Class XI Session 2025-26
Subject - Applied Maths
Sample Question Paper - 7

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. If A and B are two events such that P(A) = $\frac{1}{2}$, P(B) = $\frac{1}{3}$ and P($\frac{A}{B}$) = $\frac{1}{4}$, then P($A' \cap B'$) is equal to: **[1]**

   a) $\frac{3}{4}$ b) $\frac{1}{12}$

   c) $\frac{1}{4}$ d) $\frac{1}{16}$

2. For a certain frequency distribution median is 12, sum of lower and upper quartiles is 30 and Bowley's Skewness is 0.5. The lower and upper quartiles of the distribution respectively are **[1]**

   a) 7, 23 b) 8, 22

   c) 10, 20 d) 9, 21

3. If the simple interest on a sum of money for 2 years at 6% per annum is ₹ 120, then the compound interest on the same sum at the same rate for the same time is: **[1]**

   a) ₹ 123.60 b) ₹ 123.90

   c) ₹ 123.50 d) ₹ 123.80

4. $\sqrt[4]{\sqrt[3]{2^2}}$ is equal to **[1]**

   a) $2^{-\frac{1}{6}}$ b) 2^{-6}

   c) 2^6 d) $2^{\frac{1}{6}}$

5. For two sets A and B if A is a null set, then Cartesian product A $\times$ B will be **[1]**

   a) set B b) ϕ

c) A or B

d) A ∪ B

6. Value of $(256)^{0.16} \times (256)^{0.09}$ is **[1]**

a) 64

b) 256.25

c) 16

d) 4

7. If P(A) = $\frac{1}{3}$, P(B) P(B) = $\frac{1}{2}$ and P(A ∪ B) = $\frac{5}{6}$, then events A and B are: **[1]**

i. independent

ii. mutually exclusive

iii. independent and mutually exclusive

iv. dependent

a) ii and iii

b) iii and iv

c) only i

d) iv and i

8. In the parabola $y^2 = 4ax$ the length of the chord passing through the vertex and inclined to the axis at an angle 45^o is. **[1]**

a) 2a

b) $\sqrt{2}$a

c) $2a\sqrt{2}$

d) $4a\sqrt{2}$

9. A and B together can do a piece of work in 10 days. C can do the same work alone in 15 days. If A, B and C work together, then number of days to finish the work is: **[1]**

a) 5 days

b) 4 days

c) 6 days

d) 8 days

10. Mean of 10 observations is 12 and the mean of other 15 observations is 10, then the means of 25 observations is **[1]**

a) 14.76

b) 10.8

c) 12.67

d) 11

11. If $\frac{\log x}{a-b} = \frac{\log y}{b-c} = \frac{\log z}{c-a}$, then xyz is equal to: **[1]**

a) 1

b) 0

c) 2

d) -1

12. A sum of money at compound interest amounts to thrice of itself in 5 years. In how many years will it be 9 times of itself? **[1]**

a) 12 years

b) 9 years

c) 15 years

d) 10 years

13. The total number of 9 digit numbers which have all different digits is **[1]**

a) 9!

b) 9 × 9!

c) 10!

d) 10 × 10!

14. If two events are independent, then: **[1]**

a) they must be mutually exclusive and sum of their probability must be 1 are both correct

b) none of these

c) sum of their probability must be 1 d) they must be mutually exclusive

15. The probability that at least one of the events A and B occur is 0.6. If A and B occur simultaneously with probability 0.2, then P($\bar{A}$) + P($\bar{B}$) is: **[1]**

a) 1.6 b) 0.8

c) 0.4 d) 1.2

16. At what rate percent per annum will a sum of ₹ 12000 become ₹ 13230 in 2 years? **[1]**

a) 6% b) 6.5%

c) 5.5% d) 5%

17. The number of signals that can be made by 4 flags of different colours, taking one or more at a time is **[1]**

a) 64 b) 48

c) 52 d) 56

18. Let R = {[a, a^3) : a is a prime number less than 5} be a relation. Find the range of R. **[1]**

a) {8, 27} b) {3, 8}

c) {2, 27} d) {2, 3}

19. **Assertion (A):** Mean deviation about median of the following data: 1, 3, 5, 7, 9, 11 is 3. **[1]**
Reason (R): Median of the observations 1, 3, 5, 7, 9, 11 is 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.

