

Unit I

Commercial Mathematics

Chapter 1

Compound Interest

POINTS TO REMEMBER

I Formulae :

1. When Interest is Reckoned Annually :

(i) Let Principal = P, Rate = R% p.a. and Time = n (in years)

Then, the amount after n years is given by :

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

$$\therefore \text{C.I.} = (A - P) = P \left(1 + \frac{R}{100} \right)^n - P$$

$$\Rightarrow \text{C.I.} = P \left[\left(1 + \frac{R}{100} \right)^n - 1 \right]$$

(ii) Let the rate of interest for two successive years be $R_1\%$ and $R_2\%$ respectively. Then, the amount after 2 years is given by :

$$A = P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right)$$

(iii) Let the rate of interest for three successive years be $R_1\%$, $R_2\%$ and $R_3\%$ respectively. Then, the amount after 3 years is given by :

$$A = P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right) \left(1 + \frac{R_3}{100} \right)$$

(iv) When the period is not a complete number of years, say it is 2 years 7 months and let the rate of interest be R% p.a., compounded annually. Then,

$$A = P \left(1 + \frac{R}{100} \right)^2 \left(1 + \frac{\frac{7}{12}R}{100} \right)$$

2. When Interest is Reckoned Half-yearly (or Semi-annually) :

Let principal = P, Rate = R% p.a. and Time = n years.

And, let the interest be reckoned half-yearly. Then,

Principal = P, Rate = $\frac{R}{2}\%$ per half-year and Time = $(2n)$ half-years.

So, the amount after n years is given by :

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

Note. The S.I. and the C.I. for first unit of time are always equal.

3. Formulae for Population Growth and Population Decrease :

It is easy to derive the following formulae by unitary method.

(i) Let there be a growth of $r\%$ p.a. in the population of a place. Then,

$$(\text{Population after } n \text{ years}) = (\text{Present Population}) \times \left(1 + \frac{r}{100} \right)^n.$$

Similarly,

$$(\text{Population } n \text{ years ago}) \times \left(1 + \frac{r}{100} \right)^n = (\text{Present Population}).$$

(ii) If there is a growth of $r_1\%$ during first year and $r_2\%$ during second year, then :

$$(\text{Population after 2 years}) = (\text{Present Population}) \times \left(1 + \frac{r_1}{100} \right) \times \left(1 + \frac{r_2}{100} \right).$$

This formula can be extended for a period of more than 2 years.

(iii) When there is a regular decrease in population, we use minus sign instead of plus sign in the above formulae.

4. Formulae for Depreciation

It is easy to derive the following formulae by unitary method.

If the value of a machine depreciates by $r\%$ per annum, then :

$$(\text{Value of the machine after } n \text{ years}) = (\text{Its Present Value}) \times \left(1 - \frac{r}{100} \right)^n.$$

Similarly,

$$(\text{Value of the machine } n \text{ years ago}) \times \left(1 - \frac{r}{100} \right)^n = (\text{Its Present Value}).$$

MATURITY TABLES FOR R.D.
FOR A DEPOSIT OF Rs 100 P.M. AT RATES 6% TO 11%
(COMPOUNDED QUARTERLY)

Depositing Period, in Months								
Interest	3	6	9	12	15	18	21	24
Rate % p.a.	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P
6.00	302.9950	610.5350	922.6881	1239.5254	1561.1113	1887.5230	2218.8309	2555.1084
6.50	303.2442	611.4161	924.5958	1242.8686	1566.354	1895.0020	2229.0400	2568.5060
7.00	303.4933	612.2976	926.5061	1246.2132	1571.5152	1902.5100	2339.2971	2581.9781
7.50	303.7423	613.1797	928.4191	1249.5692	1576.7409	191.0470	2249.6027	2595.5250
8.00	303.9912	614.0622	930.3347	1252.9326	1581.9824	1917.6133	2259.9567	2609.1471
8.50	304.2401	614.9452	932.2529	1256.3033	1587.2399	1925.2088	2270.3595	2622.8447
9.00	304.4889	615.8287	934.1738	1259.6816	1592.5133	1932.8337	2280.8113	2636.6185
9.50	304.7376	616.7127	936.0973	1263.0672	1597.8027	1940.4881	2291.3123	2650.4686
10.00	304.9863	617.5972	938.0234	1266.4603	1603.1081	1948.1721	2301.8627	2664.3955
10.50	305.2349	618.4822	939.9522	1269.8609	1608.4296	1955.8858	2312.4626	2678.3997
11.00	305.4834	619.3676	941.8837	1273.2689	1613.7672	1963.6292	2323.1125	2692.4815

Depositing Period, in Months								
Interest	27	30	33	36	39	42	45	48
Rate % p.a.	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P	Rs. P
6.00	2896.4301	3242.8715	3594.5097	3951.4223	4313.6887	4681.3891	5054.6050	5433.4191
6.50	2913.4884	3264.0768	3620.3622	3982.4373	4350.3961	4724.3342	5104.3488	5490.5387
7.00	2930.6560	3285.4357	3646.4241	4013.7298	4387.4633	4767.7371	5154.6658	5548.3657
7.50	2947.9333	3306.9493	3672.6969	4045.3022	4424.8939	4811.6029	5202.5627	5606.9093
8.00	2965.3212	3328.6188	3699.1824	4077.1572	4462.6916	4855.9366	5257.0465	5666.1787
8.50	2982.8203	3350.4453	3725.8823	4109.2974	4500.8600	4900.7434	5309.1242	5726.1832
9.00	3000.4312	3372.4298	3752.7984	4141.7252	4539.4029	4946.0283	5361.8028	5786.9323
9.50	3018.1548	3394.5736	3779.9323	4174.4433	4578.3240	4991.7968	5415.0896	5848.4356
10.00	3035.9917	3416.8778	3807.2860	4207.4544	4617.6271	5038.0540	5468.9916	5910.7027
10.50	3053.9425	3439.3434	3834.8611	4240.7611	4657.3159	5084.8054	5523.5164	5973.7436
11.00	3072.0081	3461.9718	3862.6594	4274.3660	4697.3945	5132.0562	5578.6712	6037.5681

Depositing Period, in Months								
Interest Rate % p.a.	51 Rs. P	54 Rs. P	57 Rs. P	60 Rs. P	63 Rs. P	66 Rs. P	69 Rs. P	72 Rs. P
6-00	5817.9154	6208.1792	6604.2969	7006.3564	7414.4468	7828.6585	8249.0834	8675.8147
6-50	5883.0041	6281.8471	6687.1713	7099.0820	7517.6863	7943.0928	8375.4123	8814.7569
7-00	5948.9553	6356.5553	6771.2883	7193.2791	7622.6547	8059.5444	8504.0797	8956.3944
7-50	6015.7811	6432.3193	6856.6675	7288.9723	7729.3828	8178.0510	8635.1317	9100.7826
8-00	6083.4934	6509.1545	6943.3288	7386.1866	7837.9015	8298.6507	8768.6149	9247.9784
8-50	6152.1046	6587.0769	7031.2924	7484.9474	7948.2426	8421.3829	8904.5773	9398.0397
9-00	6221.6271	6666.1026	7120.5788	7585.2807	8060.4384	8546.2871	9043.0675	9551.0254
9-50	6292.0735	6746.2479	7211.2089	7687.2127	8174.5216	8673.4041	9184.1351	9706.9959
10-00	6363.4566	6827.5293	7303.2038	7790.7702	8290.5257	8802.7751	9327.8308	9866.0128
10-50	6435.7892	6909.9636	7396.5850	7895.9802	8408.4846	8934.4422	9474.2062	10028.1390
11-00	6509.0846	6993.5679	7491.3744	8002.8706	8528.4330	9068.4483	9623.3141	10193.4386

EXERCISE 1 (A)

Q. 1. Calculate the amount and the compound interest on Rs. 12800 at 5% per annum for 2 years, compounded annually.

Sol. Principal (P) = Rs. 12800
Rate (R) = 5% per annum
Period (n) = 2 years

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

$$= 12800 \left(1 + \frac{5}{100} \right)^2$$

$$= 12800 \times \left(\frac{21}{20} \right)^2$$

$$= 12800 \times \frac{21}{20} \times \frac{21}{20} = \text{Rs. } 14112.$$

$$\therefore \text{C.I.} = A - P = \text{Rs. } (14112 - 12800) \\ = \text{Rs. } 1312 \text{ Ans.}$$

Q. 2. A sum of Rs. 7500 is invested for 2 years at 6% per annum, compounded annually. calculate :

- the amount at the end of first year ;
- the amount at the end of second year ;
- interest earned during second year.

Sol. Principal (P) = Rs. 7500

Rate (R) = 6% p.a.

Period (n) = 2 years

$$\text{Interest for the first year} = \frac{p.r.t.}{100}$$

$$= \frac{7500 \times 6 \times 1}{100} = \text{Rs. } 450$$

$$(i) \therefore \text{Amount at the end of first year} \\ = \text{Rs. } 7500 + 450 = \text{Rs. } 7950$$

$$(ii) \text{ C.I. for the second year} = \frac{7950 \times 6 \times 1}{100} \\ = \text{Rs. } 477$$

$$\therefore \text{Amount at the end of second year} \\ = \text{Rs. } 7950 + 477 = \text{Rs. } 8427$$

$$(iii) \text{ Interest for the second year} \\ = \text{Rs. } 477 \text{ Ans.}$$

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

- the interest for the first year ;
- the amount standing to his credit at the end of the second year ;
- the interest for the third year.

