

Class XI Session 2025-26
Subject - Applied Maths
Sample Question Paper - 4

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. Which of the following is not a binary number? [1]

a) 11E b) 101

c) 1111 d) 000
2. The mean deviation of the data 3, 10, 10, 4, 7, 10, 5 from the mean is [1]

a) 2 b) 2.57

c) 3.75 d) 3
3. 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 selling price of the fan by the retailer (excluding tax) is: [1]

a) ₹ 1848 b) ₹ 1650

c) ₹ 1500 d) ₹ 1800
4. If the variance of the data is V, then its S.D. is [1]

a) V^2 b) $\pm\sqrt{V}$

c) \sqrt{V} d) $-\sqrt{V}$
5. If $R = \{(x, y) : x, y \in \mathbf{W}, x^2 + y^2 = 169\}$, then domain of R is [1]

- a) $\{-13, -12, -5, 0, 5, 12, 13\}$ b) $\{0, 5, 12, 13\}$
 c) $\{0, 1, 2, 3, \dots, 13\}$ d) $\{0, \pm 1, \pm 2, \dots, \pm 13\}$
6. If $5^{x+3} = 125$, then x is [1]
 a) 3 b) -1
 c) 0 d) 1
7. For two non empty sets A and B the Cartesian product is [1]
 a) $A \times B = B \times A$ b) $A \times B = B \neq A$
 c) $A \times B \neq B \times A$ d) $A \times B = \phi = B \times A$
8. The distance between the line $\frac{x}{a} - \frac{y}{b} = 1$ and point (b, a) is [1]
 a) $\left| \frac{-b^2 - a^2 + ab}{\sqrt{a^2 + b^2}} \right|$ b) $\sqrt{b^2 + a^2}$
 c) $\left| \frac{b^2 + a^2 - ab}{\sqrt{a^2 + b^2}} \right|$ d) $\left| \frac{b^2 - a^2 - ab}{\sqrt{a^2 + b^2}} \right|$
9. In a certain language, if **CAMEL** is coded as **DBNFM**, then how will **ROOM** be coded? [1]
 a) SPPN b) PPON
 c) NQQP d) NPPQ
10. Mean deviation for n observations x_1, x_2, \dots, x_n from their mean \bar{x} is given by [1]
 a) $\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2$ b) $\sum_{i=1}^n (x_i - \bar{x})^2$
 c) $\sum_{i=1}^n (x_i - \bar{x})$ d) $\frac{1}{n} \sum_{i=1}^n |x_i - \bar{x}|$
11. If $\log_{\sqrt{3}} 27 = x$, then the value of x is [1]
 a) 4 b) 6
 c) 9 d) 3
12. The amount of a regular annuity of ₹ 1000 payable at the end of each year for 3 years at 10% per annum compounded annually is: [1]
 a) ₹ 3410 b) ₹ 3310
 c) ₹ 3300 d) ₹ 3515
13. Deduction of interest on a home loan is allowed under section _____. [1]
 a) 80E b) 24
 c) 80C d) 80TTA
14. If $3^{5x} = \frac{1}{81}$, then x is [1]
 a) -4 b) 4
 c) $-\frac{4}{5}$ d) $\frac{4}{5}$
15. If A and B are two events such that $P(A) \neq 0$ and $P\left(\frac{B}{A}\right) = 1$, then [1]
 a) $A = \phi$ b) $B = \phi$



- c) $B \subset A$ d) $A \subset B$
16. Sanjay buys land for 200000 and agrees to pay an equal amount at the end of each year for 3 years. If the money is worth 8%, then the amount of each instalment is: (Given $(1.08)^{-3} = 0.7938$). [1]
- a) ₹ 78895.12 b) ₹ 75428.56
c) ₹ 75323.48 d) ₹ 77594.56
17. The sum of binary numbers 101101 and 110010, is [1]
- a) 110111 b) 1011111
c) 101111 d) 110011
18. If $R = \{(x, y) : x, y \in \mathbf{W}, 2x + y = 8\}$, then domain of R is [1]
- a) $\{0, 1, 2, 3, 4, 5, 6\}$ b) $\{0, 1, 2, 3, 4, 5\}$
c) $\{0, 1, 2, 3, 4\}$ d) $\{0, 1, 2, 3\}$
19. **Assertion (A):** If odds in favour of an event E are 2 : 3, then probability of occurrence of event E is $\frac{2}{5}$ [1]
Reason (R): Probability of occurrence of event = 1 - Probability of non-occurrence of that event.
- 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):** 4-digit numbers using digits 0, 1, 3, 5, 7 which are divisible by 5 are formed. If repetition of digits is allowed, then total number of 4-digit numbers divisible by 5 are 300. [1]
Reason (R): A number is divisible by 5 if its unit digit is 0 or 5.
- 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. The average of 15 observations is 7, the average of 10 observations is 10 and the average of 20 observations is 14. Find the average when all the observations are taken together. [2]
22. Which of the two conclusions is/are true on the basis of given statements: [2]
- Statements I: Some cups are plates
II: All plates are pots
Conclusions I: Some plates are cups
II: Some pots are cups
- OR
- In a certain language If 'SHARPNER' is coded as 'LPBJFBJJ', how 'ERASER' is coded?
23. A man covered a certain distance at some speed. If he had moved 5 km/h faster, he would have taken 1 hour less. If he had moved 3 km/h slower, he would have taken 1 hour more. What is the distance in km? [2]
24. Find the derivative of the given function: $(x^2 + 1)(x - 2)$ [2]
- OR
- Find the derivative of the given function: $(ax + b)^n (cx + d)^m$, $n, m \in \mathbf{N}$
25. The probabilities that a student will get A, B, C, or D grade are 0.4, 0.35, 0.15 and 0.1 respectively. Find the [2]



