Class XII Session 2025-26
Subject - Applied Mathematics
Sample Question Paper - 4

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section - D carries 20 marks weightage and Section - E carries 3 case-based with total weightage of 12 marks.
3. **Section – A:** It comprises of 20 MCQs of 1 mark each.
4. **Section – B:** It comprises of 5 VSA type questions of 2 marks each.
5. **Section – C:** It comprises of 6 SA type of questions of 3 marks each.
6. **Section – D:** It comprises of 4 LA type of questions of 5 marks each.
7. **Section – E:** It has 3 case studies. Each case study comprises of 3 case-based questions, where 2 VSA type questions are of 1 mark each and 1 SA type question is of 2 marks. Internal choice is provided in 2 marks question in each case-study.
8. Internal choice is provided in 2 questions in Section - B, 2 questions in Section – C, 2 questions in Section - D. You have to attempt only one of the alternatives in all such questions.

Section A

1. The matrix $\begin{bmatrix} 0 & -5 & 3 \\ 5 & 0 & -7 \\ -3 & 7 & 0 \end{bmatrix}$ is a **[1]**

a) skew-symmetric matrix

b) diagonal matrix

c) scalar matrix

d) symmetric matrix

2. A statement made about a population parameter for testing purpose is called **[1]**

a) parameter

b) level of significance

c) hypothesis

d) statistic

[1]

3. Simple interest on a certain sum of money for 3 years at 8% p.a. is half the compound interest on ₹ 4000 for 2 years at 10% p.a. The sum invested is **[1]**

a) ₹ 1650

b) ₹ 2000

c) ₹ 1550

d) ₹ 1750

4. If the objective function for an L.P.P. is Z = 3x + 4y and the comer points for unbounded feasible region are (9, 0), (4, 3), (2, 5) and (0, 8), then the minimum value of Z occurs at

a) (4, 3)

b) (0, 8)

c) (9, 0)

d) (2, 5)

5. The number of possible matrices of order 3×3 with each entry 2 or 0 is: **[1]**

a) none of these

b) 81

c) 9

d) 27

6. The probability that a person is not a swimmer is 0.3. The probability that out of 5 persons 4 are swimmers is **[1]**

a) $(0.7)^4$ (0.3)

b) $^5C_4$ (0.7) $(0.3)^4$

c) $^5C_1$ (0.7) $(0.3)^4$

d) $^5C_4$ $(0.7)^4$ (0.3)

7. A coin is tossed 10 times. The probability of getting exactly six heads is **[1]**

a) $\frac{100}{153}$

b) $\frac{105}{512}$

c) $\frac{512}{513}$

d) $^{10}C_6$

8. Integrating factor of $x\frac{dy}{dx} - y = x^4 - 3x$ is **[1]**

a) -x

b) log x

c) $\frac{1}{x}$

d) x

9. If in a 600 m race, A can beat B by 50 m and in a 500 m race, B can beat C by 60 m. Then, in a 400 m race, A will beat C by: **[1]**

a) 77 m

b) $77\frac{1}{2}$m

c) 81.33 m

d) 70 m

10. If A is a square matrix, then AA is a: **[1]**

a) skew-symmetric matrix

b) diagonal matrix

c) none of these

d) symmetric matrix

11. What is the least value of 'x' that satisfies $x \equiv 27 \pmod 4$, when $27 < x \leq 36$? **[1]**

a) 30

b) 35

c) 27

d) 31

12. Let p > 0 and q < 0 and p, q $\in$ Z, then choose the correct inequality from the given below options to complete the statement p + q ... p - q **[1]**

a) <

b) $\leq$

c) $\geq$

d) >

13. Two pipes A and B can fill a tank in 20 and 16 hours respectively. Pipe B alone is kept open for $\frac{1}{4}$ of time and both pipes are kept open for the remaining time. In how many hours, the tank will be full? **[1]**

a) $12\frac{1}{3}$ hours

b) 20 hours

c) 10 hours

d) $18\frac{1}{3}$ hours

14. The graph of the inequality 2x + 3y > 6 is **[1]**

a) half plane that neither contains origin nor

b) entire XOY-plane.

the points of the line 2x + 3y = 6

c) half plane that contains the origin

d) whole XOY-plane excluding the points on the line 2x + 3y = 6

15. Which of the following is a vertex of the positive region bounded by the inequalities, $2x + 3y \leq 6$ and $5x + 3y \leq 15$ **[1]**

a) (3, 0)

b) (0, 2)

c) (0, 0)

d) All of these

16. Which of the following values is used as a summary measure for a sample, such as a sample mean? **[1]**

a) Population mean

b) Sample Parameter

c) Sample Statistic

d) Population Parameter

17. If $f(a+b-x) = f(x)$, then $\int_a^b x f(x) dx$ is equal to **[1]**

a) $\frac{a+b}{2} \int_a^b f(a-x) dx$

b) $\frac{a+b}{2} \int_a^b f(b-x) dx$

c) $\frac{b-a}{2} \int_a^b f(x) dx$

d) $\frac{a+b}{2} \int_a^b f(x) dx$

18. For the given five values 15, 24, 18, 33, 42, the three years moving averages are **[1]**

a) 19, 22, 33

b) 19, 30, 31

c) 19, 25, 31

d) 19, 25, 33

19. **Assertion (A):** If A = $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ and B = $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$, then B is the inverse of A. **[1]**

Reason (R): If A is a square matrix of order m and if there exists another square matrix B of the same order m, such that AB = BA = I, then B is called the inverse of A.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

20. **Assertion (A):** If the demand function of a product is p = 200 - $\frac{x^2}{3}$, then the marginal revenue (MR) of selling 10 units is ₹ 120. **[1]**

Reason (R): MR = $\frac{d}{dx}$(R)

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

21. Using three-yearly moving averages, compute the trend values and short term fluctuations for the following data: **[2]**

Year:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production (Thousand tonnes):	21	22	23	25	24	22	25	26	27	26

22. A man borrows ₹ 3,00,000 at 6% per annum compound interest and promises to pay off the debt in 20 annual **[2]**

instalments beginning at the end of the first year. Find the amount of annual instalment. [Given: $(1.06)^{-20}$ = 0.312]

OR

The effective annual rate of interest corresponding to normal rate of 6% p.a. payable half yearly is ________.

