824

Question 29 – A car is purchased for Rs 348000. Its value depreciates at 10% per annum during the first year and at 20% per annum during the second year. What will be its value after 2 years?

Solution - It is given that value of car = Rs 348000

Time = 2 years

Rate of decrease during first year (p) = 10%

Rate of decrease during second year (q) = 20%

Thus, amount after 2 years = $P(1 + \frac{p}{100})(1 + \frac{q}{100})$

$$= 348000(1 - \frac{10}{100})(1 - \frac{20}{100})$$

$$= 348000(\frac{90}{100})(\frac{80}{100}) = 250560$$

Thus, value of car after 2 years = Rs 250560

Question 30 – The value of a machine depreciates at the rate of 10% per annum. It was purchased 3 years ago. If its present value is Rs 291600, for how much was it purchased?

Solution - It is given that present value of machine (A) = Rs 291600

Rate of decrease = 10%

Time = 3 years

We need to find its principal value

$$\text{We know that, } A = P \left(1 - \frac{R}{100}\right)^n$$

$$\Rightarrow 291600 = P \left(1 - \frac{10}{100}\right)^3$$

$$\Rightarrow 291600 = P \left(\frac{90}{100}\right)^3$$

$$\Rightarrow P = 291600 \times \frac{10}{9} \times \frac{10}{9} \times \frac{10}{9}$$

$$\Rightarrow P = \text{Rs } 400000$$

Thus, machine was purchased for Rs 400000

Suppose Principal = Rs P

Rate = R% pa

Time = n years

When Interest is compounded half-yearly:

Time = 2n half years

Rate = $\frac{R}{2}$ % per half year

When Interest is compounded quarterly:

Time = 4n quarters

Rate = $\frac{R}{4}$ % per quarter

Examples

Example 1 – Find the compound interest on Rs 15625 for $1\frac{1}{2}$ years at 8% per annum when compounded half-yearly.

Solution - Given that P = Rs 15625

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

Rate = 8% per annum = 4% per half year

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

$$= 15625 \left(1 + \frac{4}{100}\right)^3$$

$$= 15625 \left(\frac{104}{100}\right)^3$$

$$= 15625 \times \frac{26}{25} \times \frac{26}{25} \times \frac{26}{25}$$

$$= \text{Rs } 17576$$

$$\text{Compound interest} = 17576 - 15625 = \text{Rs } 1951$$

Example 2 – Find the compound interest on Rs 160000 for 2 years at 10% per annum when compounded semi-annually.

Solution - Given that P = Rs 160000

Time = 2 years = 4 half years

Rate = 10% per annum = 5% per half year

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

$$= 160000 \left(1 + \frac{5}{100}\right)^4$$

$$= 160000 \left(\frac{105}{100}\right)^4$$

$$= 160000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$$

$$= \text{Rs } 194481$$

$$\text{Compound interest} = 194481 - 160000 = \text{Rs } 34481$$

Example 3 – Find the compound interest on Rs 125000 for 9 months at 8% per annum, compounded quarterly.

Solution - Given that P = Rs 125000

Time = 9 months = $\frac{9}{12}$ years = $\frac{9}{12} \times 4 = 3$ quarters

Rate = 8% per annum = 2% per quarter

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

$$= 125000 \left(1 + \frac{2}{100}\right)^3$$

$$= 125000 \left(\frac{102}{100}\right)^3$$

$$= 125000 \times \frac{51}{50} \times \frac{51}{50} \times \frac{51}{50}$$

$$= \text{Rs } 132651$$

$$\text{Compound interest} = 132651 - 125000 = \text{Rs } 7651$$

Exercise 11C

Question 1 – Find the amount and the compound interest on Rs 8000 for 1 year at 10% per annum, compounded half-yearly.

Solution - Given that $P = \text{Rs } 8000$

Time = 1 years = 2 half years

Rate = 10% per annum = 5% per half year

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

$$= 8000 \left(1 + \frac{5}{100}\right)^2$$

$$= 8000 \left(\frac{105}{100}\right)^2$$

$$= 8000 \times \frac{21}{20} \times \frac{21}{20}$$

$$= \text{Rs } 8820$$

$$\text{Compound interest} = 8820 - 8000 = \text{Rs } 820$$

Question 2 – Find the amount and the compound interest on Rs 31250 for $1\frac{1}{2}$ years at 8% per annum, compounded half-yearly.

