Class XI Session 2024-25
Subject - Applied Mathematics
Sample Question Paper - 1

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. However, there is some internal choice in some questions.
2. Section A has 18 MCQ's and 02 Assertion Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer(VSA) questions of 2 marks each.
4. Section C has 6 Short Answer(SA) questions of 3 marks each.
5. Section D has 4 Long Answer(LA) questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (04 marks each) with sub parts.
7. 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 alternatives in all such questions.

Section A

1. Two cards are drawn successively without replacement from a well-shuffled pack of 52 cards. The probability of drawing two aces is **[1]**

   a) $\frac{1}{221}$ b) $\frac{1}{26}$

   c) $\frac{1}{13}$ d) $\frac{4}{223}$

2. Third Quartile is **[1]**

   a. a measure used to describe the distribution data

   b. also called upper quartile

   c. also called lower quartile

   d. the sum of numbers in a set of data divided by the number of pieces of data.

   a) Statement (a) is correct b) Statement (b) is correct

   c) Statement (d) is correct d) Statement (c) is correct

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 tax (under GST) paid by the wholesaler to the Central Government is: **[1]**

   a) ₹ 9 b) ₹ 180

   c) ₹ 90 d) ₹ 99

4. Given log 2 = 0.3010, the value of log 64 is **[1]**

   a) 0.1806 b) 18.06

c) 1.806 d) 180.06

5. If R = {(x, y) : x, y ∈ **W**, 2x + y = 8}, then domain of R is **[1]**

a) {0,1, 2, 3, 4, 5, 6} b) {0,1, 2, 3}

c) {0,1, 2, 3, 4} d) {0,1, 2, 3, 4, 5}

6. The significant digits to find mantissa for number 7 **[1]**

a) 70 b) 0.007

c) 7 d) 0.7

7. Two dice are thrown simultaneously. The probability of obtaining total score of seven is **[1]**

a) $\frac{6}{36}$ b) $\frac{8}{36}$

c) $\frac{7}{36}$ d) $\frac{5}{36}$

8. The vertex of the parabola $(y - 2)^2 = 16 (x - 1)$ is **[1]**

a) (1, 2) b) (1, -2)

c) (-1, 2) d) (2, 1)

9. **321** means **Glass of Tea**, **[1]**
426 means **Tea is Brown**,
796 means **Trunks are Brown**.
Which of the following represents **is** in that language?

a) 4 b) 6

c) 7 d) 2

10. The Karl Pearson's coefficient of skewness (S_{K_P}) is positive, if: **[1]**

a) Mean < Mode b) Mean > Mode

c) Median > Mode d) Mean = Mode

11. The value of $2 + \log_{10} (0.01)$ is **[1]**

a) 4 b) 3

c) 0 d) 1

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) ₹ 3300 b) ₹ 3410

c) ₹ 3515 d) ₹ 3310

13. 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 GST is 18%, the tax (under GST) paid by the shopkeeper to the Central Government is: **[1]**

a) ₹ 2880 b) ₹ 2160

c) ₹ 1440 d) ₹ 720

14. For any two events A and B, if $P(\bar{A}) = \frac{1}{2}$, $P(\bar{B}) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{4}$, then $P\left(\frac{\bar{A}}{\bar{B}}\right)$ equals: **[1]**

a) $\frac{1}{4}$ b) $\frac{3}{8}$

c) $\frac{8}{9}$ d) $\frac{1}{8}$

15. A pack of cards contain 4 aces, 4 kings, 4 queens and 4 jacks. Two cards are drawn at random. The probability that atleast one of them is a king is **[1]**

a) $\frac{1}{5}$ b) $\frac{3}{16}$

c) $\frac{1}{9}$ d) $\frac{9}{20}$

16. The amount of money today which is equal to a series of payments in the future is: **[1]**

i. nominal value of annuity

ii. sinking value of annuity

iii. present value of annuity

iv. future value of annuity

a) iv and i b) ii and iii

c) only iii d) i and ii

17. It is required to seat 5 men and 4 women in a row so that the women occupy the even places. How many such arrangements are possible? **[1]**

a) 720 b) 24

c) 120 d) 2880

18. For two non empty sets A and B the Cartesian product is **[1]**

a) A $\times$ B = ϕ = B $\times$ A b) A $\times$ B $\neq$ B $\times$ A

c) A $\times$ B = B $\times$ A d) A $\times$ B = B $\neq$ A

19. **Assertion (A):** If in a sample of n observations Σd^2 = 40 and Spearman's rank correlation coefficient $r = -\frac{1}{7}$, then n = 7. **[1]**

Reason (R): Spearman's rank correlation coefficient r $= 1 - \frac{6\Sigma d^2}{n(n^2-1)}$.

