Class XI Session 2024-25
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. 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. Which of the following binary numbers is equivalent to decimal number 24? **[1]**

   a) 111111 b) 11000

   c) 11001 d) 1101111

2. The mean of five numbers is 30. If one number is excluded, their mean becomes 28. The excluded number is: **[1]**

   a) 38 b) 30

   c) 35 d) 28

3. Integrated Goods and Services Tax is applicable when: **[1]**

   a) Sold in Union territory b) Sold within a state

   c) Sold from one GST dealer to another GST dealer d) There is interstate supply

4. If Karl Pearson's coefficient of skewness of a distribution is 2.5, standard deviation is 8 and mean is 30, then mode of the distribution is: **[1]**

   a) 5 b) 20

   c) 10 d) 25

5. Number of relations that can be defined on the set A = {a, b, c, d} is **[1]**

   a) 24 b) $_4{}^4$

c) 16 d) 2^{16}

6. Characteristic of log 0.0003798 is **[1]**

a) $\bar{4}$ b) $\bar{3}$

c) 4 d) 3

7. Let A = {1, 2, 3}, B = {1, 3, 5}. If relation R from A to B is given by R = {(1, 3), (2, 5), (3, 3)}. Then, R^{-1} is **[1]**

a) {(1, 3), (5, 2)} b) {(3, 3), (3, 1), (5, 2)}

c) {(1, 3), (2, 5), (3, 3)} d) {(5, 2)}

8. The equations of the lines through (-1, -1) and making angles of 45^o with the line x + y = 0 are **[1]**

a) x - 1 = 0, y - 1 = 0 b) x + 1 = 0, y + 1 = 0

c) x – 1 = 0, y – x = 0 d) x + y = 0, y + 1 = 0

9. A is a brother of F and F is daughter of D. P is brother of D. X is sister of P and M is father of X then P is related to A as **[1]**

a) niece b) father

c) uncle d) brother

10. The mean deviation of the numbers 3, 4, 5, 6, 7 from the mean is **[1]**

a) 25 b) 0

c) 1.2 d) 5

11. The value of $\log_2 \log_2 \log_4 256 + 2 \log_{\sqrt{2}} 2$ is: **[1]**

a) 3 b) 2

c) 7 d) 5

12. In what time will a sum of ₹ 1562.50 produce ₹ 195.10 at 4% per annum compound interest? **[1]**

a) $1\frac{1}{2}$ years b) 3 years

c) $2\frac{1}{2}$ years d) 2 years

13. Deduction of the principal of the home loan is allowed under section _____. **[1]**

a) 80D b) 24

c) 80E d) 80C

14. Simplified from of log 12 - log 2 - log 3 is **[1]**

a) log 4 b) log 2

c) log 6 d) log 1

15. Suppose A and B are two events. Event B has occurred and it is known that P(B) < 1. What is P(A/B') equal to? **[1]**

a) $\frac{P(A)-P(B)}{1-P(B)}$ b) $\frac{P(A)+P(B')}{1-P(B)}$

c) $\frac{P(A)-P(AB)}{1-P(B)}$ d) $\frac{P(A)+P(AB')}{1-P(B)}$

16. A man borrows ₹ 21000 at 10% per annum compound interest. How much he has to pay to the end of each year to clear his debt in two years? **[1]**

a) ₹ 12100

b) ₹ 12000

c) ₹ 10500

d) ₹ 11000

17. The number of digits in the binary system are **[1]**

a) 6

b) 4

c) 10

d) 2

18. In a city 20 percent of the population travels by car, 50 percent travels by bus and 10 percent travels by both car and bus. Then persons travelling by a car or bus is **[1]**

a) 60 percent

b) 80 percent

c) 70 percent

d) 40 percent

19. A man P speaks truth with probability p and an other man Q speaks truth with probability 2p. **[1]**

Assertion (A): If P and Q contradict each other with probability $\frac{1}{2}$, then there are two values of p.

Reason (R): A quadratic equation with real coefficients has two real roots.

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):** The Total no. words with letters of the word civilization (all taken at a time) is 19958393. **[1]**

Reason (R): The number of permutation of n distincts objects (r taken at a time) is ${}^{n}p_{r}$.

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. A takes 2 hours more than B to walk d km, but if A doubles his speed, then he can make it in 1 hour less than B. How much time does B require for walking d km? **[2]**

22. Arrange the following words in a logical and meaningful order. **[2]**

1. Country 2. Furniture 3. Forest 4. Wood 5. Trees

OR

In a certain language if **CORONA** is coded as 6 and **MALARIA** is coded as 5 then how **CANCER** coded?

23. If the second day of April month is a Friday, then find the last day of the next month. **[2]**

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

OR

Differentiate the following functions with respect to x: 5^{3-x^2} + $(3 - x^2)^5$

25. If A and B are two events associated with a random experiment such that P(A) = 0.25, P(B) = 0.4 and P(A or B) = 0.5, find the values of **[2]**

i. P(A and B)

ii. P(A and $\bar{B}$)

Section C

26. A polygon has 35 diagonals. Find the number of its sides. **[3]**

OR

Five boys and 5 girls are to be seated on a bench with the boys and girls alternately. Find the number of ways of their seating.