23. Evaluate: $\int_{0}^{8}\left(\sqrt{8x}-\frac{x^2}{8}\right)dx$ **[2]**

24. If A = $\begin{bmatrix}1 & -3 & 2\\ 2 & 0 & 2\end{bmatrix}$, B = $\begin{bmatrix}2 & -1 & -1\\ 1 & 0 & -1\end{bmatrix}$, find the matrix C such that A + B + C is zero matrix. **[2]**

OR

Solve:

$\frac{4}{x}$ + 3y = 14

$\frac{3}{x}$ - 4y = 23

25. If a = 8 and b = 3, then verify that a mod b = (a + kb) mod b for k = 5. **[2]**

Section C

26. Radium decomposes at a rate proportional to the quantity of radium present. It is found that in 25 years, approximately 1.1% of a certain quantity of radium has decomposed. Determine approximately how long it will take for one-half of the original amount of radium to decompose? [Given $\log_e$ 0.989 = 0.01106 and $\log_e$ 2 = 0.6931] **[3]**

OR

The rate of increase of bacteria in a culture is proportional to the number of bacteria present and it is found that the number doubles in 6 hours. Prove that the bacteria becomes 8 times at the end of 18 hours.

27. Madhu exchanged her old car valued at ₹ 1,50,000 with a new one priced at ₹ 6,50,000. She paid ₹ x as down payment and the balance in 20 monthly equal instalments of ₹ 21,000 each. The rate of interest offered to her is 9% p.a. Find the value of x. [Given that: $(1.0075)^{-20}$ = 0.86118985] **[3]**

28. The demand and supply functions for a commodity are p = x^2 - 6x + 16 and p = $\frac{1}{3}x^2+\frac{4}{3}x+4$ respectively. Find each of the following assuming x $\leq$ 5: **[3]**

  i. The equilibrium point.
  ii. The consumer's surplus at the equilibrium point.
  iii. The producer's surplus at the equilibrium point.

29. Find the mean, variance and standard deviation of the number of tails in three tosses of a coin. **[3]**

OR

Two dice are thrown simultaneously. If X denotes the number of sixes, find the expectation and variance of X.

30. Fit a straight line trend by the method of least squares and find the trend value for the year 2008 for the following data: **[3]**

Year	**Production (in lakh tonnes)**
2001	30
2002	35
2003	36
2004	32
2005	37

2006	40
2007	36

31. Ten individuals are chosen at random from the population and their heights are found to be in inches 63, 63, 64, 65, 66, 69, 69, 70, 70, 71. Discuss the freedom value of Student's -t and 5% level of significance is 2.62. **[3]**

Section D

32. Solve the linear programming problems by graphical method: **[5]**

Maximize Z = 3x + 4y

Subject to 2x + 2y $\leq$ 80

2x + 4y $\leq$ 120

OR

A manufacturer has employed 5 skilled men and 10 semi-skilled men and makes two models A and B of an article. The making of one item of model A requires 2 hours work by a skilled man and 2 hours work by a semi-skilled man. One item of model B requires 1 hour by a skilled man and 3 hours by a semi-skilled man. No man is expected to work more than 8 hours per day. The manufacturer's profit on an item of model A is ₹15 and on an item of model B is ₹10. How many of items of each model should be made per day in order to maximize daily profit? Formulate the above LPP and solve it graphically and find the maximum profit.

33. Three pipes A, B and C can fill a tank in 8 hours. After working at it together for 2 hours B is closed and A and C can fill the remaining part in 9 hours. Find the time in which B alone can fill the tank **[5]**

34. Let X denote the number of hours a person watches television during a randomly selected day. The probability that X can take the values x_i has the following form, where k is some unknown constant. **[5]**

$$P(X = x_i) = \begin{cases} 0.2, & \text{if } x_i = 0 \\ kx_i, & \text{if } x_i = 1 \text{ or } 2 \\ k(5 - x_i), & \text{if } x_i = 3 \\ 0, & \text{otherwise} \end{cases}$$

a. Find the value of k.

b. What is the probability that the person watches two hours of television on a selected day?

c. What is the probability that the person watches at least two hours of television on a selected day?

d. What is the probability that the person watches at most two hours of television on a selected day?

e. Calculate mathematical expectation.

f. Find the variance and standard deviation of random variable X.

OR

Find the mean, variance and standard deviation of the number of heads in a simultaneous toss of three coins.

35. Anil plans to send his daughter for higher studies abroad after 10 years. He expects the cost of the studies to be ₹ 2,00,000. How much must he set aside at the end of each quarter for 10 years to accumulate this amount, if money is worth 6% compounded quarterly? [Given: $(1.015)^{40}$ = 1.8140] **[5]**

Section E

36. **Read the text carefully and answer the questions:** **[4]**

Rohit's father wants to construct a rectangular garden using a brick wall on one side of the garden and wire fencing for the other three sides as shown in the figure. He has 200 ft of wire fencing.

(a) To construct a garden using 200 ft of fencing, what should we need to maximize?

(b) If x denotes the length of the side of the garden perpendicular to a brick wall and y denotes the length of the side parallel to a brick wall, then find the relation representing the total amount of fencing wire?

(c) Area of the garden as a function of x, say A(x), how it can be represented?

OR

At what value of x, Maximum value of A(x) occurs?

37. **Read the text carefully and answer the questions:** **[4]**

The nominal rate of return shows the yield of an investment over time without accounting for negative elements such as inflation or taxes. By calculating the nominal rate of return, you can compare the performance of your assets easily, regardless of the inflation rate or differing spans of time for each investment. By obtaining a bird's-eye view of how your assets are growing, you can make more prudent investment decisions in the future.

(a) A man invests a sum of money in ₹100 shares paying 15% dividend quoted at 20% premium. If his annual dividend is ₹540, calculate the rate of return on his investment.

(b) Mr. Satya holds 1500, ₹100 shares of a company paying 15% dividend annually quoted at 30% premium. Calculate rate of return on his investment.

(c) ₹100 shares of a company are sold at a discount of ₹ 20. If the return on the investment is 15%, find the rate of dividend declared.

OR

A company declared a dividend of 14%. Find the market value of ₹50 shares, if the return on the investment was 10%.

38. Two badminton teams A and B are staying in the same hotel. Team A has 2 male and 3 female players accompanied by 1 coach. Team B comprises of 1 male, 2 female players and 2 coaches. The daily requirement (calories and protein) for each person is as given below: **[4]**

	Calories	Protein
Male player	2500	65 g
Female player	1900	50 g
Coach	2000	54 g

Use matrix algebra to calculate the total. diet requirement of calories and protein for each team.

OR

Two farmers Ram Kishan and Gurcharan Singh cultivate only three varieties of rice namely Basmati, Permal, and Naura. The sale (in ₹) of these varieties of rice by both the farmers in the month of September and October are given by the following matrices A and B.