Solution - Given that $P = \text{Rs } 31250$

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

Rate = 8% per annum = 4% per half year

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

$$= 31250 \left(1 + \frac{4}{100}\right)^3$$

$$= 31250 \left(\frac{104}{100}\right)^3$$

$$= 31250 \times \frac{26}{25} \times \frac{26}{25} \times \frac{26}{25}$$

$$= \text{Rs } 35152$$

Compound interest = $35152 - 31250 = \text{Rs } 3902$

Question 3 – Find the amount and the compound interest on Rs 12800 for 1 year at $7\frac{1}{2}\%$ per annum, compounded semi-annually.

Solution - Given that $P = \text{Rs } 12800$

Time = 1 year = 2 half years

Rate = $7\frac{1}{2}\% = \frac{15}{2}\%$ per annum = $\frac{15}{4}\%$ per half year

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

$$= 12800 \left(1 + \frac{15}{400}\right)^2$$

$$= 12800 \left(\frac{415}{400}\right)^2$$

$$= 12800 \times \frac{83}{80} \times \frac{83}{80}$$

$$= \text{Rs } 13778$$

Compound interest = $13778 - 12800 = \text{Rs } 978$

Question 4 – Find the amount and the compound interest on Rs 160000 for 2 years at 10% per annum, compounded half-yearly.

Solution - Given that $P = \text{Rs } 160000$

Time = 2 years = 4 half years

Rate = 10% per annum = 5% per half year

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

$$= 160000 \left(1 + \frac{5}{100}\right)^4$$

$$= 160000 \left(\frac{105}{100}\right)^4$$

$$= 160000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}$$

$$= \text{Rs } 194481$$

Compound interest = $194481 - 160000 = \text{Rs } 34481$

Question 5 – Swati borrowed Rs 40960 from a bank to buy a piece of land. If the bank charges $12\frac{1}{2}\%$ per annum, compounded half-yearly, what amount will she have to pay after $1\frac{1}{2}$ years? Also, find the interest paid by her.

Solution - Given that $P = \text{Rs } 40960$

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

Rate = $12\frac{1}{2} = \frac{25}{2} \%$ per annum = $\frac{25}{4} \%$ per half year

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

$$= 40960 \left(1 + \frac{25}{400}\right)^3$$

$$= 40960 \left(\frac{425}{400}\right)^3$$

$$= 40960 \times \frac{17}{16} \times \frac{17}{16} \times \frac{17}{16}$$

$$= \text{Rs } 49130$$

Compound interest = $49130 - 40960 = \text{Rs } 8170$

Question 6 – Mohd. Aslam purchased a house from Avas Vikas Parishad on credit. If the cost of the house is Rs 125000 and the Parishad charges interest at 12% per annum compounded half-yearly, find the interest paid by Aslam after a year and a half.

Solution - Given that price of house = Rs 125000

$R = 12\%$ per year = 6% per half year

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

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

$$= 125000 \left(1 + \frac{6}{100}\right)^3$$

$$= 125000 \left(\frac{106}{100}\right)^3$$

$$= 125000 \times \frac{53}{50} \times \frac{53}{50} \times \frac{53}{50}$$

$$= \text{Rs } 148877$$

$$\text{Compound interest} = 148877 - 125000 = \text{Rs } 23877$$

Question 7 – Sheela deposited Rs 20000 in a bank, where the interest is credited half-yearly. If the rate of interest paid by the bank is 6% per annum, what amount will she get after 1 year?

Solution - Given that P = Rs 20000

R = 6% per year = 3% per half year

T = 1 year = 2 half years

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

$$= 20000 \left(1 + \frac{3}{100}\right)^2$$

$$= 20000 \left(\frac{103}{100}\right)^2$$

$$= 20000 \times \frac{103}{100} \times \frac{103}{100}$$

$$= \text{Rs } 21218$$

Question 8 – Neeraj lent Rs 65536 for 2 years at $12\frac{1}{2}\%$ per annum, compounded annually. How much more could he earn if the interest were compounded half-yearly?

