

Class XI Session 2025-26
Subject - Applied Maths
Sample Question Paper - 1

Time Allowed: 3 hours

Maximum Marks: 80

General Instructions:

Read the following instructions very carefully and strictly follow them:

1. This Question paper contains 38 questions. All questions are compulsory.
2. This Question paper is divided into five Sections - A, B, C, D and E.
3. In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 36 to 38 are case study-based questions carrying 4 marks each.
8. There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and one sub-part each in 2 questions of Section E.
9. Use of calculators is not allowed.

Section A

1. If M and N are any two events, the probability that atleast one of them occurs is [1]

a) $P(M) + P(N) - P(M \cap N)$

b) $P(M) + P(N) + P(M \cap N)$

c) $P(M) + P(N) + 2P(M \cap N)$

d) $P(M) + P(N) - 2P(M \cap N)$
2. The following information relates to a sample of size 60, $\Sigma x^2 = 18000$, $\Sigma x = 960$. Then, the variance is [1]

a) 22

b) 16

c) 44

d) 6.63
3. A shopkeeper bought a TV from a distributor at a discount of 25% of the listed price of ₹ 32000. The shopkeeper sells the TV to a consumer at the listed price. If the sales are intra-state and the rate of CST is 18%, The tax (under GST) received by the State Government is [1]

a) ₹ 4320

b) ₹ 5760

c) ₹ 1440

d) ₹ 2880
4. $\left(\frac{x^a}{x^b}\right)^{a+b} \left(\frac{x^b}{x^c}\right)^{b+c} \left(\frac{x^c}{x^a}\right)^{c+a}$ is equal to [1]

a) 2

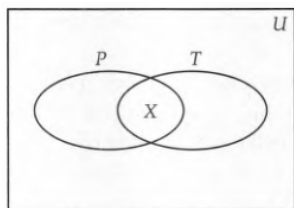
b) 1

c) $a^2 + b^2 + c^2$

d) 0

5. Let $n(A) = m$, and $n(B) = n$. Then the total number of non-empty relations that can be defined from A to B is [1]
 - a) $m^n - 1$
 - b) $n^m - 1$
 - c) $2^{mn} - 1$
 - d) m^n
 6. If $2^{5x} = \frac{1}{32}$, then value of x is [1]
 - a) 1
 - b) $\frac{1}{2}$
 - c) $-\frac{1}{2}$
 - d) -1
 7. A card is drawn from a deck of 52 cards. The probability of getting a king or a heart or a red card is: [1]
 - a) $\frac{7}{13}$
 - b) $\frac{15}{26}$
 - c) $\frac{11}{26}$
 - d) $\frac{4}{13}$
 8. The position of the point (5, 7) with respect to the circle, $x^2 + y^2 = 100$ is [1]
 - a) outside the circle
 - b) inside the circle
 - c) Center of the circle
 - d) lie on the circle
 9. A woman introduces a man as the son of the brother of her mother. How is that man related to the woman? [1]
 - a) Son
 - b) Uncle
 - c) Cousin
 - d) Nephew
 10. What is the mean deviation from the mean of the numbers 10, 9, 21, 16, 24? [1]
 - a) 4.5
 - b) 5.0
 - c) 4.0
 - d) 5.2
 11. If $\log(3x + 1) = 2$, then the value of x is [1]
 - a) $\frac{19}{3}$
 - b) $\frac{1}{3}$
 - c) 33
 - d) 99
 12. At what rate percent per annum will a sum of ₹ 12000 become ₹ 13230 in 2 years? [1]
 - a) 6%
 - b) 6.5%
 - c) 5.5%
 - d) 5%
 13. A retailer purchases a fan for ₹ 1500 from a wholesaler and sells it to a consumer at 10% profit. If the sales are intra-state and the rate of GST is 12%, the tax (under GST) paid by the retailer to the State Government is: [1]
 - a) ₹ 198
 - b) ₹ 99
 - c) ₹ 18
 - d) ₹ 9
 14. If A and B are events such that $P(A) = 0.2$, $P(B) = 0.4$ and $P(A \cup B) = 0.5$, the value of $P\left(\frac{A}{B}\right)$ is [1]
 - a) 0.05
 - b) 0.25
 - c) 0.5
 - d) 0.1
 15. If the probability for A to fail in an examination is 0.2 and that for B is 0.3, then the probability that either A fails or B fails is: [1]
 - a) 0.56
 - b) 0.44

iv. Some policemen are thieves.