20. **Assertion (A):** If a, b, c are in G.P. such that $a^p = b^q = c^r$, then $\frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in A.P. **[1]**
Reason (R): If a, b, c are in G.P., then b^2 = ac.

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. If 30th March 2020 was Monday, what would be the day after 61 days? **[2]**

22. A and B are two sets such that n(A - B) = 20 + x, n(B - A) = 3x and n(A ∩ B) = x + 1. Draw a Venn diagram to illustrate this information. If n(A) = n(B), find **[2]**

i. the value of x
ii. n(A ∪ B).

OR

Write down all the subsets of the following sets:

i. [a]
ii. {a,b}
iii. ϕ

23. At what time between 2:00 and 3:00 the minute hand and hour hand coincide? **[2]**

24. Differentiate the functions with respect to x: $(x^x)^x$ **[2]**

OR

Find the derivative of the given function from the first principle: $\frac{1}{x^2}$

25. Convert the given decimal number 569 to the binary number. **[2]**

Section C

26. If a, b, c are pth, qth and rth terms respectively of an A.P, prove that: a(q - r) + b(r - p) + c(p - q) = 0 **[3]**

OR

Find three numbers in G.P. whose product is 216 and the sum of their products in pairs is 156.

27. In the triangle with vertices A(2, 3), B(4, -1) and C (-1, 2), find the equation and length of altitude from the vertex A. **[3]**

28. If f(x) = $x - \frac{1}{x}$, prove that **[3]**

$[f(x)]^3 = f(x)^3 + 3f\left(\frac{1}{x}\right)$.

29. A bank pays 8% interest per annum compounded half-yearly. What equal amount should be deposited at the end of each half-year for $1\frac{1}{2}$ years to get an amount of ₹ 2000 at the end of 18 months? **[3]**

30. Find the value of $\frac{(0.3)^{\frac{1}{3}} \times \left(\frac{1}{27}\right)^{\frac{1}{4}} \times (9)^{\frac{1}{6}} \times (0.81)^{\frac{2}{3}}}{(0.9)^{\frac{2}{3}} \times 3^{\frac{-1}{2}} \times \left(\frac{1}{3}\right)^{-2} \times (243)^{\frac{-1}{4}}}$. **[3]**

31. Find the cardinal number of the following sets: **[3]**

i. {}

ii. {0}

iii. A -{1, 2, 2,1, 3 }

iv. The set of all letters in the word PRINCIPAL

v. The set of all vowels in the word PRINCIPAL.

Section D

32. In an experiment of tossing a coin twice, describe the sample space. What is the probability of getting **[5]**

i. no heads

ii. exactly one head

iii. two heads

iv. at least one head

v. one head and one tail

vi. at least one tail?

OR

A bag A contains 4 black and 6 red balls and bag B contains 7 black and 3 red balls. A die is thrown, if 1 or 2 appears on it, then bag A is chosen, otherwise bag B. If two balls are drawn at random (without replacement) from the selected bag, find the probability of one of them being red and another black.

33. Find the value of 'a' and 'b' if $\lim_{x \to 2} f(x)$ and $\lim_{x \to 4} f(x)$ exists where f(x) = $\begin{cases} x^2 + ax + b, & 0 \leq x < 2 \\ 3x + 2, & 2 \leq x \leq 4 \\ 2ax + 5b, & 4 < x \leq 8 \end{cases}$ **[5]**

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

Classes	0 - 30	30 - 60	60 - 90	90 - 120	120 - 150	150 - 180	180 - 210
Frequencies	2	3	5	10	3	5	2

OR

The following table shows the ages of patients admitted in hospital during the year

Age (in years)	5 - 15	15 - 25	25 - 35	35 - 45	45 - 55	55 - 65
Number of patients	6	11	21	23	14	5

Calculate Bowley's coefficient of skewness.