September Sales (in Rupees)

$$A = \begin{array}{cl} \begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array} & \\ \begin{bmatrix} 10,000 & 20,000 & 30,000 \\ 50,000 & 30,000 & 10,000 \end{bmatrix} & \begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array} \end{array}$$

October Sales (in Rupees)

$$B = \begin{array}{cl} \begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array} & \\ \begin{bmatrix} 5000 & 10,000 & 6000 \\ 20,000 & 10,000 & 10,000 \end{bmatrix} & \begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array} \end{array}$$

Find:

i. What were the combined sales in September and October for each farmer in each variety?

ii. What was the change in sales from September to October?

iii. If both farmers receive 2% profit on gross rupees sales, compute the profit for each farmer and for each variety sold in October.

Solution

Section A

1. **(a)** skew-symmetric matrix

   Explanation:

   Let A = $\begin{bmatrix} 0 & -5 & 3 \\ 5 & 0 & -7 \\ -3 & 7 & 0 \end{bmatrix}$

   So, A' = $\begin{bmatrix} 0 & 5 & -3 \\ -5 & 0 & 7 \\ 3 & -7 & 0 \end{bmatrix} = -\begin{bmatrix} 0 & -5 & 3 \\ 5 & 0 & -7 \\ -3 & 7 & 0 \end{bmatrix}$ = -A

   $\Rightarrow$ A is a skew-symmetric matrix.

   $\therefore$ Option (skew-symmetric matrix) is the correct answer.

2. **(c)** hypothesis

   Explanation:

   hypothesis

3. **(d)** ₹ 1750

   Explanation:

   Let sum invested be ₹ x.

   $\therefore$ S.I. = $\frac{x \times 3 \times 8}{100}$ = $\frac{6x}{25}$ ...(i)

   C.I. = 4000$\left[\left(1 + \frac{10}{100}\right)^2 - 1\right]$

   = 4000[$(1.1)^2$ - 1] = 4000(1.21 - 1)

   = 4000 $\times$ 0.21 = ₹ 840 ...(ii)

   $\therefore$ 2 $\times \frac{6x}{25}$ = 840

   $\Rightarrow$ $x = \frac{840 \times 25}{12}$ = 70 $\times$ 25 = ₹ 1750

   $\therefore$ Sum invested = ₹ 1750

4. **(a)** (4, 3)

   Explanation:

   The values of Z = 3x + 4y at points (9, 0), (4, 3), (2, 5) and (0,8) are 27, 24, 32 respectively.

   Hence, minimum value of Z = 24 occurs at (4, 3).

5. **(a)** none of these

   Explanation:

   Since each element a_{ij} can be filled in two ways (with either '2' or '0'), total number of possible matrices is 8 $\times$ 8 $\times$ 8 = 512

   Therefore, none of the given options are correct.

6. **(d)** $^5C_4$ $(0.7)^4$ (0.3)

   Explanation:

   Here,$\bar{p}$ = 0.3 $\Rightarrow$ p = 0.7 and q = 0.3, n = 5 and r = 4

   $\therefore$Required probability = $^5C_4$ $(0.7)^4$ (0.3)

7. **(b)** $\frac{105}{512}$

Explanation:

n = 10, X = 6, p = q = $\frac{1}{2}$

P(X = 6) $= {}^{10}C_6\left(\frac{1}{2}\right)^{10} = \frac{105}{512}$

8.

(c) $\frac{1}{x}$

Explanation:

$\frac{dy}{dx} - \frac{y}{x}$ = x^3 - 3

I.F. = $e^{\int -\frac{1}{x}dx}$ = $e^{-\log x} = e^{\log x^{-1}}$ = $\frac{1}{x}$

9.

(c) 81.33 m

Explanation:

When A cover 600 m, B cover 550 m

When B cover 500 m, C cover 440 m

When B cover 400 m, C cover = $\frac{440}{500} \times 400$ = 88 $\times$ 4 = 352 m

In a 400 m race,

B beat C by = 400 - 352 = 48 m

When A cover 400 m, B cover = $\frac{550}{600} \times 400 = \frac{1100}{3}$ m = 366.67 m

In a 400 m, race A beat B by = 400 - 366.67 = 33.33 m

$\therefore$ In a 400 m race, A beat C by = 48 + 33.33 = 81.33 m

10.

(c) none of these

Explanation:

If A is a square matrix,

Let A = $\begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$

AA = $\begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$

then AA is neither of the matrices given in the options of the question.

11.

(d) 31

Explanation:

Given x $\equiv$ 27 (mod 4)

$\Rightarrow$ x - 27 = 4λ, where $\lambda \in$ I

$\Rightarrow$ x = 27 + 4λ

Putting x = 0, $\pm$1, $\pm$2, ..., we get

x = ..., 19, 23, 27, 31, 35, ...

But 27 < x $\leq$ 36,

so, least value of x = 31.

12. **(a)** <

Explanation:

Given p > 0, q < 0, p, q $\in$ Z

So, P + q < p + 0 $\Rightarrow$ p + q < p ...(i)

Also, -q > 0 $\Rightarrow$ p + (-q) > p + 0

$\Rightarrow$ p - q > p ...(ii)

Using (i) and (ii), we have

p + q < p - q

13.

(c) 10 hours

Explanation:

Let the required time be x hours, then

$\frac{1}{16}\left(\frac{1}{4}x\right)+\frac{1}{16}\left(x-\frac{1}{4}x\right)+\frac{1}{20}\left(x-\frac{1}{4}x\right)=1$

$\Rightarrow \frac{x}{16}+\frac{3x}{80}=1$ $\Rightarrow$ x = 11 = 10 hours.

14. **(a)** half plane that neither contains origin nor the points of the line 2x + 3y = 6

Explanation:

$\because$ (0, 0) does not satisfy 2x + 3y > 6.

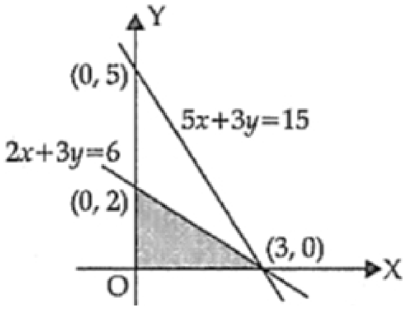
So, the graph of the inequality 2x + 3y > 6 is half plane that neither contain origin nor the points of the line 2x + 3y = 6.

15.

(d) All of these

Explanation:

Here (0, 2), (0, 0) and (3, 0) all are vertices of feasible region.



16.

(c) Sample Statistic

Explanation:

Sample Statistic

17.