23. Peter can cover a certain distance in 1 hr 24 min by covering two-third of the distance at 4 km/hr and the rest at 5 km/hr. Find the total distance. [2]

24. If $x^m y^n = (x + y)^{m+n}$, prove that $\frac{dy}{dx} = \frac{y}{x}$. [2]

OR

Find the derivative of the given function from the first principle: $(x - 1)(x - 2)$

25. Convert the decimal number to the binary number: 517 [2]

Section C

26. Insert 4 geometric means between 3 and 96. Also, show that their product is the 4th power of the G.M. between them. [3]

OR

Given a G.P. with $a = 729$ and 7th term = 64, determine S_7 .

27. Find A and B in the addition [3]

$$\begin{array}{r} 12A \\ + 6AB \\ \hline A09 \end{array}$$

28. Find the domain and the range of the given function: $f(x) = \frac{1}{\sqrt{5-x}}$ [3]

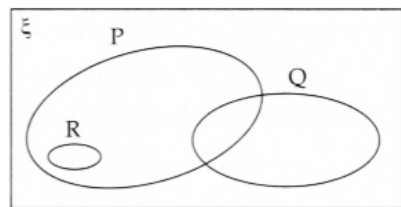
29. Divide ₹15,500 into two parts such that if one part be lent out at 15 % per annum and the other at 24 % per annum, the total annual income is ₹3,000. [3]

30. A family in Delhi consumed 48 kL of water in a month. Calculate the water bill for the month. The tariff plan for Delhi is as given below: [3]

| Monthly Consumption (in kL) | Service Charge | Water Consumption Charge per kL |
|-----------------------------|----------------|---------------------------------|
| Up to 20 | ₹ 146.41 | ₹5.27 |
| 20 - 30 | ₹219.62 | ₹26.36 |
| >30 | ₹292.82 | ₹43.93 |

Also, sewerage charges are applicable at 60% of the water consumption charges.

31. In the adjacent Venn diagram, if $n(\xi) = 80$, $n(P) = 40$, $n(Q) = 28$, $n(P \cap Q) = 12$ and $n(P \cap R) = 10$, [3]



- mark the number of elements in each region.
- determine the value of $n(P \cup Q)$ and $n((Q \cup R)')$.

Section D

32. Find n and r , if ${}^n P_r = {}^n P_{r+1}$, ${}^n C_r = {}^n C_{r-1}$. [5]

OR



If $\frac{1}{9!} + \frac{1}{10!} = \frac{x}{11!}$, find x.

33. Evaluate: $\lim_{x \rightarrow 5} \frac{x^2 - 9x + 20}{x^2 - 6x + 5}$ [5]

34. Calculate the mean and standard deviation for the following distribution: [5]

| Marks: | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 |
|------------------|-------|-------|-------|-------|-------|-------|-------|
| No. of students: | 3 | 6 | 13 | 15 | 14 | 5 | 4 |

OR

Calculate the mean deviation from the median for the following data:

| Wages per day | Number of workers |
|---------------|-------------------|
| 20-30 | 3 |
| 30-40 | 8 |
| 40-50 | 12 |
| 50-60 | 9 |
| 60-70 | 8 |

35. Mr. Pandey lives in Lucknow, Uttar Pradesh. The reading of the electric meter of his house is found to be 5678 units. If the previous month's reading was 4803 units and the connected load is 4 kW, calculate his electricity bill for that month. [5]

Tariff plan is given below.

Energy charges

| Number of units | 0 - 150 | 151 - 300 | 301 - 500 | > 500 |
|-----------------------|---------|-----------|-----------|-------|
| Price per unit (in ₹) | ₹ 5.5 | ₹ 6 | ₹ 6.5 | ₹ 7 |

Fixed charges ₹ 110 per kW/month

Energy tax is 5% of tariff rates

Surcharge is ₹ 0.26 per unit

Section E

36. Read the following text carefully and answer the questions that follow: [4]

Equation of a straight line path is $2x + y - 12 = 0$. A man is standing at a point (2, 3). He wants to reach the straight line path in least possible time.

- Find the slope of the path followed by man. (1)
- Find the equation of the path followed by man. (1)
- Find the coordinates of point where path followed by man and given straight line path meet. (2)

OR

Find the image of the point (2, 3) with respect to the given straight line path, assuming the given path to be a plane mirror. (2)

37. Read the following text carefully and answer the questions that follow: [4]

Consider the data.

| Class | Frequency |
|-------|-----------|
| 0-10 | 6 |
| 10-20 | 7 |

| | |
|-------|----|
| 20-30 | 15 |
| 30-40 | 16 |
| 40-50 | 4 |
| 50-60 | 2 |

- Find the mean deviation about median. (1)
- Find the Median. (1)
- Write the formula to calculate the Mean deviation about median? (2)

OR

Write the formula to calculate median? (2)

38. **Read the following text carefully and answer the questions that follow:** [4]

A shopkeeper sells three types of flower seeds A_1 , A_2 , and A_3 . They are sold as a mixture where the proportions are 4:4:2 respectively. The germination rates of the three types of seeds are 45%, 60% and 35%.



