

## Maharashtra State Board 12th Commerce Maths Solutions Chapter 2 Insurance and Annuity Ex 2.1

Question 1.

Find the premium on a property worth ₹ 25,00,000 at 3% if

(i) the property is fully insured

(ii) the property is insured for 80% of its value.

Solution:

Case-1

Property value = ₹ 25,00,000

Rate of Premium = 3%

Policy Value = ₹ 25,00,000

∴ Amount of Premium = 3% × 25,00,000 = ₹ 75,000

Case-2

Property Value = ₹ 25,00,000

Policy value = 80% × 25,00,000 = ₹ 20,00,000

Rate of Premium = 3%

∴ Amount of Premium = 3% × 20,00,000 = ₹ 60,000

Question 2.

A shop is valued at ₹ 3,60,000 for 75% of its value. If the rate of premium is 0.9%, find the premium paid by the owner of the shop. Also, find the agents commission if the agent gets commission at 15% of the premium.

Solution:

Property Value = ₹ 3,60,000

Policy Value = 75% × 3,60,000 = ₹ 2,70,000

Rate of Premium = 0.9%

∴ Amount of Premium = 0.9% × 2,70,000 = ₹ 2,430

Rate of Commission = 15%

∴ Amount of Commission = 15% × 2,430 = ₹ 364.5

Question 3.

A person insures his office valued at ₹ 5,00,000 for 80% of its value. Find the rate of premium if he pays ₹ 13,000 as premium. Also, find agent's commission at 11%.

Solution:

Property Value = ₹ 5,00,000

Policy Value = 80% × 5,00,000 = ₹ 4,00,000

Amount of Premium = ₹ 13000

Let the rate of Premium be x%

Amount of premium = Rate × Policy Value

∴ 13000 = x% × 4,00,000

∴  $13,000 \times 100,000 = x \times 100$

∴  $13,000 \times 100,000 = x$

∴ x = 3.25%

Rate of commission = 11%

∴ Amount of Commission = 11% × 13,000 = ₹ 1,430

Question 4.

A building is insured for 75% of its value. The annual premium at 0.70 percent amounts to ₹ 2625. If the building is damaged to the extent of 60% due to fire, how much can be claimed under the policy?

Solution:

Let the Property Value of building be ₹ x

Policy Value = 75% × x = 0.75x

Rate of Premium = 0.70%

Amount of Policy = Rate × Policy Value

2625 = 0.70% × 0.75x

$2625 \times 100 = 0.70\% \times x$

$3520 = 0.70 \times x$

$3500 \times 100 = x$

x = ₹ 5,00,000

∴ Damage = 60% × Property Value

= 60% × 5,00,000

= ₹ 3,00,000

∴ Policy Value = 0.75 × 5,00,000 = ₹ 3,75,000

∴ Claim =  $\frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$

$$= 2,25,000 \times 3,00,000$$

$$= ₹ 1,35,000$$

Question 5.

A stock worth ₹ 7,00,000 was insured for ₹ 4,50,000. Fire burnt stock worth ₹ 3,00,000 completely and damaged the remaining stock to the extent of 75% of its value. What amount can be claimed under the policy?

Solution:

$$\text{Property Value} = ₹ 7,00,000$$

$$\text{Policy Value} = ₹ 4,50,000$$

$$\text{Complete Loss} = 3,00,000$$

$$\text{Partial loss} = 75\% \times [7,00,000 - 3,00,000]$$

$$= 75\% \times 4,00,000$$

$$= ₹ 3,00,000$$

$$\therefore \text{Total loss} = ₹ 3,00,000 + ₹ 3,00,000 = ₹ 6,00,000$$

$$\therefore \text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$= \frac{4,50,000}{7,00,000} \times 6,00,000$$

$$= ₹ 3,85,714.29$$

Question 6.

A cargo of rice was insured at 0.625 % to cover 80% of its value. The premium paid was ₹ 5,250. If the price of rice is ₹ 21 per kg. find the quantity of rice (in kg) in the cargo.

Solution:

$$\text{Let Property Value be } ₹ x$$

$$\text{Policy Value} = 80\% \times x = ₹ 0.8x$$

$$\text{Rate of Policy} = 0.625\%$$

$$\text{Amount of Premium} = \text{Rate} \times \text{Policy value}$$

$$\therefore 5250 = 0.625\% \times 0.8x$$

$$\therefore 5250 = 0.005x$$

$$\therefore x = \frac{5250}{0.005}$$

$$\therefore x = ₹ 10,50,000$$

$$\text{Rate of Rice} = ₹ 21/\text{kg}$$

$$\therefore \text{Quantity of Rice (in kg)} = \frac{\text{Total value}}{\text{Rate of Rice}}$$

$$= \frac{10,50,000}{21}$$

$$= 50,000 \text{ kgs}$$

Question 7.

60,000 articles costing ₹ 200 per dozen were insured against fire for ₹ 2,40,000. If 20% of the articles were burnt and 7,200 of the remaining articles were damaged to the extent of 80% of their value, find the amount that can be claimed under the policy.

Solution:

$$\text{No of articles} = 60,000$$

$$\text{Cost of articles} = ₹ 200/\text{dozen}$$

$$\therefore \text{Property of Value} = \frac{60,000}{12} \times 200 = ₹ 10,00,000$$

$$\therefore \text{Policy Value} = ₹ 2,40,000$$

$$\text{Complete Loss} = 20\% \times 10,00,000 = ₹ 2,00,000$$

$$\text{Partial loss} = \frac{7,200}{12} \times 200 \times 80\% = ₹ 96,000$$

$$\therefore \text{Total loss} = 2,00,000 + 96,000 = ₹ 2,96,000$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$= \frac{2,40,000}{10,00,000} \times 2,96,000$$

$$= ₹ 71,040$$

Question 8.

The rate of premium is 2% and other expenses are 0.075%. A cargo worth ₹ 3,50,100 is to be insured so that all its value and the cost of insurance will be recovered in the event of total loss.

Solution:

$$\text{Let the Policy Value of Cargo be } ₹ 100 \text{ which includes insurance and other expenses}$$

$$\therefore \text{Property Value} = 100 - [2 + 0.075] = ₹ 97.925$$

$$\text{If Policy Value is } ₹ 100, \text{ then Property Value is } ₹ 97.925$$

$$\text{If Property Value is } ₹ 3,50,100$$

$$\text{Then policy Value} = \frac{100 \times 3,50,100}{97.925} = ₹ 3,57,518.51$$

Question 9.

A property worth ₹ 4,00,000 is insured with three companies. A, B, and C. The amounts insured with these companies are ₹ 1,60,000, ₹ 1,00,000 and ₹ 1,40,000 respectively. Find the amount recoverable from each company in the event of a loss to the extent of ₹ 9,000.