35. Find the equation of a circle whose centre is (3, -2) and which passes through the intersection of the lines 5x + 7y = 3 and 2x - 3y = 7. **[5]**

Section E

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

Children always keep of thinking something new, sometimes reaching a destination they say we will go by longer sometimes by shorter route, etc.

A child is standing at the point A(2, 3) and far away he can notice a straight road path represented by the equation 3x - 4y - 12 = 0. He wants to reach path in the minimum possible time.

(a) Find the slope of the path followed by child?

(b) Find the Equation of the path followed by child?

(c) Find the Distance covered by child in reaching the path?

OR

If child wants to reach at point (4, 0) on the straight road, then find the equation of path he should follow.

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]**

Out of 7 boys and 5 girls a team of 7 students is to be made.

(a) Find the number of ways, if team contain at least 3 girls.

(b) Find the number of ways, if team contain exactly 3 girls.

(c) if exactly 3 girls are selected and are arranged in a row for photograph. Find number of ways if all girls and all the boys will stand together.

(d) The number of ways to arrange 3 girls and 4 boys if no two boys and girls will stand together.

OR

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

Out of 7 boys and 5 girls a team of 7 students is to be made.

(a) In how many ways Sunil can select all four cards from same suit?

(b) In how many ways Anita can select four cards from different suit?

(c) In how many ways Sunil can select all face cards?

Solution

Section A

1.

(c) $\frac{1}{4}$

Explanation:

Given P(A) = $\frac{1}{2}$, P(B) = $\frac{1}{3}$, P(A | B) = $\frac{1}{4}$

P (A ∩ B) = P(A | B) · P(B) = $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$

P(A' ∩ B') = P(A ∪ B)' = 1 - P(A ∪ B)

= 1 - P(A) + P(B) - P(A ∩ B)

= 1 - $\left\{\frac{1}{2} + \frac{1}{3} - \frac{1}{12}\right\}$= 1 - $\left\{\frac{6+4-1}{12}\right\}$

= 1 - $\frac{3}{4} = \frac{1}{4}$

2.

(d) 9, 21

Explanation:

Given data, coefficient Sk_B = 0.5

$Q_3 + Q_1 = 30$ ....(i)

Median = 12

$Sk_B = \frac{(Q_3-Q_2)-(Q_2-Q_1)}{(Q_3-Q_2)+(Q_2-Q_1)}$

$Sk_B = \frac{Q_3+Q_1-2M_d}{Q_3-Q_1}$

$0.5 = \frac{30-2(12)}{Q_3-Q_1}$

$Q_3 - Q_1 = \frac{30-24}{0.5} = \frac{6}{0.5} = \frac{60}{5} = 12$

$Q_3 - Q_1 = 12$ .....(ii)

Adding question (i) and (ii), we get

$2Q_3 = 42$

$Q_3 = \frac{42}{2} = 21$

$Q_3 = 21$

Putting $Q_3 = 21$ in equation (i)

$21 + Q_1 = 30$

$Q_1 = 30 - 21$

$Q_1 = 9$

Hence upper quartile is 21 and lower quartile is 9.

3. **(a)** ₹ 123.60

Explanation:

Required interest = 5.1.for 2 years + 5.1. on interest for 1 year (∵ S.I. for 1 year = ₹ 60)

$= 120 + \frac{60\times6\times1}{100}$ = ₹ 120 + ₹ 3.6 = ₹ 123.6.

4.

(d) $2^{\frac{1}{6}}$

Explanation:

$\sqrt[4]{\sqrt[3]{2^2}} = \sqrt[4]{(2^2)^{\frac{1}{3}}} = \left(2^{\frac{2}{3}}\right)^{\frac{1}{4}} = 2^{\frac{1}{6}}$

5.

(b) ϕ

Explanation:

set A is null get (Given)

So, Cartesian product A $\times$ B = $\phi \times$ B = ϕ

6.