- What is the probability of a randomly chosen seed to germinate? (1)
- What is the probability that the seed will not germinate given that the seed is of type A_3 ? (1)
- What is the probability that the seed is of the type A_2 given that a randomly chosen seed does not germinate? (2)

OR

Find the probability that it is of the type A_1 given that a randomly chosen seed does not germinate? (2)

Solution

Section A

1. (a) $P(M) + P(N) - P(M \cap N)$

Explanation:

If M and N are any two events, then the probability that atleast one of them occurs is

$$P(M \cup N) = P(M) + P(N) - P(M \cap N)$$

2.

(c) 44

Explanation:

We know that,

$$\begin{aligned}\text{Variance } (\sigma^2) &= \frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N} \right)^2 \\ &= \frac{18000}{60} - \left(\frac{960}{60} \right)^2 \\ &= 300 - 256 \\ &= 44.\end{aligned}$$

3.

(d) ₹ 2880

Explanation:

Tax received by State Government

= SGST paid by distributor + SGST paid by shopkeeper

$$= ₹ 2160 + ₹ 720 = ₹ 2880$$

4.

(b) 1

Explanation:

$$\begin{aligned}&\left(\frac{x^a}{x^b} \right)^{a+b} \left(\frac{x^b}{x^c} \right)^{b+c} \left(\frac{x^c}{x^a} \right)^{c+a} \\ &= \frac{x^{a^2+ab}}{x^{ab+b^2}} \cdot \frac{x^{b^2+bc}}{x^{bc+c^2}} \cdot \frac{x^{c^2+ac}}{x^{ac+a^2}} \\ &= x^{\frac{a^2+ab+b^2+bc+c^2+ac-ab-b^2-bc-c^2-ac-a^2}{1}} \\ &= x^0 \\ &= 1\end{aligned}$$

5.

(c) $2^{mn} - 1$

Explanation:

We have, $n(A) = m$ and $n(B) = n$

$$n(A \times B) = n(A) \cdot n(B) = mn$$

Total number of relation from A to B = Number of subsets of $A \times B = 2^{mn}$

So, total number of non-empty relations = $2^{mn} - 1$

6.

(d) -1

Explanation:

$$\text{As } 2^{5x} = \frac{1}{32} = \frac{1}{2^5}$$

$$\Rightarrow 2^{5x} = 2^{-5} \Rightarrow 5x = -5 \Rightarrow x = -1$$



7. (a) $\frac{7}{13}$

Explanation:

Number of cards = 52, $n(S) = 52$

$$4 \text{ king} + 13 \text{ heart} + 26 \text{ red} - 13 - 2 = 28 = n(E)$$

$$\therefore \text{Required probability} = \frac{28}{52} = \frac{7}{13}$$

8.

(b) inside the circle

Explanation:

$$\text{Here, } h^2 + k^2 = (5)^2 + (7)^2$$

$$= 25 + 49$$

$$= 74 < a^2 = 100$$

\therefore Point (5, 7) is inside the circle.

9.

(c) Cousin

Explanation:

Son of brother of her mother is my cousin.

10.

(d) 5.2

Explanation:

Given, $x_i = 10, 9, 21, 16, 24$

$$\therefore \Sigma x_i = 10 + 9 + 21 + 16 + 24 = 80$$

$$\begin{aligned} \text{Now, } \bar{X} &= \frac{\Sigma x_i}{n} = \frac{80}{5} = 16 \Rightarrow MD = \frac{\Sigma |x_i - \bar{X}|}{n} \\ &= \frac{|10 - 16| + |9 - 16| + |21 - 16| + |16 - 16| + |24 - 16|}{5} \\ &= \frac{6 + 7 + 5 + 0 + 8}{5} = \frac{26}{5} = 5.2 \end{aligned}$$

11.

(c) 33

Explanation:

$$\log (3x + 1) = 2 \Rightarrow 10^2 = 3x + 1$$

$$\Rightarrow 3x = 99 \Rightarrow x = 33$$

12.

(d) 5%

Explanation:

Here, $P = ₹ 12000$, $A = ₹ 13230$, $n = 2$. Let rate be $r\%$.

$$\begin{aligned} \therefore 13230 &= 12000 \left(1 + \frac{r}{100}\right)^2 \\ \Rightarrow \left(1 + \frac{r}{100}\right)^2 &= \frac{13230}{12000} = \frac{441}{400} = \left(\frac{21}{20}\right)^2 \\ \Rightarrow 1 + \frac{r}{100} &= \frac{21}{20} \Rightarrow \frac{r}{100} = \frac{1}{20} \Rightarrow r = 5\%. \end{aligned}$$

13.