27. Find the values of the letter and give a reason for the steps involved. **[3]**

$$\begin{array}{r} B\,3\,4\,5 \\ +C\,9\,B\,A \\ \hline 8\,B\,A\,2 \end{array}$$

28. Prove that the greatest integer function [x] is continuous at all points except at integer points. **[3]**

29. For an industrial connection monthly consumption of water is 40 Kl, calculate the Water bill. Tariff rates can be considered as the table given below: **[3]**

Monthly Consumption (in Kilolitre)	**Service Charge (in ₹)**	**Volumetric Charge (Per Kl in ₹)**
Upto 20	146.41	5.27
20-30	219.62	*26.36
> 30	292.82	43.93
Plus Sewer Maintenance Charges: 60% of water volumetric charge		

30. A man borrowed ₹5000 for 4 years under the following terms: 4% simple interest for the first $2\frac{1}{2}$ years, 4% compound interest for the rest of the period on the amount due after $2\frac{1}{2}$ years, the interest being compounded semi-annually. How much should he pay to settle the account? **[3]**

31. In a survey of 60 people, it was found that 25 people read Newspaper H, 26 read Newspaper T, 26 read Newspaper I, 9 read both H and I,11 read both H and T, 8 read both T and I, 3 read all the three Newspapers. Find **[3]**

i. the number of people who read at least one of the three Newspapers.

ii. the number of people who read exactly one Newspaper.

Section D

32. Find four numbers forming a geometric progression in which the third term is greater than the first term by 9, and the second term is greater than the 4^{th} by 18. **[5]**

OR

Divide 32 into four parts which are in AP such that the product of extremes is to the product of means as 7 : 15.

33. Consider the real function f : R $\rightarrow$ R : f(x) = x + 5 for all x $\in$ R. Find its domain and range. Draw the graph of this function. **[5]**

34. Find the mean, variance and standard deviation for the following frequency distribution: **[5]**

Classes	0-10	10-20	20-30	30-40	40-50
Frequency	5	8	15	16	6

OR

The weights of sons and fathers (in kilograms) are given below:

Weight of father	65	66	67	67	68	69	70	72
Weight of son	67	68	65	68	72	72	69	71

Find the coefficient of correlation.

35. An air conditioner manufacturer allows a discount of 10% on marked price to dealer and the dealer sells the air conditioner to a consumer at a discount of 4% on marked price. If the marked price is ₹ 50,000 and the sales are **[5]**

intra-state sales with GST at 18%. Find:

i. the total amount paid by the consumer to the dealer.

ii. the GST paid by the consumer to the dealer.

iii. the GST paid by the dealer to the central and state governments.

iv. the GST paid by the manufacturer to the central and state governments.

Section E

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

During function lots of charts and displays are made with different colours, one such display is of concentric circles.

A circle is drawn whose equation is $x^2 + y^2 - 4x - 6y - 12 = 0$ and based on this other consecutive circles are drawn.

(a) Find the centre of given circle?

(b) Find the radius of given circle?

(c) Find the point which lies in the interior of circle?

OR

Find the Equation of a circle concentric with given circle, whose radius is double the radius of given circle?

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

The marks scored by five students in a test for 25 marks are: 8, 13, 12, 15, 22.

(a) What is the Mean of the data?

(b) What is the variance of the given data?

(c) What is the Standard Deviation of the data?

OR

What is the Mean of first 20 natural numbers?

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

In a game a girl rolls a die, if she gets an even number she will toss a coin if she gets head in coin, she will win ₹ 10 if she gets tail in coin she will win ₹ 5. If she gets odd number in die she has to pay ₹ 20 to organiser.

(a) Find the total number of sample points in sample space?

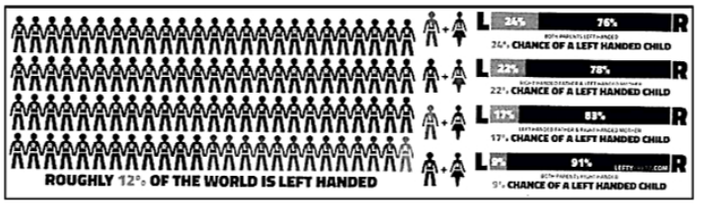
(b) Find the probability that girl will win ₹ 10?

(c) Find the probability that girl will win ₹ 5?

OR

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

Recent studies suggest that roughly 12% of the world population is left handed.



Depending upon the parents, the chances of having a left handed child are as follows:

A. When both father and mother are left handed:

Chances of left handed child is 24%.

B. When father is right handed and mother is left handed:

Chances of left handed child is 22%.

C. When father is left handed and mother is right handed:

Chances of left handed child is 17%.

D. When both father and mother are right handed:

Chances of left handed child is 9%.

Assuming that P(A) = P(B) = P(C) = P(D) = $\frac{1}{4}$ and L denotes the event that child is left handed.

(a) Find $P\left(\frac{L}{C}\right)$

(b) Find $P\left(\frac{\bar{L}}{A}\right)$

(c) Find $P\left(\frac{A}{L}\right)$

Solution

Section A

1.