(d) 4

Explanation:

$(256)^{0.16} \times (256)^{0.09} = (256)^{0.16 + 0.09}$

$= (256)^{0.25}$

$= (256)^{\frac{25}{100}}$

$= (256)^{\frac{1}{4}}$

$= (4^4)^{\frac{1}{4}}$

$= 4^1$

$= 4$

7.

(c) only i

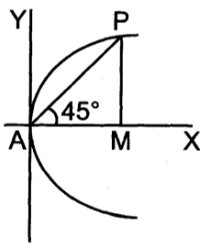
Explanation:

independent

8.

(d) $4a\sqrt{2}$

Explanation:



Let AP be the chord of length p, making angle of 45^o with the axis of the parabola.

The coordinates of P are

(p cos 45^o, p sin 45^o) = $\left(\frac{p}{\sqrt{2}}, \frac{p}{\sqrt{2}}\right)$

Since, $\left(\frac{p}{\sqrt{2}}, \frac{p}{\sqrt{2}}\right)$ lies on the parabola $y^2 = 4ax$, we have

$\frac{p^2}{2} = 4a \times \frac{p}{\sqrt{2}} \Rightarrow p = 4a\sqrt{2}$

9.

(c) 6 days

Explanation:

6 days

10.

(b) 10.8

Explanation:

As mean of 10 observations =12

$\therefore$ Total of 10 observations = 10 $\times$12 = 120

Mean of 15 observations = 10

$\therefore$ Total of 15 observations = 15 $\times$ 10 = 150

∴ Total of 25 observations = 120 + 150 = 270

∴ Mean of 25 observations = $\frac{270}{25}$ = 10.8

11. **(a)** 1

Explanation:

1

12.

(d) 10 years

Explanation:

In 5 years, a sum P becomes 3p.

∴ In next 5 years, a sum of 3P becomes 3(3P) = 9P i.e. in 10 years amount becomes 9 times.

13.

(b) $9 \times 9!$

Explanation:

as digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 i.e. 10

9^{th} place by the 10 digits = 9 ways {number cannot start with 0}

8^{th} place by 9 digits = 9 ways

7^{th} place digit can be placed by 8 digits = 8 ways So total number of ways

$= 9 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \text{ x} \times 3 \times 2 = 9 \times 9!$

14.

(b) none of these

Explanation:

Let A and B are two independent events. Then,

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

As $P(A \cap B) \neq 0$ or $P(A) + P(B) \neq 1$

So, both are neither mutually exclusive nor their sum of probabilities is 1

15.

(d) 1.2

Explanation:

We are given that $P(A \cup B) = 0.6$, and $P(A \cap B) = 0.2$

We know that if A and B are any two events, then

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

or $0.6 = 1 - P(\bar{A}) + 1 - P(\bar{B}) - 0.2$

or $P(\bar{A}) + P(\bar{B}) = 2 - 0.2 - 0.6 = 1.2$

16.

(d) 5%

Explanation:

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

$\therefore 13230 = 12000 \left(1 + \frac{r}{100}\right)^2$

$\Rightarrow \left(1 + \frac{r}{100}\right)^2 = \frac{13230}{12000} = \frac{441}{400} = \left(\frac{21}{20}\right)^2$

$\Rightarrow 1 + \frac{r}{100} = \frac{21}{20} \Rightarrow \frac{r}{100} = \frac{1}{20} \Rightarrow r = 5\%.$

17. **(a)** 64

Explanation:

Number of Signals with one flag = 4

Number of Signals with 2 flags = $^4P_2 = 12$

Number of Signals with 3 flags = $^4P_3 = 24$

Number of Signals with 4 flags = $^4P_4 = 24$

Total Number of Singals = 4 + 12 + 24 + 24 = 64

18. **(a)** {8, 27}

Explanation:

Given, R = {[a, a^3) : a is a prime number less than 5}

$\Rightarrow$ R = {(2, 8), (3, 27)}

Hence, range of R = {8, 27}.

19.

(c) A is true but R is false.

Explanation:

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

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

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

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

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

$\therefore$ R is false.

Now, mean deviation about median

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

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

$\therefore$ A is true.

