

Insurance and Annuity

EXERCISE 2.1 [PAGE 20]

Exercise 2.1 | Q 1.1 | Page 20

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

Solution:

Given, Property value = ₹ 25,00,000, Rate of premium = 3%

When property is fully insured,

Here, Property value = Policy value

∴ Policy value = ₹ 25,00,000

Amount of premium = 3% of policy value

$$= \frac{3}{100} \times 25,00,000$$

$$= ₹ 75,000$$

∴ Amount of premium is ₹ 75,000.

Exercise 2.1 | Q 1.2 | Page 20

Find the premium on a property worth ₹25,00,000 at 3% if the property is insured for 80% of its value.

Solution: Given, Property value = ₹25,00,000, Rate of premium = 3%

When property is insured to 80% of its value.

Here, Policy value = 80% of property value

$$= \frac{80}{100} \times 25,00,000$$

$$= ₹ 20,00,000$$

Amount of premium = 3% of policy value

$$= \frac{3}{100} \times 20,00,000$$

= ₹60, 000

∴ Amount of premium is ₹60,000.

Exercise 2.1 | Q 2 | Page 20

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: Given, Property value = ₹3,60,000,

Rate of premium = 0.9%

Since the shop is insured for 75% of its value,

∴ Policy Value = 75% of property value

$$\therefore \text{Policy value} = \frac{75}{100} \times 3,60,000 = ₹2,70,000$$

Amount of perimum = 0.9% of policy value

$$= \frac{0.9}{100} \times 2,70,000$$

Also, agent's rate of commission is 15% of the perimum

$$\therefore \text{Agent's commission} = \frac{15}{100} \times 2,430 = ₹364.5$$

∴ Perimum paid by owner of the shop is ₹2,430 and agent's commission is ₹364.5.

Exercise 2.1 | Q 3 | Page 20

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: Given, Property value = ₹5,00,000,

Premium = ₹13,000

Rate of commission = 11%

Since the person insures 80% of property value,



$$\therefore \text{Policy value} = \frac{8}{100} \times 5,00,000 = ₹4,00,000$$

He pays ₹13,000 as perimum

$$\text{Amount of perimum} = \frac{\text{Rate of perimum}}{100} \times \text{policy value}$$

$$\therefore 13,000 = \frac{\text{Rate of perimum}}{100} \times 4,00,000$$

$$\therefore \text{Rate of perimum} = \frac{100 \times 13,000}{4,00,000} = 3.25\%$$

Agent's rate of commission is 11% of the premium.

$$\therefore \text{Agent's commission} = \frac{11}{100} \times 13,000 = ₹1,430$$

\therefore Rate of premium is 3.25% and agent's commission is ₹1,430.

Exercise 2.1 | Q 4 | Page 20

A building is insured for 75% of its value. The annual premium at 0.70 percent amounts to ₹ 2,625. 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.

Since the building is insured for 75% of its value,

\therefore Policy value = 75% of property value

$$= \frac{75}{100} \times x$$

$$= \frac{3}{4}x$$

Now, annual premium is ₹2,625 at 0.7%.

\therefore Amount of premium = 0.7% of policy value

$$\therefore 2,625 = \frac{0.7}{100} \times \frac{3}{4} x$$

$$\therefore x = \frac{2,625 \times 100 \times 4}{0.7 \times 3}$$

$$\therefore x = ₹5,00,000$$

\therefore Property value of the building is ₹5,00,000.

$$\text{Policy value} = \frac{3}{4} x$$

$$= \frac{3}{4} \times 5,00,000$$

$$= ₹3,75,000$$

Fire damaged the building to the extent of 60%.

\therefore Loss = 60% of property value

$$= \frac{60}{100} \times 5,00,000 = ₹3,00,000$$

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

$$\therefore \text{Claim} = \frac{3,75,000}{5,00,000} \times 3,00,000$$

$$= ₹2,25,000$$

\therefore ₹2,25,000 can be claimed under the policy.

Exercise 2.1 | Q 5 | Page 20

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: Given, Stock (property value) = ₹7,00,000

Policy value = ₹4,50,000

Now, stock worth ₹3,00,000 were burnt completely due to fire.

Remaining stock = Stock value – Burnt stock

$$= 7,00,000 - 3,00,000$$

$$= ₹4,00,000$$

Remaining stock was damaged o 75% of its value.

∴ Damaged amount = 75% of Value

$$= \frac{75}{100} \times 4,00,000$$

$$= ₹3,00,000$$

∴ Total loss = Burnt stock + Damaged amount

$$= 3,00,000 + 3,00,000$$

$$= 6,00,000$$

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

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

$$= ₹3,85,714.3$$

∴ Sum of ₹3,85,714.3 can be claimed under the policy.

Exercise 2.1 | Q 6 | Page 20

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: Let the property value of the cargo be ₹ x.

Since, the cargo was insured for 80% of its value,

∴ Policy value = 80% of property value

$$= \frac{80}{100} \times x$$

$$= \frac{4x}{5}$$

Rate of premium = 0.625%

Amount of premium = ₹5,250

Amount of premium = 0.625% of policy value

$$\therefore 5,250 = \frac{0.625}{100} \times \frac{4x}{5}$$

$$\therefore x = \frac{5,250 \times 100 \times 5}{0.625 \times 4}$$

$$\therefore x = ₹10,50,000$$

\therefore Property value of cargo is ₹10,50,000.

i.e., cargo contains rice worth ₹10,50,000

Per kg rate of rice is ₹21.

$$\therefore \text{Capacity of the cargo} = \frac{\text{Value of the cargo}}{\text{Price of 1kg rice}}$$

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

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

\therefore The cargo contains 50,000 kgs of rice.

Exercise 2.1 | Q 7 | Page 20

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: Given, Total number of articles = 60,000

Cost of the articles = ₹200 per dozen

$$\text{i.e., one article costs ₹ } \frac{200}{12}$$

Policy value = ₹2,40,000

Cost of 60,000 articles (property value)

= Number of articles x Cost of one article

$$= 60,000 \times \frac{200}{12}$$

$$= ₹10,00,000$$

Given, 20% of the articles were completely burnt.

∴ Value of burnt articles

= 20% of value of total articles

$$= \frac{20}{100} \times 10,00,000$$

$$= ₹2,00,000$$

7,200 articles were damaged to 80% of their value. Total value of 7,200 articles

= 7,200 x cost of one article

$$= 7,200 \times \frac{200}{12}$$

$$= ₹1,20,000$$

∴ Loss on 7,200 articles

= 80% of value

$$= \frac{80}{100} \times 1,20,000$$

$$= ₹96,000$$

= Value of burnt articles + Loss on 7,200 articles

$$= 2,00,000 + 96,000$$

$$= ₹2,96,000$$

$$\text{Claim} = \frac{\text{Policy value}}{\text{Property value}} \times 2,96,000$$

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

$$= ₹71,0,40$$

\therefore Amount that can be claimed under the policy is ₹71,0,40.

