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 peimum 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

∴ Policy value $= \dfrac{75}{100} \times 3, 60, 000 = ₹2,70,000$

Amount of perimum = 0.9% of policy value

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

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

∴ Agent's commission $= \dfrac{15}{100} \times 2, 430 = ₹364.5$

∴ 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.

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

∴ 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,

∴ Policy value = 7% of property value

$$= \frac{7}{100} \times x$$

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

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

∴ Amount of premium = 0.7% of policy value

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

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

∴ x = ₹5,00,000

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

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%.

∴ Loss = 60% of property value

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

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

$$\therefore \text{Claiim} = \frac{3{,}75000}{5{,}00{,}000} \times 3{,}00{,}000$$

= ₹2,25,000

∴ ₹2,25,000 can be claimed under the polcy.

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

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

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

= ₹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

$$= \frac{8}{100} \times x$$

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

Rate of premium = 0.625%

Amount of premium = ₹5,250

Amount of premium = 0.625% of policy value

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

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

∴ x = ₹10,50,000

∴ Property value of cargo is ₹10,50,000.

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

Per kg rate of rice is ₹21.

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

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

= 50,000kgs

∴ 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

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

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

= ₹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

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

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

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

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

∴ 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%

∴ Amount of perimum = 4% of policy value

$$= \frac{4}{100} \times 5,00,000$$

= ₹20,000

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

∴ 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

= Loss − Claim + 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%

i.e., 0.80 ☐ 0.20% of 0.80 = 0.80 ☐ 0.16 = 0.64%

∴ Amount of perimum

= 0.64% of total policy value

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

= ₹1,280

Commission of agent

= 12% of amount of perimum

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

∴ 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

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

∴ 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

∴ For policy value of 1,00,000,

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

= ₹ 5,595.8

∴ 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

$$= 80\% \text{ of value of remaining goods}$$

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

$$= ₹1,28,000$$

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

$$= 80,000 + 1,280,000$$

$$= ₹2,08,000$$

Amount claimed on gods

$$= \frac{\text{Policy value f iids}}{\text{Prroperty value of goods}} \times \text{Loss on goods}$$

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

= ₹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

∴ Premium per year = $\dfrac{\text{Policy Value}}{\text{Period of policy}}$

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

= ₹10,000

But, the person pays premium for 10 years.

∴ Premium paid by the person

= 10,000 x 10

= ₹1,00,000

Rate of bonus = ₹20 per year for thousand,

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

= ₹4,000

∴ Bonus for 10 years

= 4,000 x 10

= ₹40,000

∴ Paid up vallue 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.

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

Now, A = $\dfrac{C}{i}\left[(1+i)^a - 1\right]$

∴ A = $\dfrac{800}{0.08}\left[(1+0.08)^3 - 1\right]$

= 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 anunity.

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

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

= 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 x 2 = 4 half years.

Rate of interest is 12% p.a

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

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

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

$= \dfrac{24,000}{0.06}\left[(1+0..06)^4 - 1\right]$

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

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

$= 4,00,00(0.2625)$

$\therefore = 1,05,000$

$\therefore$ 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

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

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

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

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

= 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.

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

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

$$= \frac{36,000}{0.09}\left[1 - (1 + 0.09)^{-3}\right]$$

= 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.

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

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

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

= 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.

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

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

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

∴ 4,64,100(0.1) C[(1.1)^4 − 1]

∴ 46,410 = C[1.4641 − 1]

∴ 46,410 = C(0.4641)

∴ C = $\frac{46,410}{0.4641}$

∴ 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.

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

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

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

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

$\therefore$ 69,615 = C[1.4641 − 1]

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

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

$\therefore$ 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.

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

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

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

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

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

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

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

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

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

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

But, i cannot be negative.

$$\therefore i = 2$$

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

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

∴ The rate of interest is 200% 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% p.a.

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

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

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

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

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

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

$\therefore (1.1)^n = 1.331$

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

$\therefore n = 3$

∴ 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.

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

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

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

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

= (1,000)(11)[1.331 − 1]

= 11,000(0.331)

∴ A = 3,641

∴ 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.

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

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

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

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

= (400)(51)[1.0404 − 1]

= 20,400(0,0404)

A = 824.16

∴ 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.

∴ n = 4

Rate of interest is 32% p.a.

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

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

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

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

$$= \frac{600(1.08)}{0.08}\left[1-(1.08)^{-4}\right]$$

$$= (7,5000)(1.08)[1-0.7350]$$

$$= (8,100)(0.2650)$$

P' = 2,146.5

∴ 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

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

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

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

$$\therefore \frac{2-1}{20,000} = \frac{012}{C}$$

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

∴ C = (0.12)(20,000)

∴ C = 2,400

∴ 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.

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

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.

∴ n = 10 x 2 = 20

Rate of intererst is 5% p.a.

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

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

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

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

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

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

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

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

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

∴ Amount of ₹3,703.70 should be set aside bi-annualy 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**.