Solution:

$$\text{Property Value} = ₹ 4,00,000$$

$$\text{Loss} = ₹ 9,000$$

$$\text{Total Value of Policies} = 1,60,000 + 1,00,000 + 1,40,000 = ₹ 4,00,000$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$\text{Claim of company A} = \frac{1,60,000}{40,000} \times 9,000 = ₹ 3,600$$

$$\text{Claim of company B} = \frac{1,00,000}{4,00,000} \times 9,000 = ₹ 2,250$$

$$\text{Claim of company C} = \frac{1,40,000}{4,00,000} \times 9,000 = ₹ 3,150$$

Question 10.

A car valued at ₹ 8,00,000 is insured for ₹ 5,00,000. The rate of premium is 5% less 20%. How much will the owner bear including the premium if value of the car is reduced to 60% of its original value.

Solution:

$$\text{Property Value} = ₹ 8,00,000$$

$$\text{Policy Value} = ₹ 5,00,000$$

$$\text{Rate of Premium} = 5\% \text{ less } 20\%$$

$$= 5\% - 20\% \times 5\%$$

$$= (5 - 1)\%$$

$$= 4\%$$

$$\text{Amount of Premium} = 4\% \times 5,00,000 = ₹ 20,000$$

$$\text{Loss} = [100 - 60]\% \times \text{Property Value}$$

$$= 40\% \times 8,00,000$$

$$= ₹ 3,20,000$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$= \frac{5,00,000}{8,00,000} \times 3,20,000$$

$$= ₹ 2,00,000$$

$$\text{Loss bear by owner} = \text{Loss} - \text{claim} + \text{Premium}$$

$$= 3,20,000 - 2,00,000 + 20,000$$

$$= ₹ 1,40,000$$

Question 11.

A shop and a godown worth ₹ 1,00,000 and ₹ 2,00,000 respectively were insured through an agent who was paid 12% of the total premium. If the shop was insured for 80% and the godown for 60% of their respective values, find the agent's commission, given that the rate of premium was 0.80% less 20%.

Solution:

$$\text{Rate of Premium} = 0.80\% \text{ Less } 20\%$$

$$= 0.80\% - 20\% \times 0.80\%$$

$$= (0.80 - 0.16)\%$$

$$= 0.64\%$$

For Shop

$$\text{Property Value} = ₹ 1,00,000$$

$$\text{Policy Value} = 80\% \times 1,00,000 = ₹ 80,000$$

$$\text{Premium} = 0.64\% \times 80,000 = ₹ 512$$

For Godown

$$\text{Property Value} = ₹ 2,00,000$$

$$\text{Policy Value} = 60\% \times 2,00,000 = ₹ 1,20,000$$

$$\text{Premium} = 0.64\% \times 1,20,000 = ₹ 768$$

$$\therefore \text{Total Premium} = 512 + 768 = ₹ 1,280$$

$$\text{Rate of Commission} = 12\%$$

$$\therefore \text{Agent Commission} = 12\% \times 1,280 = ₹ 153.6$$

Question 12.

The rate of premium on a policy of ₹ 1,00,000 is ₹ 56 per thousand per annum. A rebate of ₹ 0.75 per thousand is permitted if the premium is paid annually. Find the net amount of premium payable if the policy holder pays the premium annually.

Solution:

$$\text{Policy Value} = ₹ 1,00,000$$

$$\text{Rate of Premium} = ₹ 56 \text{ per thousand p.a.}$$

$$\text{Rate of Rebate} = ₹ 0.75 \text{ per thousand p.a.}$$

Premium is paid annually

$$\therefore \text{Net rate of} = 56 - 0.75 = ₹ 55.25 \text{ per thousand p.a.}$$

$$\therefore \text{Net Amount of Premium} = \frac{1,00,000}{1,000} \times 55.25 = ₹ 5,525$$

Question 13.

A warehouse valued at ₹ 40,000 contains goods worth ₹ 2,40,000. The warehouse is insured against fire for ₹ 16,000 and the goods to the extent of 90% of their value. Goods worth ₹ 80,000 are completely destroyed, while the remaining goods are destroyed to 80% of their value due to a fire. The damage to the warehouse is to the extent of ₹ 8,000. Find the total amount that can be claimed.

Solution:

For Warehouse

$$\text{Property Value} = ₹ 40,000$$

$$\text{Policy Value} = ₹ 16,000$$

$$\text{Loss} = ₹ 8,000$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

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$$= 16,000 \times 8,000$$

$$= ₹ 3,200$$

For Goods

$$\text{Property Value} = ₹ 2,40,000$$

$$\text{Policy Value} = 90\% \times 2,40,000 = ₹ 2,16,000$$

$$\text{Complete Loss} = 80,000$$

$$\text{Partial Loss} = 80\% \times (2,16,000 - 80,000)$$

$$= 80\% \times 1,36,000$$

$$= ₹ 1,08,800$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$= \frac{2,16,000}{2,40,000} \times 1,08,800$$

$$= ₹ 97,920$$

$$\therefore \text{Total Claim} = 3,200 + 97,920 = ₹ 1,01,120$$

Question 14.

A person takes a life policy for ₹ 2,00,000 for a period of 20 years. He pays premium for 10 years during which bonus was declared at an average rate of ₹ 20 per year per thousand. Find the paid up value of the policy if he discontinues paying premium after 10 years.

Solution:

$$\text{Policy Value} = ₹ 2,00,000$$

$$\text{Rate of Bonus} = ₹ 20 \text{ Per thousand p.a.}$$

$$\text{Total Bonus} = 2,00,000 \times 20 = ₹ 4,00,000$$

$$\therefore \text{Bonus for 10 years} = 4,00,000 \times 10 = ₹ 40,000$$

$$\text{Period of Policy} = 20 \text{ years}$$

$$\therefore \text{Amount of Premium} = \frac{2,00,000}{20} = ₹ 10,000 \text{ p.a.}$$

$$\therefore \text{Total Premium for 10 years} = 10,000 \times 10 = ₹ 1,00,000$$

$$\therefore \text{Paid up Value of Policy} = \text{Total premium} + \text{Total Bonus}$$

$$= 1,00,000 + 40,000$$

$$= ₹ 1,40,000$$

## Maharashtra State Board 12th Commerce Maths Solutions Chapter 2 Insurance and Annuity Ex 2.2

Question 1.

Find the accumulated (future) value of annuity of ₹ 800 for 3 year at interest rate 8% compounded annually. [Given:  $(1.08)^3 = 1.2597$ ]

Solution:

$$\therefore C = ₹ 800$$

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

$$\therefore r = 8\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{8}{100} = 0.08$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore A = \frac{800}{0.08} [(1+0.08)^3 - 1]$$

$$\therefore A = 10,000[(1.08)^3 - 1]$$

$$\therefore A = 10,000[1.2597 - 1]$$

$$\therefore A = 10,000 \times 0.2597$$

$$\therefore A = ₹ 2,597$$

Question 2.