probability that she will get

- i. B or C grade
- ii. atmost C grade.

Section C

26. How many different products can be obtained by multiplying two or more of the numbers 2, 5, 6, 7, 9? [3]

OR

Find the number of all possible arrangements of the letters of the word **MATHEMATICS** taken four form at a time.

27. Rohit is the husband of Vanshika. Sumita is the sister of Rohit. Anushka is the sister of Vanshika. How Anushka is related to Rohit? [3]

28. Discuss the continuity of the junction $f(x)$ at $x = \frac{1}{2}$, where [3]

$$f(x) = \begin{cases} \frac{1}{2} - x & ; 0 \leq x < \frac{1}{2} \\ 1 & ; x = \frac{1}{2} \\ \frac{3}{2} - x & ; \frac{1}{2} < x \leq 1 \end{cases}$$

29. A household in Alwar, Rajasthan consumed 205 kL of water in a month. Calculate the water bill for the month. [3]

The tariff plan of Rajasthan is as given below:

Units of Consumption (in kL) :	up to 8	8-15	15-40	>40
Price per kL consumed :	₹ 1.89	₹ 2.42	₹ 4.84	₹ 6.05

Meter rent = ₹ 42 per month; Fixed charge = ₹ 30.25; Sewerage charge = 20% of consumption charges.

30. Find the mean deviation about the mean, as well as median for the given series: 6, 7, 10, 12, 13, 4, 8, 12 [3]

31. A and B are two sets such that $n(A - B) = 14 + x$, $n(B - A) = 3x$ and $n(A \cap B) = x$. Draw a Venn diagram to illustrate this information. If $n(A) = n(B)$, find [3]

- i. the value of x
- ii. $n(A \cup B)$

Section D

32. The AM of two positive numbers a and b ($a > b$) is twice their GM. Prove that [5]

$$a : b = 2 + \sqrt{3} : 2 - \sqrt{3}.$$

OR

Find the sum to infinity for the GP, 5, $\frac{20}{7}$, $\frac{80}{49}$, ...

33. Find the domain and range of the following real functions [5]

(i) $f(x) = -|x|$

(ii) $f(x) = \sqrt{9 - x^2}$

34. Calculate the mean deviation from the median of the following data: [5]

Wages per week in Rs.	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of workers	4	6	10	20	10	6	4

OR

Calculate the first four moments of the following distribution about the mean and hence find β_1 and β_2 :

X:	0	1	2	3	4	5	6	7
Y:	1	8	28	56	70	56	28	8

35. A manufacturer sells a washing machine to a wholesaler for ₹ 15000. The wholesaler sells it to a trader at a profit of ₹ 1200 and the trader sells it to a consumer at a profit of ₹ 1800. If all the sales are intra-state and the [5]



rate of GST is 12%, find:

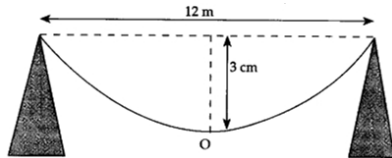
- the amount of tax (under GST) received by the State Government from the wholesaler.
- the amount of tax (under GST) received by the Central Government from the trader.
- the amount that the consumer pays for the machine.

Section E

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

[4]

A beam is supported at its ends by supports which are 12 metres apart. Since the load is concentrated at the centre, there is a deflection of 3 cm at the centre and the deflected beam is in the shape of a parabola.



- Find the equation of parabola. (1)
- How far from the centre is the deflection 1 cm? (1)
- Find the coordinates of focus of the parabola. (2)

OR

Find the equation of directrix of the parabola. (2)

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

[4]

We must start saving for our retirement from young age and there are different options available at different rates. So we must compare rates and whichever instrument gives highest returns we should invest in that but with safety of our investment.

Let us analyse of the nominal rate is 5% p.a.