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

Explanation:

Let $a^p = b^q = c^r = k$, then

$a = k^{\frac{1}{p}}, b = k^{\frac{1}{q}}, c = k^{\frac{1}{r}}$.

Since a, b, c are in G.P., $b^2 = ac$

$\Rightarrow \left(k^{\frac{1}{q}}\right)^2 = k^{\frac{1}{p}} \times k^{\frac{1}{r}} \Rightarrow k^{\frac{2}{q}} = k^{\frac{1}{p}+\frac{1}{r}}$

$\Rightarrow \frac{2}{q} = \frac{1}{p} + \frac{1}{r} \Rightarrow \frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in A.P.

$\therefore$ Assertion is true.

Also, Reason is true and Reason is the correct explanation of Assertion.

Section B

21. Given that on 30th March 2020, it was Monday.

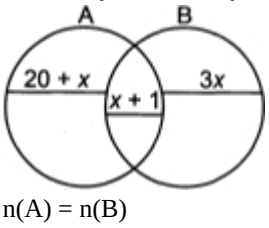
Number of days = 61

= 7 $\times$ 8 + 5

Number of odd days = 5.

Since 30th March was Monday and there are 5 odd days in next 61 days i.e.Tuesday, Wednesday, Thursday, Friday and Saturday.

$\therefore$ The day after 61 days of 30th March 2020 is Saturday.

22. 

n(A) = n(B)

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

$\Rightarrow$ 20 + x + x + 1 = 3x + x + 1 $\Rightarrow$ 2x = 20 $\Rightarrow$ x = 10

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

$= 20 + x + x + 1 + 3x = 5x + 21 = 50 + 21 = 71$

OR

Every non-empty set has two subsets ϕ and the set itself.

i. The subsets of {a} are ϕ and {a}.

ii. The subsets of {a, b} are ϕ, {a}, {b}, and {a, b}.

iii. The only subset of ϕ is ϕ.

23. Let at 2 hours x minutes, hour hand and minute hand coincide.

For hour hand: Angle formed by hour hand in 1 hour = 30^o

Angle formed by hour hand in $\left(2 + \frac{x}{60}\right)$ hrs $= \frac{1}{2}(120 + x)^\circ$

For minute hand: Angle formed by minute hand in 1 minute = 6^o

Angle formed by minute hand in x minutes = $6x^o$

$\therefore 6x = \frac{1}{2}(120 + x) \Rightarrow 11x = 120$

$\Rightarrow x = \frac{120}{11} = 10\frac{10}{11}$ minutes

$\therefore$ At $10\frac{10}{11}$ minutes hour hand and minute hand will coincide.

24. Let $y = (x^x)^x$. Then,

$y = x^{x \cdot x} = x^{x^2} \Rightarrow y = e^{x^2 \cdot \log x}$

On differentiating both sides with respect to x, we get

$\frac{dy}{dx} = e^{x^2 \cdot \log x} \frac{d}{dx}(x^2 \log x)$

$\Rightarrow \frac{dy}{dx} = e^{x^2 \cdot \log x} \{\log x \frac{d}{dx}(x^2) + x^2 \frac{d}{dx}(\log x)\}$

$\Rightarrow \frac{dy}{dx} = x^{x^2} \{(\log x) 2x + x^2 \times \frac{1}{x}\} \left[\because e^{x^2 \log x} = x^{x^2}\right]$

$\Rightarrow \frac{dy}{dx} = x^{x^2} (2x \log x + x)$

$\Rightarrow \frac{dy}{dx} = x x^{x^2} (2 \log x + 1)$

OR

Let $f(x) = \frac{1}{x^2}$, note that f is not defined at x = 0

By def., $f'(x) = \underset{h \to 0}{\text{Lt}} \frac{f(x+h) - f(x)}{h} = \underset{h \to 0}{\text{Lt}} \frac{\frac{1}{(x+h)^2} - \frac{1}{x^2}}{h}$

$= \underset{h \to 0}{\text{Lt}} \frac{x^2 - (x+h)^2}{h(x+h)^2 x^2} = \underset{h \to 0}{\text{Lt}} \frac{-2hx - h^2}{h(x+h)^2 x^2}$