A person invested ₹ 5,000 every year in finance company that offered him interest compounded at 10% p.a., what is the amount accumulated after 4 years? [Given:  $(1.1)^4 = 1.4641$ ]

Solution:

$$\therefore C = ₹ 5,000$$

$$\therefore r = 10\% \text{ p.a.}$$

$$i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore n = 4 \text{ years}$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$= \frac{5,000}{0.1} [(1+0.1)^4 - 1]$$

$$= 50,000[(1.1)^4 - 1]$$

$$= 50,000[1.4641 - 1]$$

$$= 50,000 \times 0.4641$$

$$= ₹ 23,205$$

Question 3.

Find the amount accumulated after 2 years if a sum of ₹ 24,000 is invested every six months at 12% p.a. compounded half yearly. [Given:  $(1.06)^4 = 1.2625$ ]

Solution:

$$\therefore C = ₹ 24,000$$

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

But invested half yearly

$$\therefore n = 2 \times 2 = 4$$

$$\therefore r = 12\% \text{ p.a. compounded half yearly}$$

$$\therefore r = \frac{12}{2} = 6\%$$

$$\therefore i = \frac{r}{100} = \frac{6}{100} = 0.06$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$= \frac{24,000}{0.06} [(1+0.06)^4 - 1]$$

$$= 4,00,000[(1.06)^4 - 1]$$

$$= 4,00,000[1.2625 - 1]$$

$$= 4,00,000 \times 0.2625$$

$$= ₹ 1,05,000$$

Question 4.

Find the accumulated value after 1 year of an annuity immediate in which ₹ 10,000 are invested every quarter at 16% p.a. compounded quarterly. [Given:  $(1.04)^4 = 1.1699$ ]

Solution:

$$\therefore C = ₹ 10,000$$

$$\therefore n = 1 \text{ year}$$

But invested every quarterly

$$\therefore n = 1 \times 4 = 4$$

$$\therefore r = 16\% \text{ p.a. compounded quarterly}$$

$$\therefore r = \frac{16}{4} = 4\%$$

$$\therefore i = \frac{r}{100} = \frac{4}{100} = 0.04$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$= \frac{10,000}{0.04} [(1+0.04)^4 - 1]$$

$$= \frac{10,00,000}{4} [(1.04)^4 - 1]$$

$$= 2,50,000 [1.1699 - 1]$$

$$= 2,50,000 \times 0.1699$$

$$= ₹ 42,475$$

Question 5.

Find the present value of an annuity immediate of ₹ 36,000 p.a. for 3 years at 9% p.a. compounded annually. [Given:  $(1.09)^{-3} = 0.7722$ ]

Solution:

$$\therefore C = ₹ 36,000$$

$\therefore n = 3$  years

$\therefore r = 9\%$  p.a.

$$= 4,00,000 \times 0.2278$$

$$= ₹ 91,120$$

Question 6.

Find the present value of ordinary annuity of ₹ 63,000 p.a. for 4 years at 14% p.a. compounded annually. [Given:  $(1.14)^{-4} = 0.5921$ ]

Solution:

$$\therefore C = ₹ 63,000$$

$$\therefore n = 4$$
 years

$$\therefore r = 14\%$$
 p.a.

$$\therefore i = \frac{r}{100} = \frac{14}{100} = 0.14$$

$$\therefore P = \frac{C}{i} [1 - (1 + i)^{-n}]$$

$$\therefore P = \frac{63,000}{0.14} [1 - (1 + 0.14)^{-4}]$$

$$\therefore P = \frac{63,000 \times 100}{14} [1 - (1.14)^{-4}]$$

$$= 4,50,000 [1 - 0.5921]$$

$$= 4,50,000 \times 0.4079$$

$$= ₹ 1,83,555$$

Question 7.

A lady plans to save for her daughter's marriage. She wishes to accumulate a sum of ₹ 4,64,100 at the end of 4 years. What amount should she invest every year if she get an interest of 10%p.a. compounded annually? [Given:  $(1.1)^4 = 1.4641$ ]

Solution:

$$\therefore A = ₹ 4,64,100$$

$$\therefore n = 4$$
 years

$$\therefore r = 10\%$$
 p.a.

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = \frac{C}{i} [(1 + i)^n - 1]$$

$$\therefore 4,64,100 = \frac{C}{0.1} [(1 + 0.1)^4 - 1]$$

$$\therefore 46,410 = C [1.4641 - 1]$$

$$\therefore 46,410 = C \times 0.4641$$

$$\therefore 46,410 \div 0.4641 = C$$

$$\therefore C = ₹ 1,00,000$$

Question 8.

A person wants to create a fund of ₹ 6,96,150 after 4 years at the time of his retirement. He decides to invest a fixed amount at the end of every year in a bank that offers him interest of 10% p.a. compounded annually. What amount should he invest every year? [Given:  $(1.1)^4 = 1.4641$ ]

Solution:

$$\therefore A = ₹ 6,96,150$$

$$\therefore n = 4$$
 years

$$\therefore r = 10\%$$
 p.a

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = \frac{C}{i} [(1 + i)^n - 1]$$

$$\therefore 6,96,150 = \frac{C}{0.1} [(1 + 0.1)^4 - 1]$$

$$\therefore 69,615 = C [1.4641 - 1]$$

$$\therefore 69,615 = C \times 0.4641$$

$$\therefore 69,6150.4641 = C$$

$$\therefore C = ₹ 1,50,000$$

Question 9.

Find the rate of interest compounded annually if an annuity immediate at ₹ 20,000 per year amounts to ₹ 2,60,000 in 3 years.

Solution:

$$\therefore C = ₹ 20,000$$

$$\therefore A = ₹ 2,60,000$$

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

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore 2,60,000 = \frac{20,000}{i} [(1+i)^3 - 1]$$

$$\therefore \frac{2,60,000i}{20,000} = 1 + 3i + 3i^2 + i^3 - 1$$

$$\therefore 13i = 3i + 3i^2 + i^3$$

$$\therefore 13i = i(3 + 3i + i^2)$$

$$\therefore 13 = 3 + i + i^2$$

$$\therefore i^2 + 3i + 3 - 13 = 0$$

$$\therefore i^2 + 3i - 10 = 0$$

$$\therefore (i + 5)(i - 2) = 0$$

$$\therefore i + 5 = 0 \text{ or } i - 2 = 0$$

$$\therefore i = -5 \text{ or } i = 2$$

$\therefore$  Rate of interest cannot be negative

$$\therefore i = 2 \text{ is accepted}$$

$$\therefore r_{100} = 2$$

$$\therefore r = 200\% \text{ p.a.}$$

Question 10.

Find the number of years for which an annuity of ₹ 500 is paid at the end of every years, if the accumulated amount works out to be ₹ 1,655 when interest is compounded annually at 10% p.a.

Solution:

$$\therefore C = 7500$$

$$\therefore A = 71,655$$

$$\therefore r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore 0.331 + 1 = (1.1)^n$$

$$\therefore 1.331 = (1.1)^n$$

$$\therefore (1.1)^3 = (1.1)^n$$

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

Question 11.