- Find the effective rate of compounded monthly? (1)
- Find the One effective rate, if compounded quarterly? (1)
- Find the effective rate, if compounded half-yearly? (2)

OR

The amount that person receives by investing ₹ 10000 at 5% p.a. find the compounded quarterly? (2)

38. Read the following text carefully and answer the questions that follow:

[4]

Rahul and Saurabh are playing cards. Total number of cards are 52 in numbers. Each of them draw cards one by one



- Rahul draw four cards, find the probability that all the four cards are from the same suit. (1)
- Saurabh draw four cards, find the probability that one of the four cards is an ace. (1)
- Rahul draw four cards, find the probability that one card is drawn from each suit. (2)

OR

Rahul again draw four card, find the probability that all the cards are of same colour. (2)



Solution

Section A

1. (a) 11E

Explanation:

A binary number can have only two possible digits 0 and 1. Option 11E, there is an alphabet E present which makes it invalid binary number. Alphabets are only allowed in the hexadecimal number system.

2.

(b) 2.57

Explanation:

Given observations are: 3, 10, 10, 4, 7, 10, 5

$$\therefore \bar{X} = \frac{3+10+10+4+7+10+5}{7} = \frac{49}{7} = 7$$

x_i	$d_i = x_i - \bar{x} $
3	4
10	3
10	3
4	3
7	0
10	3
5	2
Total	$\Sigma d_i = 18$

$$\text{Mean Deviation} = \frac{\Sigma d_i}{n} = \frac{18}{7} = 2.57.$$

3.

(b) ₹ 1650

Explanation:

If a retailer purchases a fan for ₹ 1500 from a wholesaler and sells it to a consumer at 10% profit and the rate of GST is 12% then, including tax (under GST) the selling price would be ₹ $\frac{1500 \times 110}{100} = 1650$

4.

(c) \sqrt{V}

Explanation:

Standard deviation have the same units as the data but the variance is mean of the square of differences.

5.

(b) {0, 5, 12, 13}

Explanation:

Given, $R = \{(x, y) : x, y \in \mathbf{W}, x^2 + y^2 = 169\}$

$$\therefore R = \{(0, 13), (5, 12), (12, 5), (13, 0)\}$$

$$\therefore \text{domain of } R = \{0, 5, 12, 13\}$$

6.

(c) 0

Explanation:



$$5^{x+3} = 125$$

$$5^{x+3} = 5^3$$

$$x + 3 = 3$$

$$x = 3 - 3$$

$$x = 0$$

7.

$$(c) A \times B \neq B \times A$$

Explanation:

let $A = \{a, b, c\}$; $B = \{p\}$

$$A \times B = \{a, b, c\} \times \{p\}$$

$$= \{(a, p), (b, p), (c, p)\}$$

$$B \times A = \{p\} \times \{a, b, c\}$$

$$= \{(p, a), (p, b), (p, c)\}$$

By the definition of ordered pairs, $(a, p) \neq (p, a)$

So $A \times B \neq B \times A$

8.

$$(c) \left| \frac{b^2 + a^2 - ab}{\sqrt{a^2 + b^2}} \right|$$

Explanation:

$$\Rightarrow bx - ay = ab$$

$$\Rightarrow bx - ay - ab = 0$$

\therefore distance of point (b, a) from line $bx - ay - ab = 0$ is

$$= \frac{|b^2 - a^2 - ab|}{\sqrt{a^2 + b^2}}$$

9.

(a) SPPN

Explanation:

Here, letters are moved 1 step forward, so, ROOM becomes 'SPPN'.

10.

$$(d) \frac{1}{n} \sum_{i=1}^n |x_i - \bar{x}|$$

Explanation:

We know for n observations x_1, x_2, \dots, x_n having \bar{x} is given by

$$M.D = \frac{\sum d_i}{n}$$

But we know

$$d_i = |x_i - \bar{x}|$$

So mean deviation becomes,

$$M.D = \frac{\sum |x_i - \bar{x}|}{n}$$

Or

$$M.D = \frac{1}{n} \sum_{i=1}^n |x_i - \bar{x}|$$

11.

(b) 6

Explanation:

$$\log_{\sqrt{3}} 27 = x \Rightarrow (\sqrt{3})^x = 27$$

$$\Rightarrow 3^{\frac{x}{2}} = 3^3 \Rightarrow \frac{x}{2} = 3 \Rightarrow x = 6$$

12.

(b) ₹ 3310

Explanation:

$$\begin{aligned} \text{Amount} &= 1000 \left[\frac{(1.1)^3 - 1}{0.1} \right] = ₹ 1000 S_{\frac{3}{0.1}} \\ &= 1000 [1.331 - 1] = ₹ 3310 \end{aligned}$$

13.

(b) 24

Explanation:

24

14.

(c) $\frac{-4}{5}$

Explanation:

$$3^{5x} = \frac{1}{81}$$

$$3^{5x} = \frac{1}{3^4}$$

$$3^{5x} = 3^{-4}$$

Now base is same, so power same

$$\therefore 5x = -4$$

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

15.