(b) 11000

Explanation: 1101111 = $1 \times 2^6 + 1 \times 2^5 + 0 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$ = 111

11000 = $1 \times 2^4 + 1 \times 2^3 + 0 + 0 + 0$ = 16 + 8 = 24

111111 = $1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$ = 63

11001 = $1 \times 2^4 + 1 \times 2^3 + 0 + 0 + 1 \times 2^0$ = 16 + 4 + 1 = 21

2. **(a)** 38

Explanation: L et the numbers are x_1, x_2, x_3, x and x_5. Then,

we have, $\frac{x_1 + x_2 + x_3 + x_4 + x_5}{5}$ = 30

$\Rightarrow x_1 + x_2 + x_3 + x_4 + x_5 = 150$ ...(i)

Now, suppose x_1 is excluded, then $\frac{x_2 + x_3 + x_4 + x_5}{4}$ = 28 [given]

$\Rightarrow x_2 + x_3 + x_4 + x_5 = 112$ ...(i)

From Eqs. (i) and (ii), we get x_1 = 150 - 112 = 38

3.

(d) There is interstate supply

Explanation: Integrated Goods and Services Tax is applicable when there is interstate supply.

4.

(c) 10

Explanation: 10

5.

(d) 2^{16}

Explanation: No. of elements in the set A = 4 . Therefore , the no. of elements in $A \times A = 4 \times 4 = 16$. As, the no. of relations in $A \times A$ = no. of subsets of $A \times A = 2^{16}$.

6. **(a)** $\bar{4}$

Explanation: 0.0003798 = 3.798×10^{-4}

∴ Characteristic of log 0.0003798 = -4 i.e. $\bar{4}$

7.

(b) {(3, 3), (3, 1), (5, 2)}

Explanation: Inverse of a relation is given by interchanging the element's position in each pair.

Ex: Inverse of relation P = {(x, y)} is given by P^{-1} = {(y, x)}.

Therefore, R^{-1} = {(3, 1), (5, 2), (3, 3)}.

8.

(b) x + 1 = 0, y + 1 = 0

Explanation: The lines x + 1 = 0 and y + 1 = 0 are perpendicular to each other.

The slope of the line x + y = 0 is -1

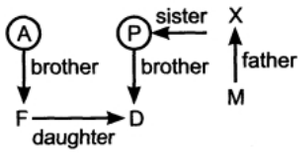
Hence the angle made by this line with respect to X-axis is 45^o

In other words, the angle made by this line with x + 1 = 0 is 45^o

Clearly the other line with which it can make 45^o is y + 1 = 0

9.

(c) uncle

Explanation: 

10.

(c) 1.2

Explanation: Mean (X) = $\frac{3+4+5+6+7}{5}$

= $\frac{25}{5}$ = 5

Taking the absolute value of deviation of each term from the mean, we get:

MD = $\frac{|(3-5)|+|(4-5)|+|(5-5)|+|(6-5)|+|(7-5)|}{5}$

= $\frac{2+1+0+1+2}{5}$

= $\frac{6}{5}$

= 1.2

11.

(d) 5

Explanation: Use the properties:

$\log_a(m)^n = n \log_a m$ and $\log_a a = 1$

Consider, $\log_2 \log_2 \log_4 256 + 2 \log_{\sqrt{2}} 2$

$= \log_2 \log_2 \log_4 (4)^4 + 2\log_{\sqrt{2}} (\sqrt{2})^2$

$= \log_2 \log_2 4 + 2(2)$

$= \log_2 \log_2 (2)^2 + 4$

$= \log_2 2 + 4$

$= 1 + 4 = 5$

12.

(b) 3 years

Explanation: Let the time required be n, then

$1562.50 \left(1 + \frac{4}{100}\right)^n$ -1562.50 = 195.10

$\Rightarrow \left(\frac{26}{25}\right)^n = \frac{1562.50+195.10}{1562.50} = \frac{1757.60}{1562.50} = \left(\frac{26}{25}\right)^3$

$\Rightarrow$ n = 3.

13.

(d) 80C

Explanation: The Principal portion of the EMI paid for the year is allowed as a deduction under Section 80C. The maximum amount that can be claimed is up to Rs 1.5 lakh. But to claim this deduction, the house property should not be sold within 5 years of possession.

14.

(b) log 2

Explanation: log 12 - log 2 - log 3

= $\frac{\log 12}{\log 2+\log 3}$

= $\frac{\log 12}{\log 2\times 3} = \frac{\log 12}{\log 6}$

= $\log \frac{12}{6}$

= log 2

15.

(c) $\frac{P(A)-P(AB)}{1-P(B)}$

Explanation: P(A/B') = $\frac{P(A\cap B')}{P(B')}$

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

16. **(a)** ₹ 12100

Explanation: Let him pay ₹ R at the end of each year.

$\therefore 21000 = R\left[\frac{100}{100+10} + \left(\frac{100}{100+10}\right)^2\right]$

$\Rightarrow 21000 = \mathrm{R}\left[\frac{100}{110} + \left(\frac{100}{110}\right)^2\right] = \mathrm{R}\left[\frac{10}{11} + \frac{100}{121}\right] = \mathrm{R}\left[\frac{210}{121}\right].$

$\therefore \mathrm{R} = \frac{21000\times121}{210} = ₹12100.$

17.