Sol. Principal (P) = Rs. 46875

$$\text{Rate (R)} = 4\%$$

$$\text{Period (n)} = 3 \text{ years}$$

$$(i) \therefore \text{Interest for the first year} = \frac{p.r.t.}{100}$$

$$= \frac{46875 \times 4 \times 1}{100} = \text{Rs. } 1875$$

$$\therefore \text{Amount at the end of first year}$$

$$= \text{Rs. } 46875 + \text{Rs. } 1875$$

$$= \text{Rs. } 48750$$

$$\text{Interest for the second year} = \text{Rs. } \frac{48750 \times 4}{100}$$

$$= \text{Rs. } 1950$$

$$(ii) \therefore \text{Amount at the end of second year}$$

$$= \text{Rs. } 48750 + \text{Rs. } 1950$$

$$= \text{Rs. } 50700$$

$$(iii) \text{Interest for the third year}$$

$$= \text{Rs. } \frac{50700 \times 4 \times 1}{100}$$

$$= \text{Rs. } 2028 \text{ Ans.}$$

Q. 4. A sum of Rs. 9600 is invested for 3 years at 10% per annum compound interest.

(i) What is the sum due to the end of the first year ?

(ii) What is the sum due at the end of the second year ?

(iii) Find the compound interest earned in first 2 years.

(iv) Find the compound interest for the third year. (1996)

Sol. Principal = Rs. 9600

Rate of Interest = 10% p.a.

Period (time) = 3 years

Interest for the first year

$$= \frac{Prt}{100} = \frac{9600 \times 10 \times 1}{100}$$

$$= \text{Rs. } 960$$

(i) \therefore Amount after one year

$$= \text{Rs. } 9600 + \text{Rs. } 960$$

$$= \text{Rs. } 10560$$

or Principal for the second year

$$= \text{Rs. } 10560$$

$$\text{Interest for the 2nd year} = \frac{10560 \times 10 \times 1}{100}$$

$$= \text{Rs. } 1056$$

(ii) Amount after two years

$$= \text{Rs. } 10560 + \text{Rs. } 1056$$

$$= \text{Rs. } 11616$$

(iii) Compound interest in first 2 years

$$= \text{Rs. } 960 + \text{Rs. } 1056$$

$$= \text{Rs. } 2016$$

(iv) Principal for the third year = Rs. 11616

Interest for the third year

$$= \text{Rs. } \frac{11616 \times 10 \times 1}{100}$$

$$= \text{Rs. } 1161.60 \text{ Ans.}$$

Q. 5. A man saves Rs. 5000 every year and invests it at the end of the year at 8% per annum compound interest. Calculate the total amount of his savings at the end of the third year.

Sol. Principal for the first year = Rs. 5000

Rate of interest (r) = 8 p.a.

\therefore Interest for 1st year

$$= \frac{Prt}{100} = \frac{5000 \times 8 \times 1}{100}$$

$$= \text{Rs. } 400$$

Amount after first year

$$= \text{Rs. } 5000 + \text{Rs. } 400$$

$$= \text{Rs. } 5400$$

Investment for the second year = Rs. 5000

\therefore Total principal for the second year

$$= \text{Rs. } 5400 + \text{Rs. } 5000$$

$$= \text{Rs. } 10400$$

Interest for second year

$$= \text{Rs. } \frac{10400 \times 8 \times 1}{100}$$

$$= \text{Rs. } 832$$

$$\begin{aligned} \therefore \text{Amount after second year} \\ &= \text{Rs. } 10400 + \text{Rs. } 832 \\ &= \text{Rs. } 11232 \end{aligned}$$

Investment for the third year = Rs. 5000

$$\begin{aligned} \therefore \text{Total amount for the third year} \\ &= \text{Rs. } 11232 + 5000 \\ &= \text{Rs. } 16232 \text{ Ans.} \end{aligned}$$

Q. 6. Calculate the amount of Rs. 15000 at the end of 2 years 4 months, **compounded** annually at 6% per annum.

Sol. Principal for the 1st year = Rs. 15000

Interest for the 1st year

$$\begin{aligned} &= \text{Rs. } \left[15000 \times \frac{6}{100} \times 1 \right] \\ &= \text{Rs. } 900 \end{aligned}$$

Amount at the end of 1st year

$$\begin{aligned} &= \text{Rs. } (15000 + 900) \\ &= \text{Rs. } 15900 \end{aligned}$$

Principal for the 2nd year = Rs. 15900

Interest for the 2nd year

$$\begin{aligned} &= \text{Rs. } \left[15900 \times \frac{6}{100} \times 1 \right] \\ &= \text{Rs. } 954 \end{aligned}$$

Amount at the end of 2nd year

$$\begin{aligned} &= \text{Rs. } (15900 + 954) \\ &= \text{Rs. } 16854 \end{aligned}$$

Principal for the 3rd year = Rs. 16854

Interest for the next 4 months

$$\begin{aligned} &= \text{Rs. } \left[16854 \times \frac{6}{100} \times \frac{4}{12} \right] \\ &= \text{Rs. } 337.08 \end{aligned}$$

Amount at the end of 2 years 4 months

$$\begin{aligned} &= \text{Rs. } (16854 + 337.08) \\ &= \text{Rs. } 17191.08 \text{ Ans.} \end{aligned}$$

Q. 7. Rahul borrowed Rs. 50,000 from a money lender at 6% per annum simple interest. He lent it to his friend Sarthak at the same rate but compounded annually. Find his

gain after $2\frac{1}{2}$ years.

Ans. In the first case,

Principal = Rs. 50000

Rate = 6% p.a.

$$\text{Period} = 2\frac{1}{2} = \frac{5}{2} \text{ years}$$

$$\therefore \text{Simple interest} = \frac{Prt}{100}$$

$$= \frac{50000 \times 6 \times 5}{100 \times 2} = \text{Rs. } 7500$$

In second case, Principal = Rs. 50000

Rate = Rs. 6% p.a. and period = $2\frac{1}{2}$ years at compound interest

$$\therefore \text{Amount} = P \left[1 + \frac{r}{100} \right]^n$$

$$= 50000 \left[1 + \frac{6}{100} \right]^2 \left[1 + \frac{6}{2 \times 100} \right]$$

$$= 50000 \times \frac{53}{50} \times \frac{53}{50} \times \frac{103}{100}$$

$$= \text{Rs. } 57865.40$$

$$\therefore \text{his gain after } 2\frac{1}{2} \text{ years} = \text{C.I.} - \text{S.I.}$$

$$= \text{Rs. } 57865.40 - \text{Rs. } 7500$$

$$= \text{Rs. } 365.40 \text{ Ans.}$$

Q. 8. Find the amount and the compound interest on Rs. 4096 at $6\frac{1}{4}\%$ per annum for 3 years.

Sol. Principal (P) = Rs. 4096

Rate of interest (r) = $6\frac{1}{4} = \frac{25}{4}\%$ p.a.

Period (n) = 3 years

$$\therefore \text{Amount} = P \left[1 + \frac{r}{100} \right]^n$$

$$= 4096 \left[1 + \frac{25}{4 \times 100} \right]^3$$

$$= 4096 \times \frac{17}{16} \times \frac{17}{16} \times \frac{17}{16} = 4913$$

$$= 17 \times 17 \times 17 = \text{Rs. } 4913$$

$$\therefore \text{Interest} = \text{Rs. } 4913 - \text{Rs. } 4096$$

$$= \text{Rs. } 817 \text{ Ans.}$$

Q. 9. The simple interest on a certain sum of money for 2 years at 10% p.a. is Rs. 1600. Find : (i) the sum, (ii) the amount due after 3 years on the above sum at the same rate and compounded annually.

Sol. (i) S.I. = Rs. 1600

Rate (R) = 10% p.a.

Period (n) = 2 years.

$$\therefore P = \frac{\text{S.I.} \times 100}{R \times t} = \frac{1600 \times 100}{10 \times 2}$$

$$= \text{Rs. } 8000$$

(ii) Now, principal (P) = Rs. 8000

Rate (R) = 10% p.a.

Period (n) = 3 years

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

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

$$= \text{Rs. } 8000 \left(\frac{11}{10} \right)^3$$

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

$$= \text{Rs. } 10648 \text{ Ans.}$$

Q. 10. A man invests Rs. 5000 for three years at a certain rate of interest, compounded annually. At the end of one year, it amounts to Rs. 5600. Calculate :

- the rate of interest per annum ;
- the interest accrued in the second year ;
- the amount at the end of the third year.

(1999)

Sol. Principal (P) = Rs. 5000

Period (n) = 3 years

Amount after one year = Rs. 5600

\therefore Interest for the first year

$$= \text{Rs. } 5600 - 5000 = \text{Rs. } 600$$

$$(i) \therefore \text{Rate \%} = \frac{\text{Interest} \times 100}{P \times t}$$

$$= \frac{600 \times 100}{5000 \times 1} = 12\% \text{ p.a.}$$

(ii) Interest for the second year

$$= \text{Rs. } \frac{5600 \times 12 \times 1}{100}$$

$$= \text{Rs. } 672$$

Amount at the end of second year

$$= \text{Rs. } 5600 + 672 = \text{Rs. } 6272$$

(iii) Interest for the third year

$$= \text{Rs. } \frac{6272 \times 12 \times 1}{100}$$

$$= \text{Rs. } 752.64$$

\therefore Amount at the end of third year

$$= \text{Rs. } 6272 + \text{Rs. } 752.64$$

$$= \text{Rs. } 7024.64 \text{ Ans.}$$

Q. 11. Calculate the amount and the compound interest on Rs. 8000 for 2 years, the rates of interest for the successive years being 5% and 6% per annum respectively.

Sol. Principal (P) = Rs. 8000

Rate for the first year (R_1) = 5% p.a.

Rate for the second year (R_2) = 6% p.a.