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 7th, 10th and 13th term of a G.P. are a, b and c respectively, then b_2 = ac. **[1]**

Reason (R): In a G.P., $a_n = \sqrt{a_{n-k} \times a_{n+k}}, n, k \in N$.

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 monthly savings of a company was ₹ 12 lakh for the first 3 months, ₹ 12.5 lakh for the next 4 months and ₹ 31.2 lakh during the next 5 months of a year. Total expenditure during the year is 78 lakh. Find the average monthly earnings of the company. **[2]**

22. Let **[2]**

U = the set of the human beings;

P = the set of all policemen;

T = the set of all thieves.

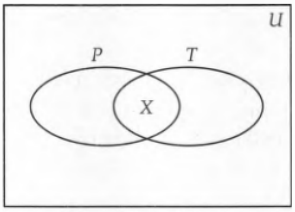
Write the truth value of the following statements from the Venn diagram shown in Fig.

i. No policemen is a thief.

ii. Thieves are not policemen.

iii. Men who are not policemen are thieves.

iv. Some policemen are thieves.



OR

A and B are brothers. C and D are sisters. A's son is D's brother. How B is related to C?

23. Workout for the day of week on the given date 13th August 1975. **[2]**

24. If y = log $\{\sqrt{x-1} - \sqrt{x+1}\}$, show that $\frac{dy}{dx} = \frac{-1}{2\sqrt{x^2-1}}$. **[2]**

OR

If y = $ae^{2x} + be^{-x}$, prove that $\frac{d^2y}{dx^2} - \frac{dy}{dx}$ - 2y = 0.

25. Convert the decimal number 13 to the equivalent binary number. **[2]**

Section C

26. The sum of the first six terms of an arithmetic progression is 42. The ratio of the 10th term to the 30th term is $\frac{1}{3}$. **[3]**
Calculate the first and the thirteenth term.

OR

If 5, x, y, z, 405 are the first five terms of a GP, find the values of x, y and z.

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. Find the domain and the range of the given function: f(x) = $\sqrt{x^2-4}$ **[3]**

29. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum is ₹ 1. Find the sum. **[3]**

30. A family in Agra, U.P. consumes 78 SCM of gas in 60 days. The VAT is included in the gas charges and the minimum charge is 10% of the gas consumption charges. The PNG rate in Agra are as follows: **[3]**

Unit of Consumption(in SCM)	Price Per Unit
up to 45 SCM / 60 days	₹ 29.50
above 45 SCM / 60 days	₹ 42.61

Calculate the bimonthly PNG bill of the family.

31. In a survey of 450 people, it was found that 110 play cricket, 160 play tennis and 70 play both cricket as well tennis. How many play neither cricket nor tennis? **[3]**

Section D

32. i. How many different words can be formed with the letters of the word HARYANA? **[5]**

ii. How many of these begin with H and end with N?

iii. In how many of these H and N are together?

OR

If ${}^{n}P_{r} = 336$, ${}^{n}C_{r} = 56$. Find n and r and hence find ${}^{n-1}C_{r-1}$.

33. Evaluate $\lim_{x \to 2} \frac{x^3+4x-16}{2x^3-3x-10}$ **[5]**

34. Find the Spearman's rank correlation between marks in Mathematics and Statistics obtained by 10 students: **[5]**

Maths in Mathematics	80	38	95	30	74	84	91	60	66	40
Marks in Statistics	85	50	92	58	70	65	88	56	52	46

OR

Compute mean deviation from mean of the following distribution:

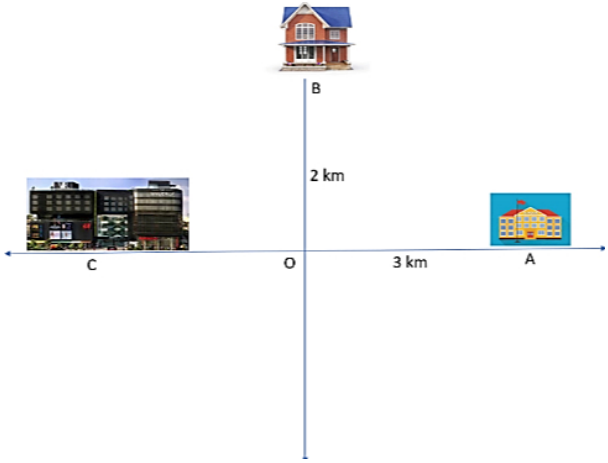
Marks	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
No. of students	8	10	15	25	20	18	9	5

35. A housewife buys the following articles from departmental store sugar 5 kg at rate of ₹ 55/kg and GST 5%, butter 500 g at rate of ₹ 600/kg, GST 12%, shampoo 200 ml bottle at rate of ₹ 110/bottle, GST 18%, hair colour 2 packets at rate of 160 per packet GST 18%. Prepare the bill for the above purchases. **[5]**

Section E

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

Given the map is showing Saloni's home and school. Her school is at the position A, home is at the position B and a shopping mall is at the position C. Assuming O is the origin, OA is along X-axis and OB is along Y-axis.