(d) 2

Explanation: 2

In a binary number system, we use only two digits, such as 0 and 1.

18. **(a)** 60 percent

Explanation: Let A denote the set of persons traveling by car, B denotes the set of persons traveling by bus, then

n(A) = 20, n(B) = 50, n(A ∩ B) = 10

∴ n(A ∪ B) = n(A) + n(B) - n(A ∩ B)

= 20 + 50 - 10 = 60

19.

(c) A is true but R is false.

Explanation: A is true but R is false.

20.

(d) A is false but R is true.

Explanation: Civilization: Letter ⇒ 12

i repeats 4 times

Total no. of rearrangement = $\frac{12!}{4!}$

= 19958400

Section B

21. Suppose B takes x hours to walk d km. Then A takes (x + 2) hours to walk d km.

A's speed = $\left(\frac{d}{x+2}\right)$ km/hr, B's speed = $\left(\frac{d}{x}\right)$ km/hr

A's new speed = $\left(\frac{2d}{x+2}\right)$ km/hr

It is given that

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

$\Rightarrow x - \left(\frac{x+2}{2}\right) = 1 \Rightarrow 2x - x - 2 = 2 \Rightarrow x = 4$

Hence, B requires 4 hours to walk d km

22. From the forest, given words, we can say that country contains forest, for has trees, trees have wood that is used to make furniture,

Hence, the correct order of the given words is 1, 3, 5, 4, 2.

OR

C = 3, O = 15, R = 18, N = 14, A = 1

CORONA = 3 + 15 + 18 + 15 + 14 + 1

$= \frac{66}{11} = 6$

M = 13, A = 1, L = 12, R = 18, I = 9

MALARIA = 13 + 1 + 12 + 1 + 18 + 9 + 1

$= \frac{55}{11} = 5$

CORONA → 6

MALARIA → 5

CANCER

= 3 + 1 + 14 + 3 + 5 + 18

$= \frac{44}{11} = 4$

Thus CANCER is coded as '4'

23. Given 2nd April is Friday.

From 3rd April to last day of the next month.

Number of days = 28 April + 31 May = 59

So, the number of odd days = $7 \times 8 + 3$ i.e. 3 days

Since 2nd April is Friday and there are 3 odd days up to last day of next month i.e. Saturday, Sunday, Monday.

∴ The last day of the next month is Monday.

24. We have, y = $\sqrt{x} + \frac{1}{\sqrt{x}}$

Differentiate with respect to x,

$\Rightarrow \frac{dy}{dx} = \frac{d}{dx}\left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)$

$\Rightarrow \frac{dy}{dx} = \frac{d}{dx}(\sqrt{x}) + \frac{d}{dx}\left(\frac{1}{\sqrt{x}}\right)$

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

$\Rightarrow \frac{dy}{dx} = \frac{1}{2\sqrt{x}} - \frac{1}{2x\sqrt{x}}$

$\Rightarrow \frac{dy}{dx} = \frac{x-1}{2x\sqrt{x}}$

$\Rightarrow 2x\frac{dy}{dx} = \frac{x-1}{\sqrt{x}}$

$\Rightarrow 2x\frac{dy}{dx} = \frac{x}{\sqrt{x}} - \frac{1}{\sqrt{x}}$

$\Rightarrow 2x\frac{dy}{dx} = \sqrt{x} - \frac{1}{\sqrt{x}}$

OR

Let y = 5^{3-x^2} + $(3 - x^2)^5$

Differentiating with respect to x, we get

$\frac{dy}{dx} = \frac{d}{dx}\left(5^{3-x^2}\right) + \frac{d}{dx}\left\{\left(3 - x^2\right)^5\right\}$

$\Rightarrow \frac{dy}{dx} = 5^{3-x^2} \log_e 5 \times \frac{d}{dx}(3 - x^2) + 5(3 - x^2)^{5-1} \times \frac{d}{dx}(3 - x^2)$

$\Rightarrow \frac{dy}{dx} = 5^{3-x^2} \log e\ 5 \times (0 - 2x) + 5(3 - x^2)^4 \times (0 - 2x)$

$\Rightarrow \frac{dy}{dx} = -2x\{5^{3-x^2} \log_e 5 + 5(3 - x^2)^4\}$

25. i. It is given that

: P(A) = 0.25, P(A or B) = 0.5 and P(B) = 0.4

To find : P(A and B)

Formula used : P(A or B) = P(A) + P(B) - P(A and B)

Substituting the value in the above formula we get,

0.5 = 0.25 + 0.4 - P(A and B)

0.5 = 0.65 - P(A and B)

P(A and B) = 0.65 - 0.5

P(A and B) = 0.15

ii. Given : P(A) = 0.25, P(A and B) = 0.15 (from part (i))

To find : P(A and $\bar{B}$)

Formula used : P(A and $\bar{B}$) = P(A) - P(A and B)

Substituting the value in the above formula we get,

P(A and $\bar{B}$) = 0.25 - 0.15

P(A and $\bar{B}$) = 0.10

P(A and $\bar{B}$) = 0.10

Section C

26. Let n be the number of sides of a polygon and D be the number of diagonals of that polygon.

We know that, D = ${}^nC_2 - n = \frac{n(n-3)}{2}$

35 = $\frac{n^2-3n}{2}$

$\Rightarrow n^2 - 3n - 70 = 0$

$\Rightarrow (n - 10)(n + 7) = 0$

$\Rightarrow n = 10, -7$

Since, sides cannot be negative, therefore n = 10.