Period (n) = 2 years

\therefore Amount after 2 years (A)

$$= P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right)$$

$$= \text{Rs. } 8000 \left(1 + \frac{5}{100} \right) \left(1 + \frac{6}{100} \right)$$

$$= \text{Rs. } 8000 \times \frac{21}{20} \times \frac{53}{50} = \text{Rs. } 8904$$

$$\text{and C.I.} = A - P = \text{Rs. } 8904 - \text{Rs. } 8000$$

$$= \text{Rs. } 904 \text{ Ans.}$$

Q. 12. Calculate the amount and the compound interest on Rs. 12500 for 3 years, the rates

of interest for the successive years being 6%, 8% and 10% respectively.

Sol. Principal (P) = Rs. 12500

Rate for the first year (R_1) = 6%

Rate for the second year (R_2) = 8%

Rate for the third year (R_3) = 10%

Period (n) = 3 years.

\therefore Amount (A)

$$= \text{Rs. } 12500 \left(1 + \frac{6}{100}\right) \left(1 + \frac{8}{100}\right) \left(1 + \frac{10}{100}\right)$$

$$= \text{Rs. } 12500 \left(1 + \frac{3}{50}\right) \left(1 + \frac{2}{25}\right) \left(1 + \frac{1}{10}\right)$$

$$= \text{Rs. } 12500 \times \frac{53}{50} \times \frac{27}{25} \times \frac{11}{10} = \text{Rs. } 15741$$

\therefore C.I. = A - P

$$= \text{Rs. } 15741 - \text{Rs. } 12500$$

$$= \text{Rs. } 3241 \text{ Ans.}$$

Q. 13. Find the amount and the compound interest on Rs. 8000 for $1\frac{1}{2}$ years at 10% per annum, the interest being compounded half-yearly.

Sol. Principal (P) = Rs. 8000

Rate of interest (r) = $\frac{10}{2}$ % p.a. half-yearly

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

$$\therefore \text{Amount} = P \left[1 + \frac{r}{100}\right]^n$$

$$= 8000 \left[1 + \frac{10}{2 \times 100}\right]^3$$

$$= 8000 \times \left[\frac{21}{20}\right]^3$$

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

$$= 21 \times 21 \times 21 = \text{Rs. } 9261$$

$$\therefore \text{Interest} = A - P$$

$$= \text{Rs. } 9261 - \text{Rs. } 8000$$

$$= \text{Rs. } 1261 \text{ Ans.}$$

Q. 14. A man borrows Rs. 7500 at 12% per annum, compounded annually. If he repays Rs. 2200 at the end of each year, find the amount outstanding against him at the beginning of the third year.

Sol. Principal (P) = Rs. 7500

Rate (R) = 12% p.a.

Period (n) = 3 years.

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

$$= \text{Rs. } 7500 \left(1 + \frac{12}{100}\right)^1$$

$$= \text{Rs. } 7500 \times \frac{28}{25} = \text{Rs. } 8400$$

Amount paid at the end of first year

$$= \text{Rs. } 2200$$

$$\therefore \text{Balance} = \text{Rs. } 8400 - \text{Rs. } 2200$$

$$= \text{Rs. } 6200$$

Now Principal = Rs. 6200

\therefore Amount after second year

$$= 6200 \left(1 + \frac{12}{100}\right) = \text{Rs. } 6200 \times \frac{28}{25}$$

$$= \text{Rs. } 6944.$$

Amount paid at the end of second year

$$= \text{Rs. } 2200$$

$$\text{Balance} = \text{Rs. } 6944 - 2200$$

$$= \text{Rs. } 4744$$

\therefore Amount due at the beginning of third year = Rs. 4744 Ans.

Q. 15. Sudhakar borrows Rs. 22500 at 10% per annum compounded annually. If he repays Rs. 11250 at the end of first year and Rs. 12550 at the end of second year, find the amount of loan outstanding against him at the end of third year.

Sol. Principal (P) = Rs. 22500

Rate (r) = 10% p.a.

Period (n) = 3 years

Amount at the end of first year

$$= P \left[1 + \frac{r}{100} \right]^1 = 22500 \left[1 + \frac{10}{100} \right]^1$$

$$= \text{Rs. } 22500 \times \frac{11}{10} = \text{Rs. } 24750$$

Amount paid at the end of first year

$$= \text{Rs. } 11250$$

Balance = Rs. 24750 - Rs. 11250

$$= \text{Rs. } 13500$$

Amount at the end of 2nd year

$$= \text{Rs. } 13500 \left[1 + \frac{10}{100} \right]^1$$

$$= \text{Rs. } 13500 \times \frac{11}{10} = \text{Rs. } 14850$$

Amount paid at the end of 2nd year

$$= \text{Rs. } 12550$$

Balance = Rs. (14850 - 12550) = 2300

Amount at the end of 3rd year

$$= \text{Rs. } 2300 \left[1 + \frac{10}{100} \right]^1$$

$$= \text{Rs. } 2300 \times \frac{11}{10}$$

$$= \text{Rs. } 2530$$

Amount paid at the end of 3rd year

$$= \text{Rs. } 2530 \text{ Ans.}$$

Q. 16. Peter invests Rs. 240000 for 2 years at 10% per annum compounded annually. If 20% of the accrued interest at the end of each year is deducted as income tax, find the amount he received at the end of 2 years.

Ans. Principal (P) = Rs. 240000

Rate of interest (r) = 10% p.a.

Interest for the first year

$$= \frac{Prt}{100} = \frac{240000 \times 10 \times 1}{100}$$

$$= \text{Rs. } 24000$$

Amount after first year

$$= \text{Rs. } 240000 + \text{Rs. } 24000$$

$$= \text{Rs. } 264000$$

Income tax at 20%

$$= \text{Rs. } 24000 \times \frac{20}{100} = \text{Rs. } 4800$$

Balance sum = Rs. 264000 - Rs. 4800

$$= \text{Rs. } 259200$$

Interest for the second year

$$= \frac{259200 \times 10 \times 1}{100} = 25920$$

$$\text{Income tax at 20\%} = \text{Rs. } 25920 \times \frac{20}{100}$$

$$= \text{Rs. } 5184$$

\therefore Amount after 2nd year

$$= \text{Rs. } 259200 + 25920 - 5184$$

$$= \text{Rs. } 279936 \text{ Ans.}$$

Q. 17. A sum of money lent out at 12% p.a., compounded annually earns an interest of Rs. 2016 in the second year. Calculate:

- the sum of money lent out ;
- the compound interest earned in first year ;
- the compound interest earned in 3 years.

Sol. Rate of interest = 12% p.a.

Interest in the second year = Rs. 2016

Let principal = Rs. x

Then interest for the first year = $\frac{prt}{100}$

$$= \frac{x \times 12 \times 1}{100} = \frac{3x}{25}$$

\therefore Amount at the end of first year

$$= x + \frac{3x}{25} = \frac{25x + 3x}{25} = \frac{28x}{25}$$

Interest for the second year

$$= \frac{28x}{25} \times \frac{12 \times 1}{100} = \frac{28x \times 3}{25 \times 25} = \frac{84x}{625}$$

According to the problem,

$$\frac{84x}{625} = 2016$$

$$\Rightarrow x = \frac{2016 \times 625}{84}$$

$$\Rightarrow x = 24 \times 625 = \text{Rs. } 15000$$

\therefore Principal = Rs. 15000

(ii) Interest for the first year

$$= \frac{3x}{25} = \frac{3 \times 15000}{25}$$

$$= \text{Rs. } 3 \times 600 = \text{Rs. } 1800$$

(iii) Amount after 2 years

$$= \text{Rs. } 15000 + 1800 + 2016$$

$$= \text{Rs. } 18816$$

\therefore Interest for the third year

$$= \frac{18816 \times 12 \times 1}{100} = \text{Rs. } 2257.92$$

\therefore Interest for 3 years

$$= \text{Rs. } (1800 + 2016 + 2257.92)$$

$$= \text{Rs. } 6073.92 \text{ Ans.}$$

EXERCISE 1(B)

Q. 1. Calculate the amount and the compound interest on a sum of Rs. 6000 at the end of 3 years at the rate of 5% p.a., compounded annually.

Sol. Principal for the 1st year = Rs. 6000

Interest for the 1st year

$$= \text{Rs. } \left[6000 \times \frac{5}{100} \times 1 \right]$$

$$= \text{Rs. } 300$$

Amount at the end of 1st year

$$= \text{Rs. } (6000 + 300)$$

$$= \text{Rs. } 6300$$

\therefore Principal for the 2nd year = Rs. 6300

Interest for the 2nd year

$$= \text{Rs. } \left[6300 \times \frac{5}{100} \times 1 \right] = \text{Rs. } 315$$

Amount at the end of 2nd year

$$= \text{Rs. } (6300 + 315) = \text{Rs. } 6615$$

Principal for the 3rd year = Rs. 6615

Interest for the 3rd year

$$= \text{Rs. } \left[6615 \times \frac{5}{100} \times 1 \right] = \text{Rs. } 330.75$$

Amount at the end of the 3rd year

$$= \text{Rs. } (6615 + 330.75)$$

$$= \text{Rs. } 6945.75$$

$$\text{C.I.} = (A - P) = \text{Rs. } (6945.75 - 6000)$$

$$= \text{Rs. } 945.75$$

Hence, amount = Rs. 6945.75 and compound interest = Rs. 945.75 **Ans.**

Q. 2. Calculate the amount and the compound interest on Rs. 25600 for 2 years at $7\frac{1}{2}\%$ per annum compounded annually.