Exercise 2.1 | Q 8 | Page 20

The rate of premium is 2% and other expenses are 0.75%. 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: Given, Property value of cargo = ₹3,50,100,

Rate of premium = 2%, Other expenses = 0.75%

Let the amount of insurance (policy value) be ₹100, which includes the premium of ₹2 and other expenses of ₹0.75

\therefore Value of cargo (property value)

= Policy value – (Premium + Other express)

$$= 100 - (2 + 0.75)$$

$$= 100 - 2.75$$

$$= 97.25$$

Now, for the property value of ₹97.25, the policy value is ₹100.

\therefore For property value of ₹97.25, the policy value is ₹100.

$$= \frac{3,50,100 \times 100}{97.25}$$

$$= ₹3,60,000$$

\therefore A cargo worth ₹3,50,100 should be insured for ₹3,60,000.

Exercise 2.1 | Q 9 | Page 20

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: Given, Property value = ₹4,00,000

Policy value of company A = ₹1,60,000

Policy value of company B = ₹1,00,000

Policy value of company C = ₹1,40,000

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

$$\therefore \text{Claim for company A} = \frac{1,60,000}{4,00,000} \times 9,000 = ₹3,600$$

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

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

\therefore Amount recoverable from Company A, B and C are ₹3,600, ₹2,250 and ₹3,150 respectively.

Exercise 2.1 | Q 10 | Page 20

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: Given, Value of the car (property value)= ₹8,00,000 Policy value = ₹5,00,000

Rate of premium is 5% less 20%

i.e., 5% 20% of 5 = 5% 1% = 4%

\therefore Amount of premium = 4% of policy value

$$\begin{aligned} &= \frac{4}{100} \times 5,00,000 \\ &= ₹20,000 \end{aligned}$$

Value of car is reduced to 60% of its original value.

\therefore Reduced value = 60% of original value

$$= \frac{60}{100} \times 8,00,000$$

$$₹ 4,80,000$$

∴ Loss = Original Value of car – Reduced value of car

$$= 8,00,000 - 4,80,000$$

$$= ₹3,20,000$$

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

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

$$= ₹2,00,000$$

∴ Actual loss borne by the owner

$$= \text{Loss} - \text{Claim} + \text{Premium}$$

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

$$= ₹1,40,000$$

∴ Loss borne by the owner is ₹1,40,000.

Exercise 2.1 | Q 11 | Page 20

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: Given, Value of shop (property value) = ₹1,00,000.

Value of godown (property value) = ₹2,00,000

Rate of commission = 12%

Shop was insured for 80% of its value.

Policy value

= 80% of its property value

$$= \frac{80}{100} \times 1,00,000$$

$$= ₹80,000$$

Godown was insured for 60% of its value.

∴ Policy value of godown

= 60% of its property value

$$= \frac{60}{100} \times 2,00,000$$

$$= ₹1,20,000$$

Total policy value = Policy value of shop + Policy value of godown

$$= 80,000 + 1,20,000$$

$$= 2,00,000$$

Rate of premium is 0.80% less 20%

$$\text{i.e., } 0.80 - 0.20\% \text{ of } 0.80 = 0.80 - 0.16 = 0.64\%$$

∴ Amount of premium

= 0.64% of total policy value

$$= \frac{0.64}{100} \times 2,00,000$$

$$= ₹1,280$$

Commission of agent

= 12% of amount of premium

$$= \frac{12}{100} \times 1,280 = 153.6$$

∴ Agent's commission is ₹153.6.

Exercise 2.1 | Q 12 | Page 20

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 policyholder pays the premium annually.

Solution: Given, Policy value = ₹ 1,00,000

Rate of premium = ₹ 56 per thousand per annum

Rebate = 0.75 per thousand, if paid annually

$$\therefore \text{Rebate} = 56 \times \frac{0.75}{1000} = 0.042$$

\therefore Net rate of premium

= Rate of premium – Rebate

= 56 – 0.042

= ₹ 55.958 per thousand

Let the policy value be ₹1,000

Then premium = ₹ 55.958

\therefore For policy value of 1,00,000,

$$\text{Net amount of perimum} = \frac{55.958 \times 1,00,000}{1,000}$$

= ₹ 5,595.8

\therefore Net amount of premium that policy holder pays annually is ₹ 5,595.8.

Exercise 2.1 | Q 13 | Page 20

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: Given, Property value of warehouse = ₹40,000

Property value of goods = ₹2,40,000

Policy value of warehouse = ₹16,000

Now, goods were insured to 90% of their value.

∴ Policy value of goods = 90% of property value

$$= \frac{90}{100} \times 2,40,000$$

$$= 2,16,000$$

Value of goods completely destroyed = ₹80,000

∴ Value of remaining goods = Property value of goods – Value of goods destroyed

$$= 2,40,000 - 80,000$$

$$= 1,60,000$$

Remaining good are destroyed to 80% of their value.

∴ Loss on remaining goods

= 80% of value of remaining goods

$$= \frac{80}{100} \times 1,60,000$$

$$= ₹1,28,000$$

∴ Total loss on goods = Value of goods completely destroyed + Loss on reduced value of goods

$$= 80,000 + 1,28,000$$

$$= ₹2,08,000$$

Amount claimed on goods

$$= \frac{\text{Policy value of goods}}{\text{Property value of goods}} \times \text{Loss on goods}$$

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

$$= ₹1,87,200$$

Loss on warehouse = ₹8,000

∴ Amount claimed on warehouse

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

$$\frac{16,000}{40,000} \times 8,000$$

$$= ₹3,200$$

∴ Total amount claimed = Amount claimed on goods + Amount claimed on warehouse

$$= 1,87,200 + 3200$$

$$= 1,90,400$$

∴ Total amount that can be claimed is ₹1,90,400.

Exercise 2.1 | Q 14 | Page 20

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: Given, Policy value = ₹2,00,000

Period of policy = 20 years

$$\therefore \text{Premium per year} = \frac{\text{Policy Value}}{\text{Period of policy}}$$

$$= \frac{2,00,000}{20}$$

$$= ₹10,000$$

But, the person pays premium for 10 years.

∴ Premium paid by the person

$$= 10,000 \times 10$$

$$= ₹1,00,000$$

Rate of bonus = ₹20 per year for thousand,

$$\text{Bonus for 1 year} = \frac{20}{1,000} \times 2,00,000$$

$$= ₹4,000$$

∴ Bonus for 10 years

$$= 4,000 \times 10$$

$$= ₹40,000$$

∴ Paid up value of the policy

= Perimum paid of the person + Bonus for 10 years

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

$$= ₹1,40,000$$

∴ Paid up value of the policy is ₹1,40,000 if the person discontinues paying the premium after 10 years.

EXERCISE 2.2 [PAGES 27 - 28]

Exercise 2.2 | Q 1.01 | Page 27

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

Solution: Given, $C = ₹800$, $n = 3$ years, $r = 8\%$ p.a.

$$i = \frac{r}{100} = \frac{8}{1000} = 0.08$$

$$\text{Now, } A = \frac{C}{i} [1 + i]^a - 1$$

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

$$= 10,000[1.08)^3 - 1]$$

$$= 10,000[1.2597 - 1]$$

$$= 10,000(0.2597)$$

$$= 2,597$$

∴ Accumulate (future) value of annuity is ₹2,597.