Find the accumulated value of annuity due of ₹ 1,000 p.a. for 3 years at 10% p.a. compounded annually. [Given:  $(1.1)^3 = 1.331$ ]

Solution:

$$\therefore C = ₹ 1,000$$

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

$$\therefore r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A' = \frac{C(1+i)}{i} [(1+i)^n - 1]$$

$$\therefore A' = \frac{1,000(1+0.1)}{0.1} [(1+0.1)^3 - 1]$$

$$\therefore A' = 10,000 \times 1.1[(1.1)^3 - 1]$$

$$\therefore A' = 11,000 [1.331 - 1]$$

$$\therefore A' = 11,000 \times 0.331$$

$$\therefore A' = ₹ 3,641$$

Question 12.

A person plans to put ₹ 400 at the beginning of each year for 2 years in a deposit that gives interest at 2% p.a. compounded annually. Find the amount that will be accumulated at the end of 2 years. [Given:  $(1.02)^2 = 1.0404$ ]

Solution:

$$\therefore C = ₹ 400$$

$$\therefore r = 2\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{2}{100} = 0.02$$

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

$$\therefore A' = \frac{C(1+i)}{i} [(1+i)^n - 1]$$

$$\therefore A' = \frac{400(1+0.02)}{0.02} [(1+0.02)^2 - 1]$$

$$= \frac{40,000(1.02)}{2} [(1.02)^2 - 1]$$

$$= 20,000 (1.02) (1.0404 - 1)$$

$$= 20,400 [0.0404]$$

$$= ₹ 824.16$$

Question 13.

Find the present value of an annuity due of ₹ 600 to be paid quarterly at 32% p.a. compounded quarterly. [Given  $(1.08)^{-4} = 0.7350$ ]

Solution:

$$\therefore C = ₹ 600$$

$$\therefore n = 1 \text{ year}$$

$\therefore$  But invested every quarterly

$$\therefore n = 1 \times 4 = 4$$

$$\therefore r = 32\% \text{ p.a. compounded quarterly}$$

$$\therefore r = \frac{32}{4} = 8\%$$

$$\therefore i = \frac{r}{100} = \frac{8}{100} = 0.08$$

$$\therefore P' = \frac{C(1+i)}{i} [1 - (1+i)^{-n}]$$

$$\therefore P' = \frac{600(1+0.08)}{0.08} [1 - (1+0.08)^{-4}]$$

$$= 7,500(1.08) [1 - 0.7350]$$

$$= 8,100 [0.2650]$$

$$= ₹ 2,146.5$$

Question 14.

An annuity immediate is to be paid for some years at 12% p.a. The present value of the annuity is ₹ 10,000 and the accumulated value is ₹ 20,000. Find the amount of each annuity payment.

Solution:

$$\therefore r = 12\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{12}{100} = 0.12$$

$$\therefore P = ₹ 10,000$$

$$\therefore A = ₹ 20,000$$

$$\therefore 1P - 1A = iC$$



$$\therefore \frac{1}{10,000} - \frac{1}{20,000} = \frac{0.12}{C}$$

$$\therefore \frac{2-1}{20,000} = \frac{0.12}{C}$$

$$\therefore \frac{1}{20,000} = \frac{0.12}{C}$$

$$\therefore C = 0.12 \times 20,000$$

$$\therefore C = ₹ 2,400$$

Question 15.

For an annuity immediate paid for 3 years with interest compounded at 10% p.a. the present value is ₹ 24,000. What will be the accumulated value after 3 years? [Given  $(1.1)^3 = 1.331$ ]

Solution:

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

$$\therefore P = ₹ 24,000$$

$$\therefore r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = P(1 + i)^n$$

$$\therefore A = 24,000 [1 + 0.1]^3$$

$$\therefore A = 24,000 \times (1.1)^3$$

$$\therefore A = 24,000 \times 1.331$$

$$\therefore A = ₹ 31,944$$

Question 16.

A person sets up a sinking fund in order to have ₹ 1,00,000 after 10 years. What amount should be deposited bi-annually in the account that pays him 5% p.a. compounded semi-annually? [Given:  $(1.025)^{20} = 1.675$ ]

Solution:

$$\therefore A = ₹ 1,00,000$$

$$\therefore n = 10 \text{ years}$$

But, invested half yearly

$$\therefore n = 10 \times 2 = 20$$

$$\therefore r = 5\% \text{ p.a. compounded half yearly}$$

$$\therefore r = \frac{r}{2} = \frac{5}{2} = 2.5\%$$

$$\therefore i = \frac{r}{100} = \frac{2.5}{100} = 0.025$$

$$\therefore A = \frac{C}{i} [(1 + i)^n - 1]$$

$$\therefore 1,00,000 = \frac{C}{0.025} [(1 + 0.025)^{20} - 1]$$

$$\therefore 1,00,000 \times 0.025 = C [(1.025)^{20} - 1]$$

$$\therefore 2,500 = C [1.675 - 1]$$

$$\therefore 2,500 = C \times 0.675$$

$$\therefore \frac{2,500}{0.675} = C$$

$$\therefore C = ₹ 3,703.70$$

## Maharashtra State Board 12th Commerce Maths Solutions Chapter 2 Insurance and Annuity Miscellaneous Exercise 2

(I) Choose the correct alternative.

Question 1.

"A contract that pledges payment of an agreed-upon amount to the person (or his/her nominee) on the happening of an event covered against" is technically known as

- (a) Death coverage
- (b) Saving for future
- (c) Life insurance
- (d) Provident fund

Answer:

- (c) Life insurance

Question 2.

Insurance companies collect a fixed amount from their customers at a fixed interval of time. This amount is called

- (a) EMI
- (b) Installment
- (c) Contribution
- (d) Premium

Answer:

- (d) Premium

Question 3.

Following are different types of insurance.

- I. Life insurance
- II. Health insurance
- III. Liability insurance

- (a) Only I
- (b) Only II
- (c) Only III
- (d) All the three

Answer:

- (d) All the three

Question 4.

By taking insurance, an individual

- (a) Reduces the risk of an accident
- (b) Reduces the cost of an accident
- (c) Transfers the risk to someone else
- (d) Converts the possibility of large loss to the certainty of a small one

Answer:

Converts the possibility of large loss to the certainty of a small one

Question 5.

You get payments of ₹ 8,000 at the beginning of each year for five years at 6%, what is the value of this annuity?

- (a) ₹ 34,720
- (b) ₹ 39,320
- (c) ₹ 35,720
- (d) ₹ 40,000

Answer:

- (c) ₹ 35,720

Question 6.

In an ordinary annuity, payments or receipts occur at

- (a) Beginning of each period
- (b) End of each period
- (c) Mid of each period
- (d) Quarterly basis

Answer:

- (b) End of each period

Question 7.

The amount of money today which is equal to a series of payments in the future is called

- (a) Normal value of the annuity
- (b) Sinking value of the annuity
- (c) Present value of the annuity
- (d) Future value of the annuity

Answer:

- (c) Present value of the annuity

Question 8.