Sol. Principal = Rs. 25600

$$\text{Rate of Interest} = 7\frac{1}{2}\% = \frac{15}{2}\%$$

and Time = 2 years

$$\therefore \text{Amount, } A = P \left[1 + \frac{r}{100} \right]^n$$

$$= \text{Rs. } \left[25600 \left(1 + \frac{15}{2 \times 100} \right)^2 \right]$$

$$= \text{Rs. } \left[25600 \left(\frac{43}{40} \right)^2 \right]$$

$$= \text{Rs. } \left[25600 \times \frac{43}{40} \times \frac{43}{40} \right]$$

$$= 16 \times 43 \times 43 = \text{Rs. } 29584$$

$$\text{C.I.} = (A - P) = \text{Rs. } (29584 - 25600)$$

$$= \text{Rs. } 3984$$

Hence, amount = Rs. 29584 and compound interest = Rs. 3984 **Ans.**

Q. 3. Find the amount and the compound interest on Rs. 3200 in 2 years if the rate is 5% for the first year and $6\frac{1}{4}\%$ for the second year.

Sol. Principal (P) = Rs. 3200

Rate of interest = 5% on the first year and

$6\frac{1}{4}\%$ for the second year

Period (n) = 2 years

$$\begin{aligned}\therefore \text{Amount} &= P \left[1 + \frac{r}{100} \right]^n \\ &= 3200 \left[1 + \frac{5}{100} \right] \left[1 + \frac{25}{4 \times 100} \right] \\ &= 3200 \times \frac{21}{20} \times \frac{17}{16} = 10 \times 21 \times 17 \\ &= \text{Rs. } 3570\end{aligned}$$

$$\begin{aligned}\text{C.I.} &= A - P = \text{Rs. } 3570 - \text{Rs. } 3200 \\ &= \text{Rs. } 370 \text{ **Ans.**}\end{aligned}$$

Q. 4. Find the compound interest on Rs. 6250 for 3 years if the rates of interest for the first, second and third years are respectively 4%, 5% and 6% per annum.

Sol. Principal for the 1st year = Rs. 6250

Rate = 4% p.a.

Interest for the 1st year

$$= \text{Rs. } \left[6250 \times \frac{4}{100} \times 1 \right] = \text{Rs. } 250$$

Amount at the end of 1st half-year

$$= \text{Rs. } (6250 + 250) = \text{Rs. } 6500$$

Principal for the 2nd year = 6500

Rate = 5% p.a.

Interest for the 2nd year

$$\begin{aligned}&= \text{Rs. } \left[6500 \times \frac{5}{100} \times 1 \right] \\ &= \text{Rs. } 325\end{aligned}$$

Amount at the end of 2nd year

$$= \text{Rs. } (6500 + 325) = \text{Rs. } 6825$$

Principal for the 3rd year = Rs. 6825

Rate = 6% p.a.

Interest for the 3rd year

$$= \text{Rs. } \left[6825 \times \frac{6}{100} \times 1 \right]$$

$$= 273 \times \frac{3}{2} = \text{Rs. } 409.50$$

Amount at the end of 3rd year

$$= \text{Rs. } (6825 + 409.50)$$

$$= \text{Rs. } 7234.50$$

\therefore C.I. for 3 years = (Final amount)

– (Original principal)

$$= \text{Rs. } (7234.50 - 6250)$$

$$= \text{Rs. } 984.50$$

Hence, amount = Rs. 7234.50

and compound interest = Rs. 984.50 **Ans.**

Q. 5. Find the difference between the compound interest and simple interest on a sum of Rs.

3375 for 2 years at the rate of $6\frac{2}{3}\%$ p.a.

Sol. Principal (P) = Rs. 3375

Rate of interest (r)

$$= 6\frac{2}{3}\% \text{ p.a.} = \frac{20}{3}\% \text{ p.a.}$$

Period (n) = 2 years

$$\begin{aligned}\therefore \text{S.I.} &= \frac{Prt}{100} = \text{Rs. } \frac{3375 \times 20 \times 2}{100 \times 3} \\ &= \text{Rs. } 450\end{aligned}$$

When compounded yearly

$$\begin{aligned}A &= P \left[1 + \frac{r}{100} \right]^n = 3375 \left[1 + \frac{20}{3 \times 100} \right]^2 \\ &= \text{Rs. } 3375 \times \frac{16}{15} \times \frac{16}{15} = 15 \times 16 \times 16 \\ &= \text{Rs. } 3840\end{aligned}$$

$$\begin{aligned}\therefore \text{C.I.} &= A - P = \text{Rs. } 3840 - \text{Rs. } 3375 \\ &= \text{Rs. } 465\end{aligned}$$

$$\begin{aligned}\therefore \text{Difference between C.I and S.I.} \\ &= \text{Rs. } (465 - 450) = \text{Rs. } 15 \text{ Ans.}\end{aligned}$$

Q. 6. If the simple interest on a sum of money at 5% per annum for 3 years is Rs. 1200, find the compound interest on the same sum for the same period at the same rate.

Sol. Given : S.I. = Rs. 1200, $r = 5\%$,

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

$$\begin{aligned}P &= \frac{\text{S.I.} \times 100}{r \times t} = \text{Rs. } \left[\frac{1200 \times 100}{5 \times 3} \right] \\ &= \text{Rs. } 8000\end{aligned}$$

Now, we have : $P = 8000$, $r = 5\%$,

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

$$\therefore \text{Amount, } A = P \left[1 + \frac{r}{100} \right]^n$$

$$= \text{Rs. } \left[8000 \times \left(1 + \frac{5}{100} \right)^3 \right]$$

$$= \text{Rs. } \left[8000 \times \left(\frac{21}{20} \right)^3 \right]$$

$$= \text{Rs. } \left[8000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} \right]$$

$$= 21 \times 21 \times 21 = \text{Rs. } 9261$$

$$\begin{aligned}\text{So, C.I.} &= (A - P) = \text{Rs. } (9261 - 8000) \\ &= \text{Rs. } 1261\end{aligned}$$

$$\begin{aligned}\text{Hence, compound interest} \\ &= \text{Rs. } 1261 \text{ Ans.}\end{aligned}$$

Q. 7. Find the compound interest on Rs. 16000 at 15% per annum for 2 years 4 months, compounded annually.

Sol. Principal for the 1st year = Rs. 16000.

Rate of interest = 15%

Interest for the 1st year

$$= \text{Rs. } \left[16000 \times \frac{15}{100} \times 1 \right] = \text{Rs. } 2400$$

Amount at the end of 1st year
= Rs. (16000 + 2400) = Rs. 18400

Principal for the 2nd year = Rs. 18400

Interest for the 2nd year

$$= \text{Rs. } \left[18400 \times \frac{15}{100} \times 1 \right] = \text{Rs. } 2760$$

Amount at the end of 2nd year

$$= \text{Rs. } (18400 + 2760) = \text{Rs. } 21160$$

Principal for the 3rd year = rs. 21160

Interest for the next 4 months

$$= \text{Rs. } \left[21160 \times \frac{15}{100} \times \frac{4}{12} \right]$$

$$= 21160 \times \frac{3}{20} \times 1 = \text{Rs. } 1058$$

Amount at the end of 2 years 4 months

$$= \text{Rs. } (21160 + 1058)$$

$$= \text{Rs. } 22218$$

\therefore C.I. for 2 years 4 months

$$= \text{Rs. } (22218 - 16000)$$

$$= \text{Rs. } 6218$$

Hence, amount = Rs. 22218 and compound interest = Rs. 6218 **Ans.**

Q. 8. If the interest is compounded half-yearly, calculate the amount when the principal is Rs.7400, the rate of interest is 5% per annum and the duration is one year.

(2005)

Sol. Principal (P) = Rs.7400

Rate (r) = 5% p.a. or $\frac{5}{2}$ % half-yearly.

Period (n) = 1 year or 2 half years.

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

$$= 7400 \left(1 + \frac{5}{2 \times 100} \right)^2$$

$$= 7400 \left(\frac{41}{40} \right)^2$$

$$= \text{Rs. } 7400 \times \frac{41}{40} \times \frac{41}{40} = \text{Rs. } 7774.625$$

Amount = Rs. 7774.63 **Ans.**

Q. 9. What is the difference between the compound interests on Rs. 50000 for $1\frac{1}{2}$ years at 4% per annum compounded yearly and half-yearly?

Sol. Principal (P) = Rs. 50000

Rate = 4% p.a. or 2% half-yearly

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

In first case, when compounded annually

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

$$= 50000 \left[1 + \frac{4}{100} \right] \left[1 + \frac{2}{100} \right] = 50000 \times \frac{26}{25} \times \frac{51}{50}$$

$$= 40 \times 26 \times 51 = \text{Rs. } 53040$$

$$\therefore \text{C.I.} = A - P = \text{Rs. } 53040 - \text{Rs. } 50000 = \text{Rs. } 3040$$

In second case, when compounded half yearly

$$A = 50000 \left[1 + \frac{2}{100} \right]^3$$

$$= 50000 \times \frac{51}{50} \times \frac{51}{50} \times \frac{51}{50} = \frac{2}{5} \times 51 \times 51 \times 51$$

$$= \text{Rs. } 53060.40$$

$$\therefore \text{C.I.} = A - P$$

$$= \text{Rs. } 53060.40 - \text{Rs. } 50000 = \text{Rs. } 3060.40$$

Difference between the two C.I.

$$= \text{Rs. } 3060.40 - 3040.00 = \text{Rs. } 20.40 \text{ **Ans.**}$$

Q. 10. Find the difference between the simple interest and compound interest on Rs.

10240 for 2 years at $12\frac{1}{2}\%$ per annum,

compound interest being reckoned half-yearly.