Hence, polygon is a decagon.

OR

Mark the seat numbers on the bench as 1, 2, 3 ,..., 10 as shown:

×	×	×	×	×	×	×	×	×	×
1	2	3	4	5	6	7	8	9	10

The boys and girls will sit alternately if the boys sit at seat numbers 1, 3, 5, 7 and 9 or sit on the seat numbers 2,4, 6, 8 and 10. The girls will sit on the remaining seats.

Now 5 boys can be arranged among themselves in $\underline{|5}$ ways and 5 girls can be arranged among themselves in $\underline{|5}$ ways.

∴ Required number of ways = $\underline{|5} \times \underline{|5} \times 2 = 120 \times 120 \times 2 = 28800$

27.
$$\begin{array}{r} B345 \\ +C9BA \\ \hline 8BA2 \end{array}$$

We have to find the value of A, B, and C.

For this, 5 + A we get 2, a number whose unit digit is 2

Clearly 5 + 7 = 12

So, A= 7, and Question becomes,

$$\begin{array}{r} 1 \\ B345 \\ +C9B7 \\ \hline 8B72 \end{array}$$

Now, we have 1 + 4 + B = 7, A number whose unit digit is 7

So, the number should be 2, as 1 + 4 + 2 = 7

∴ B = 2

Now, the question reduced to,

$$\begin{array}{r} 11 \\ 2345 \\ +C927 \\ \hline 8272 \end{array}$$

Again we have 1 + 2 + C = 8

So, the number should be 5, as 1 + 2 + 5 = 8

∴ C = 5

So, the question reduced to,

$$\begin{array}{r} 11 \\ 2345 \\ +5927 \\ \hline 8272 \end{array}$$

Hence , A = 7; B = 2; C = 5

28. Let f(x) = [x] be the greatest integer function and let k be any integer. Then,

f(x) = $[x] = \begin{cases} k-1, & \text{if } k-1 \le x < k \\ k, & \text{if } k \le x < k+1 \end{cases}$ [By definition of [x]]

Now, (LHL at x = k) = $\lim\limits_{x \to k^-} f(x) = \lim\limits_{h \to 0} f(k-h) = \lim\limits_{h \to 0} [k-h]$

= $\lim\limits_{h \to 0} (k-1)$ = k - 1 [∵ k − 1 ≤ k − h < k ∴ [k − h] = k − 1]

and (RHL at x = k) = $\lim\limits_{x \to k^+} f(x) = \lim\limits_{h \to 0} f(k+h) = \lim\limits_{h \to 0} [k+h]$

= $\lim_{h \to 0} k$ = k [∵ k ≤ k + h < k + 1 ∴ [k + h] = k]

∴ $\lim\limits_{x \to k^-} f(x) \neq \lim\limits_{x \to k^+} f(x)$.

So, f(x) is not continuous at x = k.

Since k is an arbitrary integer. Therefore, f(x) is not continuous at integer points. Let a be any real number other than an integer.

Then, there exists an integer k such that

k - 1 < a < k.

Now,

(LHL at x = a) = $\lim_{x \to a^-} f(x) = \lim_{h \to 0} f(a-h) = \lim_{h \to 0}[a-h]$

= $\lim_{h \to 0} k - 1$ = k - 1 [$\because$ k - 1 < a - h < k [a - h] = k - 1]

(RHL at x = a) = $\lim_{x \to a^+} f(x) = \lim_{h \to 0} f(a+h)$

= $\lim_{h \to 0}[a+h] = \lim_{h \to 0}(k-1)$ = k - 1 $\begin{bmatrix} \because k-1 < a+h < k \\ \therefore [a+h] = k-1 \end{bmatrix}$

and, f(a) = [a] = k - 1 [$\because$k − 1 < a < k $\therefore$ [a] = k − 1]

Thus, $\lim_{x-a^-} f(x) = \lim_{x \to a^+} f(x) = f(a)$

So, f(x) is continuous at x = a. Since a is an arbitrary real number, other than an integer. Therefore, f(x) is continuous at all real points except integer points.

29. Volumetric Charge for consumption upto 20kl = ₹ 20 × 5.27 = ₹ 105.4

Volumetric Charge for consumption between 20-30 kl = ₹ 10 × 26.36 = ₹ 263.6

Volumetric Charge for consumption between 30-40 kl = ₹ 10 × 43.93 = ₹ 439.3

Total volumetric Charge for consumption of 40 kl = ₹(105.4 + 263.6 + 439.3) = ₹ 808.3

Service Charge = ₹ 292.82

Sewage Charges = 60% of Volumetric Charges

= 808.3 × 60% = ₹ 484.98

Amount of water bill for the given month = ₹(808.3 + 292.82 + 484.98) = ₹ 1586.1

Thus, amount of domestic water bill is ₹ 1586.