Rental payment for an apartment is an example of

- (a) Annuity due
- (b) Perpetuity
- (c) Ordinary annuity
- (d) Installment

Answer:

- (b) Perpetuity

Question 9.

\_\_\_\_\_ is a series of constant cash flows over a limited period of time.

- (a) Perpetuity
- (b) Annuity
- (c) Present value
- (d) Future value

Answer:

- (b) Annuity

Question 10.

A retirement annuity is particularly attractive to someone who has

- (a) A severe illness
- (b) Risk of low longevity
- (c) Large family
- (d) Chance of high longevity

Answer:

- (d) Chance of high longevity

(II) Fill in the blanks.

Question 1.

An installment of money paid for insurance is called \_\_\_\_\_

Answer:

premium

Question 2.

General insurance covers all risks except \_\_\_\_\_

Answer:

life

Question 3.

The value of insured property is called \_\_\_\_\_

Answer:

property value

Question 4.

The proportion of property value to insured is called \_\_\_\_\_

Answer:

policy value

Question 5.

The person who receive annuity is called \_\_\_\_\_

Answer:

Annuitant

Question 6.

The payment of each single annuity is called \_\_\_\_\_

Answer:

installment

Question 7.

The intervening time between payment of two successive installments is called as \_\_\_\_\_

Allguidesite -

- Arjun

- Digvijay

Answer:

payment period

Question 8.

An annuity where payments continue forever is called \_\_\_\_\_

Answer:

perpetuity

Question 9.

If payments of an annuity fall due at the beginning of every period, the series is called \_\_\_\_\_

Answer:

annuity due

Question 10.

If payments of an annuity fall due at the end of every period, the series is called annuity \_\_\_\_\_

Answer:

immediate

(III) State whether each of the following is True or False.

Question 1.

General insurance covers life, fire, and theft.

Answer:

False

Question 2.

The amount of claim cannot exceed the amount of loss.

Answer:

True

Question 3.

Accident insurance has a period of five years.

Answer:

False

Question 4.

Premium is the amount paid to the insurance company every month.

Answer:

True

Question 5.

Payment of every annuity is called an installment.

Answer:

False

Question 6.

Annuity certainly begins on a fixed date and ends when an event happens.

Answer:

True

Question 7.

Annuity contingent begins and ends on certain fixed dates.

Answer:

False

Question 8.

The present value of an annuity is the sum of the present value of all installments.

Answer:

True

Question 9.

The future value of an annuity is the accumulated value of all installments.

Answer:

False

## Question 10.

The sinking fund is set aside at the beginning of a business.

Answer:

True

## (IV) Solve the following problems.

## Question 1.

A house valued at ₹ 8,00,000 is insured at 75% of its value. If the rate of premium is 0.80%. Find the premium paid by the owner of the house. If the agent's commission is 9% of the premium, find the agent's commission.

Solution:

Property value = ₹ 8,00,000

Policy value =  $75\% \times 8,00,000 = ₹ 6,00,000$

∴ Rate of Premium = 0.80%

∴ Amount of Premium =  $0.80\% \times 6,00,000 = ₹ 4,800$

∴ Rate of commission = 9%

∴ Agent commission =  $9\% \times 4800 = ₹ 432$

## Question 2.

A shopkeeper insures his shop and godown are valued at ₹ 5,00,000 and ₹ 10,00,000 respectively for 80% of their values. If the rate of premium is 8%, find the total annual premium.

Solution:

Property value of shop = ₹ 5,00,000

∴ Policy value =  $80\% \times 5,00,000 = ₹ 4,00,000$

∴ Rate of Premium = 8%

∴ Amount of premium =  $8\% \times 4,00,000 = ₹ 32,000$

∴ Property value of Godown = ₹ 10,00,000

∴ Policy value =  $80\% \times 10,00,000 = ₹ 8,00,000$

∴ Rate of Premium = 8%

∴ Amount of Premium =  $8\% \times 8,00,000 = ₹ 64,000$

∴ Total annual Premium =  $64,000 + 32,000 = ₹ 96,000$

## Question 3.

A factory building is insured for  $(\frac{56}{100})^{th}$  of its value at a rate of premium of 2.50%. If the agent is paid a commission of ₹ 2,812.50, which is 7.5% of the premium, find the value of the building.

Solution:

Let the Property value be ₹ x

∴ Policy value = ₹  $\frac{56}{100}x$

∴ Rate of premium = 2.50%

∴ Amount of premium =  $\frac{56}{100}x \times 2.50\% = ₹ \frac{x48}{100}$

∴ Rate of Agent commission = 7.5%

∴ Agent commission =  $7.5\% \times \frac{x48}{100}$

∴  $2812.50 = \frac{x640}{100}$

∴  $2812.50 \times 100 = 640x$

∴  $x = ₹ 18,00,000$

∴ Value of the building is ₹ 18,00,000.

## Question 4.

A merchant takes a fire insurance policy to cover 80% of the value of his stock. Stock worth ₹ 80,000 was completely destroyed in a fire. While the rest of the stock was reduced to 20% of its value. If the proportional compensation under the policy was ₹ 67,200, find the value of the stock.

Solution:

Let the Property value be ₹ x

∴ Policy value  $80\% \times x = ₹ \frac{4x}{5}$

∴ Complete loss = ₹ 80,000

∴ Partial loss =  $20\% \times (x - 80,000) = \frac{x-80,000}{5}$

∴ Total loss =  $80,000 + \frac{x-80,000}{5} = \frac{4x+320,000}{5}$

∴ Claim = ₹ 67,200

$$\therefore \frac{\text{Policy value}}{\text{Property value}} \times \text{loss} = 67,200$$

$$\therefore \frac{4x}{\frac{5}{x}} \times \left[ \frac{x}{5} + 64,000 \right] = 67,200$$

$$\therefore \frac{4x}{25} + \frac{4 \times 64,000}{5} = 67,200$$

$$\therefore \frac{4x}{25} + 51,200 = 67,200$$

$$\therefore \frac{4x}{25} = 67,200 - 51,200$$

$$\therefore x = \frac{16,000 \times 25}{4}$$

$$\therefore x = ₹ 1,00,000$$

$\therefore$  The value of the stock is ₹ 1,00,000.

Question 5.

A 35-year old person takes a policy for ₹ 1,00,000 for a period of 20 years. The rate of premium is ₹ 76 and the average rate of bonus is ₹ 7 per thousand p.a. If he dies after paying 10 annual premiums, what amount will his nominee receive?

Solution:

Policy value = ₹ 1,00,000

Period of Policy = 20 years

\* Rate of premium = ₹ 76 per thousand

$\therefore$  Amount of premium =  $76 \times 1,00,000 = ₹ 7,600$

$\therefore$  Total Premium =  $7,600 \times 10 = ₹ 76,000$

$\therefore$  Rate of Bonus = ₹ 7 per thousand p.a

$\therefore$  Total Bonus =  $7 \times 1,00,000 = ₹ 7,000$

$\therefore$  Amount received by Nominee = Policy value + Bonus earned

=  $1,00,000 + 7,000$

= ₹ 1,07,000

Question 6.