Exercise 2.2 | Q 1.02 | Page 27

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: Given, $C = ₹5,000$, $r = 10\%$ p.a., $n = 4$ years

$$i = \frac{r}{100} = \left(\frac{10}{100} = 0.1 \right)$$

It is an immediate annuity.

$$\text{Now, } A = \frac{C}{i} [(1 + I)^n - 1]$$

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

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

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

$$= 50,000(0.464)$$

$$= 23,205$$

∴ Amount accumulated after 4 years is ₹23,205.

Exercise 2.2 | Q 1.03 | Page 27

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: Given, $C = ₹24,000$, Since amount is invested at the end of every 6 months for two years, it is an immediate annuity.

∴ $n = 2 \times 2 = 4$ half years.

Rate of interest is 12% p.a

$$\therefore r = \frac{12}{2} = 6\% \text{ fr six months}$$

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

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

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

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

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

$$= 4,00,00(0.2625)$$

$$\therefore = 1,05,000$$

\therefore Amount accumulated after 2 years is ₹1,05,000.

Exercise 2.2 | Q 1.04 | Page 27

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

Solution: Given, $C = ₹10,000$

Amount is invested every quarter for one year.

$$\therefore n = 4$$

Rate of interest is 16% p.a

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

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

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

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

$$= 2,50,000[(1.04)^4 - 1]$$

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

$$= 2,50,000[0.1699 - 1]$$

$$= 42,475$$

∴ Amount accumulated value after 1 years is ₹42,475.

Exercise 2.2 | Q 1.05 | Page 27

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: Given, $C = ₹36,000$, $n = 3$ years, $r = 9\%$ p.a.

$$\therefore i = \frac{r}{100} = \frac{9}{100} = 0.09$$

$$\begin{aligned} \text{Now, } P &= \frac{C}{i} [1 + (1 + i)^{-n}] \\ &= \frac{36,000}{0.09} [1 - (1 + 0.09)^{-3}] \end{aligned}$$

$$= 4,00,000[1 - (1.09)^{-3}]$$

$$= 4,00,000[1 - 0.7722]$$

$$= 4,00,000(0.2278)$$

$$= 91,120$$

∴ Present value of the immediate annuity is ₹91,120.

Exercise 2.2 | Q 1.06 | Page 27

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

Solution: Given, $C = 63,000$, $n = 4$ years, $r = 14\%$ p.a.

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

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

$$= \frac{63000}{0.14} \left[1 - (1 + 0.14)^{-4} \right]$$

$$= 4,50,000[1 - (1.14)^{-4}]$$

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

$$= 4,50,000(0.4079)$$

$$= 1,83,555$$

∴ Present value of an ordinary annuity is ₹1,83,555.

Exercise 2.2 | Q 1.07 | Page 28

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 gets an interest of 10% p.a. compounded annually? [Given $(1.1)^4 = 1.4641$]

Solution: Given, A = ₹4,64,100, n = 4 years, r = 10% p.a.

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

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

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

$$\therefore 4,64,100(0.1) = C[(1.1)^4 - 1]$$

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

$$\therefore 46,410 = C(0.4641)$$

$$\therefore C = \frac{46,410}{0.4641}$$

$$\therefore C = 1,00,000$$

∴ She must invest ₹1,00,000 every year.

Exercise 2.2 | Q 1.08 | Page 28

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: Given, $A = ₹6,96,150$, $n = 4$ years, $r = 10\%$ p.a.

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

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

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

$$\therefore 6,96,150 \times 0.1 = C[(1.1)^4 - 1]$$

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

$$\therefore 69,615 = C(0.4641)$$

$$\therefore C = \frac{69,615}{0.4641}$$

$$\therefore C = ₹1,50,000$$

\therefore Sum of ₹1,50,000 should be invested every year.

Exercise 2.2 | Q 1.09 | Page 28

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: Given, $C = ₹20,000$, $A = ₹2,60,000$, $n = 3$ years.

Given, $C = ₹20,000$, $A = ₹2,60,000$, $n = 3$ years.

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

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

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

$$\therefore 13 = \frac{3i + 3i^2 + i^3}{i}$$

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

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

$$\therefore i^2 + 5i - 2i - 10 = 0$$

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

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

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

But, i cannot be negative.

$$\therefore i = 2$$

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

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

$$\therefore \text{The rate of interest is } 200\% \text{ p.a.}$$

Exercise 2.2 | Q 1.1 | Page 28

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

Solution: Given, $C = ₹500$, $A = ₹1,655$, $r = 10\% \text{ p.a.}$

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

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

$$\therefore 1,655 = \frac{500}{0.1} [(1 + 0.1)^n - 1]$$

$$\therefore \frac{(1,655)(0.1)}{500} = (1.1)^n - 1$$

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

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

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

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

$$\therefore n = 3$$

\therefore The annuity is paid for 3 years.

Exercise 2.2 | Q 1.11 | Page 28

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: Given $C = ₹1,000$, $n = 3$ years, $r = 10\%$ p.a.

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

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

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

$$= \frac{1,000(1.1)}{0.1} [(1.1)^3 - 1]$$

$$= (1,000)(1.1)[1.331 - 1]$$

$$= 11,000(0.331)$$

$$\therefore A = 3,641$$

\therefore Accumulated value of annuity due is ₹3,641.

Exercise 2.2 | Q 1.12 | Page 28

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.

Solution: Given, C = ₹400, n = 2 years, r = 2% p.a.

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

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

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

$$= \frac{400(1.02)}{0.02} [(1.02)^2 - 1]$$

$$= (400)(51)[1.0404 - 1]$$

$$= 20,400(0.0404)$$

$$A = 824.16$$

\therefore Accumulated amount after 2 years is ₹824.16.

Exercise 2.2 | Q 1.13 | Page 28

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: Given, C = ₹600,

Amount is invested every quarter for one year.

$$\therefore n = 4$$

Rate of interest is 32% p.a.

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

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

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

$$\begin{aligned}
 \therefore P' &= \frac{600(1 + 0.08)}{0.08} \left[1 - (1 + 0.08)^{-4} \right] \\
 &= \frac{600(1.08)}{0.08} \left[1 - (1.08)^{-4} \right] \\
 &= (7,5000)(1.08)[1 - 0.7350] \\
 &= (8,100)(0.2650) \\
 P' &= 2,146.5
 \end{aligned}$$

\therefore Present value of annuity due is ₹2,146.5.

Exercise 2.2 | Q 1.14 | Page 28

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: Given, $P = ₹10,000$, $r = 12\%$ p.a., $A = ₹20,000$

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

$$\text{Now, } \frac{1}{P} - \frac{1}{A} = \frac{i}{C}$$

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

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

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

$$\therefore C = (0.12)(20,000)$$

$$\therefore C = 2,400$$

\therefore The amount of each annuity payment is ₹2,400.

Exercise 2.2 | Q 1.15 | Page 28

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: Given, $P = ₹24,000$, $n = 3$ years, $r = 10\%$ p.a.

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

$$\text{Now, } A = P(1 + i)^n$$

$$= 24,000(1 + 0.1)^3$$

$$= 24,000(1.1)^3$$

$$= 24,000(1.331)$$

$$A = 31,944$$

∴ Accumulated amount after 3 years is ₹31,944.