(d) $A \subset B$

Explanation:

$$P(A) \neq 0 \text{ and } P\left(\frac{B}{A}\right) = 1$$

$$\therefore P\left(\frac{B}{A}\right) = \frac{P(A \cap B)}{P(A)}$$

$$\therefore 1 = \frac{P(A \cap B)}{P(A)}$$

$$\Rightarrow P(A) = P(A \cap B)$$

$$\therefore A \subset B.$$

16.

(d) ₹ 77594.56

Explanation:

Present value = ₹ 200000, time = 3 years, $i = 0.08$ Let each instalment be of ₹ R.

\therefore It forms an annuity.

$$\therefore ₹ 200000 = R \left[\frac{1 - (1.08)^{-3}}{0.08} \right]$$

$$\Rightarrow R = \frac{200000 \times 0.08}{1 - 0.7938} = \frac{200000 \times 0.08}{0.2062} = ₹ 77594.56$$

17.

(b) 1011111

Explanation:

1011111

18.

(c) {0, 1, 2, 3, 4}

Explanation:

{0, 1, 2, 3, 4}

19.

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

Explanation:

Given odds in favour of an event $E = 2 : 3$

So, $P(\text{occurrence of event } E) = \frac{2}{2+3} = \frac{2}{5}$.

\therefore A is true.

Also, R is true but R is not the correct explanation of A.

20.

(d) A is false but R is true.

Explanation:

Unit place can be filled in two ways by 0 or 5. Thousand place can be filled in 4 ways by 1, 3, 5 or 7. Tens and hundreds places each can be filled in 5 ways by 0, 1, 3, 5 or 7.

So, total number of 4-digit numbers divisible by 5 = $4 \times 5 \times 5 \times 2 = 200$

\therefore A is false. R is true.

Section B

21. Average of 15 observations = 7

\therefore Total of 15 observations = $15 \times 7 = 105$...(i)

Average of 10 observations = 10

\therefore Total of 10 observations = $10 \times 10 = 100$...(ii)

Average of 20 observations = 14

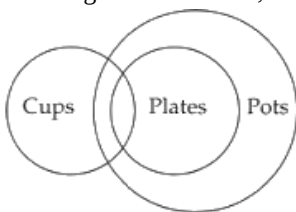
\therefore Total of 20 observations = $14 \times 20 = 280$...(iii)

\therefore Total of (15 + 10 + 20) observations = $105 + 100 + 280 = 485$

i.e. total of 45 observations = 485

\therefore Average = $\frac{485}{45} = 10.78$

22. For the given statements, the possible Venn diagram is shown in the adjacent figure.



Since both, the conclusions can be deduced from the Venn diagram, so both the conclusions are true.

OR

Clearly, new positions of the letters of word 'SHARPER' are obtained by multiplying the original position by 2.

Here,

S	H	A	R	P	N	E	R
↓	↓	↓	↓	↓	↓	↓	↓
19	8	1	18	16	14	5	18
$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$
38	16	2	36	32	28	10	36
-26			-26	-26	-26		-26
12			10	6	2		10
L	P	B	J	F	B	J	J

So,

E	R	A	S	E	R
↓	↓	↓	↓	↓	↓
5	18	1	19	5	18
$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$	$\times 2$
10	36	2	38	10	36
	-26		-26		-26
	10		12		10
J	J	B	L	J	J

'ERASER' is coded as 'JJBLJJ'.

23. Let the distance be d km and actual speed be x km/h.

Then $\frac{d}{x} - \frac{d}{x+5} = 1$ and $\frac{d}{x-3} - \frac{d}{x} = 1$

$$\therefore \frac{d}{x} - \frac{d}{x+5} = \frac{d}{x-3} - \frac{d}{x}$$

$$\Rightarrow \frac{1}{x} - \frac{1}{x+5} = \frac{1}{x-3} - \frac{1}{x} \Rightarrow \frac{x+5-x}{x(x+5)} = \frac{x-x+3}{(x-3)x} \Rightarrow \frac{5}{x+5} = \frac{3}{x-3} \quad (\because x \neq 0)$$

$$\Rightarrow 5x - 15 = 3x + 15 \Rightarrow 2x = 30 \Rightarrow x = 15 \text{ km/h}$$

Putting this value of x in equation $\frac{d}{x} - \frac{d}{x+5} = 1$, we get

$$\frac{d}{15} - \frac{d}{20} = 1$$

$$\Rightarrow \frac{d}{60} = 1 \Rightarrow d = 60 \text{ km}$$

24. Let $f(x) = (x^2 + 1)(x - 2) = x^3 - 2x^2 + x - 2$, diff. w.r.t. x , we get

$$f'(x) = 3x^2 - 2 \cdot 2x^1 + 1 - 0 = 3x^2 - 4x + 1$$

Alternatively

$f(x) = (x^2 + 1)(x - 2)$, diff. w.r.t. x , we get

$$f'(x) = (x^2 - 1) \cdot \frac{d}{dx}(x - 2) + (x - 2) \cdot \frac{d}{dx}(x^2 + 1) \text{ (product rule)}$$