(d) ₹ 9

Explanation:

₹ 9

14.

(b) 0.25

Explanation:

Given, $P(A) = 0.2$, $P(B) = 0.4$

and $(A \cup B) = 0.5$

We know that,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$\therefore P(A \cap B) = 0.2 + 0.4 - 0.5$$

$$\text{or } P(A \cap B) = 0.1$$

$$\text{Now, } P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{0.1}{0.4} = 0.25.$$

15.

(b) 0.44

Explanation:

Given, $P(A \text{ fails in examination}) = 0.2$ and $P(B \text{ fails in examination}) = 0.3$

$$P(A \cap B) = P(A)P(B) = (0.2 \times 0.3)$$

$$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$= 0.2 + 0.3 - 0.06 = 0.44$$

16.

(c) 10.38%

Explanation:

10.38%

17.

(d) 2000

Explanation:

The number of ways of selecting 3 red balls out of 6 red balls = 6C_3

The number of ways of selecting 3 white balls out of 5 white balls = 5C_3

The number of ways of selecting 3 blue balls out of 5 blue balls = 5C_3

The number of ways of selecting 3 balls of each colour = ${}^6C_3 \times {}^5C_3 \times {}^5C_3$

$$= \frac{6 \times 5 \times 4}{1 \times 2 \times 3} \times \frac{5 \times 4}{1 \times 2} \times \frac{5 \times 4}{1 \times 2}$$

$$= 20 \times 10 \times 10$$

$$= 2000$$

18.

(c) {(a, b), (a, c)}

Explanation:

{(a, b), (a, c)}

19.

(c) A is true but R is false.

Explanation:

The data values in ascending order are 1, 3, 5, 7, 9, 11.

Here, total number of observations (n) = 6, which is even.

$$\text{So, median} = \frac{\left(\frac{6}{2}\right) \text{th observation} + \left(\frac{6}{2} + 1\right) \text{th observation}}{2}$$

$$= \frac{3 \text{rd observation} + 4 \text{th observation}}{2}$$

$$= \frac{5+7}{2} = 6$$

\therefore R is false.

Now, mean deviation about median

$$\text{M.D.} = \frac{|1-6|+|3-6|+|5-6|+|7-6|+|9-6|+|11-6|}{6}$$

$$= \frac{5+3+1+1+3+5}{6} = 3$$

∴ A is true.

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

Explanation:

$1 + 3 + 5 + \dots n$ terms is an A.P. whose $a = 1$, $d = 2$.

$$\text{So, } S_n = \frac{n}{2} [2 \times 1 + (n - 1) \times 2]$$

$$\Rightarrow S_n = n^2$$

∴ Sum of first n odd natural numbers $= n^2$

∴ Reason is true.

$$\text{Given } 1 + 3 + 5 + \dots + n = 169 = 13^2$$

$$\Rightarrow n = 13\text{th odd natural number}$$

$$\Rightarrow n = 1 + (13 - 1) \times 2$$

$$\Rightarrow n = 25$$

∴ Assertion is true and Reason is the correct explanation of Assertion.

Section B

21. Let the sixth number be x , then seventh and eighth numbers are $x + 4$ and $x + 7$ respectively. The average of 8 numbers is 20.

$$\therefore \text{The sum of eight numbers} = 20 \times 8 = 160$$

The average of first two numbers is 15.5

$$\therefore \text{The sum of first two numbers} = 15.5 \times 2 = 31$$

$$\text{The average of next three numbers} = \frac{64}{3}$$

$$\therefore \text{The sum of next three numbers} = \frac{64}{3} \times 3 = 64$$

$$\therefore \text{Sum of sixth, seventh and eighth numbers} = 160 - 31 - 64 = 65$$

$$\Rightarrow x + (x + 4) + (x + 7) = 65 \Rightarrow 3x = 54 \Rightarrow x = 18$$

Hence, the numbers are 18, 22 and 25.

22. Here, the new positions are obtained by multiplying the original position by 3.

So,

| | | | | | |
|-----|-----|-----|-----|--------|-----|
| J | H | A | N | S | I |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 10 | 8 | 1 | 14 | 19 | 9 |
| × 3 | × 3 | × 3 | × 3 | × 3 | × 3 |
| 30 | 24 | 3 | 42 | 57 | 27 |
| -26 | | | -26 | -2(26) | -26 |
| 4 | 24 | 3 | 16 | 5 | 1 |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| D | X | C | P | E | A |

So, 'JHANSI' is coded as 'DECPEA'.