Exercise 2.2 | Q 1.16 | Page 28

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: Given $A = ₹1,00,000$,

Amount is deposited bi-annually for 10 years.

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

Rate of interest is 5% p.a.

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

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

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

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

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

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

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

$$\therefore 2,500 = C(0.675)$$

$$\therefore C = \frac{2,500}{0.675} = 3,703.70$$

\therefore Amount of ₹3,703.70 should be set aside bi-annually into the account.

MISCELLANEOUS EXERCISE 2 [PAGES 29 - 32]

Miscellaneous Exercise 2 | Q 1.01 | Page 29

Choose the correct alternative :

“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

1. Death coverage
2. Saving for future
3. Life insurance
4. Provident fund

Solution: “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 **Life insurance**.

Miscellaneous Exercise 2 | Q 1.02 | Page 29

Choose the correct alternative :

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

1. EMI
2. Installment
3. Contribution
4. Premium



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

Miscellaneous Exercise 2 | Q 1.03 | Page 29

Choose the correct alternative :

Following are different types of insurance.

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

- 1. Only I
- 2. Only II
- 3. Only III
- 4. **All the three**

Solution: All the three

Miscellaneous Exercise 2 | Q 1.04 | Page 29

Choose the correct alternative :

By taking insurance, an individual

- 1. Reduces the risk of an accident
- 2. Reduces the cost of an accident
- 3. Transfers the risk to someone else.
- 4. **Converts the possibility of large loss to certainty of a small one.**

Solution: By taking insurance, an individual **Converts the possibility of large loss to certainty of a small one.**

Miscellaneous Exercise 2 | Q 1.05 | Page 29

Choose the correct alternative :

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

- 1. ₹ 34,720
- 2. ₹ 39,320
- 3. **₹ 35,720**
- 4. ₹ 40,000

Solution:



$$\begin{aligned}
 P' &= \frac{C(1+i)}{i} [1 - (1+i)^{-n}] \\
 P' &= \frac{8000(1+0.06)}{0.06} [1 - (1+0.06)^{-5}] \\
 &= \frac{8000(1.06)}{0.06} [1 - (1.06)^{-5}] \\
 &= (1,41,333.33)(0.25274) \\
 \therefore P' &= \text{₹}35,720.
 \end{aligned}$$

Miscellaneous Exercise 2 | Q 1.06 | Page 29

Choose the correct alternative :

In an ordinary annuity, payments or receipts occur at

1. Beginning of each period
2. **End of each period**
3. Mid of each period
4. Quarterly basis

Solution: In an ordinary annuity, payments or receipts occur at **End of each period**.

Miscellaneous Exercise 2 | Q 1.07 | Page 29

Choose the correct alternative :

Amount of money today which is equal to series of payments in future is called

1. Normal value of annuity
2. Sinking value of annuity
3. **Present value of annuity**
4. Future value of annuity

Solution: Amount of money today which is equal to series of payments in future is called **Present value of annuity**.

Miscellaneous Exercise 2 | Q 1.08 | Page 29

Choose the correct alternative :

Rental payment for an apartment is an example of

1. Annuity due

2. **Perpetuity**

- 3. Ordinary annuity
- 4. Installment

Solution: Rental payment for an apartment is an example of **Perpetuity**.

Miscellaneous Exercise 2 | Q 1.09 | Page 29

Choose the correct alternative :

_____ is a series of constant cashflows over a limited period of time.

- 1. Perpetuity
- 2. **Annuity**
- 3. Present value
- 4. Future value

Solution: Annuity is a series of constant cashflows over a limited period of time.

Miscellaneous Exercise 2 | Q 1.1 | Page 29

Choose the correct alternative :

A retirement annuity is particularly attractive to someone who has

- 1. A severe illness
- 2. Risk of low longevity
- 3. Large family
- 4. **Chance of high longevity**

Solution: A retirement annuity is particularly attractive to someone who has **Chance of high longevity**.

Miscellaneous Exercise 2 | Q 2.01 | Page 29

Fill in the blank :

An installment of money paid for insurance is called _____.

Solution: An installment of money paid for insurance is called premium.

Miscellaneous Exercise 2 | Q 2.02 | Page 29

Fill in the blank :

General insurance covers all risks except _____.

Solution: General insurance covers all risks except life.

Miscellaneous Exercise 2 | Q 2.03 | Page 29

Fill in the blank :

The value of insured property is called _____.

Solution: The value of insured property is called property value.

Miscellaneous Exercise 2 | Q 2.04 | Page 29

Fill in the blank :

The proportion of property value to insured value is called _____.

Solution: The proportion of property value to insured value is called policy value.

Miscellaneous Exercise 2 | Q 2.05 | Page 29

Fill in the blank :

The person who receives annuity is called _____.

Solution: The person who receives annuity is called annuitant.

Miscellaneous Exercise 2 | Q 2.06 | Page 29

Fill in the blank :

The payment of each single annuity is called _____.

Solution: The payment of each single annuity is called installment.

Miscellaneous Exercise 2 | Q 2.07 | Page 29

Fill in the blank :

The intervening time between payment of two successive installments is called as _____.

Solution: The intervening time between payment of two successive installments is called as payment period.

Miscellaneous Exercise 2 | Q 2.08 | Page 29

Fill in the blank :

An annuity where payments continue forever is called _____.

Solution: An annuity where payments continue forever is called perpetuity.

Miscellaneous Exercise 2 | Q 2.09 | Page 30

Fill in the blank :

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



Solution: If payments of an annuity fall due at the beginning of every period, the series is called annuity due.

Miscellaneous Exercise 2 | Q 2.1 | Page 30

Fill in the blank :

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

Solution: If payments of an annuity fall due at the end of every period, the series is called annuity immediate.

Miscellaneous Exercise 2 | Q 3.01 | Page 30

State whether the following is True or False :

General insurance covers life, fire, and theft.

1. True
2. False

Solution: General insurance covers life, fire, and theft False.

Miscellaneous Exercise 2 | Q 3.02 | Page 30

State whether the following is True or False :

The amount of claim cannot exceed the amount of loss.

1. True
2. False

Solution: The amount of claim cannot exceed the amount of loss True.

Miscellaneous Exercise 2 | Q 3.03 | Page 30

State whether the following is True or False :

Accident insurance has a period of five years.

1. True
2. False

Solution: Accident insurance has a period of five years False.

Miscellaneous Exercise 2 | Q 3.04 | Page 30

State whether the following is True or False :

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

1. True

2. False

Solution: Premium is the amount paid to the insurance company every month True.

Miscellaneous Exercise 2 | Q 3.05 | Page 30

State whether the following is True or False :

Payment of every annuity is called an installment.

1. True

2. False

Solution: Payment of every annuity is called an installment True.

Miscellaneous Exercise 2 | Q 3.06 | Page 30

State whether the following is True or False :

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

1. True

2. False

Solution: Annuity certain begins on a fixed date and ends when an event happens True.

Miscellaneous Exercise 2 | Q 3.07 | Page 30

State whether the following is True or False :

Annuity contingent begins and ends on certain fixed dates.