$= \underset{h \to 0}{\text{Lt}} \frac{-2x - h}{(x+h)^2 x^2} = \frac{-2x - 0}{(x+0)^2 x^2} = -\frac{2x}{x^4} = -\frac{2}{x^3}$, $x \neq 0$

25. Given: decimal number = 569

	Quotient	Remainder
2	569	
2	284	1
2	142	0
2	71	0
2	35	1
2	17	1
2	8	1
2	4	0
2	2	0
2	1	0

$\therefore (569)_{10} = (1000111001)_2$

Section C

26. Let A be the first erm and D be the common difference of the given A.P.

Then, a = pth term

$\Rightarrow a = A + (p - 1) D$

b = qth term

$\Rightarrow$ b = A + (q - 1) D

c = rth term

$\Rightarrow$ c = A + (r - 1)D

We have.

a(q - r) + b(r - p) + c(p - q)

= [A + (p - 1) D](q - r)+[A + (q - 1) D](r - p) + [A + (r - 1) D](p - q)

= A[(q - r) + (r - p) + (p - q)] + D[(p - 1)(q - r) + (q - 1)(r - p)+(r - 1)(p - q)]

= A $\times$ 0 + D[p(q - r) + q(r - p) + r(p - q) - (q - r) - (r - p) -(p - q)]

= 0 + D $\times$ 0

= 0

OR

Let three numbers in G.P. be $\frac{a}{r}$, a, ar

$\therefore$ Their product = $\frac{a}{r}$·a·ar = 216 (given)

$\Rightarrow a^3 = 216 = (6)^3 \Rightarrow$ a = 6.

Also sum of their products in pairs = 156 (given)

$\Rightarrow \frac{a}{r}\cdot$ a + a · ar + ar $\cdot \frac{a}{r}$ = 156

$\Rightarrow a^2\left(\frac{1}{r}+r+1\right)$ = 156

$\Rightarrow 6^2 \cdot \frac{1+r^2+r}{r}$ = 156

$\Rightarrow 3 \cdot \frac{r^2+r+1}{r}$ = 13

$\Rightarrow 3r^2 + 3r + 3 = 13r$

$\Rightarrow 3r^2 - 10r + 3 = 0$

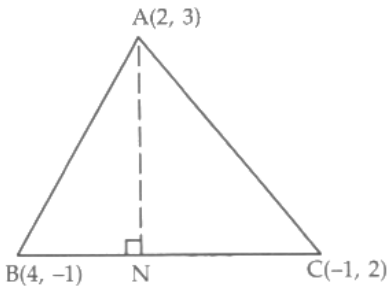
$\Rightarrow$ (r - 3)$\left(r-\frac{1}{3}\right)$ = 0 $\Rightarrow$ r = 3, $\frac{1}{3}$

When r = 3, numbers are 2, 6,18 and when r = $\frac{1}{3}$, numbers are 18, 6, 2

27. From A, draw AN $\perp$ BC

Slope of BC = $\frac{2+1}{-1-4} = -\frac{3}{5}$

As AN $\perp$ BC, slope of AN = $\frac{5}{3}$



$\therefore$ Equation of altitude from vertex A i.e. of AN is

y - 3 = $\frac{5}{3}$ (x - 2)

or 5x - 3y - 1 = 0

Equation of BC is y + 1 = $-\frac{3}{5}$ (x - 4) i.e. 3x + 5y - 7 = 0

Length of altitude from A = AN = $\frac{|3\times2+5\times3-7|}{\sqrt{3^2+5^2}}$ units = $\frac{14}{\sqrt{34}}$ units.