OR

- It is evident from the Venn diagram that the policeman x is a thief also. So, the given statement is not true. Hence, its truth value is 'F'.
- From the Venn-diagram, we find that $P \cap T \neq \Phi$. So, there are some thieves who are also policemen. Hence, the above statement is not true. So, its truth value is 'F'.
- It is evident from the Venn-diagram that there are some human beings who are neither policemen nor thieves. So, the above statement is not true and its truth value is 'F'.
- Clearly, policeman x is a thief also. Therefore, the given statement is true and its truth value is 'T'.

23. Let the total distance be x km.

$$\text{Then, } \frac{\frac{2}{3}x}{4} + \frac{\frac{1}{3}x}{5} = \frac{7}{5}$$

$$[\therefore 1 \text{ hr } 24 \text{ min} = \left(1 + \frac{24}{60}\right) \text{ hr} = \frac{7}{5} \text{ hr}]$$

$$\Rightarrow \frac{x}{6} + \frac{x}{15} = \frac{7}{5}$$

$$\Rightarrow 7x = 42$$

$$\Rightarrow x = 6$$

Thus, total distance = 6km.

24. We have,

$$x^m \cdot y^n = (x + y)^{m+n}$$

Taking log on both sides, we get

$$m \log x + n \log y = (m + n) \log(x + y)$$

Differentiating both sides with respect to x, we get

$$m \times \frac{1}{x} + n \times \frac{1}{y} \frac{dy}{dx} = \frac{m+n}{x+y} \frac{d}{dx} (x + y)$$

$$\Rightarrow \frac{m}{x} + \frac{n}{y} \times \frac{dy}{dx} = \frac{m+n}{x+y} \left(1 + \frac{dy}{dx}\right)$$

$$\Rightarrow \left\{ \frac{n}{y} - \frac{m+n}{x+y} \right\} \frac{dy}{dx} = \frac{m+n}{x+y} - \frac{m}{x}$$

$$\Rightarrow \left\{ \frac{nx+ny-my-ny}{y(x+y)} \right\} \frac{dy}{dx} = \left\{ \frac{mx+nx-mx-my}{(x+y)x} \right\}$$

$$\Rightarrow \frac{nx-my}{y(x+y)} \cdot \frac{dy}{dx} = \frac{nx-my}{(x+y)x} \Rightarrow \frac{dy}{dx} = \frac{y}{x}$$

OR

$$\text{Let } f(x) = (x - 1)(x - 2) = x^2 - 3x + 2$$

$$\text{By def., } f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{[(x+h)^2 - 3(x+h) + 2] - [x^2 - 3x + 2]}{h}$$

$$= \lim_{h \rightarrow 0} \frac{h^2 + 2xh - 3h}{h} = \lim_{h \rightarrow 0} (h + 2x - 3)$$

$$= 0 + 2x - 3 = 2x - 3$$

25. Given decimal number is 517

| | | |
|---|-----|---|
| 2 | 517 | |
| 2 | 258 | 1 |
| 2 | 129 | 0 |
| 2 | 64 | 1 |
| 2 | 32 | 0 |
| 2 | 16 | 0 |
| 2 | 8 | 0 |
| 2 | 4 | 0 |
| 2 | 2 | 0 |
| 2 | 1 | 0 |
| 2 | 0 | 1 |

The required binary number is 1000000101

Section C

26. Let G_1, G_2, G_3, G_4 be four G.M.'s between 3 and 96. Then 3, $G_1, G_2, G_3, G_4, 96$ are in G.P.

Let r be the common ratio. Since 96 is the 6th term,

$$96 = 3r^5 \Rightarrow r^5 = 32 = 2^5 \Rightarrow r = 2$$

$$\therefore G_1 = ar = 3 \times 2 = 6,$$

$$G_2 = ar^2 = 3 \times 2^2 = 12, G_3 = 24, G_4 = 48$$

Hence, the four geometric means are 6, 12, 24, 48



Also, if G is G.M. of 3 and 96, then $G = \sqrt{3 \times 96} = \sqrt{288} = 12\sqrt{2}$

Now $G_1 \cdot G_2 \cdot G_3 \cdot G_4 = 6 \cdot 12 \cdot 24 \cdot 48 = 12^4 \cdot 2^2 = (12\sqrt{2})^4 = G^4$