1. True

2. False

Solution: Annuity contingent begins and ends on certain fixed dates **False**.

Miscellaneous Exercise 2 | Q 3.08 | Page 30

State whether the following is True or False :

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

1. True

2. False

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

Miscellaneous Exercise 2 | Q 3.09 | Page 30

State whether the following is True or False :



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

1. True
2. False

Solution: The future value of an annuity is the accumulated values of all installments False.

Miscellaneous Exercise 2 | Q 3.1 | Page 30

State whether the following is True or False :

Sinking fund is set aside at the beginning of a business.

1. True
2. False

Solution: Sinking fund is set aside at the beginning of a business True.

Miscellaneous Exercise 2 | Q 4.01 | Page 30

Solve the following :

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 agent's commission is 9% of the premium, find agent's commission.

Solution: Given, Property value = ₹8,00,000

Since the house is insured for 75% of its value, Policy value = 75% of property value

$$\begin{aligned} &= \frac{75}{100} \times 8,00,000 \\ &= ₹6,00,000 \end{aligned}$$

Rate of premium = 0.80%

∴ Amount of premium = 0.80% of policy value

$$= \frac{0.80}{100} \times 6,00,000$$

$$= ₹4,800$$

Agent's rate of commission is 9% of the premium

∴ Agent's commission = 9% of premium

$$= \frac{9}{100} \times 4,800$$

$$= ₹432$$

∴ Premium paid by the owner of house is ₹4,800 and the agent's commission is ₹432.

Miscellaneous Exercise 2 | Q 4.02 | Page 30

Solve the following :

A shopkeeper insures his shop and godown 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: Given, Property value of the shop = ₹5,00,000 Property value of the godown = ₹10,00,000

Since shopkeeper insures shop for 80% and godown for 80%,

∴ Policy value of shop = 80% of its property value

$$= \frac{80}{100} \times 5,00,000$$

$$= ₹4,00,000$$

Policy value of godown

= 80% of its property value

$$= \frac{80}{100} \times 10,00,000 = ₹8,00,000$$

Rate of premium is 8% for the shop as well as for godown.

∴ Amount of premium for the shop

= 8% of its policy value

$$= \frac{8}{100} \times 4,00,000 = ₹32,000$$

∴ Amount of premium for the shop

= 8% of its policy value

$$= \frac{8}{100} \times 8,00,000 = ₹64,000$$

∴ Total premium = amount of premium for the shop + amount of premium for the godown

$$= 32,000 + 64,000$$

$$= ₹96,000$$

∴ Total premium payable by the shopkeeper is ₹ 96,000.

Miscellaneous Exercise 2 | Q 4.03 | Page 30

Solve the following :

A factory building is insured for $(\frac{5}{6})^{\text{th}}$ 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 of the factory building be ₹ x.

Since, the building is insured for $(\frac{5}{6})^{\text{th}}$ of its value,

∴ Policy value = $(\frac{5}{6})^{\text{th}}$ of property value

$$= \frac{5}{6} \times x$$

$$= \frac{5x}{6}$$

Rate of perimum is 2.5%

∴ Amount of perimum = 2.50% of policy value

$$\begin{aligned} &= \frac{2.50}{100} \times \frac{5x}{6} \\ &= \frac{0.1}{4} \times \frac{5x}{6x} \\ &= \frac{0.5x}{24} \end{aligned}$$

Agent's commission is ₹2,812.50 and his rate of commission is 7.5 % of premium.

Agent's commission = 7.5 % of premium

$$\begin{aligned} \therefore 2,812.50 &= \frac{7.5}{100} \times \frac{0.5x}{24} \\ \therefore 2,812.50 &= \frac{0.3}{4} \times \frac{0.5x}{24} \\ \therefore 2,812.50 &= \frac{0.1}{4} \times \frac{0.5x}{8} \\ \therefore 2,812.50 &= \frac{0.05x}{32} \\ \therefore x &= \frac{2,812.50 \times 32}{0.05} \end{aligned}$$

$$\therefore x = 56,250 \times 32$$

$$\therefore x = ₹18,00,000$$

∴ Property value of the factory building is 18 lakh rupees.

Miscellaneous Exercise 2 | Q 4.04 | Page 30

Solve the following :

A merchant takes 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 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 Property value of the stock be ₹ x .

Since, merchant insures 80% of value of the stock, \therefore Policy value = 80% of value of the stock

$$= \frac{80}{100} \times x$$

$$= \frac{4x}{5}$$

Now, stock worth ₹80,000 were completely destroyed.

\therefore Remaining value of the stock

$$= ₹(x - 80,000)$$

But, this remaining stock was damaged and reduced to 20% of the book value.

\therefore Loss on this stock is to the extent of 80%.

\therefore Loss of the remaining stock

$$= 80\% \text{ of } ₹(x - 80,000)$$

$$= \frac{80}{100} \times (x - 80,000)$$

$$= \frac{4(x - 80,000)}{5}$$

\therefore Total loss = Value of completely destroyed stock + Loss due reduction in value

$$= 80,000 + \frac{4(x - 80,000)}{5}$$

$$= \frac{4,00,000 + 4x - 3,20,000}{5}$$

$$= \left(\frac{80,000 + 4x}{5} \right)$$

Now, the merchant receives ₹67,200 as proportional compensation.

$$\therefore \text{Claim} = ₹67,200$$

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

$$\therefore 67,200 = \frac{\frac{4x}{5}}{x} \times \left(\frac{80,000 + 4x}{5} \right)$$

$$\therefore 67,200 = \frac{4}{5} \times \left(\frac{80,000 + 4x}{5} \right)$$

$$\therefore \frac{67,200 \times 5 \times 5}{4} = 80,000 + 4x$$

$$\therefore 16,800 \times 25 = 80,000 + 4x$$

$$\therefore 4,20,000 = 80,000 + 4x$$

$$\therefore 4x = 4,20,000 - 80,000$$

$$\therefore 4x = ₹3,40,000$$

$$\therefore x = \frac{3,40,000}{4} = 85,000$$

\therefore Value of the stock is ₹85,000.

Miscellaneous Exercise 2 | Q 4.05 | Page 30

Solve the following :

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:

Given, Policy value = ₹1 lakh,

Period of the policy = 20 years

But, the person dies after paying 10 annual premiums.

∴ Nominee will get entire Policy value of ₹1,00,000 on account of death. Also, rate of bonus is ₹7 per thousand per annum

$$\therefore \text{Bonus (per year)} = \frac{7}{1,000} \times 1,00,000 = ₹7,00$$

$$\therefore \text{Bonus for 10 years} = 700 \times 10 = ₹7,000$$

∴ Amount received by his nominee

= Policy value + Bonus

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

$$= ₹1,07,000$$

∴ Amount received by his nominee is ₹1,07,000.

Miscellaneous Exercise 2 | Q 4.06 | Page 30**Solve the following :**

15,000 articles costing ₹200 per dozen were insured against fire for ₹1,00,000. If 20 % of the articles were burnt completely and 2400 of other articles were damaged to the extent of 80% of their value, find the amount that can be claimed under the policy.