(a) Find the coordinates of A and B also find slope of AB

(b) What would be the equation of the line passing through A and B.

(c) A shopping mall is situated at the position C. If slope of the line BC is 1, then find equation of BC

OR

Find the equation of line passing through (-2, 4) and perpendicular to AB

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

Data of all the previous cricket matches are stored to analyze the average batting score of various batsmen. The scores of a batsman in ten innings are:

38, 70, 48, 34, 42, 55, 63, 46, 54, 44

(a) What is the median of the data?

(b) What is the mean deviation about the median of the given scores?

(c) If the scores 38 and 34 are replaced by 68 and 74 what will be the mean of the data?

OR

Difference between maximum value of data and minimum vale of data is called?

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

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

(a) Rahul draw four cards, find the probability that all the four cards are from the same suit.

(b) Saurabh draw four cards, find the probability that one of the four cards is an ace.

(c) Rahul draw four cards, find the probability that one card is drawn from each suit.

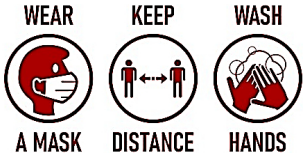
OR

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

The reliability of a Covid-19 test is specified as follows:

Of people having Covid-19, 90% of the test detect the disease but 10% go undetected. Of people free of Covid-19, 99% of the test are judged Covid-19 negative but 1% are diagnosed as showing Covid-19 positive.

From a large population of which only 0.1% have Covid-19, one person is selected at random, given the Covid-19 test and Pathologist reports him/her as Covid-19 positive.



(a) What is the probability of the person to be tested as Covid-19 positive given that he is actually having Covid-19?

(b) What is the probability of the person to be tested as Covid-19 positive given that he is not actually having Covid-19?

(c) What is the probability that the person selected will be diagnosed as Covid-19 positive?

Solution

Section A

1. **(a)** $\frac{1}{221}$

   Explanation: Total number of ways drawing 2 cards successively without replacement

   = $^{52}C_1 \times {}^{51}C_1$ and number of ways 2 aces without replacement = $^{4}C_1 \times {}^{3}C_1$

   $\therefore$ Required probability = $\frac{^4C_1 \times {}^3C_1}{^{52}C_1 \times {}^{51}C_1} = \frac{4 \times 3}{52 \times 51}$

   $= \frac{1}{13 \times 17} = \frac{1}{221}$

2. **(b)** Statement (b) is correct

   Explanation: Third Quartile, Q_3 is upper quartile where first quartile, Q_1 is lower quartile.

3. **(c)** ₹ 90

   Explanation: Tax paid by wholesaler to Central Government

   = 6% of ₹ 1500 = $\frac{6}{100} \times 1500$ = ₹ 90.

4. **(c)** 1.806

   Explanation: log 64 = $\log 2^6$ = 6 log 2 = 6 $\times$ 0.3010 = 1.8060

5. **(c)** {0,1, 2, 3, 4}

   Explanation: {0,1, 2, 3, 4}

6. **(c)** 7

   Explanation: The significant digits to find mantissa for number 7 = 7

7. **(a)** $\frac{6}{36}$

   Explanation: When two dices are thrown, there are (6 $\times$ 6) = 36 outcomes.

   The set of all these outcomes is the sample space given by

   S = (1, 1) , (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)

   (2, 1) , (2, 2), (2, 3), (2, 4), (2, 5), (2, 6)

   (3, 1) , (3, 2), (3, 3), (3, 4), (3, 5), (3, 6)

   (4, 1) , (4, 2), (4, 3), (4, 4), (4, 5), (4, 6)

   (5, 1) , (5, 2), (5, 3), (5, 4), (5, 5), (5, 6)

   (6, 1) , (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

   $\therefore$ n(S) = 36

   Let E be the event of getting a total score of 7.

   Then E = {(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)}

   $\therefore$ n(E) = 6

   Hence, required probability = nEnS = $\frac{6}{36}$

8. **(a)** (1, 2)

   Explanation: Given:

   $(y - 2)^2 = 16 (x - 1)$

   Let X = x − 1, Y = y − 2

   Rewriting the equation in terms of X and Y.