$$= (x^2 + 1)(1 - 0) + (x - 2)(2x + 0)$$

$$= x^2 + 1 + 2x^2 - 4x = 3x^2 - 4x + 1$$

OR

Let $f(x) = (ax + b)^n (cx + d)^m$, $n, m \in \mathbb{N}$

Differentiating w.r.t. x , we get

$$f'(x) = (ax + b)^n \cdot \frac{d}{dx}((cx + d)^m) + (cx + d)^m \cdot \frac{d}{dx}((ax + b)^n) \dots \text{(product rule)}$$

$$= (ax + b)^n \cdot m(cx + d)^{m-1} \cdot c + (cx + d)^m \cdot n(ax + b)^{n-1} \cdot a \dots \text{(using result 4)}$$

$$= (ax + b)^{n-1} (cx + d)^{m-1} (mc(ax + b) + na(cx + d))$$

$$= (ax + b)^{n-1} (cx + d)^{m-1} (ac(m + n)x + (mbc + nad))$$

25. Let the probability that student receive A

grade be $P(A)$

$$P(A) = 0.40$$

similarly $P(B) = 0.35$

$$P(C) = 0.15 \text{ and } P(D) = 0.10$$

i. B or C grade

$$P(\text{B or C grade}) = P(B) + P(C)$$

$$= 0.35 + 0.15$$

$$= 0.5$$

ii. P (at most C grade)

$$= P(C) + P(D) = 0.15 + 0.10$$

$$= 0.25$$

Section C

26. The given numbers are 2, 5, 6, 7, 9.

The numbers of different products when 2 or more is taking = the number of ways of taking product of 2 numbers + number of ways of taking product of 3 numbers + numbers of ways of taking product of 4 numbers + number of ways of taking 5 together

$$\begin{aligned}
&= {}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5 \\
&= \frac{5!}{3!2!} + \frac{5!}{2!3!} + \frac{5!}{1!4!} + \frac{5!}{0!5!} \\
&= \frac{5 \cdot 4}{2 \cdot 1} + \frac{5 \cdot 4}{2 \cdot 1} + \frac{5}{1} + 1 \\
&= 10 + 10 + 5 + 1 \\
&= 26.
\end{aligned}$$

OR

The word MATHEMATICS consists of 11 letters:

(M, M), (A, A), (T, T), H, E, I, C, S C

Case 1: In this case 2 similar and 2 similar letters are selected, number of arrangements

$$\begin{aligned}
&= {}^3C_9 \times \frac{4!}{2!2!} \\
&= 18.
\end{aligned}$$

Case 2: In this case 2 similar and 2 different letters are selected, number of arrangements

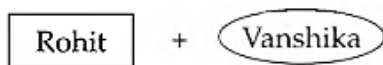
$$= {}^3C_1 \times {}^7C_2 \times \frac{4!}{2!} = 756.$$

Case 3: In this case all 4 letters selected are different, number of arrangements = ${}^8C_4 \times 4! = 1680$.

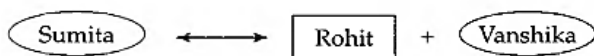
Therefore, total number of arrangements

$$= 18 + 756 + 1680 = 2454.$$

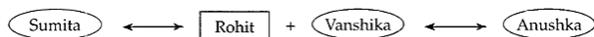
27. Rohit is the husband of Vanshika



Sumita is the sister of Rohit



Anushka is the sister of Vanshika



So Anushka is Rohit's wife's sister

Anushka is the sister-in-law of Rohit.

28. We observe that:

$$(L \text{ H.L at } x = \frac{1}{2}) = \lim_{x \rightarrow 1/2^-} f(x) = \lim_{x \rightarrow \frac{1}{2}} \left(\frac{1}{2} - x \right) \left[\because f(x) = \frac{1}{2} - x \text{ for } 0 \leq x < \frac{1}{2} \right]$$

$$= \frac{1}{2} - \frac{1}{2} = 0 \text{ [Using direct substitution method]}$$

$$\text{and, (R H L at } x = 1/2) = \lim_{x \rightarrow 1/2^+} f(x) = \lim_{x \rightarrow 1/2} (3/2 - x) \dots \left[\because f(x) = \frac{3}{2} - x \text{ for } \frac{1}{2} < x \leq 1 \right]$$

$$= \frac{3}{2} - \frac{1}{2} = 1 \dots \text{[Using direct substitution method]}$$

$$\text{Clearly, } \lim_{x \rightarrow 1/2^-} f(x) \neq \lim_{x \rightarrow 1/2^+} f(x)$$

Hence, $f(x)$ is not continuous at $x = \frac{1}{2}$. Clearly, $f(x)$ has discontinuity of first kind at $x = \frac{1}{2}$.