Solution: Given, Total number of articles = 15,000,

Cost of articles = ₹200 per dozen

$$\therefore \text{Cost of one article} = ₹ \frac{200}{12}.$$

Policy value = ₹ 1 lakh

Cost of articles = ₹200 per dozen

∴ Cost of one article ₹ $\frac{200}{12}$.

Policy value = ₹ 1 lakh

Cost of 15,000 articles (property value)

= cost of one article x number of articles

$$= \frac{200}{12} \times 15,000 = ₹2,50,000$$

Now, 20% of the articles were completely burnt.

∴ Number of articles burnt = 20% of total articles

$$= \frac{20}{100} \times 15,000$$

$$= 3,000$$

Cost of 3,000 burnt articles = cost of one article x number of articles

$$= \frac{200}{12} \times 3,000 = ₹50,000$$

Also, 2,400 articles were damaged to the extent of 80% of their value.

$$\therefore \text{Cost of 2,400 articles} = \frac{200}{12} \times 2,400$$

$$= ₹40,000$$

∴ Loss on 2,400 articles = 80% of cost value

$$= \frac{80}{100} \times 40,000$$

$$= ₹32,000$$

∴ Total loss = Cost of 3,000 burnt articles + Loss on 2,400 articles

$$= 50,000 + 32,000$$

$$= ₹82,000$$

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

$$= \frac{1,00,000}{2,50,000} \times 82,000 = ₹32,800$$

∴ Amount that can be claimed under the policy is ₹32,800.

Miscellaneous Exercise 2 | Q 4.07 | Page 30

Solve the following :

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

Solution: Given, Property value of cargo = ₹25,350,

Rate of premium = 2.50 %

Let the policy value be ₹100, which includes the premium ₹2.50.

∴ Value of cargo = Policy value – Premium

$$= 100 - 2.50 = ₹97.50$$

For the property value of ₹97.50, the policy value is ₹100.

∴ For property value of ₹25,350,

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

∴ Cargo worth ₹25,350 should be insured for ₹26,000.

Miscellaneous Exercise 2 | Q 4.08 | Page 30

Solve the following :

A cargo of grain is insured at $(\frac{3}{4})$ % 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 of cargo be ₹ x.

Since, cargo is insured to 70% of its value,

∴ Policy value = 70% of property value

$$= \frac{70}{100} \times x$$

$$= ₹ \frac{7x}{10}$$

$$\text{Rate of perimum} = \frac{3}{4}\%$$

Amount of perimum = ₹1,008.

$$\therefore \text{Amount of premium} = \frac{3}{4}\% \text{ of policy value}$$

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

$$\therefore x = \frac{1008 \times 4 \times 100 \times 10}{3 \times 7}$$

$$\therefore x = ₹1,92,000$$

\therefore Property value of cargo is ₹1,92,000,

i.e., cargo contains grain of ₹1,92,000.

Price of grain is ₹12 per kg.

$$\therefore \text{Capacity of cargo} = \frac{\text{Value of cargo}}{\text{Price of 1kg grain}}$$

$$= \frac{1,92,000}{12}$$

$$= 16,000 \text{ kgs}$$

\therefore Cargo contains 16,000 kgs of grains.

Miscellaneous Exercise 2 | Q 4.09 | Page 31

Solve the following :

4,000 bedsheets worth ₹6,40,000 were insured for $(\frac{3}{7})^{\text{th}}$ 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: Given, Property value of 4,000 bed sheets = ₹6,40,000

$$\therefore \text{Cost of 1 bedsheet} = \frac{6,40,000}{4,000} = ₹160$$

Since, bedsheets were insured to $\left(\frac{3}{7}\right)^{\text{th}}$ value,

$$\text{Policy value} = \left(\frac{3}{7}\right)^{\text{th}} \text{ of property value}$$

$$= \frac{3}{7} \times 6,40,000 = ₹\frac{19,20,000}{7}$$

Let the cost of bedsheets that were damaged be ₹ x.

Since, the value of damaged bedsheets is reduced to 40% of their value.

\therefore Loss on damaged bedsheets

= 60% of their value

$$= \frac{60}{100} \times x = ₹\frac{3x}{5}$$

Amount recovered against damage is ₹32,000

\therefore Claim = ₹32,000

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

$$\therefore 32,000 = \frac{\left(\frac{19,20,000}{7}\right)}{6,40,000} \times \frac{3x}{5}$$

$$\therefore 32,000 = \frac{192 \times 3 \times x}{64 \times 5 \times 7}$$

$$\therefore x = \frac{32,000 \times 64 \times 5 \times 7}{192 \times 3}$$

$$\therefore x = 1,24,444.4$$

\therefore Cost value of the damaged bedsheets is ₹1,24,444.40

\therefore Number of damaged bedsheets

$$= \frac{\text{cost of damaged bedsheets}}{\text{cost of one bedsheets}}$$

$$= \frac{1,24,444}{160}$$

$$= 777.78, \text{ i.e. approx } 778$$

\therefore The number of damaged bedsheets are 778.

Miscellaneous Exercise 2 | Q 4.1 | Page 31

Solve the following :

A property valued at ₹7,00,000 is insured to the extent of ₹5,60,000 at $(5/8)^{\text{th}}$ % 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: Given, Property value = ₹7,00,000,
Policy value = ₹5,60,000,

$$\text{Rate of perimum} = \frac{5}{8} \% \text{ less } 20\%$$

$$\text{Now, for the rate of perimu} = \frac{5}{8} \%$$

$$\text{Amount of perimum} = \frac{5}{8} \% \text{ of policy value}$$

$$= \frac{5}{8} \times \frac{1}{100} \times 5,60,000$$

$$= ₹3,500$$

For the rate of perimum

$$= \frac{5}{8} \% \text{ less } 20\%$$

$$\begin{aligned}
&= \left(\frac{5}{8} - 20\% \text{ of } \frac{5}{8} \right) \\
&= \left(\frac{5}{8} - \frac{20}{100} \times \frac{5}{8} \right) \% \\
&= \left(\frac{5}{8} - \frac{1}{8} \right) \% \\
&= \frac{4}{8} \% \\
&= \frac{1}{2} \%
\end{aligned}$$

Amount of perimum = $\frac{1}{2}\%$ of policy value

$$\begin{aligned}
&= \frac{1}{2} \times \frac{1}{100} \times 5,60,000 \\
&= ₹2,800
\end{aligned}$$

∴ Savings made in the premium

$$\begin{aligned}
&= \text{premium on } \frac{5}{8}\% - \text{premium on } \frac{1}{2}\% \\
&= 3,500 - 2,800 \\
&= ₹700
\end{aligned}$$

∴ Savings made in the premium is ₹700.

Now, the property is damaged to the extent of 40% of its value.

∴ Value of damaged property (loss)

$$\begin{aligned}
&= 40\% \text{ of property value} \\
&= \frac{40}{100} \times 7,00,000 = ₹2,80,000
\end{aligned}$$

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

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

$$\therefore \text{Claim} = ₹2,24,000$$

\therefore Loss borne by the owner including premium

$$= (\text{Loss} - \text{Claim}) + \text{Premium on } \frac{1}{2}\%$$

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

$$= 56,000 + 2,800$$

$$= ₹58,800$$

\therefore Loss borne by the owner including the premium is ₹58,800.