   $\therefore Y^2 = 16 X$

   Vertex = (X = 0, Y = 0) = (x − 1 = 0, y − 2 = 0) = (x = 1, y = 2)

   Hence, the vertex is at (1, 2)

9. **(a)** 4
Explanation: From first and second, Tea is coded as 2.
From second and third, Brown is coded as 6.
∴ 'is' coded as 4.

10. **(b)** Mean > Mode
Explanation: Mean > Mode

11. **(c)** 0
Explanation: $2 + \log_{10}(0.01) = 2 + \log_{10}\frac{1}{100} = 2 + \log_{10} 10^{-2}$
$= 2 - 2\log_{10} 10 = 2 - 2 = 0$

12. **(d)** ₹ 3310
Explanation: Amount $= 1000\left[\frac{(1.1)^3-1}{0.1}\right] = ₹1000\ S_{\overline{3}|0.1}$
= 1000 [1.331 - 1] = ₹ 3310

13. **(d)** ₹ 720
Explanation: ₹ 720

14. **(b)** $\frac{3}{8}$
Explanation: $\frac{3}{8}$

15. **(d)** $\frac{9}{20}$
Explanation: Required probability = 1 - P [none of the two cards is a king]
$= 1 - \frac{^{12}C_2}{^{16}C_2}$
$= 1 - \frac{11}{20} = \frac{9}{20}$

16. **(c)** only iii
Explanation: present value of annuity

17. **(d)** 2880
Explanation: In a row of 9 seats, the 2nd, 4th, 6th and 8th are the even places.
These 4 places can be occupied by 4 women in $^4P_4$ ways = 24 ways
Remaining 5 places can be occupied by 5 men in $^5P_5$ ways = 120 ways.
∴ total number of seating arrangements $= (24 \times 120)$ = 2880

18. **(b)** $A \times B \neq B \times A$
Explanation: let A = {a, b, c}; B = {p}
$A \times B$ = {a, b, c} × {p}
= {(a, p),(b, p),(c, p)}
$B \times A$ = {p} × {a, b, c}
= {(p, a),(p, b),(p, c)}
By the definition of ordered pairs, (a, p) ≠ (p, a)
So $A \times B \neq B \times A$

19. **(d)** A is false but R is true.
Explanation: We know that Spearman's rank correlation coefficient

$r = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$

∴ R is true.

Given Σd^2 = 40 and r = $-\frac{1}{7}$

$\therefore -\frac{1}{7} = 1 - \frac{6\times 40}{n(n^2-1)}$

$\Rightarrow \frac{240}{n(n-1)(n+1)} = \frac{8}{7} \Rightarrow$ (n + 1) n (n -1) = 210

$\Rightarrow$ (n + 1). n (n -1) = 7.6.5

$\Rightarrow$ n = 6 (by inspection)

∴ A is false.

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

Explanation: We know that in a G.P., terms taken at regular intervals also form a G.P.

So, a_{n-k}, a_n, a_{n+k} are in G.P.

$\Rightarrow an^2 = a_{n-k}.\ a_{n+k} \Rightarrow a_n = \sqrt{a_{n-k}\cdot a_{n+k}}$

∴ R is true.

Given a_7 = a, a_{10} = b and a_{13} = c

So, $a_{10} = \sqrt{a_{10-3}\times a_{10+3}} = \sqrt{a_7\cdot a_{13}}$

$\Rightarrow b = \sqrt{ac} \Rightarrow b^2 = ac$

∴ A is true and R is the correct explanation of A.

Section B

21. Given, average monthly savings for the first 3 months = ₹ 12 lakh

$\Rightarrow$ total savings for the first 3 months = ₹(3 $\times$ 12) lakh = ₹ 36 lakh.

Given, average monthly savings for the next 4 months = ₹ 12.5 lakh

$\Rightarrow$ total savings for the next 4 months = ₹(4 $\times$ 12.5) lakh = ₹ 50 lakh.

Also, given average monthly savings for the next 5 months = ₹ 31.2 lakh

$\Rightarrow$ total savings for the next 5 months = ₹(5 $\times$ 31.2)lakh = ₹ 56 lakh

∴ Total annual savings = ₹ 36 lakh + ₹ 50 lakh + ₹ 156 lakh = ₹ 242 lakh

Given total yearly expenditure = ₹ 78 lakh

∴ Total yearly earnings = ₹ 242 lakh + ₹ 78 lakh = ₹320 lakh

∴ Average monthly earnings = ₹$\frac{320}{12}$ lakh = ₹ 26.67 lakh.

22. i. It is evident from the Venn diagram that the policemen x is a thief also. So, the given statement is not true. Hence, its truth value is 'F'.

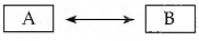
ii. From the Venn-diagram, we find that $P \cap T \neq \Phi$. So, there are some thieves who are also policemen. Hence, the above statement is not true. So, its truth value is 'F'.

iii. 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'.

iv. Clearly, policemen x is a thief also. Therefore, the given statement is true and its truth value is 'T'.