Sol. Principal (P) = Rs. 10240

Rate of interest (r) = $12\frac{1}{2}\%$ p.a. or

$$= \frac{25}{2}\% \text{ p.a.}$$

Period (n) = 2 years or 4 half-years

$$\therefore \text{S.I.} = \frac{Prt}{100} = \frac{10240 \times 25 \times 2}{2 \times 100} = \frac{10240}{4}$$

$$= \text{Rs. } 2560$$

When compounded semi-annually,

$$A = P \left[1 + \frac{r}{100} \right]^n = 10240 \left[1 + \frac{6.25}{100} \right]^4$$

$$= 10240 \times \frac{106.25}{100} \times \frac{106.25}{100} \times \frac{106.25}{100} \times \frac{106.25}{100}$$

$$= \text{Rs. } 13050.16$$

$$\text{C.I.} = A - P = \text{Rs. } 13050.16 - \text{Rs. } 10240 = \text{Rs. } 2810.16$$

Difference between C.I. and S.I.

$$= \text{Rs. } 2810.16 - \text{Rs. } 2560 = \text{Rs. } 250.16 \text{ **Ans.**}$$

Q. 11. The simple interest on a sum of money for 2 years at 4% per annum is Rs. 340. Find (i) the sum of money and (ii) the compound interest on this sum for one year payable half yearly at the same rate.

(2008)

Sol. Simple interest (S.I.) = Rs. 340

Rate (R) = 4% p.a.

Period (T) = 2 year

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

$$= \text{Rs. } \frac{340 \times 100}{4 \times 2} = \text{Rs. } 4250$$

(ii) Principal (P) = Rs. 4250

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

Period (n) = 1 year or 2 half years

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

$$= \text{Rs. } 4250 \left(1 + \frac{2}{100}\right)^n = \text{Rs. } 4250 \times \left(\frac{51}{50}\right)^2$$

$$= \text{Rs. } 4250 \times \frac{51}{50} \times \frac{51}{50}$$

$$= \text{Rs. } 4421.70$$

$$\therefore \text{Compound interest} = A - P$$

$$= \text{Rs. } 4421.70 - 4250 = \text{Rs. } 171.70$$

Q. 12. (i) What sum of money will amount to Rs. 3630 in 2 years at 10% per annum compound interest? (2003)

(ii) What sum of money will amount to Rs. 9261 in 3 years at 5% per annum compound interest? (2009)

Sol.(i) Given : $A = \text{Rs. } 3630$, $R (r) = 10\%$ p.a.
and $n = 2$ years

Let the required sum be Rs. P . Then,

$$A = P \left[1 + \frac{r}{100}\right]^n \Rightarrow \text{Rs. } 3630 = P \left[1 + \frac{10}{100}\right]^2$$

$$\Rightarrow \text{Rs. } 3630 = P \times \frac{11}{10} \times \frac{11}{10}$$

\Rightarrow The required sum of money P

$$= \text{Rs. } 3630 \times \frac{10}{11} \times \frac{10}{11} = \text{Rs. } 3000 \text{ Ans.}$$

(ii) Here $A = \text{Rs. } 9261$,

$r = 5\%$ Time $(t) = 3$

$P = ?$

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

$$9261 = P \left(1 + \frac{5}{100}\right)^3 \Rightarrow 9261 = P \left(\frac{21}{20}\right)^3$$

$$P = \frac{9261 \times 20 \times 20 \times 20}{21 \times 21 \times 21} \Rightarrow P = \text{Rs. } 8000$$

Q. 13. On what sum of money will the compound interest for 2 years at 8% per annum be Rs. 3744.

Sol. C.I. = Rs. 3744

Rate of interest $(r) = 8\%$ p.a.

Period $(n) = 2$ years

We know that $A = P \left[1 + \frac{r}{100}\right]^n$

and C.I. = $A - P = P \left[1 + \frac{r}{100}\right]^n - P$

$$= P \left[\left[1 + \frac{r}{100}\right]^n - 1 \right]$$

$$\therefore 3744 = P \left[\left[1 + \frac{8}{100}\right]^2 - 1 \right] = P \left[\left[\frac{27}{25}\right]^2 - 1 \right]$$

$$= P \left[\frac{729}{625} - 1 \right] = P \left[\frac{729 - 625}{625} \right] = P \times \frac{104}{625}$$

$$\therefore P = 3744 \times \frac{625}{104} = \text{Rs. } 22500$$

Principal = Rs. 22500 Ans.

14. Mr. Dubey borrows Rs. 1,00,000 from State Bank of India at 11% per annum compound interest. He repays Rs. 41,000 at the end of first year and Rs. 47,700 at the end of the second year. Find the amount outstanding at the beginning of the third year. (2009)

Sol. Given : Borrowed money = P.A.

= Rs. 100000

Rate = 11% p.a.

Amount after 1st year = $P + \frac{100000 \times 11 \times 1}{100}$

= Rs. 100000 + 11000 = Rs. 111000

Paid at the end of 1st year = Rs. 41000

\therefore Principal for 2nd year = Rs. 111000 - 41000
= Rs. 70000

Amount after 2nd year = $P + \frac{70000 \times 11 \times 1}{100}$

= Rs. 70000 + 7700 = Rs. 77700

Paid at the end of 2 years = Rs. 47700

\therefore Amount outstanding at the beginning of 3rd year

$$= \text{Rs. } 77700 - 47700 = \text{Rs. } 30000$$

Q. 15. The compound interest on a sum for 2 years at $12\frac{1}{2}\%$ per annum is Rs. 510. Calculate the simple interest on the same sum at the same rate for the same period of time.

Sol. Given : C.I. = Rs. 510, $r = 12\frac{1}{2}\%$ p.a.,

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

Let the required sum be Rs. P. Then,

$$\text{C.I.} = P \left[\left(1 + \frac{r}{100} \right)^n - 1 \right]$$

$$\therefore P \times \left[\left(1 + \frac{25}{2 \times 100} \right)^2 - 1 \right] = 510$$

$$\Rightarrow P \times \left[\left(\frac{9}{8} \times \frac{9}{8} \right) - 1 \right] = 510$$

$$\Rightarrow P \times \left[\frac{81}{64} - 1 \right] = 510$$

$$\Rightarrow P \times \left[\frac{81 - 64}{64} \right] = 510$$

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

$$\Rightarrow P = \left[510 \times \frac{64}{17} \right]$$

$$\Rightarrow P = 1920$$

Now, we have : P = Rs. 1920,

$$r = \frac{25}{2}\% \text{ p.a.}, t = 2 \text{ years}$$

$$\therefore \text{S.I.} = \frac{P \times r \times t}{100}$$

$$= \text{Rs.} \left[\frac{1920 \times 25 \times 2}{2 \times 100} \right] = \text{Rs. } 480$$

Hence, simple interest = Rs. 480.

Q. 16. The difference between the simple interest and the compound interest on a certain sum of money at the end of 2 years is Rs. 117 at the rate of 15% per annum, the interest being credited annually. Find the sum.

Sol. Let the sum be Rs. 100

$$\begin{aligned} \text{Then, S.I.} &= \text{Rs.} \left[100 \times \frac{15}{100} \times 2 \right] \\ &= \text{Rs. } 30 \end{aligned}$$

$$\text{C.I.} = \text{Rs.} \left[100 \times \left\{ \left(1 + \frac{15}{100} \right)^2 - 1 \right\} \right]$$

$$= \text{Rs.} \left[100 \times \left\{ \left(\frac{23}{20} \right)^2 - 1 \right\} \right]$$

$$= \text{Rs.} \left[100 \times \left\{ \left(\frac{23}{20} \times \frac{23}{20} \right) - 1 \right\} \right]$$

$$= \text{Rs.} \left[100 \times \frac{529}{400} - 1 \right]$$

$$= \text{Rs.} \left[100 \times \frac{(529 - 400)}{400} \right]$$

$$= \text{Rs.} \frac{129}{4}$$

$$\therefore (\text{C.I.}) - (\text{S.I.}) = \text{Rs.} \left[\frac{129}{4} - 30 \right]$$

$$= \text{Rs.} \frac{(129 - 120)}{4} = \text{Rs.} \frac{9}{4}$$

If the difference between C.I. and S.I. is Rs. $\frac{9}{4}$, the sum = Rs. 100.

If the difference between C.I. and S.I. is Rs. 117 then sum

$$= \text{Rs.} \left[100 \times \frac{4}{9} \times 117 \right] = \text{Rs. } 5200$$

Hence, the sum is Rs. 5200.

Alternate Method

Let the sum be Rs. x . Then,

$$\text{S.I.} = \text{Rs.} \left[x \times \frac{15}{100} \times 2 \right] = \text{Rs.} \frac{30x}{100}$$

$$\text{C.I.} = \text{Rs.} \left[x \times \left(1 + \frac{15}{100} \right)^2 - x \right]$$

$$= \text{Rs.} \left[\frac{23 \times 23 \times x}{20 \times 20} - x \right]$$

$$= \text{Rs.} \frac{(529x - 400x)}{400} = \text{Rs.} \frac{129x}{400}$$

$$\therefore \text{C.I.} - \text{S.I.} = \text{Rs.} \left[\frac{129x}{400} - \frac{30x}{100} \right]$$

$$= \text{Rs.} \frac{129x - 120x}{400} = \text{Rs.} \frac{9x}{400}$$

$$\text{Thus, } \frac{9x}{400} = 117$$

$$\Leftrightarrow x = \left[\frac{400 \times 117}{9} \right]$$

$$\Rightarrow x = 5200.$$

Hence, the required sum is Rs. 5200.

Q. 17. The difference between the simple interest and the compound interest earned on a sum of money at the end of 4 years at the rate of 10% per annum is Rs. 256.40. What is the sum ?