29. Here, the consumption of water is given to be 205 kL.

According to the given tariff plan :

$$\text{Water consumption charge} = ₹[(8 \times 1.89) + (7 \times 2.42) + (25 \times 4.84) + (165 \times 6.05)]$$

$$= ₹(15.12 + 16.94 + 121.00 + 998.25)$$

$$= ₹1151.31$$

The sewerage charge is 20% of the consumption charges.

$$\therefore \text{Sewerage charge} = 20\% \text{ of } ₹1151.31 = ₹230.26$$

Also, the fixed charge is given to ₹30.25 and the meter rent + is given to be ₹42

$$\therefore \text{Total water bill} = \text{Water consumption charge} + \text{sewerage charge} + \text{Fixed charge} + \text{Meter rent}$$

$$= ₹1151.31 + ₹230.26 + ₹30.25 + ₹42.00 = ₹1453.82$$

30.

x_i	$x_i - \bar{x}$	$ x_i - \bar{x} $
6	$6 - 9 = 3$	$ -3 = 3$
7	$7 - 9 = -2$	$ -2 = 2$
10	$10 - 9 = 1$	$ 1 = 1$



12	$12 - 9 = 3$	$ 3 = 3$
13	$13 - 9 = 4$	$ 4 = 4$
4	$4 - 9 = -5$	$ -5 = 5$
8	$8 - 9 = -1$	$ -1 = 1$
12	$12 - 9 = -3$	$ -3 = 3$
		22

$$\text{Mean} = \frac{\sum x_i}{n}$$

$$\bar{x} = \frac{72}{8}$$

$$= 9$$

$$\text{Mean deviation about Mean} = \frac{\sum |x_i - \bar{x}|}{n}$$

$$= \frac{22}{8}$$

$$= 2.75$$

Now Arrange data in ascending order

4, 6, 7, 8, 10, 12, 12, 13

No. of observation $n = 8$ (even)

$$\text{Median} = \frac{1}{2} \left[\left(\frac{n}{2} \right)^{th} + \left(\frac{n}{2} + 1 \right)^{th} \text{ term} \right]$$

$$= \frac{1}{2} \left[\left(\frac{8}{2} \right)^{th} + \left(\frac{8}{2} + 1 \right)^{th} \text{ term} \right]$$

$$= \frac{1}{2} [4^{th} + 5^{th}] \text{ term}$$

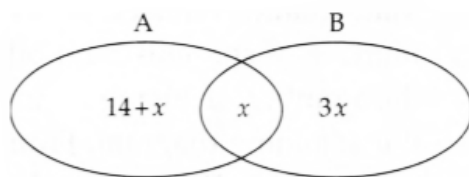
$$= \frac{1}{2} [8 + 10] = \frac{1}{2} \times 18$$

$$= 9$$

$$\text{Median} = \text{Mean} = 9$$

\therefore Mean deviation about Median is also 2.75

31. The adjoining Venn diagram represents the information given in the question.



i. From the Venn diagram, we get

$$n(A) = n(A - B) + n(A \cap B)$$

$$= (14 + x) + x = 14 + 2x \text{ and}$$

$$n(B) = n(B - A) + n(A \cap B)$$

$$= 3x + x = 4x$$

$$\text{But } n(A) = n(B) \text{ (given)}$$

$$\Rightarrow 14 + 2x = 4x \Rightarrow 2x = 14 \Rightarrow x = 7$$

$$\text{ii. } n(A \cup B) = n(A - B) + n(B - A) + n(A \cap B)$$

$$= (14 + x) + 3x + x = 14 + 5x$$

$$= 14 + 5 \times 7 = 14 + 35 = 49$$

Section D

32. $AM = 2GM$

$$\Rightarrow \frac{a+b}{2} = 2\sqrt{ab}$$

$$\Rightarrow a + b = 4\sqrt{ab}$$

$$\Rightarrow \frac{a+b}{2\sqrt{ab}} = 2 \Rightarrow \frac{a+b+2\sqrt{ab}}{a+b-2\sqrt{ab}} = \frac{2+1}{2-1}$$

$$\Rightarrow \frac{(\sqrt{a}+\sqrt{b})^2}{(\sqrt{a}-\sqrt{b})^2} = 3 \Rightarrow \frac{\sqrt{a}+\sqrt{b}}{\sqrt{b}} = \frac{\sqrt{3}}{1}$$

$$\Rightarrow \frac{2\sqrt{a}}{2\sqrt{b}} = \frac{\sqrt{3}+1}{\sqrt{3}-1}$$

Squaring, we get

$$\frac{a}{b} = \frac{3+1+2\sqrt{3}}{3+1-2\sqrt{3}} \Rightarrow \frac{a}{b} = \frac{2+\sqrt{3}}{2-\sqrt{3}}$$

OR

$$\text{Here, } a = 5, r = \frac{4}{7}$$

$$S = \frac{5}{1 - \frac{4}{7}} = \frac{5}{\frac{3}{7}} = \frac{35}{3}$$

33. (i) Here $f(x) = -|x|$

The function is defined for all real values of x .