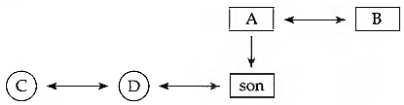
OR

A and B are brothers



C and D are sisters

A's son is D's brother



∴ B is C's uncle

23. We know that:

In 1600 years, we have 0 odd days.

In 300 years, we have 1 odd day.

So, in 1900 years there 0 + 1 = 1 odd day.

Now from 1901 to 1974, there are 18 leap years and 56 non-leap years.

So, the number of odd days is 18 × 2 + 56 × 1 = 92 odd days or 13 × 7 + 1

= 1 odd day (up to 31st Dec. 1974).

Since 1975 is a non-leap year, so from 1st Jan. 1975 to 13th Aug. 1975, we have

31 (Jan.) + 28 (Feb.) + 31 (Mar.) + 30 (Apr.) + 31 (May) + 30 (Jun.) + 31 (Jul.) + 13 days

= 225 days = 32 × 7 + 1 = 1 odd day

So, the total number of odd days = 1 + 1 + 1 = 3 odd days.

∴ Day on 13th Aug. 1975 was Wednesday

24. Here, y = log $\{\sqrt{x-1}-\sqrt{x+1}\}$

Differentiate it with respect to x we get,

$\frac{dy}{dx} = \frac{d}{dx}$ log $\{\sqrt{x-1}-\sqrt{x+1}\}$

$= \frac{1}{(\sqrt{x-1}-\sqrt{x+1})} \frac{d}{dx}(\sqrt{x-1}-\sqrt{x+1})$ [Using chain rule]

$= \frac{1}{(\sqrt{x-1}-\sqrt{x+1})}\left[\frac{d}{dx}\sqrt{x-1}-\frac{d}{dx}\sqrt{x+1}\right]$

$= \frac{1}{(\sqrt{x-1}-\sqrt{x+1})}\left[\frac{1}{2}(x-1)^{\frac{-1}{2}}-\frac{1}{2}(x+1)^{\frac{-1}{2}}\right]$

$= \frac{1}{2}\frac{1}{(\sqrt{x-1}-\sqrt{x+1})}\left(\frac{1}{\sqrt{x-1}}-\frac{1}{\sqrt{x+1}}\right)$

$= \frac{1}{2}\frac{1}{(\sqrt{x-1}-\sqrt{x+1})}\left\{\frac{-(\sqrt{x-1}-\sqrt{x+1})}{(\sqrt{x-1})(\sqrt{x+1})}\right\}$

$= \frac{-1}{2}\left(\frac{1}{(\sqrt{x-1})(\sqrt{x+1})}\right)$

$= \frac{-1}{2\sqrt{x^2-1}}$

So, $\frac{dy}{dx} = \frac{-1}{2\sqrt{x^2-1}}$

OR

Given: $y = ae^{2x} + be^{-x}$ .... (1)

Differentiate equation (1), w.r.t. 'x', we get

$\frac{dy}{dx} = \frac{d}{dx}(ae^{2x}) + \frac{d}{dx}(be^{-x})$

$\frac{dy}{dx} = 2ae^{2x} - be^{-x}$ .... (2)

Again differentiate equation (2), w.r.t. 'x'

$\Rightarrow \frac{d^2y}{dx^2} = 4ae^{2x} + be^{-x}$ .... (3)

(3) - (2) $\Rightarrow$

$\Rightarrow \quad \frac{d^2y}{dx^2} - \frac{dy}{dx} = 4ae^{2x} - 2ae^{2x} + be^{-x} + be^{-x}$

$\Rightarrow \quad \frac{d^2y}{dx^2} - \frac{dy}{dx} = 2(ae^{2x} + be^{-x})$

using (1)

$\Rightarrow \quad \frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = 0$

25. Step I: Divide the number by 2 to get the quotient. Keep the whole part for the next step and set the remainder aside.

Step II: Divide the whole part of the quotient from step I by 2. Again keep the whole part for the next step and set the remainder aside.

Step III: Repeat step 2 until the whole part is 0.

The given decimal number is 13

2	13	
2	6	1
2	3	0
2	1	1
2	0	1

Put the remainder together in reverse order.

So the required binary number is 1101.