15,000 articles costing ₹ 200 per dozen were insured against fire for ₹ 1,00,000. If 20% of the articles were burnt completely and 2,400 other articles were damaged to the extent of 80% of their value, find the amount that can be claimed under the policy.

Solution:

Total Articles = 15,000

$\therefore$  Property value =  $15,000 \div 12 \times 200 = 2,50,000$

\* Policy value = ₹ 1,00,000

$\therefore$  Complete loss =  $20\% \times 2,50,000 = ₹ 50,000$

$\therefore$  Partial loss =  $80\% \times 2,400 \div 12 \times 200 = ₹ 3,20,000$

$\therefore$  Total loss =  $32,000 + 50,000 = ₹ 82,000$

$\therefore$  Claim =  $\frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$

=  $\frac{1,00,000}{2,50,000} \times 82,000$

= ₹ 32,800

Question 7.

For what amount should a cargo worth ₹ 25,350 be insured so that in the event of a total loss, its value, as well as the cost of insurance, may be recovered when the rate of premium is 2.5%.

Solution:

Let the policy value be ₹ 100 which includes the cost of insurance and premium

$\therefore$  Property value =  $100 - 2.50 = ₹ 97.50$

If the value of the cargo is ₹ 97.50, then the policy value is ₹ 100.

If the value of the cargo is ₹ 25,350, then

Policy value =  $100 \times \frac{25,350}{97.50} = ₹ 26,000$

Question 8.

A cargo of grain is insured at (34)% to cover 70% of its value. ₹1,008 is the amount of premium paid. If the grain is worth ₹ 12 per kg, how many kg of the grain did the cargo contain?

Solution:

Let the Property value be ₹ x

$\therefore$  policy value =  $70\% \times x = ₹ 7x/10$

\* Rate of premium = 34%

$\therefore$  Amount

$$\therefore 1,008 = \frac{7x}{10} \times \frac{3}{4} \times \frac{1}{100}$$

$$\therefore 1,008 = \frac{21x}{4,000}$$

$$\therefore \frac{1,008 \times 4,000}{21} = x$$

$$\therefore x = ₹ 1,92,000$$

$$\therefore \text{Rate of Jowar} = ₹ 12/\text{kg}$$

$$\therefore \text{Quantity of Jowar} = \frac{1,92,000}{12} = 16,000 \text{ kgs}$$

Question 9.

4,000 bedsheets worth ₹ 6,40,000 were insured for  $\left(\frac{37}{100}\right)^{\text{th}}$  of their value. Some of

the bedsheets were damaged in the rainy season and were reduced to 40% of their value. If the amount recovered against damage was ₹ 32,000. Find the number of damaged bedsheets.

Solution:

$$\therefore \text{Property value} = ₹ 6,40,000$$

$$\therefore \text{Policy value} = 6,40,000 \times \frac{37}{100} = ₹ 19,20,000$$

$$\therefore \text{Cost of one Bedsheet} = \frac{6,40,000}{4,000} = ₹ 160$$

Let 'x' bedsheets be damaged.

$$\therefore \text{Cost of } x \text{ bedsheets} = ₹ 160x$$

$$\therefore \text{Value of loss} = 160x \times \frac{40}{100} = ₹ 64x$$

$$\therefore \text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$\therefore 24,000 = \frac{19,20,000}{6,40,000} \times 64x$$

$$\therefore 24,000 = \frac{19,20,000 \times 64x}{6,40,000 \times 7}$$

$$\therefore 24,000 = \frac{192}{7}x$$

$$\therefore \frac{24,000 \times 7}{192} = x$$

$$\therefore x = 875$$

$\therefore$  875 Bedsheets damaged.

Question 10.

A property valued at ₹ 7,00,000 is insured to the extent of ₹ 5,60,000 at  $\left(\frac{58}{100}\right)^{\text{th}}$  less 20%. Calculate the saving made in the premium. Find the amount of loss that the owner must bear, including premium, if the property is damaged to the extent of 40% of its value.

Solution:

$$\therefore \text{Property value} = ₹ 7,00,000$$

$$\therefore \text{Policy value} = ₹ 5,60,000$$

$$\therefore \text{Rate of premium} = 58\%$$

$$\therefore \text{Amount of premium} = 58\% \times 5,60,000 = ₹ 3,500$$

$$\text{New rate of premium} = 58\% \text{ less } 20\%$$

$$= 58 - [20\% \times 58]$$

$$= 58 - 18$$

$$= 40\%$$

$$\therefore \text{Amount of premium} = 40\% \times 5,60,000 = ₹ 2,800$$

$$\therefore \text{Saving made in premium} = 3,500 - 2,800 = ₹ 700$$

$$\therefore \text{Loss} = 7,00,000 \times 40\% = 2,80,000$$

$$\therefore \text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss}$$

$$= \frac{5,60,000}{7,00,000} \times 2,80,000$$

$$= ₹ 2,24,000$$

$$\therefore \text{Loss bear by owner} = \text{loss} - \text{claim} + \text{premium}$$

$$= 2,80,000 - 2,24,000 + 2,800$$

$$= ₹ 58,800$$

Question 11.

Stocks in a shop and godown worth ₹ 75,000 and ₹ 1,30,000 respectively were insured through an agent who receive 15% of the premium as commission. If the shop was insured for 80% and godown for 60% of the value, find the amount of agent's commission

when the premium was 0.80% less 20%. If the entire stock in the shop and 20% stock in the godown is destroyed by fire, find the amount that can be claimed under the policy.

Solution:

$$\begin{aligned} \therefore \text{Rate of premium} &= 0.80\% \text{ less } 20\% \\ &= 0.80 - 20\% \times 0.80 \\ &= 0.80 - 0.16 \\ &= 0.64\% \end{aligned}$$

For Shop

$$\begin{aligned} \therefore \text{Property value} &= ₹ 75,000 \\ \therefore \text{Policy value} &= 80\% \times 75,000 = ₹ 60,000 \\ \therefore \text{Premium} &= 0.64\% \times 60,000 = ₹ 384 \\ \therefore \text{Loss} &= ₹ 75,000 \\ \therefore \text{Claim} &= \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss} \\ &= \frac{60,000}{75,000} \times 75,000 \\ &= ₹ 60,000 \end{aligned}$$

For Godown

$$\begin{aligned} \therefore \text{Property value} &= ₹ 1,30,000 \\ \therefore \text{Policy value} &= 60\% \times 1,30,000 = ₹ 78,000 \\ \therefore \text{Premium} &= 0.64\% \times 78,000 = ₹ 499.2 \\ \text{Loss} &= 20\% \times 1,30,000 = ₹ 26,000 \\ \therefore \text{Claim} &= \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss} \\ &= \frac{78,000}{1,30,000} \times 26,000 \\ &= ₹ 15,600 \\ \text{Total claim} &= 16,600 + 60,000 = ₹ 75,600 \\ \therefore \text{Rate of commission} &= 15\% \\ \therefore \text{Agent commission} &= 15\% \times [384 + 499.2] \\ &= 15\% \times 883.2 \\ &= ₹ 132.48 \end{aligned}$$

Question 12.