28. We have, f(x) = $x-\frac{1}{x}$

$\therefore$ f(x^3) = $x^3 - \frac{1}{x^3}$

and $[f(x)]^3 = \left(x-\frac{1}{x}\right)^3$

Now, $[f(x)]^3 = \left(x-\frac{1}{x}\right)^3$

$[f(x)]^3 = x^3 - \frac{1}{x^3} - 3x + \frac{3}{x}$

$[f(x)]^3 = \left(x^3-\frac{1}{x^3}\right) - 3\left(x-\frac{1}{x}\right)$

$[f(x)]^3$ = f(x^3)-3f(x)

$[f(x)]^3$ = f(x^3)+3f($\frac{1}{x}$).

$\left(\because f(x) = -f\left(\frac{1}{x}\right)\right)$

29. Given A = ₹ 2000, i = $\frac{8}{2 \times 100}$ = 0.04 and n = 3 ($\because 1\frac{1}{2}$ years = 3 half-years)

$\therefore A = R\left[\frac{(1+i)^n - 1}{i}\right]$

$\Rightarrow 2000 = R\left[\frac{(1+0.04)^3 - 1}{0.04}\right] \Rightarrow$ 2000 × 0.04 = R[(1 + 0.04)^3 - 1]

80 = R[(1.04)^3 - 1] ...(i)

Let x = (1.04)^3

Taking log on both sides, we get

log x = 3 log 1.04 = 3 × 0.0170 = 0.0510

$\Rightarrow$ x = antilog 0.0510 $\Rightarrow$ x = 1.125

Substituting the value of x in equation (i), we get

80 = R[1.125 - 1] $\Rightarrow R = \frac{80}{0.125} \Rightarrow$ R = 640

30. $\frac{(0.3)^{\frac{1}{3}} \times \left(\frac{1}{27}\right)^{\frac{1}{4}} \times (9)^{\frac{1}{6}} \times (0.81)^{\frac{2}{3}}}{(0.9)^{\frac{2}{3}} \times 3^{\frac{-1}{2}} \times \left(\frac{1}{3}\right)^{-2} \times (243)^{\frac{-1}{4}}}$

$= \frac{\left(\frac{3}{10}\right)^{\frac{1}{3}} \times \left(\frac{1}{3^3}\right)^{\frac{1}{4}} \times (3^2)^{\frac{1}{6}} \times \left(\frac{81}{100}\right)^{\frac{2}{3}}}{\left(\frac{9}{10}\right)^{\frac{2}{3}} \times 3^{\frac{-1}{2}} \times \left(\frac{1}{3}\right)^{-2} \times (3^5)^{\frac{-1}{4}}}$

$= \frac{\left(3^{\frac{1}{3}} \times 10^{\frac{-1}{3}}\right)(3^{-3})^{\frac{1}{4}} \times (3^2)^{\frac{1}{6}} \times (3^4 \times 10^{-2})^{\frac{2}{3}}}{(3^2 \times 10^{-1})^{\frac{2}{3}} \times 3^{\frac{-1}{2}} \times (3^{-1})^{-2} \times (3^5)^{\frac{-1}{4}}}$ [$\because \frac{81}{100} = \frac{3^4}{10^2} = 3^4 \times 10^{-2}$ and $\frac{9}{10} = \frac{3^2}{10} = 3^2 \times 10^{-1}$]

$= \frac{\left(3^{\frac{1}{3}} \times 10^{\frac{-1}{3}}\right)(3^{-3})^{\frac{1}{4}} \times \left(3^{\frac{2}{6}}\right) \times \left((3^4)^{\frac{2}{3}} \times (10^{-2})^{\frac{2}{3}}\right)}{(3^2)^{\frac{2}{3}} \times (10^{-1})^{\frac{2}{3}} \times 3^{\frac{-1}{2}} \times 3^2 \times 3^{\frac{-5}{4}}}$

$= \frac{\left(3^{\frac{1}{3}} \times 3^{\frac{-3}{4}} \times 3^{\frac{2}{6}} \times 3^{\frac{8}{3}}\right)\left(10^{\frac{-1}{3}} \times 10^{\frac{-4}{3}}\right)}{\left(3^{\frac{4}{3}} \times 3^{\frac{-1}{2}} \times 3^2 \times 3^{\frac{-5}{4}}\right)\left(10^{\frac{-2}{3}}\right)} = \frac{\left(3^{\frac{1}{3} - \frac{3}{4} + \frac{1}{3} + \frac{8}{3}}\right)\left(10^{\frac{1}{3} - \frac{4}{3}}\right)}{\left(3^{\frac{4}{3} - \frac{1}{2} + 2 - \frac{5}{4}}\right)\left(10^{-\frac{2}{3}}\right)}$