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

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**.

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:

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

$$P' = \frac{8000(1+0.06)}{0.06}\left[1-(1+0.06)^{-5}\right]$$

$$= \frac{8000(1.06)}{0.06}\left[1-(1.06)^{-5}\right]$$

$$= (1,41,333.33)(0.25274)$$

$$\therefore P' = ₹35,720.$$

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: <u>**Annuity**</u> 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**.

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**.

Fill in the blank :

The person who receives annuity is called _____.

Solution: The person who receives annuity is called **annuitant**.

Fill in the blank :

The payment of each single annuity is called _____.

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

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**.

Fill in the blank :

An annuity where payments continue forever is called _____.

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

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**.

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**.

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**.

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**.

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**.

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 **<u>True</u>**.

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 **<u>True</u>**.

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 **<u>True</u>**.

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 **<u>True</u>**.

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

$$= \frac{75}{100} \times 8,00,000$$

$$= ₹6,00,000$$

Rate of perimum = 0.80%

∴ Amount of perimum = 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 commision = 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 vale 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 $(5/6)^{th}$ 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 $\left(\frac{5}{6}\right)^{th}$ of its value,

∴ Policy value = $\left(\frac{5}{6}\right)^{th}$ 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

$$= \frac{2.50}{100} \times \frac{5x}{6}$$

$$= \frac{0.1}{4} \times \frac{5x}{6x}$$

$$= \frac{0.5x}{24}$$

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

Agent's commission = 7.5 % of premium

$$\therefore 2,812.50 = \frac{7.5}{100} \times \frac{0.5x}{24}$$

$$\therefore 2,812.50 = \frac{0.3}{4} \times \frac{0.5x}{24}$$

$$\therefore 2,812.50 = \frac{0.1}{4} \times \frac{0.5x}{8}$$

$$\therefore 2,812.50 = \frac{0.05x}{32}$$

$$\therefore x = \frac{2,812.50 \times 32}{0.05}$$

∴ x = 56,250 x 32

∴ 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, ∴ Policy value = 80% of value of the stock

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

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

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

∴ Remaining value of the stock

= ₹(x – 80,000)

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

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

∴ Loss of the remaining stock

= 80% of ₹(x – 80,000)

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

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

∴ 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.

∴ Claim = ₹67,200

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

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

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

∴ $\dfrac{67,200 \times 5 \times 5}{4}$ = 80,000 + 4x

∴ 16,800 x 25 = 80,000 + 4x

∴ 4,20,000 = 80,000 + 4x

∴ 4x = 4,20,000 – 80,000

∴ 4x = ₹3,40,000

∴ x $= \dfrac{3,40,000}{4}$ = 85,000

∴ 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

∴ Bonus (per year) = $\dfrac{7}{1,000}$ × 1, 00, 000 = ₹7,00

∴ Bonus for 10 years = 700 x 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.

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

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

Policy value = ₹ 1 lakh

Cost of articles = ₹200 per dozen

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

Policy value = ₹ 1 lakh

Cost of 15,000 articles (property value)

= cost of one article x number of articles

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

Now, 20% of the articles were completely burnt.

∴ Number of articles burnt = 20% of total articles

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

= 3,000

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

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

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

∴ Cost of 2,400 articles $= \dfrac{200}{12} \times 2,400$

= ₹40,000

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

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

= ₹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 (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

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

$$= ₹\frac{7x}{10}$$

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

Amount of perimum = ₹1.008.

∴ Amount od premium $= \frac{3}{4}\%$ of policy value

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

∴ $x = \dfrac{1008 \times 4 \times 100 x 10}{3 \times 7}$

∴ x = ₹1,,92,000

∴ Property value of cargo is ₹,92,000,

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

Price of grain is ₹12 per kg.

∴ Capacity of cargo $= \dfrac{\text{Value of cargo}}{\text{Price of 1kg grain}}$

$$= \frac{192,000}{12}$$

= 16,000 kgs

∴ Cargo contains 16,000 kgs of grains.

Solve the following :

4,000 bedsheets worth ₹6,40,000 were insured for (3/7)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,

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

∴ Loss on damaged bedsheets

= 60% of their value

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

Amount recovered against damage is ₹32,000

∴ Claim = ₹32,000

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

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

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

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

∴ x = 1,24,444.4

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

∴ Number of damaged bedsheets

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

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

= 777.78, i.e. approx 778

∴ 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,

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

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

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

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

= ₹3,500

For the rate of perimum

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

$$= \left(\frac{5}{8} - 20\% \text{ of } \frac{5}{8} \right)$$

$$= \left(\frac{5}{8} - \frac{20}{100} \times \frac{5}{8} \right) \%$$

$$= \left(\frac{5}{8} - \frac{1}{8} \right) \%$$

$$= \frac{4}{8} \%$$

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

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

$$= \frac{1}{2} \times \frac{1}{100} \times 5,60,000$$

= ₹2,800

∴ Savings made in the premium

= premium on $\frac{5}{8}$% – premium on $\frac{1}{2}$%

= 3,500 – 2,800

= ₹700

∴ 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)