OR

Let r be the common ratio of G.P. Then

$$a_7 = 64 \Rightarrow ar^{7-1} = 64 \Rightarrow 729r^6 = 64$$

$$\Rightarrow r^6 = \frac{64}{729} \Rightarrow r^6 = \left(\frac{2}{3}\right)^6 \text{ or } \left(-\frac{2}{3}\right)^6$$

$$\Rightarrow r = \frac{2}{3} \text{ or } -\frac{2}{3}$$

$$\text{When } r = \frac{2}{3}, S_7 = \frac{a(1-r^7)}{1-r} = \frac{729\left(1-\left(\frac{2}{3}\right)^7\right)}{1-\frac{2}{3}} = 3 \times 729 \left(1 - \left(\frac{2}{3}\right)^7\right)$$

$$= 2187 - 128 = 2059$$

$$\text{When } r = -\frac{2}{3}, S_7 = \frac{729\left(1-\left(-\frac{2}{3}\right)^7\right)}{1-\left(-\frac{2}{3}\right)} = \frac{3}{5} \times 729 \left(1 + \frac{2^7}{3^7}\right)$$

$$= \frac{1}{5}(2187 + 128) = \frac{2315}{5} = 463$$

27. Observe the unit column of the addition.

A + B cannot exceed 18 and the unit digit in the sum is 9, so A + B = 9

This is possible when

A = 1, B = 8; A = 2, B = 7, ..., A = 8, B = 1

Now, observe ten's column

As 2 + A cannot exceed 11 and the digit below the sum of ten's column is 0, therefore

$$2 + A = 10$$

$$\Rightarrow A = 8$$

$$\therefore A = 8, B = 1$$

Now check the sum

$$\begin{array}{r} 1 \quad 2 \quad \textcircled{8} \\ + 6 \quad \textcircled{8} \quad \textcircled{1} \\ \hline \textcircled{8} \quad 0 \quad 9 \end{array}$$

Hence, the required digits are A = 8, B = 1

28. Given $f(x) = \frac{1}{\sqrt{5-x}}$

For D_f , $f(x)$ must be a real number

$$\Rightarrow \frac{1}{\sqrt{5-x}} \text{ must be a real number}$$

$$\Rightarrow 5 - x > 0 \Rightarrow 5 > x \Rightarrow x < 5$$

$$\Rightarrow D_f = (-\infty, 5)$$

$$\text{For } R_f, \text{ let } y = \frac{1}{\sqrt{5-x}}$$

As $x < 5, 0 < 5 - x$

$$\Rightarrow 5 - x > 0 \Rightarrow \sqrt{5-x} > 0$$

$$\Rightarrow \frac{1}{\sqrt{5-x}} > 0 \left(\because \frac{1}{a} > 0 \text{ if and only if } a > 0 \right)$$

$$\Rightarrow y > 0$$

$$\Rightarrow R_f = (0, \infty)$$

29. Let one of the parts be ₹ x. Then the other part is ₹(15,500 - x).

For the first part, we have

$$P = x, r = \frac{15}{100} \text{ and } t = 1$$

$$\therefore I_1 = \text{Simple Interest} = \text{Prt} = x \times \frac{15}{100} \times 1 = \frac{3x}{20}$$

For the second part, we have

$$P = (15,500 - x), r = \frac{24}{100} = \frac{6}{25} \text{ and } t = 1$$

$$\therefore I_2 = \text{Simple interest} = \text{Prt} = (15,500 - x) \times \frac{6}{25} \times 1 = \frac{1}{25}(93000 - 6x)$$

It is given that total annual interest is ₹ 3000.

$$\therefore I_1 + I_2 = 3000$$

$$\Rightarrow \frac{3x}{20} + \frac{1}{25} (93,000 - 6x) = 3000$$

$$\Rightarrow 15x + 372,000 - 24x = 300,000 \Rightarrow 9x = 72,000 \Rightarrow x = 8,000$$

Hence, two parts are ₹ 8,000 and ₹(15,500 - 8,000) = ₹ 7,500

30. Here, the volume of water consumed is 48 kL which is above 30 kL.

Thus, the rate for first 20 kL will be ₹ 5.27/kL, for the next 10 kilolitres the rate will be ₹ 26.36/kL and for the balance 18 kiloliters, the rate will be ₹ 43.93 / kL.

$$\therefore \text{Water consumption charges} = ₹(5.27 \times 20) + ₹(26.36 \times 10) + ₹(18 \times 43.93)$$

$$= ₹(105.40 + 263.60 + 790.74)$$

$$= ₹ 1159.74$$

Also, the Sewerage charge is 60% of consumption charges.

$$\therefore \text{Sewerage charge} = 60\% \text{ of } ₹ 1159.74 = ₹ 695.84$$

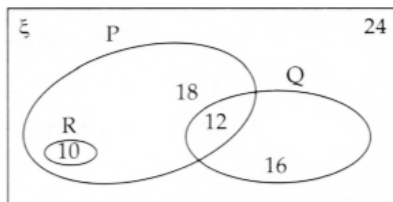
According to the given tariff plan, the service charge for the consumption above 30 kL is ₹ 292.82

$$\therefore \text{Service charge} = ₹ 292.82$$

$$\therefore \text{Total water bill} = \text{Water consumption charge} + \text{Sewerage charge} + \text{Service charge}$$

$$= ₹ 1159.74 + ₹ 695.84 + ₹ 292.82 = ₹ 2148.40$$

31. i. The number of elements in different regions are shown in the adjoining figure.