\therefore Domain of function = \mathbb{R}

Now when $x < 0$, $|x| = -x$

$\therefore f(x) = -(-x) = x < 0$

When $x = 0$, $|x| = 0$

$\therefore f(x) = -|0| = 0$

When $x > 0$, $|x| = x$

$\therefore f(x) = -x < 0$

So $f(x) \leq 0$ for all real values of x .

\therefore Range of function = $(-\infty, 0]$

(ii) Here $f(x) = \sqrt{9 - x^2}$

The function is not defined when $9 - x^2 < 0$

\therefore Domain of function = $\{x : 9 - x^2 \geq 0\} = \{x : x^2 - 9 \leq 0\}$

$= \{x : (x + 3)(x - 3) \leq 0\}$

$= [-3, 3]$

Now $f(x) = \sqrt{9 - x^2} \geq 0$ for $x \in [-3, 3]$

\therefore Range of function = $[0, \infty)$

Wages per week (on Rs)	Mid value x	Frequency f	c.f.	$ x - 45 $	$f x - 45 $
10 - 20	15	4	4	30	120
20 - 30	25	6	10	20	120
30 - 40	35	10	20	10	100
40 - 50	45	20	40	0	0
50 - 60	55	10	50	10	100
60 - 70	65	6	56	20	120
70 - 80	75	4	60	30	120
		60			680

Here $N = 60$, $\frac{N}{2} = \frac{60}{2} = 30$. Cumulative frequency just greater than 30 is 40.

\therefore Median class is 40 - 50

Median = $40 + \frac{(30 - 20)}{20} \times 10 = 40 + 5 = 45$

Mean deviation from median = $\frac{f|x - 45|}{N} = \frac{680}{60} = 11.33$

OR

To compute first four moments about the mean and the values of β_1 and β_2 we shall first compute the moments about a suitable point, $x = 4$ (say).

Calculation of Moments about $x = 4$

x_i	f_i	$x_i - 4$	$f_i(x_i - 4)$	$f_i(x_i - 4)^2$	$f_i(x_i - 4)^3$	$f_i(x_i - 4)^4$
0	1	-4	-4	16	-64	256
1	8	-3	-24	72	-216	648
2	28	-2	-56	112	-224	448
3	56	-1	-56	56	-56	56
4	70	0	0	0	0	0



5	56	1	56	56	56	56
6	28	2	56	112	224	448
7	8	3	24	72	216	648
8	1	4	4	16	64	256
	$\Sigma f_i = 256$		$\Sigma f_i(x_i - 4) = 0$	$\Sigma f_i(x_i - 4)^2 = 512$	$\Sigma f_i(x_i - 4)^3 = 0$	$\Sigma f_i(x_i - 4)^4 = 2816$

Now, $\mu'_1 = \frac{1}{N} \Sigma f_i(x_i - 4) = \frac{0}{256} = 0$, $\mu'_2 = \frac{1}{N} \Sigma f_i(x_i - 4)^2 = \frac{512}{256} = 2$

$\mu'_3 = \frac{1}{N} \Sigma f_i(x_i - 4)^3 = \frac{0}{256} = 0$ and $\mu'_4 = \frac{1}{N} \Sigma f_i(x_i - 4)^4 = \frac{2816}{256} = 11$

Moment about mean: We know that $\mu_1 = 0$

$\mu_2 = \mu'_2 - \mu_1^2$

$\mu_3 = \mu'_3 - 3\mu'_2\mu'_1 + 2\mu_1^3$

and $\mu_4 = \mu'_4 - 4\mu'_3\mu'_1 + 6\mu'_2\mu_1^2 - 3\mu_1^4$

Putting the values of μ'_1, μ'_2, μ'_3 and μ'_4 , we get

$\mu_2 = 2 - 0 = 2$, $\mu_3 = 0 - 3 \times 2 \times 0 + 2 \times 0 = 0$ and, $\mu_4 = 11 - 4 \times 0 + 6 \times 2 \times 0 - 3 \times 0 = 11$

Values of β_1 and β_2 : We have, $\beta_1 = \frac{\mu_3^2}{\mu_2^3}$ and $\beta_2 = \frac{\mu_4}{\mu_2^2}$

Putting the value of μ_2, μ_3 and μ_4 , we obtain

$\beta_1 = 0$ and $\beta_2 = \frac{11}{4} = 2.75$

35. As the sales are intra-state and rate of GST is 12%, so it comprises of CGST of 6% and SGST of 6%.

Manufacturer sells washing machine to wholesaler for ₹ 15000.

Wholesaler sells washing machine to trader for ₹ 15000 + ₹ 1200 = ₹ 16200

Trader sells washing machine to consumer for ₹ 16200 + ₹ 1800 = ₹ 18000.

i. SGST paid by wholesaler = 6% of ₹ 15000 = ₹ $\left(\frac{6}{100} \times 15000\right)$ = ₹900 ,

SGST collected by wholesaler = 6% of ₹ 16200 = ₹ $\left(\frac{6}{100} \times 16200\right)$ = ₹972 .