30. For first $2\frac{1}{2}$ year.

P = ₹5000, R = 4%, T = $2\frac{1}{2}$ year = $\frac{5}{2}$ year

$I = ₹\frac{5000 \times 4 \times 10}{2 \times 100}$

$= 250 \times 4$

= 1000

A = 5000 + 1000 = 6000

For remaining $1\frac{1}{2}$year: P = 6000, T = $\frac{3}{2}$ year , R = 4% p.a.

$A = P\left(1 + \frac{R}{200}\right)^{2n}$

$= 6000\left(1 + \frac{4}{200}\right)^{\frac{3}{2} \times 2}$

$= 6000\left(\frac{51}{50}\right)$

$= 6000 \times \frac{51}{50} \times \frac{51}{50} \times \frac{51}{50}$

$= \frac{795906}{125}$ = ₹6367.248

Total amount to be paid = ₹6367.248

31. Here

n(U) = a + b + c + d + e + f + g + h = 60 ...(i)

n (H) = a + b + c +d = 25 ...(ii)

n(T) = b + c + f + g = 26 ...(iii)

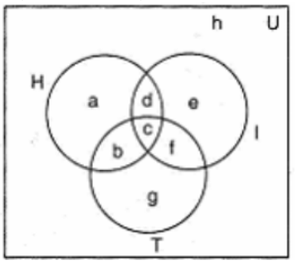
n(I) = c + d + e + f = 26 ...(iv)

$n(H \cap I)$ = c + d = 9 ...(v)

$n(H \cap T)$ = b + c = 11 ...(vi)

$n(T \cap I)$ = c + f = 8 ...(vii)

$n(H \cap T \cap I)$ = c = 3 ...(viii)



Putting value of c in (vii),

3+ f = 8 $\Rightarrow$ f = 5

Putting value of c in (vi),

3 +b = 11 $\Rightarrow$ b = 8

Putting values of c in (v),

3 + d = 9 $\Rightarrow$ d = 6

Putting value of c, d, f in (iv),

3 + 6 + e + 5 = 26 $\Rightarrow$ e = 26 - 14 = 12

Putting value of b, c, f in (iii),

8 + 3 + 5 + g = 26 $\Rightarrow$ g = 26 - 16 = 10

Putting value of b, c, d in (ii)

a + 8 + 3 + 6 = 25 $\Rightarrow$ a = 25 - 17 = 8

i. Number of people who read at least one of the three newspapers

= a + b + c + d +e + f + g

= 8 + 8 + 3 + 6 + 12 + 5 + 10 = 52

ii. Number of people who read exactly one newspapers

= a + e + g

= 8 + 12 +10 = 30

Section D

32. Let the four numbers in G.P. be a, ar, ar^2, ar^3

$\therefore$ ar^2 = a + 9 and ar = ar^3 + 18

Now, ar^2 - a = 9

$\Rightarrow$ a(r^2 - 1) = 9 ...(i)

And ar - ar^3 = 18

$\Rightarrow$ ar(1 - r^2) = 18+

$\Rightarrow$ -ar(r^2 - 1) = 18 ...(ii)

Dividing eq. (ii) by eq. (i), we have

$\frac{-ar(r^2-1)}{a(r^2-1)} = \frac{18}{9}$

$\Rightarrow$ r = -2

Putting value of r in eq. (i), we get

a(4 - 1) = 9

$\Rightarrow$ a = 3

$\therefore$ ar = 3 $\times$ (-2) = -6

ar^2 = 3 $\times$ $(-2)^2$ = 12a r ^ { 3 }

= 3 $\times$ $(-2)^3$ = -24

Therefore, the required numbers are 3, -6, 12, -24

OR

Let four parts be (a - 3d), (a - d), (a + d) and (a + 3d).

Then, Sum of four parts = 32

$\Rightarrow$ (a - 3d) + (a - d) + (a + d) + (a + 3d) = 32

$\Rightarrow$ 4a = 32

$\Rightarrow$ a = 8

and $\frac{(a-3d)(a+3d)}{(a-d)(a+d)} = \frac{7}{15}$

$\Rightarrow$ $\frac{a^2-9d^2}{a^2-d^2} = \frac{7}{15}$

$\Rightarrow$ $\frac{64-9d^2}{64-d^2} = \frac{7}{15}$ [put a = 8]

$\Rightarrow$ 960 - 135 d^2 = 448 - 7 d^2

$\Rightarrow$ 128 d^2 = 512

$\Rightarrow$ d^2 = 4

$\therefore$ d = $\pm$ 2

Hence, the required parts are 8 - 3 $\times$ 2, 8 - 2, 8 + 2, 8 + 3 $\times$ 2 or 8 - 3 (- 2), 8 - (- 2), 8 - 2, 8 + 3 (- 2) i.e., 2, 6, 10, 14

33. Here we have, f(x) = x + 5 $\forall$ x $\in$ R

We need to find the Domain and Range of f(x).