(d) $\frac{a+b}{2}\int\limits_a^b f(x)dx$

Explanation:

Let $\mathrm{I}=\int\limits_a^b xf(x)dx$ ...(i)

$\mathrm{I}=\int\limits_a^b (a+b-x)f(a+b-x)dx$ (by property P_3)

$\mathrm{I}=\int\limits_a^b (a+b-x)f(x)dx$ ($\because$ f(a + b - x) = f(x) given) ...(ii)

Adding (i) and (ii), we get

$2\mathrm{I}=\int\limits_a^b (x+a+b-x)f(x)dx$

$\Rightarrow \mathrm{I}=\frac{a+b}{2}\int_a^b f(x)dx$

18.

(c) 19, 25, 31

Explanation:

3-years moving average are

$\frac{15+24+18}{3}, \frac{24+18+33}{3}, \frac{18+33+42}{3}$

i.e. $\frac{57}{3}, \frac{75}{3}, \frac{93}{3}$ i.e. 19, 25, 31

19. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Let A = $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$ be two matrices.

Then, AB = $\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$

$= \begin{bmatrix} 4-3 & -6+6 \\ 2-2 & -3+4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

Also, BA = $\begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}\begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$

$= \begin{bmatrix} 4-3 & 6-6 \\ -2+2 & -3+4 \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

Thus, B is the inverse of A.

20.

(d) A is false but R is true.

Explanation:

Given P = 200 - $\frac{x^2}{3}$

⇒ R(x) = P·x ⇒ R(x) = 200x - $\frac{x^3}{3}$

Now, Marginal Revenue (MR) = $\frac{d}{dx}$R = $\frac{d}{dx}$(200x - $\frac{x^3}{3}$)

⇒ MR = $200-x^2$

= $[MR]_{x=10}$ = ₹(200 - 10^2) = ₹100

Assertion is false.

Reason is true.

Section B

21. Computation of trend values

Year	Production (Thousand tonnes)	3-yearly moving totals	3-yearly moving averages Y_c	Short term fluctuations $(Y - Y_c)$
2008	21	-	-	-
2009	22	66	22.00	0
2010	23	70	23.33	-0.33
2011	25	72	24.00	1.00
2012	24	71	23.67	0.33
2013	22	71	23.67	-1.67
2014	25	73	24.33	0.67
2015	26	78	26.00	0.00
2016	27	79	26.33	0.67
2017	26	-	-	-

22. Here, V= ₹ 3,00,000, r = 6% and n = 20

We know V = $\frac{A}{r}[1 - (1 + r)^{-n}]$

Thus 3,00,000 = $\frac{A}{0.06}[1 - (1 + 0.06)^{-20}]$

⇒ A = $\frac{300000 \times 0.06}{\left[1-(1+0.06)^{-20}\right]}$

⇒ A = $\frac{18000}{\left[1-(1.06)^{-20}\right]}$

⇒ A = ₹ 26,162.79

hence, the amount of annual instalment is ₹ 26,162.79

OR

Let principal be ₹ 100

Rate = 3% half yearly

$\therefore$ Interest for 1st half year $= \frac{100\times3\times1}{100}$ = ₹ 3

Interest for 2nd half year $= \frac{103\times3\times1}{100}$ = ₹ 3.09

$\therefore$ Total yearly interest = ₹ 6.09

Let effective rate of interest be r%

$\therefore 6.09 = \frac{100\times r\times1}{100}$ ⇒ r = 6.09 %

Using formula $\left(1+\frac{3}{100}\right)^2$ - 1 =$(1.03)^2$ - 1

= 1.0609 - 1 = 0.0609

$\therefore$ Effective rate % = 6.09%

23. $\int\limits_0^8 \left(\sqrt{8x} - \frac{x^2}{8}\right) dx = \left[\sqrt{8}\cdot\frac{x^{3/2}}{\frac{3}{2}} - \frac{1}{8}\cdot\frac{x^3}{3}\right]_0^8 = \left(\frac{2}{3}\sqrt{8}\cdot 8^{3/2} - \frac{1}{24}\cdot 8^3\right) - (0-0)$

$= \frac{2}{3} \times 64 - \frac{1}{3} \times 64 = \frac{64}{3}$.

24. Given,

A = $\begin{bmatrix} 1 & -3 & 2 \\ 2 & 0 & 2 \end{bmatrix}$, B = $\begin{bmatrix} 2 & -1 & -1 \\ 1 & 0 & -1 \end{bmatrix}$

And

A + B + C = 0

⇒ C = - A - B + 0

⇒ C = - A - B

⇒ C = - $\begin{bmatrix} 1 & -3 & 2 \\ 2 & 0 & 2 \end{bmatrix}$ - $\begin{bmatrix} 2 & -1 & -1 \\ 1 & 0 & -1 \end{bmatrix}$

⇒ C = $\begin{bmatrix} -1 & 3 & -2 \\ -2 & 0 & -2 \end{bmatrix}$ - $\begin{bmatrix} 2 & -1 & -1 \\ 1 & 0 & -1 \end{bmatrix}$

⇒ C = $\begin{bmatrix} -1-2 & 3+1 & -2+1 \\ -2-1 & 0-0 & -2+1 \end{bmatrix}$

⇒ C = $\begin{bmatrix} -3 & 4 & -1 \\ -3 & 0 & -1 \end{bmatrix}$

OR

Given equations are

$\frac{4}{x}$ + 3y = 14

$\frac{3}{x}$ - 4y = 23

Let $\frac{1}{x}$ = p

The given equations reduce to:

4p + 3y = 14

⇒ 4p + 3y - 14 = 0 ...(i)

and 3p - 4y = 23

⇒ 3p - 4y - 23 = 0 ...(ii)

Using cross-multiplication method, we obtain:

$\frac{p}{-69-56} = \frac{y}{-42-(-92)} = \frac{1}{-16-9}$

⇒ $\frac{p}{-125} = \frac{y}{50} = \frac{-1}{25}$

Taking $\frac{p}{-125} = \frac{-1}{25}$

⇒ p = 5,

Also taking $\frac{y}{50} = \frac{-1}{25}$

⇒ y = -2

$\therefore$ p = $\frac{1}{x}$ = 5

⇒ x = $\frac{1}{5}$, y = -2

Therefore the solution of given equations is x = $\frac{1}{5}$, y = -2

25. For given a = 8, b = 3

a mod b = 8 mod 3 = 2

Also, (a + kb) mod b = (8 + 5 $\times$ 3) mod 3 = 23 mod 3 = 2

$\therefore$ 8 mod 3 = 23 mod 3 = 2

Hence, verified.