A person holding a life policy of ₹ 1,20,000 for a term of 25 years wants to discontinue after paying a premium for 8 years at the rate of ₹ 58 per thousand p.a. Find the amount of paid-up value he will receive on the policy. Find the amount he will receive if the surrender value granted is 35% of the premium paid, excluding the first year's premium.

Solution:

$$\begin{aligned} \text{Policy value} &= ₹ 1,20,000 \\ \therefore \text{Rate of premium} &= ₹ 58 \text{ per thousand p.a.} \\ \therefore \text{Premium for 8 years} &= 8 \times 58 \times 1000 \times 1,20,000 = ₹ 55,680 \\ \therefore \text{Amount of 1st premium} &= 55,680 \div 8 = ₹ 6,960 \\ \therefore \text{Paid-up value of policy} &= \frac{\text{No of Premium paid}}{\text{Terms of policy}} \times \text{Policy value} \\ &= \frac{8}{25} \times 1,20,000 \\ &= ₹ 38,400 \\ \therefore \text{Surrender value} &= 35\% \times [\text{Total premium} - \text{1st year premium}] \\ &= 35\% \times [55,680 - 6,960] \\ &= 35\% \times 48,720 \\ &= ₹ 17,052 \end{aligned}$$

Question 13.

A godown valued at ₹ 80,000 contained stock worth ₹ 4,80,000. Both were insured against fire. Godown for ₹ 50,000 and stock for 80% of its value. A part of stock worth ₹ 60,000 was completely destroyed and the rest was reduced to 60% of its value. The amount of damage to the godown is ₹ 40,000. Find the amount that can be claimed under the policy.

Solution:

For Godown

$$\begin{aligned} \therefore \text{Property value} &= ₹ 80,000 \\ \therefore \text{Policy value} &= ₹ 50,000 \\ \therefore \text{Loss} &= ₹ 40,000 \\ \therefore \text{Claim} &= \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss} \\ &= \frac{50,000}{80,000} \times 40,000 \\ &= ₹ 25,000 \end{aligned}$$

For stock

$$\begin{aligned} \therefore \text{Property value} &= ₹ 4,80,000 \\ \therefore \text{Policy value} &= 80\% \times 4,80,000 = ₹ 3,84,000 \\ \therefore \text{Complete loss} &= ₹ 60,000 \\ \therefore \text{Partial loss} &= (100 - 60)\% \times [4,80,000 - 60,000] \\ &= 40\% \times 4,20,000 \\ &= ₹ 1,68,000 \\ \therefore \text{Total loss} &= 1,68,000 + 60,000 = ₹ 2,28,000 \\ \therefore \text{Claim} &= \frac{\text{Policy value}}{\text{Property value}} \times \text{Loss} \\ &= \frac{3,84,000}{4,80,000} \times 2,28,000 \end{aligned}$$



$$= ₹ 1,82,400$$

$$\therefore \text{Total claim} = 25,000 + 1,82,400 = ₹ 2,07,400$$

Question 14.

Find the amount of an ordinary annuity if a payment of ₹ 500 is made at the end of every quarter for 5 years at the rate of 12% per annum compounded quarterly. [Given:  $(1.03)^{20} = 1.8061$ ]

Solution:

$$\therefore C = ₹ 500$$

$$\therefore r = 12\% \text{ p.a. compounded quarterly,}$$

$$\therefore r = \frac{12}{4} = 3\%$$

$$\therefore n = 5 \text{ years}$$

But, payment is made quarterly

$$\therefore n = 5 \times 4 = 20$$

$$\therefore i = \frac{r}{100} = \frac{3}{100} = 0.03$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore A = \frac{500}{0.03} [(1+0.03)^{20} - 1]$$

$$\therefore A = \frac{500}{0.03} [1.8061 - 1]$$

$$\therefore A = \frac{500}{0.3} \times 0.8061$$

$$\therefore A = ₹ 13,435$$

Question 15.

Find the amount a company should set aside at the end of every year if it wants to buy a machine expected to cost ₹ 1,00,000 at the end of 4 years and interest rate is 5% p.a. compounded annually.

Solution:

$$\therefore A = ₹ 1,00,000$$

$$\therefore r = 5\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{5}{100} = 0.05$$

$$\therefore n = 4 \text{ years}$$

$$\therefore A = Ci[(1+i)^n - 1]$$

$$\therefore 1,00,000 = C \cdot 0.05 [(1+0.05)^4 - 1]$$

$$\therefore 1,00,000 \times 0.05 = C [(1.05)^4 - 1]$$

$$\therefore 5,000 = C(1.2155 - 1)$$

$$\therefore 5,000 = C \times 0.2155$$

$$\therefore 5,000 \cdot 2155 = C$$

$$\therefore C = ₹ 23,201.86$$

Question 16.

Find the least number of years for which an annuity of ₹ 3,000 per annum must run in order that its amount exceeds ₹ 60,000 at 10% compounded annually. [Given:  $(1.1)^{11} = 2.8531$ ,  $(1.1)^{12} = 3.1384$ ]

Solution:

$$\therefore A = ₹ 60,000$$

$$\therefore C = ₹ 3,000$$

$$\therefore r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = Ci[(1+i)^n - 1]$$

$$\therefore 60,000 = 3,000 \cdot 0.1 [(1+0.1)^n - 1]$$

$$\therefore 60,000 = 30,000 [(1.1)^n - 1]$$

$$\therefore \frac{60,000}{30,000} + 1 = (1.1)^n$$

$$\therefore 2 + 1 = (1.1)^n$$

$$\therefore 3 = (1.1)^n$$

Taking log

$$\therefore \log 3 = \log (1.1)^n$$

$$\therefore \log 3 = n \log(1.1)$$

$$\therefore \log 3 / \log 1.1 = n$$

$$\therefore n = 0.4771 / 0.0414 = 11.52 \sim 12 \text{ years}$$

Question 17.

Find the rate of interest compounded annually if an ordinary annuity of ₹ 20,000 per year amounts to ₹ 41,000 in 2 years.

Solution:

$$\because C = ₹ 20,000$$

$$\because A = ₹ 41,000$$

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

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore 41,000 = \frac{20,000}{i} [(1+i)^2 - 1]$$

$$\therefore \frac{41,000i}{20,000} = 1 + 2i + i^2 - 1$$

$$\therefore \frac{41i}{20} = i(2+i)$$

$$\therefore 41 = 40 + 20i$$

$$\therefore 41 - 40 = 20i$$

$$\therefore \frac{1}{20} = i$$

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

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

$$\therefore r = 5\% \text{ p.a.}$$

Question 18.