Section C

26. Let 'a' be the first term and 'd' be a common difference.

$S_6 = 42$

$\frac{6}{2}$|(2a + 5d) = 14

2a = 14 - 5d ...(i)

$\frac{a_{10}}{a_{30}} = \frac{1}{3}$

$\frac{a+9d}{a+29d} = \frac{1}{3}$

$\frac{2a+18d}{2a+58d} = \frac{1}{3}$

$\frac{14-5d+18d}{14-5d+58d} = \frac{1}{3}$ From (i)

$\frac{14+13d}{14+53d} = \frac{1}{3}$

42 + 39d = 14 + 53d

28 = 14d

$\Rightarrow$ d = 2

From (i)

2a + 5d = 14

$\Rightarrow$ a = 2

Now, a_{13} = 2 + 12 $\times$ 2 = 26

OR

5, x, y, z, 405 are in GP.

Let the ratio be r, also a_5 = 405

$\therefore$ 5$(r)^4$ = 405

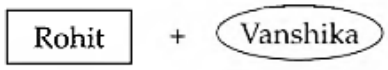
$\Rightarrow (r)^4 = 81 = (3)^4 \Rightarrow$ r = 3

$\Rightarrow$ x = 5 $\times$ 3 = 15,

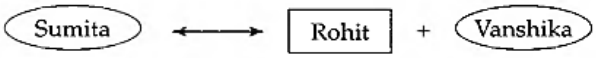
y = 15 $\times$ 3 = 45,

z = 45 $\times$ 3 = 135

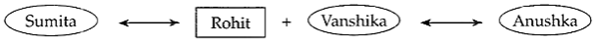
27. Rohit is the husband of Vanshika



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. Given f(x) = $\sqrt{x^2-4}$

For D_f, f(x) must be a real number $\Rightarrow \sqrt{x^2-4}$ must be a real number

x^2 - 4 $\geq$ 0 $\Rightarrow$ (x + 2) (x - 2) $\geq$ 0

either x $\leq$ -2 or x $\geq$ 2

$\Rightarrow D_f = (-\infty, -2] \cup [2, \infty)$

For R_f, let y = $\sqrt{x^2-4}$ ...(i)

As square root of a real number is always non-negative, y $\geq$ 0

On squaring (i), we get $y^2 = x^2 - 4$

$\Rightarrow x^2 = y^2 + 4$ but $x^2 \geq 0$ for all x $\in D_f$

$\Rightarrow y^2 + 4 \geq 0 \Rightarrow y^2 \geq -4$, which is true for all y $\in$ **R**. Also y $\geq$ 0

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

29. Let the sum be ₹ x. Then,

Compound Interest = A_n - P $\Rightarrow$ I = $(1 + i)^n$ - 1

Her, P = x, i = 4% = $\frac{4}{100}$ = 0.04, n = 2

Compound Interest = $x(1 + 0.04)^2$ - x

= $\frac{676}{625}$x - x

$= \frac{51}{625}x$

Now, simple interest,

I = P i t

$= x \times 0.04 \times 2$

$= \frac{2x}{25}$

Since, given difference = ₹ 1

i.e., $\frac{51}{625}x - \frac{2x}{25} = 1$

$\Rightarrow$ x = 625.

30. Here, the consumption of gas is given to be 78SCM for 60 days.

According to the given tariff plan:

Gas consumption charges = ₹ [(45×29.50) + (33×42.61)]

= ₹(1327.50 + 1406.13)

= ₹ 2733.63

The minimum charge is 10% of the gas consumption charge.

∴Minimum charge = 10% of ₹ 2733.63

=₹ 273.36

∴ Bimonthly PNG bill of the family = Gas consumption charges + Minimum charges

= ₹ 2733.63 + ₹ 273.36

= ₹ 3006.99

31. Let C and T denotes the students who play cricket and tennis, respectively.

Given, n(C) = 110, n(T) = 160, n(C ∩ T) = 70, n(U) = 450.

Using identity,

n(C ∪ T) = n(C) + n(T) - n(C ∩ T)

= 110 + 160 - 70

= 200

∴ No. of students play neither cricket nor tennis

= n(U) - n(C ∩ T)

= 450 - 200

= 250

Section D

32. i. There are 7 letters in the word 'HARYANA' of which 3 are A's and remaining all are each of its own kind.

So, total number of words = $\frac{7!}{3!1!1!1!1!} = \frac{7!}{3!}$ = 840

ii. After fixing H in first place and N in last place, we have 5 letters out of which three are alike i.e. A's and remaining all are each of its own kind.

So, total number of words = $\frac{5!}{3!}$ = 20

iii. Considering H and N together we have 7 - 2 + 1 = 6 letters out of which three are alike i.e A's and others are each of its own kind. These six letters can be arranged in $\frac{6!}{3!}$ ways. But H and N can be arranged amongst themselves in 2! ways.