The domain of the given function is all real numbers except where the expression is undefined. In this case, there is no real number which makes the expression undefined.

As f(x) is a polynomial function, we can have any value of x

Therefore,

Domain (f) = $(-\infty, \infty)\{x \mid x \in R\}$

Now,

Let y = f(x)

y = x + 5

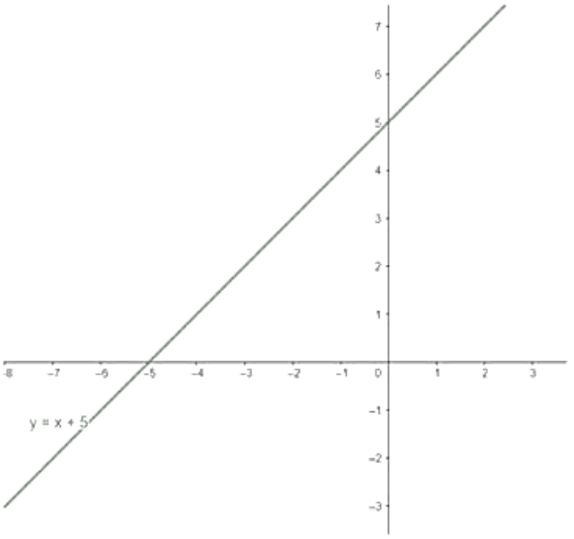
x = y - 5

The range is set of all valid values of y.

Therefore,

Range(f) = $(-\infty, \infty)\{y \mid y \in R\}$

Graph:



34.

Class	Frequency f_i	Mid-point x_i	$\frac{y_i(x_i-25)}{10}$	y_i^2	f_iy_i	$f_jy_i^2$
0-10	5	5	-2	4	-10	20
10-20	8	15	-1	1	-8	8
20-30	15	25	0	0	0	0
30-40	16	35	1	1	16	16
40-50	6	45	2	4	12	24
	50				10	68

Mean, $\bar{x} = A + \frac{\sum_{i=1}^{5} f_iy_i}{N} \times h = 25 + \frac{10}{50} \times 10 = 25 + 2 = 27$

Variance $(\sigma^2) = \frac{h^2}{N^2}\left[N\sum_{i=1}^{5} f_iy_i^2 - \left(\sum_{i=1}^{5} f_iy_i\right)^2\right]$

$= \frac{(10)^2}{(50)^2}[50 \times 68 - (10)^2]$

$= \frac{1}{25}[3400 - 100] = \frac{3300}{25}$

$= 132$

OR

Assumed mean for weight of father be A = 67 and for weight of son be B = 68. We construct the following table:

x	u = x - A	u^2	y	v = y - B	v^2	uv
65	-2	4	67	-1	1	2
66	-1	1	68	0	0	0
67	0	0	65	-3	9	0

67	0	0	68	0	0	0
68	1	1	72	4	16	4
69	2	4	72	4	16	4
70	3	9	69	1	1	3
72	5	25	71	3	9	15
	8	44		8	52	32

Here, N = 8

$\therefore r = \frac{\Sigma uv - \frac{1}{N}\Sigma u \Sigma v}{\sqrt{\Sigma u^2 - \frac{(\Sigma u)^2}{N}}\sqrt{\Sigma v^2 - \frac{(\Sigma v)^2}{N}}} = \frac{32 - \frac{1}{8} \times 8 \times 8}{\sqrt{44 - \frac{8^2}{8}}\sqrt{52 - \frac{8^2}{8}}}$

$= \frac{24}{\sqrt{36}\sqrt{44}} = 0.603$

35. The sales are intra-state sales with GST at 18 %. So, there are two components of GST (i) SGST at 9 % and (ii) CGST at 9 %

i. The manufacturer sells the air conditioner to the dealer at discount of 10 % on the marked price of ₹ 50,000.

$\therefore$ Discount = 10 % of ₹ 50,000 = ₹ $\left(\frac{10}{100} \times 50,000\right)$ = ₹ 5000

Selling price of the air conditioner (S.P.) = ₹ 50,000 - ₹ 5000 = ₹ 45000.

CGST paid by the dealer to the manufacturer = 9 % of ₹ 45000.

= ₹ $\left(\frac{9}{100} \times 45000\right)$ = ₹ 4050

SGST paid by the dealer to the manufacturer = 9 % of ₹ 45000

= ₹ $\left(\frac{9}{100} \times 45000\right)$ = ₹ 4050

Total GST paid by the dealer to the manufacturer = ₹ 4050 + ₹ 4050

= ₹ 8100.

i.e. Input GST of the dealer = ₹ 8100.

The dealer sells the air conditioner at a discount of 4 % on marked price.