Sol. Let Principal = Rs. 100

Rate = 10% p.a.

Period = 4 years

$$\therefore \text{S.I.} = \frac{Prt}{100} = \frac{100 \times 10 \times 4}{100} = \text{Rs.} 40$$

At compound interest,

$$A = P \left[1 + \frac{r}{100} \right]^n = 100 \left[1 + \frac{10}{100} \right]^4$$

$$= 100 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}$$

$$= \text{Rs.} \frac{14641}{100}$$

$$\therefore \text{C.I.} = A - P = \text{Rs.} \frac{14641}{100} - 100$$

$$= \text{Rs.} \frac{14641 - 10000}{100} = \text{Rs.} \frac{4641}{100}$$

Difference between C.I. and S.I.

$$= \text{Rs.} \frac{4641}{100} - \text{Rs.} 40$$

$$= \text{Rs.} \frac{4641 - 4000}{100} = \frac{641}{100}$$

If difference is Rs. $\frac{641}{100}$

then sum = Rs. 100 and if difference is Rs. 256.40,

$$\text{then sum} = \frac{100 \times 100}{641} \times 256.40$$

$$= 100 \times 100 \times 0.4$$

$$= \text{Rs.} 4000 \text{ Ans.}$$

Q. 18. If the difference between the compound interest compounded every six months, and the simple interest on a certain sum of money at the rate of 12% per annum for one year is Rs. 36, find the sum.

Sol. Let sum = Rs. 100

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

Period (n) = 1 year or 2 half-years

$$\therefore A = P \left[1 + \frac{r}{100} \right]^n$$

$$= 100 \left[1 + \frac{6}{100} \right]^2 = 100 \times \frac{53}{50} \times \frac{53}{50}$$

$$= \text{Rs.} \frac{5618}{50}$$

$$\therefore \text{C.I.} = A - P = \text{Rs.} \frac{5618}{50} - \text{Rs.} 100$$

$$= \text{Rs.} \frac{5618 - 5000}{50}$$

$$= \text{Rs.} \frac{618}{50}$$

$$\text{S.I.} = \frac{Prt}{100} = \frac{100 \times 12 \times 1}{100} = \text{Rs. } 12$$

Difference between C.I. and S.I.

$$= \text{Rs. } \frac{618}{50} - 12 = \text{Rs. } \frac{18}{50}$$

If difference is Rs. $\frac{18}{50}$, then sum

$$= \text{Rs. } 100$$

and if difference is Rs. 36, then sum

$$= \frac{100 \times 50 \times 36}{18} = \text{Rs. } 10000 \text{ Ans.}$$

Q. 19. On a certain sum of money, the difference between the compound interest for a year, payable half-yearly and the simple interest for a year is Rs. 180. Find the sum lent out, the rate of interest in both the cases being 10%. (2002)

Ans. Let sum = Rs. 100

Rate = 10% p.a. or 5% half-yearly

Period = 1 year or 2 half-years

$$\therefore A = P \left[1 + \frac{r}{100} \right]^n$$

$$= 100 \left[1 + \frac{5}{100} \right]^2 = 100 \times \frac{21}{20} \times \frac{21}{20}$$

$$= \text{Rs. } \frac{441}{4}$$

$$\therefore \text{C.I.} = A - P$$

$$= \text{Rs. } \frac{441}{4} - \text{Rs. } 100 = \text{Rs. } \frac{41}{4}$$

$$\text{S.I.} = \frac{Prt}{100} = \frac{100 \times 10 \times 1}{100} = \text{Rs. } 10$$

Difference between C.I. and S.I.

$$= \text{Rs. } \frac{41}{4} - 10 = \text{Rs. } \frac{1}{4}$$

If difference is Rs. $\frac{1}{4}$, then sum = Rs. 100,

and if difference is Rs. 180, then sum

$$= \frac{100 \times 4 \times 180}{1} = \text{Rs. } 72000 \text{ Ans.}$$

Q. 20. At what rate per cent per annum compound interest will Rs. 6250 amount to Rs. 7290 in 2 years ?

Sol. Amount = Rs. 7290, Principal = Rs. 6250

Period (n) = 2 years

Let rate percent = r % p.a.

$$\text{We know that } A = P \left[1 + \frac{r}{100} \right]^n$$

$$\Rightarrow \left[1 + \frac{r}{100} \right]^n = \frac{A}{P}$$

$$\Rightarrow \left[1 + \frac{r}{100} \right]^2 = \frac{7290}{6250} = \frac{729}{625} = \left[\frac{27}{25} \right]^2$$

$$\Rightarrow 1 + \frac{r}{100} = \frac{27}{25}$$

$$\Rightarrow \frac{r}{100} = \frac{27}{25} - 1 = \frac{2}{25}$$

$$\Rightarrow r = \frac{2 \times 100}{25} = \frac{200}{25} = 8$$

\therefore Rate = 8% p.a. **Ans.**

Q. 21. At what rate per cent per annum will Rs. 3000 amount to Rs. 3993 in 3 years if the interest is compounded annually ?

$$\text{Sol. Rs. } 3993 = \text{Rs. } 3000 \left[1 + \frac{r}{100} \right]^3$$

$$\Rightarrow \frac{3993}{3000} = \left[1 + \frac{r}{100} \right]^3$$

$$\Rightarrow \frac{1331}{1000} = \left[\frac{11}{10} \right]^3 = \left[1 + \frac{r}{100} \right]^3$$

$$\Rightarrow \left[1 + \frac{r}{100} \right] = \frac{11}{10}$$

$$\Rightarrow \frac{r}{100} = \frac{11}{10} - 1 = \frac{1}{10}$$

$$\therefore r = \frac{100}{10} = 10$$

\therefore Rate of interest = 10% p.a.

Q. 22. At what rate per cent per annum, will Rs. 3780 yield Rs. 520.80 as compound interest in 1 year, when compounded half-yearly?

Sol. Principal (P) = Rs. 3780

C.I. = Rs. 520.80

$$\therefore \text{Amount (A)} = \text{Rs. } 3780 + \text{Rs. } 520.80 \\ = \text{Rs. } 4300.80$$

Period (n) = 1 year = 2 half years

Let rate of interest = R% half yearly.

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

$$\Rightarrow 4300.80 = 3780 \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \frac{430080}{3780 \times 100} = \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \frac{256}{225} = \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \left(1 + \frac{R}{100} \right)^2 = \left(\frac{16}{15} \right)^2$$

$$\Rightarrow 1 + \frac{R}{100} = \frac{16}{15}$$

$$\Rightarrow \frac{R}{100} = \frac{16}{15} - 1 = \frac{1}{15}$$

$$\Rightarrow R = \frac{100}{15} = \frac{20}{3}$$

$$\therefore \text{Rate of p.a.} = \frac{20 \times 2}{3} = \frac{40}{3}$$

$$= 13\frac{1}{3}\% \text{ Ans.}$$

Q. 23. The compound interest, calculated yearly, on a certain sum of money for the second year is Rs. 880 and for the third year it is

Rs. 968. Calculate the rate of interest and the sum of money. (1995)

Sol. C.I. for the third year = Rs. 968 and
C.I. for the second year = Rs. 880.

$$\therefore \text{S.I. on Rs. 880 for one year} \\ = \text{Rs. } 968 - \text{Rs. } 880 = \text{Rs. } 88$$

$$\therefore \text{Rate of interest} = \frac{88 \times 100}{880 \times 1} \% = 10\%$$

Let the original money be Rs. P.

$$\text{Amount after 2 years} - \text{Amount after one year} \\ = \text{C.I. for second year}$$

$$\Rightarrow P \left[1 + \frac{10}{100} \right]^2 - P \left[1 + \frac{10}{100} \right] = 880$$

$$\Rightarrow P \left[\left(\frac{11}{10} \right)^2 - \frac{11}{10} \right] = 880$$

$$\Rightarrow P \left[\frac{121}{100} - \frac{11}{10} \right] = 880$$

$$\Rightarrow P \times \frac{11}{100} = 880$$

$$\Rightarrow P = 8000$$

\therefore The rate of interest = 10% and original sum of money = Rs. 8000.

Q. 24. A certain sum of money amounts to Rs. 5292 in 2 years and to Rs. 5556.60 in 3 years, interest being compounded annually. Find the rate per cent. (1994)

Sol. Amount after 2 years = Rs. 5292

and amount after 3 years = Rs. 5556.60

$$\therefore \text{Difference} = \text{Rs. } 5556.60 - \text{Rs. } 5292 \\ = \text{Rs. } 264.60$$

\therefore Rs. 264.60 is interest on Rs. 5292 for 1 year

$$\therefore \text{Rate \%} = \frac{\text{S.I.} \times 100}{P \times t} = \frac{264.60 \times 100}{5292 \times 1}$$

$$= \frac{26460 \times 100}{100 \times 5292} = 5\% \text{ p.a.}$$

Q. 25. A sum of money amounts to Rs. 6690 after 3 years and to Rs. 10035 after 6 years on compound interest. Find the sum.

Sol. Amount after 3 years = Rs. 6690

$$\Rightarrow P \left[1 + \frac{r}{100} \right]^3 = \text{Rs. } 6690 \quad \dots(i)$$

Amount after 6 years = Rs. 10035

$$\Rightarrow P \left[1 + \frac{r}{100} \right]^6 = \text{Rs. } 10035 \quad \dots(ii)$$

On dividing (ii) by (i), we get :

$$\begin{aligned} \frac{P \left[1 + \frac{r}{100} \right]^6}{P \left[1 + \frac{r}{100} \right]^3} &= \frac{10035}{6690} \\ &= \left[1 + \frac{r}{100} \right]^3 = \frac{669}{446} \\ &= \left[1 + \frac{r}{100} \right]^3 = \frac{3}{2} \end{aligned}$$

$$\text{We know that } A = P \left[1 + \frac{r}{100} \right]^n$$

$$\therefore 6690 = P \times \frac{3}{2}$$

$$\begin{aligned} \Rightarrow P &= 6690 \div \frac{3}{2} = 6690 \times \frac{2}{3} \\ &= \text{Rs. } 4460 \text{ Ans.} \end{aligned}$$

Q. 26. On a sum of money, the simple interest for 2 years is Rs. 660, while the compound interest is Rs. 696.30, the rate of interest being the same in both the cases. Find the rate of interest.