= 40% of property value

$$= \frac{40}{100} \times 7,00,000 = ₹2,80,000$$

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

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

∴ Claim = ₹2,24,000

∴ Loss borne by the owner including premium

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

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

$= 56,000 + 2,800$

$= ₹58,800$

∴ 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

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

= ₹60,000

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

∴ Policy value of stock in the godown

= 60% of its stock value

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

= ₹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% of 0.80

= 0.80 − 0.16

= 0.64%

∴ Amount of perimum

= 0.64% of total policy value

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

= ₹883.20

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

∴ Agent's commision = 15% of total premium

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

= ₹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

$\therefore$ Paid up value of one year $= \dfrac{\text{Policy value}}{\text{Period of policy}}$

$$= \dfrac{1,20,000}{25}$$

= ₹4,800

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

$\therefore$ Paid up value = 4,800 x 8 = ₹38,400

Amount of premium paid for one year

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

$\therefore$ Amount of premium paid for 8 years

= 6,960 x 8

= ₹55,680

Surrender value

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

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

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

= ₹17,052

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

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 vale 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% 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

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

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

= ₹1,82,400

Loss on godown = ₹40,000,

Claim for godown =
$\dfrac{\text{Policy value of godown}}{\text{Property value of stock}} \times$ 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.

∴ r = $\dfrac{12}{4}$% = 3% per quarter

∴ i = $\dfrac{r}{100}$ = $\dfrac{3}{100}$ 0..03

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

∴ n = 5 x 4 = 20

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

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

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

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

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

= $\dfrac{403.05}{0.03}$

= $\dfrac{40305}{3}$

= ₹13,435

∴ Amount of ordinary annuity is ₹13,435.

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.

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

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

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

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

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

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

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

$\therefore C = ₹23,201.18$

$\therefore$ 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.

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

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

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

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

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

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

$\therefore (1.1)^n = 3$

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.

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

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

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

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

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

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

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

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

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

But $i = \dfrac{r}{100}$

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

∴ 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]

Wait — correcting superscript: $[(1.01)^{-24} = 0.7875]$

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.

∴ r = $\dfrac{12}{12}$ = 1% p.m.

∴ i = $\dfrac{r}{100}$ = $\dfrac{1}{100}$ = 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.

∴ P = $\dfrac{C}{i}\left[1 - (1+i)^{-n}\right]$

∴ P = $\dfrac{1,000}{0.01}\left[1 - (1+0.01)^{24}\right]$

= 1,00,000 [1 − (1.01)$^{-24}$]

= 1,00,000 (1 − 0.7875)

= 1,00,000 x 0.2125

∴ 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.

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.

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

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

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

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

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

$= 2,00,000(0.2487)$

$= ₹49,740$

∴ 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.

$$\therefore i = \frac{r}{100} = \frac{2}{100} = 0.2$$

Here, we have to find present value of annuity.

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

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

= 10,800[1 – (1.2)$^{-3}$]

= 10,800[1 – 0.5787]

= 10,800[0.4213]

∴ P = ₹4,550

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

∴ Total paid value of instalments

= 3 x 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:

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

Now, A = $\dfrac{C}{i}\left[(1+i)^n - 1\right]$

∴ 9,28,200 = $\dfrac{C}{0.1}\left[(1+0.1)^4 - 1\right]$

∴ 9,28,200 x 0.1 = C[(1.1)^4 – 1]

∴ 92,820 = C[1.4641 – 1]

∴ 92,820 = C(0.4641)

∴ C = $\dfrac{92,820}{0.4641}$

∴ C = ₹2,00,000

∴ 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.

∴ n = 2 x 2 = 4 half years

Rate of interest is 12% p.a.

∴ r = $\dfrac{12}{2}$ = 6% per half year

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

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

∴ A = $\dfrac{12,000}{0.06}\left[(1+0.06)^4 - 1\right]$

= 2,00,000 [(1.06)^4 – 1]

= 2,00,000 (1.2625 – 1]

= 2,00,000 (0.2625)

∴ A = 52,500

∴ Future value after 2 years is ₹52,500.

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.

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

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

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

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

∴ 19,324.80 = 3,000 × 6 $[(1.2)^n - 1]$

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

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

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

∴ 1.0736 = $(1.2)^n - 1$

∴ $(1.2)^n$ = 1.0736 + 1

∴ $(1.2)^n$ = 2.0736

∴ $(1.2)^n = (1.2)^4$ ...[Θ $(1.2)^4 = 2.0736$]

∴ n = 4 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,

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

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

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

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

$\therefore$ 36,000 = C (2.653 – 1)

$\therefore$ 36,000 = C x 1.653

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

$\therefore$ C = ₹21,778.58

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