ii. From the Venn diagram, we get

$$n(P \cup Q) = 10 + 18 + 12 + 16 = 56,$$

$$n(Q \cup R) = 16 + 12 + 10 = 38$$

$$\Rightarrow n((Q \cup R)') = 80 - 38 = 42$$

Section D

$$32. {}^nP_r = {}^nP_{r+1}$$

$$\Rightarrow \frac{n!}{(n-r)!} = \frac{n!}{(n-r-1)!}$$

$$\Rightarrow n - r = 1 \dots(i)$$

$${}^nC_r = {}^nC_{r-1}$$

$$\frac{n!}{r!(n-r)!} = \frac{n!}{(r-1)!(n-r+1)!} \Rightarrow \frac{n-r+1}{r} = 1$$

$$\Rightarrow n - r + 1 = r$$

$$\Rightarrow n - 2r + 1 = 0 \dots(ii)$$

On solving (i) and (ii), we get

$$r + 1 = 2r - 1 \Rightarrow r = 2$$

$$r = 2 \text{ and } n = 3$$

OR

$$\text{Given } \frac{1}{9!} + \frac{1}{10!} = \frac{x}{11!}$$

$$\Rightarrow \frac{11!}{9!} + \frac{11!}{10!} = x \Rightarrow 11 \times 10 + 11 = x$$

$$\Rightarrow 110 + 11 = x \Rightarrow x = 121$$

33. If we substitute $x = 5$, the expression $\frac{x^2-9x+20}{x^2-6x+5}$ assumes the indeterminate form $\frac{0}{0}$.

We should cancel factor $(x - 5)$, based on $x \rightarrow 5$, from numerator and denominator. Therefore, factorising the numerator and denominator, we have

$$\lim_{x \rightarrow 5} \frac{(x-4)(x-5)}{(x-1)(x-5)} = \lim_{x \rightarrow 5} \frac{x-4}{x-1} = \frac{5-4}{5-1} = \frac{1}{4}$$

34. For the Calculation of Standard Deviation we prepare the following table.

| Class-interval | Frequency (f_i) | Mid-values (x_i) | $u_i = \frac{x_i - 55}{10}$ | $f_i u_i$ | u_i^2 | $f_i u_i^2$ |
|----------------|---------------------|----------------------|-----------------------------|-----------|---------|-------------|
| 20-30 | 3 | 25 | -3 | -9 | 9 | 27 |
| 30-40 | 6 | 35 | -2 | -12 | 4 | 24 |
| | | | | | | |



| | | | | | | |
|-------|---------------------|----|----|--------------------|---|------------------------|
| 40-50 | 13 | 45 | -1 | -13 | 1 | 13 |
| 50-60 | 15 | 55 | 0 | 0 | 0 | 0 |
| 60-70 | 14 | 65 | 1 | 14 | 1 | 14 |
| 70-80 | 5 | 75 | 2 | 10 | 4 | 20 |
| 80-90 | 4 | 85 | 3 | 12 | 9 | 36 |
| | $N = \sum f_i = 60$ | | | $\sum f_i u_i = 2$ | | $\sum f_i u_i^2 = 134$ |

Here, $N = 60$, $\sum f_i u_i = 2$, $\sum f_i u_i^2 = 134$ and $h = 10$

$$\therefore \text{Mean} = \bar{X} = A + h \left(\frac{1}{N} \sum f_i u_i \right) = 55 + 10 \left(\frac{2}{60} \right) = 55.333$$

$$\text{and, Var}(X) = h^2 \left\{ \left(\frac{1}{N} \sum f_i u_i^2 \right) - \left(\frac{1}{N} \sum f_i u_i \right)^2 \right\} = 100 \left[\frac{134}{60} - \left(\frac{2}{60} \right)^2 \right] = 222.9$$

$$\therefore \text{S.D.} = \sqrt{\text{Var}(\bar{X})} = \sqrt{222.9} = 14.94$$

OR

We make the table from the given data:

| Wages per day (in Rs.) | Mid value (x_i) | f_i | cf | $ x_i - M = x_i - 47.5 $ | $f_i x_i - M $ |
|------------------------|---------------------|----------|----|----------------------------|----------------------------|
| 20-30 | 25 | 3 | 3 | 22.5 | 67.5 |
| 30-40 | 35 | 8 | 11 | 12.5 | 100.0 |
| 40-50 | 45 | 12 | 23 | 2.5 | 30.0 |
| 50-60 | 55 | 9 | 32 | 7.5 | 67.5 |
| 60-70 | 65 | 8 | 40 | 17.5 | 140.0 |
| Total | | $N = 40$ | | | $\sum f_i x_i - M = 405$ |

Here, $N = 40$, $\frac{N}{2} = 20$. The cumulative frequency just greater than 20 is 23, so the median class is 40-50.