Sol. S.I. for 2 years = Rs. 660

$$\text{and S.I. for 1 year} = \text{Rs. } \frac{660 \times 1}{2} = 330$$

and C.I. for 2 years = Rs. 696.30

$$\begin{aligned} \therefore \text{Difference} &= \text{Rs. } 696.30 - \text{Rs. } 330 \\ &= \text{Rs. } 366.30 \end{aligned}$$

Difference between the C.I. of two successive years = Rs. 366.30 – Rs. 330
= Rs. 36.30

\Rightarrow Rs. 36.30 is the interest for one year on the interest of 1st year i.e. on Rs. 330.

$$\begin{aligned} \therefore \text{Rate \%} &= \frac{100 \times I}{P \times T} = \frac{100 \times 36.30}{330 \times 1} \% \\ &= 11\% \text{ Ans.} \end{aligned}$$

Q. 27. The difference between the compound interest and the simple interest on an amount of Rs. 15000 for 2 years is Rs. 96. What is the rate of interest per annum ?

Sol. Given : P = Rs. 15000, n = 2 years.

Let the rate be r % p.a.

$$\text{C.I.} - \text{S.I.} = 96$$

$$\begin{aligned} \Rightarrow 15000 \left[\left(1 + \frac{r}{100} \right)^2 - 1 \right] - \left[\frac{15000 \times r \times 2}{100} \right] &= 96 \end{aligned}$$

$$\Rightarrow 15000 \left[\left(\frac{100+r}{100} \right)^2 - 1 - \frac{2r}{100} \right] = 96$$

$$\Rightarrow 15000 \left[\frac{(100+r)^2 - 10000 - 200r}{10000} \right] = 96$$

$$\Rightarrow 15000$$

$$\begin{aligned} \left[\frac{10000 + 2 \times 100 \times r + r^2 - 10000 - 200r}{10000} \right] &= 96 \end{aligned}$$

$$\Rightarrow 15 \left[\frac{r^2}{10} \right] = 96$$

$$\Rightarrow \frac{3}{2} r^2 = 96$$

$$\Rightarrow r^2 = \left[96 \times \frac{2}{3} \right] = 64$$

$$\Rightarrow r = 8$$

Hence, rate = 8% p.a.

Q. 28. The compound interest on Rs. 30000 at 7% per annum for a certain period is Rs. 4347. Find the period for which the sum is invested.

Sol. Principal (P) = Rs. 30000

C.I. = Rs. 4347

$$\therefore \text{Amount (A)} = \text{Rs. } 30000 + \text{Rs. } 4347 \\ = \text{Rs. } 34347$$

We know that $\frac{A}{P} = \left[1 + \frac{r}{100}\right]^n$

$$\Rightarrow \frac{34347}{30000} = \left[1 + \frac{7}{100}\right]^n$$

$$\Rightarrow \frac{34347}{30000} = \left[\frac{107}{100}\right]^n$$

$$\Rightarrow \frac{11449}{10000} = \left[\frac{107}{100}\right]^n$$

$$\Rightarrow \left[\frac{107}{100}\right]^2 = \left[\frac{107}{100}\right]^n$$

$$\therefore n = 2$$

Hence, time = 2 years **Ans.**

Q. 29. In what time will Rs. 800 amount to Rs. 882 at 5% per annum compound interest ?

Sol. Principal (P) = Rs. 800

Amount (A) = Rs. 882

Rate = 5% p.a.

Let period = n years.

We know that

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

$$\Rightarrow \frac{882}{800} = \left[1 + \frac{5}{100}\right]^n$$

$$\Rightarrow \left[\frac{882}{800}\right] = \left[\frac{105}{100}\right]^n$$

$$\Rightarrow \left[\frac{882}{800}\right] = \left[\frac{21}{20}\right]^n$$

$$\Rightarrow \left[\frac{441}{400}\right] = \left[\frac{21}{20}\right]^n$$

$$\Rightarrow \left[\frac{21}{20}\right]^2 = \left[\frac{21}{20}\right]^n$$

$$\therefore n = 2$$

Hence, time = 2 years **Ans.**

Q. 30. In how many years will a sum of Rs. 1600 amount to Rs. 1852.20 at the rate of 10% per annum, compounded half-yearly ?

Sol. Principal (P) = Rs. 1600

Amount (A) = Rs. 1852.20

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

Let period = n half-years

Let the number of conversion periods be n .

$$\text{Then } A = P \left[1 + \frac{r}{100}\right]^n$$

$$\text{Rs. } 1852.20 = \text{Rs. } 1600 \left[1 + \frac{5}{100}\right]^n$$

$$\Rightarrow \frac{185220}{100} = 1600 \left[\frac{21}{20}\right]^n$$

$$\Rightarrow \left[\frac{21}{20}\right]^n = \frac{185220}{100 \times 1600} = \frac{185220}{160000}$$

$$\Rightarrow \frac{9261}{8000} = \left[\frac{21}{20}\right]^n$$

$$\Rightarrow \left[\frac{21}{20}\right]^3 = \left[\frac{21}{20}\right]^n$$

$$\therefore n = 3 \text{ half-years}$$

Hence, time = $\frac{3}{2} = 1\frac{1}{2}$ years **Ans.**

EXERCISE 1 (C)

Q. 1. A town has 15625 inhabitants. If the population of this town increases at the rate of 4% per annum, find the number of inhabitants of the town at the end of 3 years.

Sol. Present population (P) = 15625

Rate of increase (R) = 4% p.a.

Period (n) = 3 years

∴ Population at the end of 3rd years (A)

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

$$= 15625 \left(\frac{26}{25} \right)^3$$

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

$$= 17575 \text{ Ans.}$$

Q. 2. The population of a town is increasing at the rate of 10% per annum. If its present population is 36300, find :

(i) its population after 2 years,

(ii) its population 2 years ago.

Sol. (i) Present population (P) = 36300

Rate of increase (R) = 10%

Period (n) = 2 years.

∴ Population after 2 years

$$= 36300 \left(1 + \frac{10}{100} \right)^2$$

$$= 36300 \times \left(\frac{11}{10} \right)^2$$

$$= 36300 \times \frac{11}{10} \times \frac{11}{10} = 43923$$

(ii) Present population (A) = 36300

Let population 2 years ago = P

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

$$\Rightarrow 36300 = P \left(1 + \frac{10}{100} \right)^2$$

$$\Rightarrow 36300 = P \left(\frac{11}{10} \right)^2 = P \times \frac{121}{100}$$

$$\therefore P = 36300 \times \frac{100}{121} = 30000$$

Hence population 2 years ago

$$= 30000 \text{ Ans.}$$

Q. 3. The present population of a town is 176400. If the rate of growth in its population is 5% per annum, find :

(i) its population 2 years hence,

(ii) its population one year ago.

Sol. (i) Present population (P) = 176400

Rate of growth (R) = 5% p.a.

Period (n) = 2 years.

∴ Population after 2 years (A)

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

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

$$= 176400 \times \left(\frac{21}{20} \right)^2$$

$$= 176400 \times \frac{21}{20} \times \frac{21}{20} = 194481 \text{ Ans.}$$

(ii) Present population (A) = 176400

Let one year ago, its population = P

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

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

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

$$\Rightarrow P = 176400 \times \frac{20}{21} = 168000$$

∴ Population one year ago = 168000 Ans.

Q. 4. Three years ago, the population of a city was 50000. If the annual increase during three successive years be 5%, 8% and

10% respectively, find the present population of the city.

Sol. Three years ago, the population of a city (P) = 50000

Rate of increase for the first year (R_1) = 5%

Rate of increase for the second year (R_2) = 8%

and rate of increase for the third year (R_3) = 10%

\therefore Present population

$$= P \left(1 + \frac{R_1}{100}\right) \left(1 + \frac{R_2}{100}\right) \left(1 + \frac{R_3}{100}\right)$$

$$= 50000 \left(1 + \frac{5}{100}\right) \left(1 + \frac{8}{100}\right) \left(1 + \frac{10}{100}\right)$$

$$= 50000 \times \frac{21}{20} \times \frac{27}{25} \times \frac{11}{10} = 62370 \text{ Ans.}$$

Q. 5. A farmer has an increase of 12.5% in the output of wheat in his farm every year. This year, he produced 2916 quintals of wheat. What was his annual production of wheat 2 years ago?

Sol. Present production (P) = 2916 quintals
Rate of increase (R) = 12.5%

$$= \frac{25}{2} \% \text{ p.a.}$$

Period (n) = 2 years

Let 2 years ago, his production = P

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

$$\Rightarrow 2916 = P \left(1 + \frac{25}{2 \times 100}\right)^2$$

$$\Rightarrow 2916 = P \times \left(\frac{9}{8}\right)^2 \Rightarrow 2916 = P \times \frac{81}{64}$$

$$\Rightarrow 2916 \times \frac{64}{81} = 2304 \text{ quintals Ans.}$$

Q. 6. The population of a town is 64000. If the annual birth rate is 11.7% and annual death rate is 4.2%, calculate the population of the town after 3 years.