Solution - Given that P = Rs 65536

T = 2 years = 4 half years

$$R = 12\frac{1}{2}\% \text{pa} = \frac{25}{2}\% \text{pa} = \frac{25}{4}\% \text{per half year}$$

$$\text{Thus, amount when interest is compounded half yearly} = A = P \left(1 + \frac{R}{100}\right)^n$$

$$= 65536 \left(1 + \frac{25}{400}\right)^4$$

$$= 65536 \left(\frac{425}{400}\right)^4 = 65536 \left(\frac{17}{16}\right)^4$$

$$= 65536 \times \frac{17}{16} \times \frac{17}{16} \times \frac{17}{16} \times \frac{17}{16}$$

$$= \text{Rs } 83521$$

So, interest earned when compounded half yearly = $83521 - 65536 = \text{Rs } 17985$

$$\text{Amount when interest is compounded yearly} = A = P \left(1 + \frac{R}{100}\right)^n$$

$$= 65536 \left(1 + \frac{25}{200}\right)^2$$

$$= 65536 \left(\frac{225}{200}\right)^2 = 65536 \left(\frac{9}{8}\right)^2$$

$$= 65536 \times \frac{9}{8} \times \frac{9}{8}$$

$$= \text{Rs } 82944$$

$$\text{CI} = 82944 - 65536 = \text{Rs } 17408$$

Difference between interest when compounded yearly and interest when compounded half yearly
 $= 17985 - 17408 = \text{Rs } 577$

Question 9 – Sudhershana deposited Rs 32000 in a bank, where the interest is credited quarterly. If the rate of interest be 5% per annum, what amount will he receive after 6 months?

Solution - Given that $P = \text{Rs } 32000$, $R = 5\%$ per year = $\frac{5}{4}\%$ per quarter

$$T = 6 \text{ months} = \frac{6}{12} \text{ years} = \frac{6}{12} \times 4 = 2 \text{ quarters}$$

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

$$= 32000 \left(1 + \frac{5}{400}\right)^2$$

$$= 32000 \left(\frac{405}{400}\right)^2 = 32000 \left(\frac{81}{80}\right)^2$$

$$= 32000 \times \frac{81}{80} \times \frac{81}{80}$$

$$= \text{Rs } 32805$$

Question 10 – Arun took a loan of Rs 390625 from Kuber Finance. If the company charges interest at 16% per annum, compounded quarterly, what amount will discharge his debt after one year?

Solution - Given that $P = \text{Rs } 390625$

R = 16% per annum = 4% per quarter

T = 1 year = 4 quarters

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

$$= 390625 \left(1 + \frac{4}{100}\right)^4$$

$$= 390625 \left(\frac{104}{100}\right)^4 = 390625 \left(\frac{26}{25}\right)^4$$

$$= 390625 \times \frac{26}{25} \times \frac{26}{25} \times \frac{26}{25} \times \frac{26}{25}$$

= Rs 456976

Exercise 11D

Question 1 – The compound interest on Rs 5000 at 8% per annum for 2 years, compounded annually, is?

Solution - Given that P = Rs 5000

T = 2 years, R = 8% per annum

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

$$= 5000 \left(1 + \frac{8}{100}\right)^2$$

$$= 5000 \left(\frac{108}{100}\right)^2 = 5000 \left(\frac{27}{25}\right)^2$$

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

= Rs 5832

CI = 5832 – 5000 = Rs832

Question 2 – The compound interest on Rs 10000 at 10% per annum for 3 years, compounded annually, is?

Solution - Given that P = Rs 10000

T = 3 years, R = 10% per annum

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

$$= 10000 \left(1 + \frac{10}{100}\right)^3$$

$$= 10000 \left(\frac{110}{100}\right)^3 = 10000 \left(\frac{11}{10}\right)^3$$

$$= 10000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}$$

$$= \text{Rs } 1331$$

$$\text{CI} = 13310 - 10000 = \text{Rs } 3310$$

Question 3 – The compound interest on Rs 10000 at 12% per annum for $1\frac{1}{2}$ years, compounded annually, is?

Solution - Given that P = Rs 10000

T = $1\frac{1}{2}$ years = $\frac{3}{2}$ years, R = 12% per annum

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

$$\text{Amount} = 10000 \left(1 + \frac{12}{100}\right) \left(1 + \frac{\frac{1}{2} \times 12}{100}\right)$$

$$\text{Amount} = 10000 \left(\frac{112}{100}\right)^2 \left(1 + \frac{6}{100}\right)$$

$$\text{Amount} = 10000 \times \frac{28}{25} \times \frac{106}{100}$$

$$= \text{Rs } 11872$$

$$\text{CI} = 11872 - 10000 = \text{Rs } 1872$$

Question 4 – The compound interest on Rs 4000 at 10% per annum for 2 years 3 months, compounded annually, is?