Miscellaneous Exercise 2 | Q 4.11 | Page 31

Solve the following :

Stocks in a shop and godown worth ₹75,000 and ₹1,30,000 respectively were insured through an agent who receives 15% of 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: Given, Stock (property) value of shop = ₹75,000

Stock (property) value of godown = ₹1,30,000.

The shop was insured to 80% of its stock value.

Policy value of stock in the shop

= 80% of its property value

$$= \frac{80}{100} \times 75,000$$

$$= ₹60,000$$

Also, 60% of stock value of the godown was insured.

∴ Policy value of stock in the godown

= 60% of its stock value

$$= \frac{60}{100} \times 1,30,000$$

$$= ₹78,000$$

Total policy value = Policy value of stock in the shop + Policy value of stock in the godown

$$= 60,000 + 78,000$$

$$= ₹1,38,000$$

Rate of premium was 0.80% less 20%

i.e. $0.80 - 20\% \text{ of } 0.80$

$$= 0.80 - 0.16$$

$$= 0.64\%$$

∴ Amount of premium

= 0.64% of total policy value

$$= \frac{0.64}{100} \times 1,38,000$$

$$= ₹883.20$$

Agent's rate of commission is 15% of total premium.

∴ Agent's commission = 15% of total premium

$$= \frac{15}{100} \times 883.20$$

$$= ₹132.4$$

Now, entire stock in the shop was destroyed by fire.

∴ Loss occurred in the shop = Stock value of the shop

∴ Loss occurred on the shop = ₹75,000

∴ Claim for shop =

$$\frac{\text{Policy value of stock in shop}}{\text{Property value of stock in shop}} \times \text{Loss in shop}$$

$$= \frac{60,000}{75,000} \times 75,000$$

$$= ₹60,000$$

20% of stock was destroyed by fire in the godown.

∴ Destroyed value of stock (loss) in godown

= 20% of stock value

$$= \frac{20}{100} \times 1,30,000$$

$$= ₹26,000$$

∴ Claim for the godown =

$$\frac{\text{Policy value of stock in godown}}{\text{Property value of stock in godown}} \times \text{Loss in godown}$$

$$= \frac{78,000}{1,30,000} \times 26,000$$

$$= ₹15,600.$$

∴ Total Claim

= Claim for shop + Claim for godown

$$= 60,000 + 15,600$$

$$= ₹75,600$$

∴ Amount that can be claimed under the policy is ₹75,600 and commission to the agent is ₹132.40.

Miscellaneous Exercise 2 | Q 4.12 | Page 31

Solve the following :

A person holding a life policy of ₹1,20,000 for a term of 25 years wants to discontinue after paying 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 premiums paid, excluding the first year's premium.

Solution: Given, Policy value = ₹1,20,000

Period of policy = 25 years

$$\therefore \text{Paid up value of one year} = \frac{\text{Policy value}}{\text{Period of policy}}$$
$$= \frac{1,20,000}{25}$$

$$= ₹4,800$$

But, the person wishes to discontinue after paying premium for 8 years

$$\therefore \text{Paid up value} = 4,800 \times 8 = ₹38,400$$

Amount of premium paid for one year

$$= \frac{58}{1000} \times 1,20,000 = ₹6,960$$

\therefore Amount of premium paid for 8 years

$$= 6,960 \times 8$$

$$= ₹55,680$$

Surrender value

= 35% of (premium paid for 8 years – premium paid for first year)

$$= \frac{35}{100} \times (55,680 - 6,960)$$

$$= \frac{35}{100} \times 48,720$$

$$= ₹17,052$$

\therefore The person holding life policy will get amount of ₹17,052.

Miscellaneous Exercise 2 | Q 4.13 | Page 31

Solve the following :

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: Given, Property value of godown = ₹80,000.

Property value of stock = ₹4,80,000

Policy value of godown = ₹50,000

Stock is insured for 80% of its value.

Policy value of stock

= 80% of its property value

$$= \frac{80}{100} \times 4,80,000$$

$$= ₹3,84,000$$

Value of stock completely destroyed = ₹60,000

∴ Value of remaining stock = Property value of stock – Value of stock completely destroyed

$$= 4,80,000 - 60,000$$

$$= ₹4,20,000$$

Value of remaining stock is reduced to 60% of its value. Thus, loss is to the extent of 40%.

∴ Loss on remaining stock

$$= 40\% \text{ of its value}$$

$$= \frac{40}{100} \times 4,20,000$$

$$= ₹1,68,000$$

∴ Total loss of the stock

= Value of stock completely destroyed + Loss on reduced value of stock

$$= 60,000 + 1,68,000$$

$$= 2,28,000$$

$$\therefore \text{Claim for stock} = \frac{\text{Policy value of stock}}{\text{Property value of stock}} \times \text{Loss on stock}$$

$$= \frac{3,84,000}{4,80,000} \times 2,28,000$$

$$= ₹1,82,400$$

$$\text{Loss on godown} = ₹40,000,$$

Claim for godown =

$$\frac{\text{Policy value of godown}}{\text{Property value of stock}} \times \text{Loss on godown}$$

$$= \frac{50,000}{80,000} \times 40,000$$

$$= ₹25,000$$

∴ Total amount claimed

= Amount claimed on stock + Amount claimed on godown

$$= 1,82,400 + 25,000$$

$$= 2,07,400$$

∴ Amount that can be claimed under the policy is ₹ 2,07,400.

Miscellaneous Exercise 2 | Q 4.14 | Page 31

Solve the following :

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. $[(1.03)^{20} = 1.8061]$

Solution: Given, $C = ₹500$

Amount is invested at the end of every quarter.

∴ It is an immediate annuity.

Rate of interest is 12% p.a.

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

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

The period is of 5 years and payment is made on quarterly basis.

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

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

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

$$= \frac{500}{0.03} [(1.03)^{20} - 1]$$

$$= \frac{500}{0.03} (1.8061 - 1)$$

$$= \frac{500}{0.03} \times (0.8061)$$

$$= \frac{403.05}{0.03}$$

$$= \frac{40305}{3}$$

$$= ₹13,435$$

∴ Amount of ordinary annuity is ₹13,435.

Miscellaneous Exercise 2 | Q 4.15 | Page 31

Solve the following :

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. $[(1.05)^4 = 1.21550625]$

Solution: Given, $A = ₹1,00,000$, $n = 4$ years, $r = 5\%$ p.a.

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

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

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

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

$$\therefore 5,000 = C(1.21550625 - 1)$$

$$\therefore 5,000 = C \times 0.21550625$$

$$\therefore C = \frac{5000}{0.21550625}$$

$$\therefore C = ₹23,201.18$$

\therefore The company should set aside a sum of ₹23,201.18 in order to buy the machine.

Miscellaneous Exercise 2 | Q 4.16 | Page 31**Solve the following :**

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. $[(1.1)^{11} = 2.8531, (1.1)^{12} = 3.1384]$

Solution: Given, $C = ₹3,000$, $A = ₹60,000$, $r = 10\%$ p.a.