A person purchases a television by paying ₹ 20,000 in cash and promising to pay ₹ 1,000 at the end of every month for the next 2 years.

If money is worth 12% p.a., converted monthly. Find the cash price of the television. [Given:  $(1.01)^{-24} = 0.7880$ ]

Solution:

Down payment = ₹ 20,000

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

But, EMI Payable monthly

$$\therefore n = 2 \times 12 = 24$$

$$\because r = 12\% \text{ p.a. compounded monthly}$$

$$\therefore r = \frac{12}{12} = 1\%$$

$$\therefore i = \frac{r}{100} = \frac{1}{100} = 0.01$$

$$\because P = \frac{C}{i} [1 - (1+i)^{-n}]$$

$$\therefore P = \frac{1000}{0.01} [1 - (1+0.01)^{-24}]$$

$$\therefore P = 1,00,00 [1 - 0.7880]$$

$$\therefore P = 1,00,00 \times 0.2120$$

$$\therefore P = ₹ 21,200$$

Cash price = Present value + Down payment

$$= 21,200 + 20,000$$

$$= ₹ 41,200$$

Question 19.

Find the present value of an annuity immediate of ₹ 20,000 per annum for 3 years at 10% p.a. compounded annually. [Given:  $(1.1)^{-3} = 0.7513$ ]

Solution:

$$\because C = ₹ 20,000$$

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

$$\because r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\because P = \frac{C}{i} [1 - (1+i)^{-n}]$$

$$\therefore P = \frac{20,000}{0.1} [1 - (1+0.1)^{-3}]$$

$$\therefore P = 2,00,000 [1 - 0.7513]$$

$$\therefore P = 2,00,000 [0.2487]$$

$$\therefore P = ₹ 49,740$$

Question 20.

A man borrowed some money and paid it back in 3 equal installments of ₹ 2,160 each. What amount did he borrow if the rate of interest was 20% per annum compounded annually? Also, find the total interest charged. [Given:  $(1.2)^{-3} = 0.5788$ ]

Solution:

$$\therefore C = ₹ 2,160$$

$$\therefore n = 3$$

$$\therefore r = 20\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{20}{100} = 0.2$$

$$\therefore P = \frac{C}{i} [1 - (1+i)^{-n}]$$

$$\therefore P = \frac{2,160}{0.2} [1 - (1+0.2)^{-3}]$$

$$\therefore P = \frac{21,600}{2} (1 - 0.5788)$$

$$\therefore P = 10,800 \times 0.42112$$

$$\therefore P = ₹ 6,251.04$$

$$\therefore \text{Total amount paid} = 2,160 \times 3 = ₹ 6,480$$

$$\therefore \text{Interest} = 6,480 - 6,251.04 = ₹ 228.96$$

Question 21.

A company decides to set aside a certain amount at the end of every year to create a sinking fund that should amount to ₹ 9,28,200 in 4 years at 10% p.a. Find the amount to be set aside every year. [Given:  $(1.1)^4 = 1.4641$ ]

Solution:

$$\therefore A = ₹ 9,28,200$$

$$\therefore n = 4 \text{ years}$$

$$\therefore r = 10\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{10}{100} = 0.1$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore 9,28,200 = \frac{C}{0.1} [(1+0.1)^4 - 1]$$

$$\therefore 9,28,200 \times 0.1 = C[1.4641 - 1]$$

$$\therefore 92,820 = C \times 0.4641$$

$$\therefore 92,820 \div 0.4641 = C$$

$$\therefore C = ₹ 2,00,000$$

Question 22.

Find the future value after 2 years if an amount of ₹ 12,000 is invested at the end of every half-year at 12% p.a. compounded half-yearly. [Given:  $(1.06)^4 = 1.2625$ ]

Solution:

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

$$\text{Payable half yearly, } n = 2 \times 2 = 4$$

$$\therefore C = ₹ 12,000$$

$$\therefore r = 12\% \text{ p.a. Compounded half yearly}$$

$$\therefore r = \frac{12}{2} = 6\%$$

$$\therefore i = \frac{r}{100} = \frac{6}{100} = 0.06$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$\therefore A = \frac{12,000}{0.12} [(1 + 0.06)^4 - 1]$$

$$\therefore A = \frac{12,00,000}{12} [(1.06)^4 - 1]$$

$$\therefore A = 1,00,000 [1.2625 - 1]$$

$$\therefore A = 1,00,000 \times 0.2625$$

$$\therefore A = ₹ 26,250$$

Question 23.

After how many years would an annuity due of ₹ 3,000 p.a. accumulated ₹ 19,324.80 at 20% p.a. compounded annually? [Given:  $(1.2)^4 = 2.0736$ ]

Solution:

$$\therefore C = ₹ 3,000$$

$$\therefore A = ₹ 9,324.80$$

$$\therefore r = 20\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{20}{100} = 0.2$$

$$\therefore A = \frac{C(1+i)}{i} [(1+i)^n - 1]$$

$$\therefore 19,324.80 = \frac{3,000(1+0.2)}{0.2} [(1+0.2)^n - 1]$$

$$\therefore 19,324.80 = 15,000 \times 1.2 [(1.2)^n - 1]$$

$$\therefore 19,324.80 = 18,000 [(1.2)^n - 1]$$

$$\therefore 19,324.80 / 18,000 + 1 = (1.2)^n$$

$$\therefore 1.0736 + 1 = (1.2)^n$$

$$\therefore 2.0736 = (1.2)^n$$

$$\therefore (1.2)^4 = (1.2)^n$$

$$\therefore n = 4 \text{ years}$$

Question 24.

Some machinery is expected to cost 25% more over its present cost of ₹ 6,96,000 after 20 years. The scrap value of the machinery will realize ₹ 1,50,000. What amount should be set aside at the end of every year at 5% p.a. compound interest for 20 years to replace the machinery? [Given:  $(1.05)^{20} = 2.655$ ]

Solution:

$$\text{Present cost} = ₹ 6,96,000$$

$$\text{Expected cost} = 25\% \times 6,96,000 + 6,96,000$$

$$= 1,74,000 + 6,96,000$$

$$= ₹ 8,70,000$$

$$\therefore \text{Scrap value} = ₹ 1,50,000$$

$$\therefore \text{Sinking fund} = 8,70,000 - 1,50,000 = ₹ 7,20,000$$

$$\therefore A = ₹ 7,20,000, n = 20 \text{ years, } r = 5\% \text{ p.a.}$$

$$\therefore i = \frac{r}{100} = \frac{5}{100} = 0.05$$

$$\therefore A = \frac{C}{i} [(1+i)^n - 1]$$

$$7,20,000 = \frac{C}{0.05} [(1+0.05)^{20} - 1]$$

$$\therefore 7,20,000 \times 0.05 = C [(1.05)^{20} - 1]$$

$$\therefore 36,000 = C [2.655 - 1]$$

$$\therefore 36,000 = C \times 1.655$$

$$\therefore 36,000 / 1.655 = C$$

$$\therefore C = ₹ 21,752.27$$