Solution - Given that P = Rs 4000

$T = 2 \text{ years } 3 \text{ months} = 2\frac{1}{4} \text{ years}$, $R = 10\% \text{ per annum}$

$$\text{Amount} = P\left(1 + \frac{R}{100}\right)^2 \left(1 + \frac{\frac{1}{4}R}{100}\right)$$

$$\text{Amount} = 4000\left(1 + \frac{10}{100}\right)^2 \left(1 + \frac{\frac{1}{4} \times 10}{100}\right)$$

$$\text{Amount} = 4000 \left(\frac{110}{100}\right)^2 \left(1 + \frac{5}{200}\right)$$

$$\text{Amount} = 4000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{205}{200}$$

$$= \text{Rs } 49610$$

$$\text{CI} = 4961 - 4000 = \text{Rs } 961$$

Question 5 – A sum of Rs 25000 was given as loan on compound interest for 3 years compounded annually at 5% per annum during the first year, 6% per annum during the second year and 8% per annum during the third year. The compound interest is?

Solution - Given that $P = \text{Rs } 25000$

Time = 3 years

Rate of interest during first year (p) = 5%

Rate of interest during second year (q) = 6%

Rate of interest during third year (r) = 8%

$$\text{Thus, amount after 3 years} = P\left(1 + \frac{p}{100}\right)\left(1 + \frac{q}{100}\right)\left(1 + \frac{r}{100}\right)$$

$$= 25000\left(1 + \frac{5}{100}\right)\left(1 + \frac{6}{100}\right)\left(1 + \frac{8}{100}\right)$$

$$= 25000 \left(\frac{105}{100}\right) \left(\frac{106}{100}\right) \left(\frac{108}{100}\right) = \text{Rs } 30051$$

$$\text{Compound interest} = 30051 - 25000 = \text{Rs } 5051$$

Question 6 – The compound interest on Rs 6250 at 8% per annum for 1 year, compounded half-yearly, is?

Solution - Given that $P = \text{Rs } 6250$

Time = 1 years = 2 half years

Rate = 8% per annum = 4% per half year

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

$$= 6250 \left(1 + \frac{4}{100}\right)^2$$

$$= 6250 \left(\frac{104}{100}\right)^2$$

$$= 6250 \times \frac{26}{25} \times \frac{26}{25}$$

$$= \text{Rs } 6760$$

$$\text{Compound interest} = 6760 - 6250 = \text{Rs } 510$$

Question 7 – The compound interest on Rs 40000 at 8% per annum for 6 months, compounded quarterly, is?

Solution - Given that $P = \text{Rs } 40000$

$$\text{Time} = 6 \text{ months} = \frac{6}{12} \text{ years} = \frac{6}{12} \times 4 = 2 \text{ quarters}$$

$$\text{Rate} = 8\% \text{ per annum} = \frac{8}{4}\% \text{ per quarter}$$

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

$$= 40000 \left(1 + \frac{2}{100}\right)^2$$

$$= 40000 \left(\frac{102}{100}\right)^2$$

$$= 40000 \times \frac{102}{100} \times \frac{102}{100}$$

$$= \text{Rs } 41209$$

$$\text{Compound interest} = 41209 - 40000 = \text{Rs } 1209$$

Question 8 – The present population of a town is 24000. If it increases at the rate of 5% per annum, what will be its population after 2 years?

Solution - Given that present population of town = 24000

Rate of increase = 5% per annum

Population after 2 years = ?

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

$$\Rightarrow A = 24000 \left(1 + \frac{5}{100}\right)^2$$

$$\Rightarrow A = 24000 \left(\frac{105}{100}\right)^2$$

$$\Rightarrow A = 24000 \times \frac{21}{20} \times \frac{21}{20}$$

$$\Rightarrow A = 26460$$

Question 9 – The value of a machine depreciates at the rate of 10% per annum. It was purchased 3 years ago for Rs 60000. What is the present value of the machine?

Solution - Given that Price of machine = Rs 60000

Rate of decrease = 10% pa

Value after 3 years =?

We know that, $A = P \left(1 - \frac{R}{100}\right)^n$

$$\Rightarrow A = 60000 \left(1 - \frac{10}{100}\right)^3$$

$$\Rightarrow A = 60000 \left(\frac{90}{100}\right)^3$$

$$\Rightarrow A = 60000 \times \frac{9}{10} \times \frac{9}{10} \times \frac{9}{10} = 43740$$

Thus, value of machine after 3 years = Rs43740

Question 10 – The value of a machine depreciates at the rate of 20% per annum. It was purchased 2 years ago. If its present value is Rs 40000, for how much was it purchased?