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

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

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

$$\therefore \frac{60,000 \times 0.1}{3,000} = (1.1)^n - 1$$

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

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

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

It is given that $(1.1)^{11} = 2.8531$ and $(1.1)^{12} = 3.1384$

$\therefore n$ will be between 11 years and 12 years.

Thus, the least number of years for which an annuity of ₹3,000 per annum must run is 12 years.

Miscellaneous Exercise 2 | Q 4.17 | Page 31

Solve the following :

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

Solution: Given, $A = ₹41,000$, $C = ₹20,000$, $n = 2$ years

We need to find r such that an ordinary annuity of ₹20,000 amounts to ₹41,000 in 2 years.

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

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

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

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

$$\frac{41}{20} = \frac{i^2 + 2i}{i}$$

$$\frac{41}{20} = i + 2$$

$$\frac{41}{20} - 2 = i$$

$$\frac{41 - 40}{20} = i$$

$$\therefore i = \frac{1}{20} = 0.05$$

$$\text{But } i = \frac{r}{100}$$

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

$$\therefore r = 5\%$$

The rate of interest is 5%.

Miscellaneous Exercise 2 | Q 4.18 | Page 31

Solve the following :

A person purchases a television by paying ₹20,000 in cash and promising to pay ₹1,000 at 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. $[(1.01)^{-24} = 0.7875]$

Solution: Person buys the television for ₹20,000 in cash.

∴ First payment = ₹20,000

Remaining value of the television was paid in monthly instalments of ₹1,000.

∴ $C = ₹1,000$,

The duration of monthly installments is of 2 years.

∴ $n = 24$

Rate of interest is 12% p.a.

$$\therefore r = \frac{12}{12} = 1\% \text{ p.m.}$$

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

The amount is paid at the end of every month.

∴ It is an immediate annuity.

Now, to find sum of all instalments we have to find present value.

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

$$\therefore P = \frac{1,000}{0.01} [1 - (1 + 0.01)^{24}]$$

$$= 1,00,000 [1 - (1.01)^{-24}]$$

$$= 1,00,000 (1 - 0.7875)$$

$$= 1,00,000 \times 0.2125$$

$$\therefore P = ₹21,250$$

∴ Cash price of the television = First Payment + Present Value

$$= 20,000 + 21,250$$

$$= ₹41,250$$

∴ Cash price of the television is ₹41,250.

Miscellaneous Exercise 2 | Q 4.19 | Page 31

Solve the following :

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

Solution: Given, $C = ₹20,000$, $n = 3$ years, $r = 10\%$ p.a.

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

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

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

$$= 2,00,000 [1 - (1.1)^{-3}]$$

$$= 2,00,000 [1 - 0.7513]$$

$$= 2,00,000 (0.2487)$$

$$= ₹49,740$$

\therefore Present value of an annuity immediate is ₹49,740.

Miscellaneous Exercise 2 | Q 4.2 | Page 31**Solve the following :**

A man borrowed some money and paid 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. $[(1.2)^3 = 0.5787]$

Solution: Given, $C = ₹2,160$, $n = 3$ years, $r = 20\%$ p.a.

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

Here, we have to find present value of annuity.

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

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

$$= 10,800[1 - (1.2)^{-3}]$$

$$= 10,800[1 - 0.5787]$$

$$= 10,800[0.4213]$$

$$\therefore P = ₹4,550$$

The man has paid 3 equal instalments of ₹2,160 each.

\therefore Total paid value of instalments

$$= 3 \times 2,160$$

$$= ₹6,480$$

Interest = Total paid value of instalments – Present Value

$$= 6,480 - 4,550$$

$$= ₹1,930.$$

Miscellaneous Exercise 2 | Q 4.21 | Page 32

Solve the following :

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. $[(1.1)^4 = 1.4641]$

Solution:

$$\text{Given, } A = ₹9,28,200, n = 4 \text{ years, } r = 10\% \text{ p.a, } i = \frac{r}{100} = \frac{10}{100} = 0.1$$

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

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

$$\therefore 9,28,200 \times 0.1 = C[(1.1)^4 - 1]$$

$$\therefore 92,820 = C[1.4641 - 1]$$

$$\therefore 92,820 = C(0.4641)$$

$$\therefore C = \frac{92,820}{0.4641}$$

$$\therefore C = ₹2,00,000$$

\therefore The amount to be set aside each year is ₹2,00,000.

Miscellaneous Exercise 2 | Q 4.22 | Page 32

Solve the following :

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. $[(1.06)^4 = 1.2625]$

Solution: Given, $C = ₹12,000$

Since, the amount is invested at the end of every half year, it is immediate annuity. The period is of two years.

$$\therefore n = 2 \times 2 = 4 \text{ half years}$$

Rate of interest is 12% p.a.

$$\therefore r = \frac{12}{2} = 6\% \text{ per half year}$$

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

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

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

$$= 2,00,000 [(1.06)^4 - 1]$$

$$= 2,00,000 (1.2625 - 1)$$

$$= 2,00,000 (0.2625)$$

$$\therefore A = 52,500$$

\therefore Future value after 2 years is ₹52,500.

Miscellaneous Exercise 2 | Q 4.23 | Page 32

Solve the following :

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

Solution: Given, $C = ₹3,000$, $A' = 19324.80$, $r = 20\%$ p.a.

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

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

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

$$\therefore 19,324.80 = \frac{3,000 \times 1.2}{0.2} [(1.2)^n - 1]$$

$$\therefore 19,324.80 = 3,000 \times 6 [(1.2)^n - 1]$$

$$\therefore \frac{19,324.80}{18,000} = (1.2)^n - 1$$

$$\therefore \frac{19,32,480}{18,000 \times 100} = (1.2)^n - 1$$

$$\therefore \frac{1,07,360}{1,00,000} = (1.2)^n - 1$$

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

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

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

$$\therefore (1.2)^n = (1.2)^4 \quad \dots [\because (1.2)^4 = 2.0736]$$

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

∴ After 4 years, an annuity due of ₹3,000 p.a. would accumulate to ₹19,324.80 at 20% p.a. compounded annually.

Miscellaneous Exercise 2 | Q 4.24 | Page 32

Solve the following :

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 $(1.05)^{20} = 2.653$]

Solution: Since, the machinery is expected to cost 25% more over its present cost i.e., 6,96,000,

∴ Expected value of machinery

= Present cost + 25% of present cost

$$= 6,96,000 + \frac{25}{100} \times 6,96,000$$

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

$$= ₹8,70,000$$

After 20 years, scrap value of the machinery is ₹ 1,50,000.

∴ Accumulated value of machinery = Expected value of machinery

– Scrap value of machinery

$$= 8,70,000 - 1,50,000$$

$$= ₹7,20,000$$

$$∴ A = ₹ 7,20,000$$

Also, $r = 5\%$ p.a., $n = 20$ years,

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

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

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

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

$$\therefore 36,000 = C (2.653 - 1)$$

$$\therefore 36,000 = C \times 1.653$$

$$\therefore C = \frac{36,000}{1.653}$$

$$\therefore C = ₹21,778.58$$

\therefore Sum of ₹21,778.58 should be set aside at the end of each year.