$\therefore$ Discount given by the dealer = 4 % of ₹ 50,000 = ₹ $\left(\frac{4}{100} \times 50,000\right)$ = ₹ 2000

Selling price of the dealer = ₹ 50,000 - ₹ 2000 = ₹ 48000

$\therefore$ CGST paid by the consumer = 9 % of ₹ 48000 = ₹ $\left(\frac{9}{100} \times 48000\right)$ = ₹ 4320

SGST paid by the consumer = 9 % of ₹ 48000 = ₹ $\left(\frac{9}{100} \times 48000\right)$ = ₹ 4320

Total GST paid by the consumer (output GST of dealer) = CGST + SGST

= ₹ 4320 + ₹ 4320 = ₹ 8640

Total amount paid by the consumer to the dealer = ₹ 48000 + ₹ 8640 = ₹ 56640

ii. GST paid by the consumer to the dealer = ₹ 8640.

iii. GST paid by the dealer to the central and state governments

= Output GST of dealer - Input GST of dealer

= ₹ 8640 - ₹ 8100 = ₹ 540

iv. GST paid by the manufacturer to the central and state governments

= Output GST of the manufacturer - Input of the manufacturer

= ₹ 8100 - ₹ 0 = ₹ 8100

Section E

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

During function lots of charts and displays are made with different colours, one such display is of concentric circles.

A circle is drawn whose equation is $x^2 + y^2 - 4x - 6y - 12 = 0$ and based on this other consecutive circles are drawn.

(i) $x^2 + y^2 - 4x - 6y - 12 = 0$

Here, 2g = -4, 2f = -6, c = -12

g = -2, f = -3, c = -12

Centre (-g, -f) = (2, 3)

(ii) r = $\sqrt{4 + 9 + 12} = \sqrt{25}$ = 5 units

(iii) as $\sqrt{(2-0)^2 + (3-3)^2} < 5$

hence, (0,3) lies inside the circle.

OR

Radius of given circle = 5

Radius of required circle = 10

$\therefore$ Circle is $(x - 2)^2 + (y - 3)^2 = (10)^2$

$\Rightarrow x^2 + y^2 - 4x - 6y - 87 = 0$

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

The marks scored by five students in a test for 25 marks are: 8, 13, 12, 15, 22.

(i) Mean = $\frac{12+8+13+15+22}{5}$

= 14

(ii) Since, mean $(\bar{x})$ = 14

x_i	$x_i - \bar{X}$	$(x_i - \bar{X})^2$
8	-6	36
12	-2	4
13	-1	1
15	1	1
22	8	64

Var(X) = $\frac{1}{n}\sum\left(x_i - \bar{X}\right)$

= $\frac{106}{5}$ = 21.2

(iii) Standard Deviation = $\sqrt{\text{Var.}}$

= $\sqrt{21.2}$ = 4.604

OR

Sum of first 20 natural numbers = S_{20}

= $\frac{20}{2}[2 \times 1 + (19)1]$

S_{20} = 210

Mean = $\frac{210}{20}$

= 10.5

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

In a game a girl rolls a die, if she gets an even number she will toss a coin if she gets head in coin, she will win ₹ 10 if she gets tail in coin she will win ₹ 5. If she gets odd number in die she has to pay ₹ 20 to organiser.

(i) Total sample points = 9

(ii) Girl will win ₹ 10 if she get head

E = {(2H), (4H), (6H)}

P(E) = $\frac{1}{12} + \frac{1}{12} + \frac{1}{12} = \frac{3\times1}{12} = \frac{1}{4}$

(iii) Girl will win ₹ 5 if she get tail

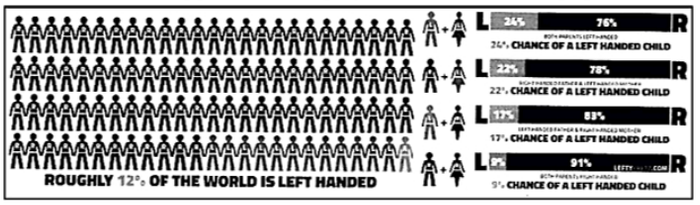
F = {(2T), (4T), (6T)}

P(F) = $\frac{3\times1}{12} = \frac{1}{4}$

OR

Read the text carefully and answer the questions:

Recent studies suggest that roughly 12% of the world population is left handed.



Depending upon the parents, the chances of having a left handed child are as follows:

A. When both father and mother are left handed:
Chances of left handed child is 24%.

B. When father is right handed and mother is left handed:
Chances of left handed child is 22%.

C. When father is left handed and mother is right handed:
Chances of left handed child is 17%.

D. When both father and mother are right handed:
Chances of left handed child is 9%.

Assuming that P(A) = P(B) = P(C) = P(D) = $\frac{1}{4}$ and L denotes the event that child is left handed.

(i) $P\left(\frac{L}{C}\right) = \frac{17}{100}$

(ii) $P\left(\frac{\bar{L}}{A}\right) = 1 - P\left(\frac{L}{A}\right) = 1 - \frac{24}{100} = \frac{76}{100}$ or $\frac{19}{25}$

(iii) $P\left(\frac{A}{L}\right) = \frac{\frac{1}{4}\times\frac{24}{100}}{\frac{1}{4}\times\frac{24}{100}+\frac{1}{4}\times\frac{22}{100}+\frac{1}{4}\times\frac{17}{100}+\frac{1}{4}\times\frac{9}{100}} = \frac{24}{72} = \frac{1}{3}$