Hence, the requisite number of words = $\frac{6!}{3!} \times$ 2! = 120 × 2 = 240

OR

${}^{n}P_{r} = 336$, ${}^{n}C_{r} = 56$

We know ${}^{n}P_{r} = r!\ {}^{n}C_{r} \Rightarrow 336 = 56r!$

$\Rightarrow$ r! = 6 = 3! $\Rightarrow$ r = 3

Consider ${}^{n}C_{r} = 56 \Rightarrow {}^{n}C_{3} = 56$

$\Rightarrow \frac{n(n-1)(n-2)}{3!} = 56$

$\Rightarrow$ n(n - 1)(n - 2) = 56 × 6 = 8 × 7 × 6

$\Rightarrow$ n(n - 1)(n - 2) = 8(8 - 1)(8 - 2) $\Rightarrow$ n = 8

Hence n = 8, r = 3

$\therefore {}^{n-1}C_{r-1} = {}^{7}C_{2} = \frac{7\times6}{2} = 21.$

33. $\lim_{x \to 2} \frac{x^3+4x-16}{2x^3-3x-10}$

$= \lim_{x \to 2} \frac{(x-2)(x^2+2x+8)}{(x-2)(2x^2+4x+5)}$

$= \lim_{x \to 2} \frac{x^2+2x+8}{2x^2+4x+5} = \frac{4+4+8}{8+8+5} = \frac{16}{21}$

34. We construct the following table:

Marks in Mathematics	Rank R_1	Marks in Statistics	Rank R_2	Diff. $d = R_1 - R_2$	d^2
80	4	85	3	1	1
38	9	50	9	0	0
95	1	92	1	0	0
30	10	58	6	4	16
74	5	70	4	1	1
84	3	65	5	-2	4
91	2	88	2	0	0
60	7	56	7	0	0
66	6	52	8	-2	4
40	8	46	10	-2	4
					30

$\therefore$ Spearman's rank correlation = r = 1 - $\frac{6\Sigma d^2}{n(n^2-1)} = 1 - \frac{180}{10 \times 99} = +\frac{9}{11}$

$\therefore$ r = + 0.82

OR

For Computation of mean deviation from the mean: we prepare the following table.

Marks	Number of Students f_i	Midpoints x_i	$f_i x_i$	$\lvert x_i - X \rvert = \lvert x_i - 49 \rvert$	$f_i \lvert x_i - X \rvert$
10-20	8	15	120	34	272
20-30	10	25	250	24	240
30-40	15	35	525	14	210
40-50	25	45	1125	4	100
50-60	20	55	1100	6	120
60-70	18	65	1170	16	288
70-80	9	75	675	26	234
80-90	5	85	425	36	180
	$N = \sum_{i=1}^{8} f_i = 110$		$\sum_{i=1}^{8} f_i x_i = 5390$		$\sum_{i=1}^{8} f_i \lvert x_i - X \rvert = 1644$

$N = \sum_{i=1}^{8} f_i = 110$ and $\sum_{i=1}^{8} f_i x_i = 5390$

$X = \frac{\sum_{i=1}^{8} f_i x_i}{N}$

$= \frac{5390}{110} = 49$

Mean deviation = $\frac{\sum_{i=1}^{8} f_i \lvert x_i - X \rvert}{N}$

$= \frac{1644}{110}$

$= 14.945$

≈ 14.95

35. Bill for housewife

Article	**Weight/Number of articles**	**Cost/article (in ₹)**	**Amount (in ₹)**	**Total amount (in ₹)**

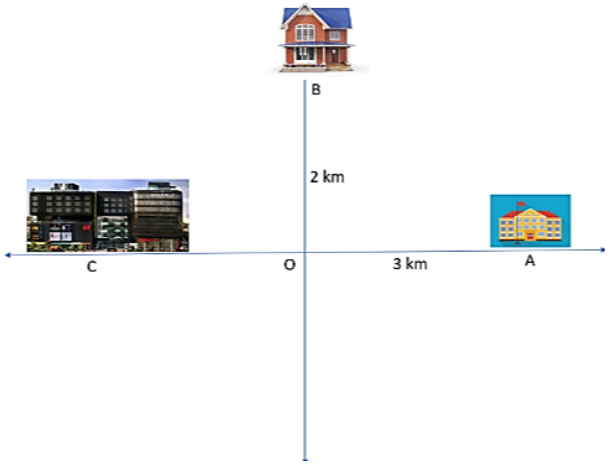
Sugar	5 Kg	₹ 55 per kg GST 5%	275.0013.75	288.75
Butter	500 g	₹ 600/kg GST 12%	300.0036.00	336.00
Shampoo	1 bottle	₹ 110/bottle GST 18%	110.0019.80	129.80
Hair colour	2 packets	₹ 160/packets GST 18%	320.0057.60	377.60
Total bill				1132.15

Amount of bill = ₹ 1132.15.