Section C

26. Let A be the quantity of radium present at time t and A_0 be the initial quantity of radium.

Therefore, we have,

$\frac{dA}{dt} \propto A$

$\frac{dA}{dt}$ = - 2A

$\frac{dA}{A}$ = - 2dt

$\int \frac{dA}{A} = -\lambda t dt$

log A = $-\lambda t$ + c ...(i)

Now, A = A_0 when t = 0

log A_0 = 0 + c

c = log A_0

Put value of c in equation

log A = $-\lambda$ t + log A_0

$\log\left(\frac{A}{A_0}\right) = -\lambda t$ ...(ii)

Given that, In 25 years, bacteria decomposes 1.1 %, so

A = (100 - 1.1)% = 98.996 %= 0.989 A_0, t = 25

Therefore, (ii) gives,

$\log\left(\frac{0.989 A_0}{A_0}\right)$ = - 25λ

log (0.989) = -25λ

$\lambda = -\frac{1}{25}$ log (0.989)

Now, equation (ii) becomes,

$\log\left(\frac{A}{A_0}\right)$ = {$\frac{1}{25}$ log (0.989)} t

Now A = $\frac{1}{2}A_0$

$\log\left(\frac{A}{2A}\right) = \frac{1}{25}$ log (0.989) t

$\frac{-\log 2\times 25}{\log(0.989)}$ = t

$-\frac{0.6931\times 25}{0.01106}$ = t

t = 1567 years

Required time = 1567 years

OR

Let A be the quantity of bacteria present in culture at any time t and initial quantity of bacteria is A_0

$\frac{dA}{dA} \propto A$

$\frac{dA}{dt} = \lambda A$

$\frac{dA}{A} = \lambda dt$

$\int \frac{dA}{A} = \int \lambda dt$

log A = λt + c ...(i)

Initially, A = A_0, t = 0

log A_0 = 0 + c

log A_0 = c

Now equation (i) becomes,

log A = λt + log A_0

$\log\left(\frac{A}{A_0}\right) = \lambda t$ ...(ii)

Given A = 2 A_0 when t = 6 hours

$\log\left(\frac{A}{A_0}\right) = 6\lambda$

$\frac{\log 2}{6} = \lambda$

Now equation (ii) becomes,

$\log\left(\frac{A}{A_0}\right) = \frac{\log 2}{6}t$

Now, $A = 8 A_0$

so, $\log\left(\frac{8A_0}{A_0}\right) = \frac{\log 2}{6}t$

$\log 2^3 = \frac{\log 2}{6}t$

$3 \log 2 = \frac{\log 2}{6}t$

18 = t

Hence, Bacteria becomes 8 times in 18 hours.

27. Madhu paid the balance in 20 monthly installments of ₹ 21000 each

Let Principle = P, $i = \frac{9}{1200} = 0.0075$, n = 20 and E = 21000

$E = \frac{Pi}{1-(1+i)^{-n}}$

$\Rightarrow 21000 = \frac{P\times(0.0075)}{1-(1.0075)^{-20}}$

$\Rightarrow 21000 = \frac{P\times(0.0075)}{1-0.8611}$

$\Rightarrow 21000 = \frac{P\times(0.0075)}{0.1389}$

$\Rightarrow 21000 \times 0.1389 = P \times (0.0075)$

$\Rightarrow$ P = 388920

Thus, the balance is ₹ 388920

Madhu exchanged her old car valued at ₹ 150000 and a new one priced at ₹ 650000.

So, Madhu had ₹ 500000 after the exchange.

She paid approximately ₹ 388920in the form of monthly installments.

Therefore, the down payment x = 500000 - 388920 = 111080.

Hence, the value of x is 111080.

28. The demand and supply functions are p = D(x) and p = S(x), where $D(x) = x^2 - 6x + 16$ and $S(x) = \frac{1}{3}x^2 + \frac{4}{3}x + 4$

i. The equilibrium point (x_0, p_0) is the point at which the demand-supply curves intersect. Therefore, the equilibrium point is obtained by setting D(x) = S(x).

   Now, D(x) = S(x)

   $\Rightarrow x^2 - 6x + 16 = \frac{1}{3}x^2 + \frac{4}{3}x + 4$

   $\Rightarrow \frac{2}{3}x^2 - \frac{22}{3}x + 12 = 0 \Rightarrow x^2 - 11x + 18 = 0 \Rightarrow (x - 2)(x - 9) \Rightarrow x = 2\ [\because x \leq 5]$

   Putting x = 2 either in p = D (x) or in p = S(x), we obtain p = 8. Thus, $x_0 = 2$ and $p_0 = 8$. Hence, (2, 8) is the equilibrium point.

ii. The consumer's surplus (CS) at the equilibrium point (2, 8) is given by

   $CS = \int_0^{x_0} D(x)dx - p_0x_0$

   $\Rightarrow CS = \int_0^2 \left(x^2 - 6x + 16\right) dx - 8 \times 2$

   $\Rightarrow CS = \left[\frac{x^3}{3} - 3x^2 + 16x\right]_0^2 - 16 = \left(\frac{8}{3} - 12 + 32\right) - 16 = \frac{20}{3}$

iii. The producer's surplus (PS) at the equilibrium point (2, 8) is given by

   $PS = p_0x_0 - \int_0^{x0} S(x)dx$

   $\Rightarrow PS = 8 \times 2 - \int_0^2 \left(\frac{1}{3}x^2 + \frac{4}{3}x + 4\right) dx$

   $\Rightarrow PS = 16 - \left[\frac{x^3}{9} + \frac{2}{3}x^2 + 4x\right]_0^2 = 16 - \left(\frac{8}{9} + \frac{8}{3} + 8\right) = \frac{40}{9}$

29. Let X be a random variable denoting the number of tails in three tosses of a coin. Then, X can take the values 0, 1, 2 and 3

Now, we have,

$P(X = 0) = P(HHH) = \frac{1}{8}$

$P(X = 1) = P(THH \text{ or } HHT \text{ or } HTH) = \frac{3}{8}$

$P(X = 2) = P(TTH \text{ or } THT \text{ or } HTT) = \frac{3}{8}$

$P(X = 3) = P(TTT) = \frac{1}{8}$

Thus, the probability distribution of X is as follows:

X	0	1	2	3
P(X)	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

Computation of mean and variance:

x_i	p_i	p_ix_i	$p_ix_i^2$
0	$\frac{1}{8}$	0	0
1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$
2	$\frac{3}{8}$	$\frac{6}{8}$	$\frac{12}{8}$
3	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{9}{8}$
		$\sum p_ix_i = \frac{3}{2}$	$\sum p_ix_i^2 = 3$

Therefore, mean = $\sum p_ix_i = \frac{3}{2}$

Variance = $\sum p_ix_i^2$ - (Mean)^2

= 3 - $\left(\frac{3}{2}\right)^2$

= 3 - $\frac{9}{4}$

= $\frac{3}{4}$

Standard deviation = $\sqrt{\text{Variance}}$

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

= 0.87

OR

Let X be a random variable denoting the number of sixes in throwing a die two times. Then, X can take values 0, 1, 2.