Here, $l = 40$, $f = 12$, $cf = 11$, $h = 10$

$$\therefore \text{Median} = l + \frac{\frac{N}{2} - cf}{f} \times h = 40 + \frac{20 - 11}{12} \times 10$$

$$= 40 + \frac{90}{12} = 40 + 7.5 = 47.5$$

$$\therefore \text{Mean deviation from the median} = \frac{\sum f_i |x_i - M|}{N} = \frac{405}{40} = 10.125$$

35. Given current month's reading = 5678 units

Previous month's reading = 4803 units

Number of units consumed = 5678 - 4803 = 875

Energy charges

| Units | Price | Amount |
|-----------|-------|--------|
| 0 - 150 | ₹ 5.5 | ₹ 825 |
| 151 - 300 | ₹ 6 | ₹ 900 |
| 301 - 500 | ₹ 6.5 | ₹ 1300 |
| 501 - 875 | ₹ 7 | ₹ 2625 |
| | Total | 5650 |

Fixed charges = ₹(110 × 4) = ₹ 440

Surcharge = ₹(0.26 × 875) = ₹ 227.50

Energy tax = 5% of (₹ 5650 + ₹ 440) = 5% of ₹ 6090 = ₹ 304.50

Electricity bill = ₹ 5650 + ₹ 440 + ₹ 227.50 + ₹ 304.50 = ₹ 6622

Section E

36. i. Slope of $2x + y - 12 = 0$ is $m = -2$.

The man will walk on the perpendicular of this path,

\therefore so required slope = $\frac{1}{2}$.



ii. Equation of path taken will be

$$y - 3 = \frac{1}{3}(x - 2)$$

$$\therefore 2y - 6 = x - 2 \text{ i.e. } x - 2y + 4 = 0.$$

iii. On solving $2x + y - 12 = 0$ and $x - 2y + 4 = 0$, we get $x = 4, y = 4$

\therefore Point is (4, 4).

OR

Let the image be (u, v) and (4, 4) is the mid-point of (2, 3) and (u, v)

$$\text{i.e. } \frac{u+2}{2} = 4 \Rightarrow u = 6, \frac{v+3}{2} = 4 \Rightarrow v = 5.$$

\therefore Image is (6, 5).

37. i. We make the table from the given data.

| Class | f_i | cf | Mid-point(x_i) | $ x_i - M $ | $f_i x_i - M $ |
|-------|-------|----|--------------------|-------------|----------------|
| 0-10 | 6 | 6 | 5 | 23 | 138 |
| 10-20 | 7 | 13 | 15 | 13 | 91 |
| 20-30 | 15 | 28 | 25 | 3 | 45 |
| 30-40 | 16 | 44 | 35 | 7 | 112 |
| 40-50 | 4 | 48 | 45 | 17 | 68 |
| 50-60 | 2 | 50 | 55 | 27 | 54 |
| | 50 | | | | 508 |

$$\text{Here, } \frac{N}{2} = \frac{50}{2} = 25$$

Here, 25th item lies in the class 20-30. Therefore, 20-30 is the median class.

Here, $l = 20$, $cf = 13$, $f = 15$, $b = 10$ and $N = 50$

$$\therefore \text{Median, } M = l + \frac{\frac{N}{2} - cf}{f} \times b$$

$$\Rightarrow M = 20 + \frac{25 - 13}{15} \times 10 = 20 + 8 = 28$$

Thus, mean deviation about median is given by

$$MD(M) = \frac{1}{N} \sum_{i=1}^6 f_i |x_i - M| = \frac{1}{50} \times 508 = 10.16$$

Hence, mean deviation about median is 10.16.

ii. Here, $l = 20$, $cf = 13$, $f = 15$, $b = 10$ and $N = 50$

$$\therefore \text{Median, } M = l + \frac{\frac{N}{2} - cf}{f} \times b$$

$$\Rightarrow M = 20 + \frac{25 - 13}{15} \times 10 = 20 + 8 = 28$$

$$\text{iii. } MD = \frac{\sum f_i |x_i - M|}{N}$$

OR

$$M = l + \frac{\frac{N}{2} - cf}{f} \times h$$

38. i. The probability of a randomly chosen seed to germinate is 0.49.

$$\text{ii. } \frac{65}{100}$$

$$\text{iii. } \frac{16}{51}$$

OR

$$\frac{22}{51}$$