Solution - Given that Present Price of machine = Rs 40000

Rate of decrease = 20% pa

Value before 2 years =?

We know that, $A = P \left(1 - \frac{R}{100}\right)^n$

$$\Rightarrow 40000 = P \left(1 - \frac{20}{100}\right)^2$$

$$\Rightarrow 40000 = P \left(\frac{80}{100} \right)^2$$

$$\Rightarrow P = 40000 \times \frac{10}{8} \times \frac{10}{8} = 62500$$

Thus, value of machine before 2 years = Rs62500

Question 11 – The annual rate of growth in population of a town is 10%. If its present population is 33275, what was it 3 years ago?

Solution - Given that present population of town = 33275

Rate of growth = 10%

Population 3 years ago =?

$$\text{We know that, } A = P \left(1 + \frac{R}{100} \right)^n$$

$$\Rightarrow 33275 = P \left(1 + \frac{10}{100} \right)^3$$

$$\Rightarrow 33275 = P \left(\frac{110}{100} \right)^3$$

$$\Rightarrow P = 33275 \times \frac{10}{11} \times \frac{10}{11} \times \frac{10}{11} = 25000$$

Thus, population before 3 years = Rs25000

Question 12 – If the simple interest on a sum of money at 5% per annum for 3 years is Rs 1200 then the compound interest on the same sum for the same period at the same rate will be?

Solution - Given that SI = Rs 1200

$$R = 5\%$$

Time = 3 years

$$SI = P \times R \times T$$

$$\Rightarrow 1200 = \frac{P \times 5 \times 3}{100}$$

$$\Rightarrow P = \frac{1200 \times 100}{15} = Rs8000$$

$$\text{Thus, amount after 3 years} = A = P \left(1 + \frac{R}{100} \right)^n$$

$$= 8000\left(1 + \frac{5}{100}\right)^3$$

$$= 8000\left(\frac{105}{100}\right)^3 = 8000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} = 9261$$

Thus, compound interest = $9261 - 8000 = \text{Rs } 1261$

Question 13 – If the compound interest on a sum for 2 years at $12\frac{1}{2}\%$ per annum is Rs 510, the simple interest on the same sum at the same rate for the same period of time is?

Solution - Given that CI = Rs 510, $R = 12\frac{1}{2}\%$, $T = 2$ years

$$\Rightarrow A - P = 510$$

$$\Rightarrow A = 510 + P$$

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

$$\Rightarrow 510 + P = P\left(1 + \frac{25}{200}\right)^2$$

$$\Rightarrow 510 + P = P\left(\frac{225}{200}\right)^2 = P\left(\frac{9}{8}\right)^2$$

$$\Rightarrow 510 + P = \frac{81}{64}P$$

$$\Rightarrow 510 = \frac{81}{64}P - P$$

$$\Rightarrow 510 = \frac{17}{64}P$$

$$\Rightarrow P = \frac{510 \times 64}{17} = \text{Rs } 1920$$

$$SI = P \times R \times T$$

$$= \frac{1920 \times 25 \times 2}{200} = \text{Rs } 480$$

Question 14 – the sum that amounts to Rs 4913 in 3 years at $6\frac{1}{4}\%$ per annum compounded annually, is?

Solution - Given that Amount = Rs 4913

$$T = 3 \text{ years}$$

$$R = 6\frac{1}{4}\% = \frac{25}{4}\%$$

P = ?

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

$$\Rightarrow 4913 = P \left(1 + \frac{25}{400}\right)^3$$

$$\Rightarrow 4913 = P \left(\frac{425}{400}\right)^3$$

$$\Rightarrow P = 4913 \times \frac{16}{17} \times \frac{16}{17} \times \frac{16}{17} = \text{Rs } 4096$$

Question 15 – At what rate per cent per annum will a sum of Rs 7500 amount to Rs 8427 in 2 years compounded annually?

Solution - Given that P = Rs 7500

Amount = Rs 8427

Time = 2 Years

Let Rate be R%

We know that,

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

$$\Rightarrow 8427 = 7500 \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \frac{8427}{7500} = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(\frac{53}{50}\right)^2 = \left(1 + \frac{R}{100}\right)^2$$

$$\Rightarrow \left(1 + \frac{R}{100}\right) = \frac{53}{50}$$

$$\Rightarrow \frac{R}{100} = \frac{53}{50} - 1 = \frac{3}{50}$$

$$\Rightarrow R = \frac{3}{50} \times 100 = 6$$

Thus, rate of interest is 6%