Now,

P(X = 0) = P(six does not appear on any of die) = $\frac{5}{6} \times \frac{5}{6} = \frac{25}{36}$

P(X = 1) = P(six appears atleast once of the die) = $\left(\frac{1}{6} \times \frac{5}{6}\right) + \left(\frac{1}{6} \times \frac{5}{6}\right) = \frac{10}{36} = \frac{5}{18}$

P(X = 2) = P(six does appear on both of die) = $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$

Hence, the required probability distribution is,

X	0	1	2
P(X)	$\frac{25}{36}$	$\frac{5}{18}$	$\frac{1}{36}$

Computation of mean and variance

x_i	$p_i = P(X = x_i)$	p_ix_i	$p_ix_i^2$
0	$\frac{25}{36}$	0	0
1	$\frac{10}{36}$	$\frac{10}{36}$	$\frac{10}{36}$
2	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{4}{36}$
		$\Sigma p_ix_i = \frac{12}{36}$	$\Sigma p_ix_i^2 = \frac{14}{36}$

Thus, we have

$\Sigma p_ix_i = \frac{12}{36} = \frac{1}{3}$ and $\Sigma p_ix_i^2 = \frac{7}{18}$

$\therefore$ E(X) = $\Sigma p_ix_i = \frac{1}{3}$ and, Var(X) = $\Sigma p_ix_i^2 - (\Sigma p_ix_i)^2$ = $\frac{7}{18} - \frac{1}{9} = \frac{5}{18}$

Hence, E(X) = $\frac{1}{3}$ and Var(X) = $\frac{5}{18}$

30. Taking middle-year value at A i.e. A = 2004

Year (X_i)	**Production (Y)**	**$X = x_i - A = x_i - 2004$**	**X^2**	**XY**
2001	30	-3	9	-90
2002	35	-2	4	-70
2003	36	-1	1	-36

2004	32	0	0	0
2005	37	1	1	37
2006	40	2	4	80
2007	36	3	9	108
n = 7	$\sum y$ = 246	$\sum x$ = 0	$\sum x^2 = 28$	$\sum xy$ = 29

a = $\frac{\sum y}{n} = \frac{246}{7}$ = 35.14

b = $\frac{\sum xy}{\sum x^2} = \frac{29}{28}$ = 1.036

Therefore, the required equation of the straight-line trend is given by Y = 35.14 + 1.036 X

Now, the trend value for the year 2008 is given by

Y = 35.14 + 1036(2008 - 2004) = 39.284

Hence the trend value for the year is 39.284 lakh tonnes.

31.

x	$x - \bar{x}$	$(x - \bar{x})^2$
63	-4	16
63	-4	16
64	-3	9
65	-2	4
66	-1	1
69	2	4
69	2	4
70	3	9
70	3	9
71	4	16
$\sum x = 670$		$\sum (x - \bar{x})^2$ = 88

$= \frac{\sum x}{n}$

$= \frac{670}{10}$ = 67

Now, compute the standard deviation using formula as,

$\sigma = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$

$= \sqrt{\frac{88}{9}}$

= 3.13 inches

H$_0$ = The mean of universe, μ = 65 inches, we get

$t = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$

$= \frac{67-65}{\frac{3.13}{\sqrt{10}}}$

$= \frac{2}{\frac{3.13}{3.16}}$

$= \frac{2}{0.9905}$

= 2.02

The number of degree of freedom = n - 1 = 9 Given that the tabulated value for 9 d.f. at level of significance is 2.62.

Since calculated value of t is less than the tabulated value i.e., 2.02 < 2.62, the error has arisen due to fluctuations and we may conclude that the data are consistent with the assumption of mean of height in the universe of 65 inches.

Section D

32. Given,

Objective function is: Z = 3x + 4y

Constraints are:

$2x + 2y \leq 80$

$2x + 4y \leq 120$

First convert the given inequations into corresponding equations and plot them:

$2x + 2y \leq 80 \Rightarrow 2x + 2y = 80$ (corresponding equation)

Two coordinates required to plot the equation are obtained as:

Put, $x = 0 \Rightarrow y = 40(0, 40)$ ...first coordinate.

Put, $y = 0 \Rightarrow x = 40(40, 0)$ ...second coordinate

Join them to get the line.

As we know, Linear inequation will be a region in a plane, and we observe that the equation divides the XY plane into 2 halves only, so we need to check which region represents the given inequation.

If the given line does not pass through origin then just put (0, 0) to check whether inequation is satisfied or not. If it satisfies the inequation origin side is the required region else the other side is the solution.

Similarly, we repeat the steps for other inequation also and find the common region.

$2x + 4y \leq 120 \Rightarrow 2x + 4y = 120$ (corresponding equation)

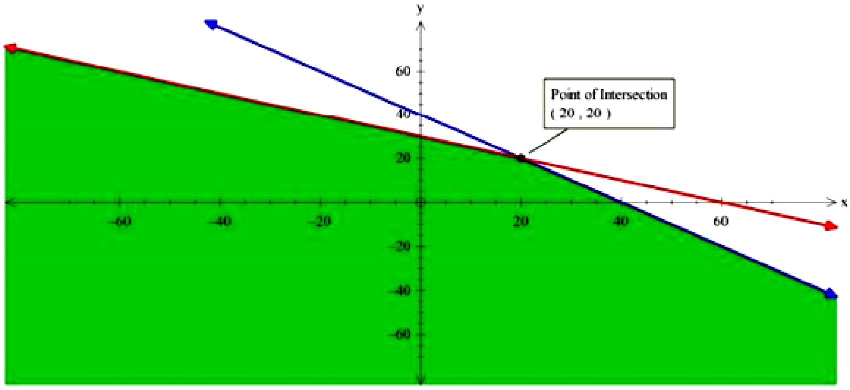
Two coordinates required to plot the equation are obtained as:

Put, $x = 0 \Rightarrow y = 30(0, 30)$ ...first coordinate.

Put, $y = 0 \Rightarrow x = 60(60, 0)$ ...second coordinate

$x = 0$ is the y-axis and $y = 0$ is the x-axis

Hence, we obtain a plot as shown in figure:



Now to maximize our objective function, we need to find the coordinates of the corner points of the shaded region.