Section E

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

Given the map is showing Saloni's home and school. Her school is at the position A, home is at the position B and a shopping mall is at the position C. Assuming O is the origin, OA is along X-axis and OB is along Y-axis.



(i) A is on x-axis at a distance 3 km from origin. B is on y-axis at a distance of 2km from origin.

Hence coordinates of A = (3,0) and B= (0,2)

A = (3, 0) and B = (0, 2)

Slope of line AB is $\frac{y_2-y_1}{x_2-x_1} = \frac{2-0}{0-3} = \frac{-2}{3}$

(ii) 2x + 3y = 6

Since slope = $\frac{2}{-3}$ A = (3, 0)

Equation of line in point slope form is

$y - y_1 = m(x - x_1)$

$\Rightarrow y - 0 = \frac{2}{-3}(x - 3)$

$\Rightarrow -3y - 0 = 2x - 6$

$\Rightarrow 2x + 3y = 6$

(iii) x - y + 2 = 0

Since slope BC = 1 and B = (0, 2)

Equation of line in point slope form is

$y - y_1 = m(x - x_1)$

$\Rightarrow y - 2 = 1(x - 0)$

$\Rightarrow y - 2 = x - 0$

$\Rightarrow x - y + 2 = 0$

OR

slop AB = $\frac{-2}{3}$ since required line is $\perp$AB

slope of required line = m = $\frac{3}{2}$

Hence equation of line passing through (-2, 4) and having slope m = $\frac{3}{2}$

$\Rightarrow y - y_1 = m(x - x_1)$

$\Rightarrow y - 4 = \frac{3}{2}(x + 2)$

$\Rightarrow 2y - 8 = 3x + 6$

$\Rightarrow 3x - 2y + 14 = 0$

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

Data of all the previous cricket matches are stored to analyze the average batting score of various batsmen. The scores of a batsman in ten innings are:

38, 70, 48, 34, 42, 55, 63, 46, 54, 44

(i) Arranging the data in ascending order = 34, 38, 42, 44, 46, 48, 54, 55, 63, 70

Median = A.M. of 5th and 6th observation

= $\frac{46+48}{2}$ = 47

(ii)

x_i	$\|d_1\| = \|x_1 - 47\|$
38	9
70	23
48	1
34	13
42	5
55	8
63	16
46	1
54	7
44	3
Total	$\sum \|d_i\|$ **= 86**

Mean Deviation = $\frac{1}{n} \times \sum |d_i|$ = $\frac{86}{10}$ = 8.6

(iii) Sum of new scores = 564

New mean = $\frac{564}{10}$ = 56.4

OR

It is called range of the data.

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

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

(i) As we know there are four suits,

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

$= 4(^{13}C_4)$

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 = $^{48}C_4$

$\therefore$ Probability of four cards so that none is an ace

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

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

$= \frac{38916}{54145}$

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

$= \frac{15229}{54145}$

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

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

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

$= \frac{\frac{13 \times 13 \times 13 \times 13}{52 \times 51 \times 50 \times 49}}{4 \times 3 \times 2 \times 1}$

$= \frac{2197}{20825}$

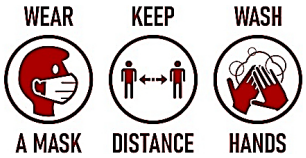
OR

Read the text carefully and answer the questions:

The reliability of a Covid-19 test is specified as follows:

Of people having Covid-19, 90% of the test detect the disease but 10% go undetected. Of people free of Covid-19, 99% of the test are judged Covid-19 negative but 1% are diagnosed as showing Covid-19 positive.

From a large population of which only 0.1% have Covid-19, one person is selected at random, given the Covid-19 test and Pathologist reports him/her as Covid-19 positive.



(i) Let E: the person selected is actually having Covid-19

E' : the person selected is not having Covid-19

A: Person's Covid-19 test is diagnosed as +ve.

P(A | E) = 90% = 0.9

(ii) Let E: the person selected is actually having Covid-19

E' : the person selected is not having Covid-19

A: Person's Covid-19 test is diagnosed as +ve.

P(A | E') = 1% = 0.01

(iii) Let E: the person selected is actually having Covid-19

E' : the person selected is not having Covid-19

A: Person's Covid-19 test is diagnosed as +ve.

$P(E) = 0.1\% = \frac{0.1}{100} = \frac{1}{1000} = 0.001$

P(E') = 1 - P(E) = 1 - 0.001 = 0.999

P(A) = P(A | E) P(E) + P(A | E') .P(E')

$= \frac{90}{100} \times \frac{1}{1000} + \frac{1}{100} \times \frac{999}{1000} = \frac{1089}{10000}$ = 0.01089