∴ SGST received by State Government from wholesaler = ₹ 972 - ₹ 900 = ₹ 72.

ii. CGST paid by trader = 6% of ₹ 16200 = ₹ $\left(\frac{6}{100} \times 16200\right)$ = ₹972 ,

CGST received by trader = 6% of ₹ 18000 = ₹ $\left(\frac{6}{100} \times 18000\right)$ = ₹1080 .

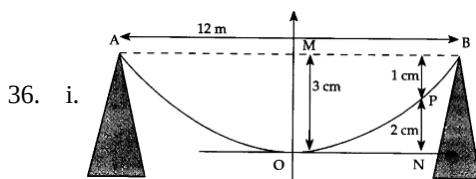
∴ CGST received by Central Government from trader

= ₹ 1080 - ₹ 972 = ₹ 108.

iii. Amount paid by the consumer = ₹ 18000 + SGST + CGST

= ₹ 18000 + ₹ 1080 + ₹ 1080 = ₹ 20160.

Section E



Take the vertex O of the parabola as origin and the axis of the parabola as y-axis. The given parabola is of third standard form, its equation is $x^2 = 4ay$, $a > 0$.

Given AB = 12 m and OM = 3 cm = $\frac{3}{100}$ m.

As M is mid-point of AB, MB = 6 m, therefore, the coordinates of B are $\left(6, \frac{3}{100}\right)$.

Since B lies on the parabola, $6^2 = 4a \times \frac{3}{100} \Rightarrow 4a = 1200$.

Hence, the equation of parabola is $x^2 = 1200y$

ii. Let P be the point on the parabola whose deflection is 1 cm, then NP = 2 cm = $\frac{2}{100}$ m.

Let ON = x metres, then the coordinates of P are $\left(x, \frac{2}{100}\right)$.

Since P lies on the parabola, we get

$$x^2 = 4 \times 300 \times \frac{2}{100} \Rightarrow x^2 = 24 \Rightarrow x = \pm 2\sqrt{6}.$$

Hence, the points of the beam where the deflection is 1 cm are at a distance of $2\sqrt{6}$ metres from the centre.

iii. For parabola $x^2 = 1200y$

$$4a = 1200 \Rightarrow a = 300$$

So, focus of the parabola is (0, 300).

OR

We know that the equation of the directrix of the parabola

$$x^2 = 4ay \text{ is } y = -a.$$

So, the equation of directrix is $y = -300$ i.e. $y + 300 = 0$.

37. i. Effective rate if compounded monthly

$$= \left(1 + \frac{0.05}{12}\right)^{12} - 1 = (1.004)^{12} - 1$$

$$= 1.0512 - 1 = 0.0512 = 5.12\%$$

ii. Effective rate = $\left(1 + \frac{0.05}{4}\right)^4 - 1$

$$= (1.0125)^4 - 1 = 1.0509 - 1$$

$$= 0.0509 = 5.09\%$$

iii. Effective rate = $\left(1 + \frac{0.05}{2}\right)^2 - 1$

$$= (1.025)^2 - 1 = 1.0506 - 1$$

$$= 0.0506 = 5.06\%$$

OR

$$\text{Amount} = ₹ 10,000 \times 1.0509$$

$$= ₹ 10509$$

38. i. As we know there are four suits,

$$\text{Favourable cases are: } {}^{13}C_4 + {}^{13}C_4 + {}^{13}C_4 + {}^{13}C_4$$

$$= 4({}^{13}C_4)$$

$$\text{Required probability} = \frac{4({}^{13}C_4)}{{}^{52}C_4}$$

ii. Since, there are 4 aces in the pack of 52 cards, therefore, the no. of ways of drawing 4 cards so that no card is an ace = ${}^{48}C_4$

∴ Probability of four cards so that none is an ace

$$= \frac{{}^{48}C_4}{{}^{52}C_4}$$

$$= \frac{48 \times 47 \times 46 \times 45}{52 \times 51 \times 50 \times 49}$$

$$= \frac{38916}{54145}$$

$$\text{Thus, required probability} = 1 - \frac{38916}{54145}$$

$$= \frac{15229}{54145}$$

iii. Favourable cases to draw one card from each suit is:

$${}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1 = ({}^{13}C_1)^4$$

$$\text{Require probability} = \frac{({}^{13}C_1)^4}{{}^{52}C_4}$$

$$= \frac{13 \times 13 \times 13 \times 13}{52 \times 51 \times 50 \times 49}$$

$$= \frac{4 \times 3 \times 2 \times 1}{20825}$$

OR

$$\text{Total favourable cases of drawing all cards of same colour} = {}^{26}C_4 \times {}^{26}C_4 = 2({}^{26}C_4)$$

$$\text{Required probability} = \frac{2({}^{26}C_4)}{{}^{52}C_4}$$