We can determine the coordinates graphically our by solving equations. But choose only those equations to solve which gives one of the corner coordinates of the feasible region.

Solving $2x + 4y = 120$ and $2x + 2y = 80$ gives (20, 20)

There are no other corners in the region obtained.

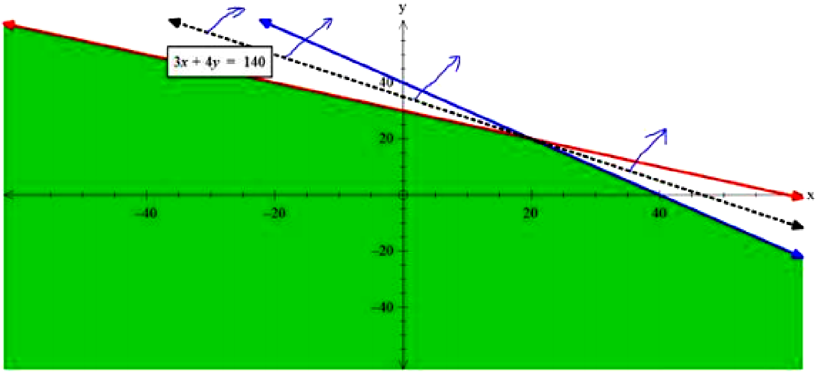
So maxima will occur at (20, 20)

Now we have coordinates of the corner points so we will put them one by one to our objective function and will find at which point it is maximum.

$\because z = 3x + 4y$

Note: As the region is unbounded, so we need to check whether maxima occurs or not.

For this we define inequation using the optimal function if the solution region of the inequation does not coincide with the feasible region, it means it has a maximum.



$\therefore$ inequation is: $3x + 4y > 140$

Clearly, from the graph we observe that $3x + 4y > 140$ does not overlap with the feasible region

$\therefore$ Z is maximum at (20, 20) and max. value is 140

$\therefore$ Z is maximum at x = 20 and y = 20; and max value is 140

OR

Let x items of model A and y items of model B be made.

$\therefore$ x, y $\geq$ 0 (number of items can not be negative)

According to the question, we have

The making of model A requires 2 hours work by a skilled man and the model B requires 1 hour by a skilled man.

$\therefore$ 2x + y $\leq$ 40

and, the making of model A requires 2 hours work by a semi-skilled man and model B requires 3 hours work by a semi-skilled man.

$\therefore$ 2x + 3y $\leq$ 80

and, the profit, Z = 15x + 10y, which is to be maximised.

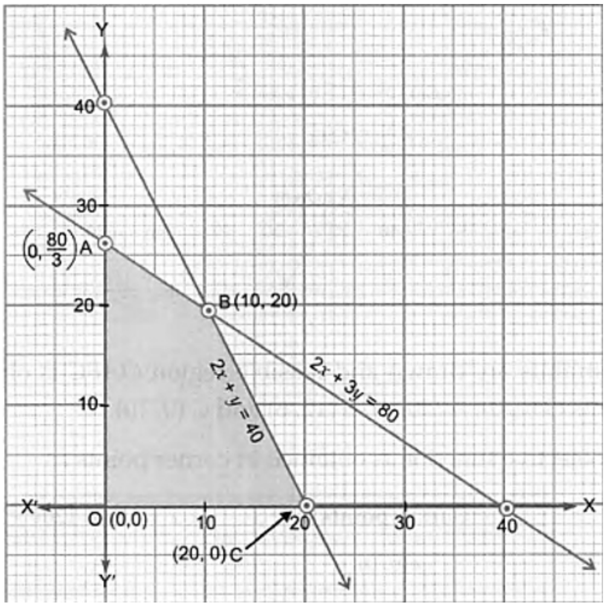
Thus, we have the mathematical formulation of the given linear programming problem as $Z_{\text{Max.}}$ = 15x + 10y

Subject to constraints

2x + y $\leq$ 40 ... (i)

2x + 3y $\leq$ 80 ...(ii)

x, y $\geq$ 0 ...(iii)



The feasible region determined by the system of constraints is OABC.

The corner points are A(0, $\frac{80}{3}$), B (10,20), C (20, 0).

Comer points	Z = 15x + 10y
A(0, $\frac{80}{3}$)	800
B(10, 20)	350 $\leftarrow$ Maximum
B (10, 20)	300
C (20,0)	300

The maximum value of Z = 350 which is attained at B (10, 20).

Hence, the maximum profit is ₹350 when 10 units of model A and 20 units of model B are produced.

33. 24 hours

34. From the given information, we find that the probability distribution of X is

X	0	1	2	3
P(X)	0.2	k	2k	2k

a. We know that $\sum p_i$ = 1

$\Rightarrow$ 0.2 + k + 2k + 2k = 1

$\Rightarrow$ 5k = 0.8 $\Rightarrow$ k = $\frac{4}{25}$

b. Probability that the person watches two hours of television

$= P(X = 2) = 2k = 2 \times \frac{4}{25} = \frac{8}{25}$

c. P (the person watches at least two hours of television)

$= P(X \geq 2) = P(X = 2) + P(X = 3)$

$= 2k + 2k = 4k$

$= 4 \times \frac{4}{25} = \frac{16}{25}$

d. P (the person watches at most two hours of television)

$= P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2)$

$= 0.2 + k + 2k$

$= 0.2 + 3k = \frac{1}{5} + \frac{12}{25} = \frac{17}{25}$

e. We construct the following table:

x_i	**p_i**	**p_ix_i**	**$p_ix_i^2$**
0	0.2	0	0
1	$\frac{4}{25}$	$\frac{4}{25}$	$\frac{4}{25}$
2	$\frac{8}{25}$	$\frac{16}{25}$	$\frac{32}{25}$
3	$\frac{8}{25}$	$\frac{24}{25}$	$\frac{72}{25}$
Total		$\frac{44}{25}$	$\frac{108}{25}$

$E(X) = \Sigma p_ix_i = \frac{44}{25}$ = 1.76

f. Variance $\sigma^2 = \Sigma p_ix_i^2 - (\Sigma p_ix_i)^2$

$= \frac{108}{25} - \left(\frac{44}{25}\right)^2 = \frac{108}{25} - \frac{1936}{625} = \frac{764}{625}$ = 1.22

and standard deviation $\sigma = \sqrt{\text{Variance}} = \sqrt{1.22}$ = 1.1

OR

Let X denote the number of heads in a simultaneous toss of three coins. Then, X can take values 0, 1, 2, 3.