Sol. Present population (P) = 64000

Annual birth rate = 11.7%

and annual death rate = 4.2%

\therefore Increase rate per year (R)

$$= 11.7 - 4.2 = 7.5\%$$

Period (n) = 3 years.

\therefore Population of the town after 3 years

$$= P \left(1 + \frac{R}{100}\right)^n = 64000 \left(1 + \frac{7.5}{100}\right)^3$$

$$= 64000 \left(1 + \frac{75}{10 \times 100}\right)^3$$

$$= 64000 \times \left(\frac{43}{40}\right)^3 = 64000 \times \frac{43}{40} \times \frac{43}{40} \times \frac{43}{40}$$

$$= 79507 \text{ Ans.}$$

Q. 7. A mango tree was planted 2 years ago. The rate of its growth is 20% per annum. If at present, the height of the tree is 162 cm, what it was when the tree was planted?

Sol. Present height of the tree (A) = 162 cm.

Rate of growth (R) = 20% p.a.

Period (n) = 2 years

Let P be the height of the tree 2 years ago.

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

$$\Rightarrow 162 = P \left(1 + \frac{20}{100}\right)^2$$

$$\Rightarrow 162 = P \left(\frac{6}{5}\right)^2$$

$$\Rightarrow P = 162 \times \frac{5}{6} \times \frac{5}{6}$$

$$\Rightarrow P = 112.5 \text{ cm.}$$

\therefore Height of the tree 2 years ago

$$= 112.5 \text{ cm. Ans.}$$

Q. 8. Two years ago, the population of a village was 4000. During next year it increased by 6% but due to an epidemic, it decreased by 5% in the following year. What is its population now?

Sol. 2 years ago, population of a village = 4000

Rate of increase for the first year (R_1) = 6% p.a.

and rate of decrease in second year (R_2) = 5% p.a.

\therefore Present population

$$\begin{aligned} &= P \left(1 + \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \\ &= 4000 \left(1 + \frac{6}{100} \right) \left(1 - \frac{5}{100} \right) \\ &= 4000 \times \frac{53}{50} \times \frac{19}{20} = 4028 \text{ Ans.} \end{aligned}$$

Q. 9. The count of bacteria in a culture grows by 10% during first hour, decreases by 8% during second hour and again increases by 12% during third hour. If the count of bacteria in the sample is 13125000, what will be the count of bacteria after 3 hours?

Sol. Present count of bacteria (P) = 13125000.

Rate of increase in first hour (R_1) = 10%

Rate of decrease in second hour (R_2) = 8%

Rate of increase in third hour (R_3) = 12%

\therefore Count of bacteria after 3 hours

$$\begin{aligned} &= 13125000 \left(1 + \frac{10}{100} \right) \left(1 - \frac{8}{100} \right) \left(1 + \frac{12}{100} \right) \\ &= 13125000 \times \frac{11}{10} \times \frac{23}{25} \times \frac{28}{25} \\ &= 2100 \times 11 \times 23 \times 28 \\ &= 14876400 \text{ Ans.} \end{aligned}$$

Q. 10. In a factory, the production of scooters was 40000, per year which rose to 50625 in 2 years. Find the rate of growth of per annum.

Sol. Present production (P) = 40000

Production after 2 years (A) = 50625

Let rate of increase = $R\%$

Period (n) = 2 years

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

$$\Rightarrow 50625 = 40000 \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \frac{50625}{40000} = \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \frac{81}{64} = \left(1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \left(1 + \frac{R}{100} \right)^2 = \left(\frac{9}{8} \right)^2$$

$$\Rightarrow 1 + \frac{R}{100} = \frac{9}{8}$$

$$\Rightarrow \frac{R}{100} = \frac{9}{8} - 1 = \frac{1}{8}$$

$$\Rightarrow R = \frac{1}{8} \times 100 = \frac{25}{2} = 12.5$$

Hence rate of increase = 12.5% p.a. **Ans.**

Q. 11. Amit started a shop by investing Rs. 300000. In the first year, he incurred a loss of 5%. However, during the second year, he earned a profit of 10% which in the third year rose to 12%. Calculate his net profit for the entire period of three years.

Sol. Present investment (P) = Rs. 300000

Loss in first year (R_1) = 5%

gain in second year (R_2) = 10%

gain in third year (R_3) = 12%

\therefore Total amount after 3 years

$$= \text{Rs. } 300000 \left(1 - \frac{5}{100} \right) \left(1 + \frac{10}{100} \right)$$

$$\left(1 + \frac{12}{100} \right)$$

$$= \text{Rs. } 300000 \times \frac{19}{20} \times \frac{11}{10} \times \frac{28}{25}$$

$$= \text{Rs. } 60 \times 19 \times 11 \times 28$$

$$= \text{Rs. } 351120$$

$$\therefore \text{Net profit} = \text{Rs. } 351120 - \text{Rs. } 300000 \\ = \text{Rs. } 51120 \text{ Ans.}$$

Q. 12. The value of a machine depreciates 10% annually. Its present value is Rs. 36300. Find :

(i) its value after 2 years,

(ii) its value 2 years ago.

Sol. (i) Present value of machine (P) = Rs. 36300

Rate of depreciation (R) = 10% p.a.

Period (n) = 2 years

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

$$= \text{Rs. } 36300 \left(1 - \frac{10}{100} \right)^2$$

$$= \text{Rs. } 36300 \times \left(\frac{9}{10} \right)^2$$

$$= \text{Rs. } 36300 \times \frac{9}{10} \times \frac{9}{10}$$

$$= \text{Rs. } 29403$$

(ii) Present value (P) = Rs. 36300

\therefore Value 2 years ago

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

$$\Rightarrow 36300 = P \left(1 - \frac{10}{100} \right)^2$$

$$\Rightarrow 36300 = P \times \left(\frac{9}{10} \right)^2$$

$$\Rightarrow P = 36300 \times \frac{10 \times 10}{9 \times 9}$$

$$\Rightarrow P = 44814.82$$

\therefore Value 2 years ago

$$= \text{Rs. } 44814.82 \text{ Ans.}$$

Q. 13. The value of a machine depreciates at the rate of $16\frac{2}{3}\%$ per annum. It was purchased 3 years ago. If its present value is Rs. 50625, find its purchase price.

Sol. Present value of machine (P) = Rs. 50625

Rate of depreciation (R)

$$= 16\frac{2}{3}\% = \frac{50}{3}\% \text{ p.a.}$$

Period (n) = 3 years

Let value of machine 3 years ago = P

$$\therefore A = P \left(1 - \frac{R}{100} \right)^3$$

$$\Rightarrow 50625 = P \left(1 - \frac{50}{3 \times 100} \right)^3$$

$$\Rightarrow 50625 = P \left(\frac{5}{6} \right)^3$$

$$\Rightarrow P = 50625 \times \left(\frac{6}{5} \right)^3$$

$$= 50625 \times \frac{6}{5} \times \frac{6}{5} \times \frac{6}{5} = \text{Rs. } 87480$$

\therefore Value of machine 3 years ago

$$= \text{Rs. } 87480 \text{ Ans.}$$

Q. 14. A refrigerator was purchased 3 years ago for Rs. 15625. Its value depreciates at 16% per annum. Find :

(i) its present value.

(ii) its value after 1 year.

Sol. Cost price of refrigerator 3 years ago = Rs. 15625

Rate of depreciation (R) = 16% p.a.

Period (n) = 3 years

$$(i) \therefore \text{Present value (A)} = P \left(1 - \frac{R}{100} \right)^n$$

$$= \text{Rs. } 15625 \left(1 - \frac{16}{100} \right)^3$$

$$\begin{aligned}
 &= \text{Rs. } 15625 \left(1 - \frac{4}{25}\right)^3 \\
 &= 15625 \times \left(\frac{21}{25}\right)^3 \\
 &= 15625 \times \frac{21}{25} \times \frac{21}{25} \times \frac{21}{25} = \text{Rs. } 9261 \text{ Ans.}
 \end{aligned}$$

(ii) Value of refrigerator after one year

$$\begin{aligned}
 &= \text{Rs. } 9261 \left(1 - \frac{16}{100}\right) \\
 &= \text{Rs. } 9261 \times \left(1 - \frac{4}{25}\right) \\
 &= \text{Rs. } 9261 \times \frac{21}{25} = \text{Rs. } 7779.24 \text{ Ans.}
 \end{aligned}$$

Q. 15. A machine depreciates each year at 8% of its value in the beginning of the year. If its value be Rs. 55200 at the end of the year 2004, find :

- (i) its value at the end of the year 2003,
 (ii) its value at the end of the year 2005.

Sol. In the end of year 2004,

$$\text{Value of machine (A)} = \text{Rs. } 55200$$

$$\text{Rate of depreciation (R)} = 8\%$$

(i) Value of machine at the end of the year 2003 = P

$$\therefore A = P \left[1 - \frac{R}{100}\right]$$

$$\Rightarrow \text{Rs. } 55200 = P \left[1 - \frac{8}{100}\right]$$

$$\Rightarrow \text{Rs. } 55200 = P \times \frac{23}{25}$$

$$\Rightarrow P = \text{Rs. } \frac{55200 \times 25}{23}$$

$$= 2400 \times 25$$

$$\Rightarrow P = \text{Rs. } 60000 \text{ Ans.}$$

\therefore Value of machine at the end of year 2003 = Rs. 60000 Ans.

(ii) Value at the end of year 2005

$$= \text{Rs. } 55200 \left[1 - \frac{8}{100}\right]$$

$$= \text{Rs. } 55200 \times \frac{23}{25}$$

$$= \text{Rs. } 50784 \text{ Ans.}$$