Now, P(X = 0) = P(TTT) = $\frac{1}{8}$, P(X = 1) = P(HTT) or (TTH or THT) = $\frac{3}{8}$

P(X = 2) = P (HHT or THH or HTH) = $\frac{3}{8}$ and, P(X = 3) = P(HHH) = $\frac{1}{8}$

Thus, the probability distribution of X is given by:

X	0	1	2	3
P(X)	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

Computation of mean and variance

x_i	$p_i = P(X = x_i)$	p_ix_i	$p_ix_i^2$
0	$\frac{1}{8}$	0	0
1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$
2	$\frac{3}{8}$	$\frac{6}{8}$	$\frac{12}{8}$
3	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{9}{8}$
		$\Sigma p_ix_i = \frac{3}{2}$	$\Sigma p_ix_i^2$ = 3

Thus, we have,

$\Sigma p_ix_i = \frac{3}{2}$ and $\Sigma p_i{x_i}^2$ = 3

$\therefore \overline{X}$ = Mean = $\Sigma p_ix_i = \frac{3}{2}$ and, Var(X) = $\Sigma p_ix_i^2 - (\Sigma p_ix_i)^2 = 3 - \left(\frac{3}{2}\right)^2 = \frac{3}{4}$

$\therefore$ Standard deviation = $\sqrt{\text{Var}(X)} = \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2}$ = 0.87

Hence, Mean = $\frac{3}{2}$, Variance = $\frac{3}{4}$ and, Standard deviation = 0.87

35. FC = P $\times \left(\frac{(1+r)^{nt}-1}{r}\right)$

2,00,000 = P $\times \left(\frac{(1+0.015)^{4\times10}-1}{0.015}\right)$

Now, calculate the value inside the parentheses:

$(1.015)^{40}$- 1 = 1.8140 - 1= 0.8140

2,00,000 = P $\times \left(\frac{0.8140}{0.015}\right)$

Now, calculate the value inside the second set of parentheses:

$\frac{0.8140}{0.015} \approx$ 54.267

Now, solve for P:

P = $\frac{2,00,000}{54.267}$

P $\approx$ ₹ 3,684.81

So, Anil must set aside approximately ₹ 3,684.81 at the end of each quarter for 10 years to accumulate ₹ 2,00,000 with a 6% quarterly compounded interest rate.

Section E

36. **Read the text carefully and answer the questions:**

Rohit's father wants to construct a rectangular garden using a brick wall on one side of the garden and wire fencing for the other three sides as shown in the figure. He has 200 ft of wire fencing.

(i) To create a garden using 200 ft fencing, we need to maximise its area.

(ii) Required relation is given by 2x + y = 200

(iii)Area of the garden as a function of x can be represented as

A(x) = x · y - x(200 - 2x) = 200x - $2x^2$

OR

A(x) = 200x - $2x^2$

$\Rightarrow$ A'(x) = 200 - 4x

For the area to be maximum A'(x) = 0

$\Rightarrow$ 200 - 4x = 0 $\Rightarrow$ x = 50 ft

37. **Read the text carefully and answer the questions:**

The nominal rate of return shows the yield of an investment over time without accounting for negative elements such as inflation or taxes. By calculating the nominal rate of return, you can compare the performance of your assets easily, regardless of the inflation rate or differing spans of time for each investment. By obtaining a bird's-eye view of how your assets are growing, you can make more prudent investment decisions in the future.

(i) 12.5%

(ii) $11\frac{7}{13}$%

(iii)12%

OR

₹70

38. Number of male players, female players and coaches of teams A and B can be represented by matrix N.

$$N = \begin{array}{c} \\ \\ \end{array}\left(\begin{array}{ccc} \text{Male players} & \text{Female players} & \text{Coaches} \\ 2 & 3 & 1 \\ 1 & 2 & 2 \end{array}\right)\begin{array}{l} \\ \text{Team A} \\ \text{Team B} \end{array}$$

Also, daily requirement of calories and protein for each person can be represented by matrix D.

$$D = \left(\begin{array}{cc} \text{Calories} & \text{Protein} \\ 2500 & 65\text{ g} \\ 1900 & 50\text{ g} \\ 2000 & 54\text{ g} \end{array}\right)\begin{array}{l} \\ \text{Male player} \\ \text{Female player} \\ \text{Coach} \end{array}$$

Now, the total diet requirement of calories and protein for each team can be obtained by multiplying N and D.

So, total diet requirement = ND = $\begin{pmatrix} 2 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}\begin{pmatrix} 2500 & 65\text{ g} \\ 1900 & 50\text{ g} \\ 2000 & 54\text{ g} \end{pmatrix}$

$$= \begin{pmatrix} 5000 + 5700 + 2000 & 170 + 150 + 54 \\ 2500 + 3800 + 4000 & 65 + 100 + 108 \end{pmatrix}$$

$$= \begin{pmatrix} 12700 & 334\text{ g} \\ 10300 & 273\text{ g} \end{pmatrix}\begin{array}{l} \text{Team A} \\ \text{Team B} \end{array}$$

Hence, total diet requirement of

Team A: 12700 calories and 334 g protein

Team B: 10300 calories and 273 g protein.

OR

i. Combined sales in September and October is given by A + B.

$$A + B = \begin{array}{c} \\ \end{array}\begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array}$$

$$A + B = \left[\begin{array}{ccc} 15{,}000 & 30{,}000 & 36{,}000 \\ 70{,}000 & 40{,}000 & 20{,}000 \end{array}\right]\begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array}$$

ii. Change in sales from September to October is given by A - B.

$$A - B = \begin{array}{c} \\ \end{array}\begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array}$$

$$A - B = \left[\begin{array}{ccc} 5000 & 10{,}000 & 24{,}000 \\ 30{,}000 & 20{,}000 & 0 \end{array}\right]\begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array}$$

iii. 2% of B = $\frac{2}{100} \times B = 0.02 \times B$

$$\begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array}$$

$$0.02\left[\begin{array}{ccc} 5000 & 10{,}000 & 6000 \\ 20{,}000 & 10{,}000 & 10{,}000 \end{array}\right]\begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array}$$

$$\begin{array}{ccc} \text{Basmati} & \text{Permal} & \text{Naura} \end{array}$$

$$\left[\begin{array}{ccc} 100 & 200 & 120 \\ 400 & 200 & 200 \end{array}\right]\begin{array}{l} \text{Ramkishan} \\ \text{Gurcharan Singh} \end{array}$$

Thus, in October Ramkishan receives ₹ 100, ₹ 200, and ₹ 120 as profit in the sale of each variety of rice, respectively, and Gurcharan Singh receives a profit of ₹400, ₹ 200, and ₹ 200 in the sale of each variety of rice, respectively.