$= \frac{3^{\frac{31}{12}} \times 10^{\frac{-5}{3}}}{3^{\frac{19}{12}} \times 10^{\frac{-2}{3}}} = 3^{\frac{31}{12} \frac{19}{12}} \times 10^{\frac{5}{3} + \frac{2}{3}} = 3 \times 10^{-1} = \frac{3}{10}$

31. i. {}

We know that {} or ϕ is empty set.

Therefore, The cardinal number of the set {} is 0.

ii. Given: {0}

{0} is a singleton set

Therefore, the cardinal number of the set {0} is 1.

iii. A = {1, 2, 2, 1, 3}

So, A = {1, 2, 3}

Therefore, the cardinal number of the set A = {1, 2, 3} is 3.

iv. Let x = The set of all letters in the word PRINCIPAL

$\Rightarrow$ x = {P, R, I, N, C, A, L}

Therefore, the cardinal number of the set x = {P, R, I, N, C, A, L} is 7.

v. Let x = The set of all vowels in the woval PRINCIPAL

$\therefore$ x = {A, I}

The Cardinality of x = {A, I} is 2.

Section D

32. Sample space is {HH, HT, TH, TT}. It has 4 outcomes which are equally likely.

i. The outcome favourable to the event "no heads" is TT.

$\therefore$ P (no heads) = $\frac{1}{4}$

ii. The outcomes favourable to the event "exactly one head" are HT, TH.

$\therefore$ P (exactly one head) = $\frac{2}{4} = \frac{1}{2}$

iii. The outcome favourable to the event "two heads" is HH.

$\therefore$ P (two heads) = $\frac{1}{4}$

iv. The outcomes favourable to the event "at least one head" are HH, HT and TH.

$\therefore$ P (at least one head) = $\frac{3}{4}$

v. The outcomes favourable to the event "one head and one tail" are HT, TH.

$\therefore$ P (one head and one tail) = $\frac{2}{4} = \frac{1}{2}$

vi. The outcomes favourable to the event "at least one tail" are TT, TH, HT.

$\therefore$ P (at least one tail) = $\frac{3}{4}$

OR

Bag A: 4 black + 6 red

Bag B: 7 black + 3 red

Die is thrown, if 1 or 2 appears then bag A is chosen.

P(A) = $\frac{2}{6} = \frac{1}{3}$; P(B) = $\frac{2}{3}$

E: 1 red, 1 black

P($\frac{E}{A}$) = $\frac{^4C_1 \times ^6C_1}{^{10}C_2}$; P($\frac{E}{B}$) = $\frac{^7C_1 \times ^3C_1}{^{10}C_2}$

P(E) = P(A) $\cdot$ P($\frac{E}{A}$) + P(B) $\cdot$ P($\frac{E}{B}$)

$\frac{1}{3} \times \frac{^4C_1 \times ^6C_1}{^{10}C_2} + \frac{2}{3} \times \frac{^7C_1 \times ^3C_1}{^{10}C_2} = \frac{1}{3} \times \frac{4 \times 6}{45} + \frac{2}{3} \times \frac{7 \times 3}{45}$

$= \frac{8+14}{45} = \frac{22}{45}$

33. Given,

$$f(x) = \begin{cases} x^2 + ax + b, & 0 \leq x < 2 \\ 3x + 2, & 2 \leq x \leq 4 \\ 2ax + 5b, & 4 < x \leq 8 \end{cases}$$

To find $\lim_{x \to 2} f(x)$

L.H.L. = $\lim_{x \to 2^-} f(x) = \lim_{x \to 2^-} (x^2 + ax + b)$

$= 2^2 + a \times 2 + b$

$= 2a + b + 4$

and,

R.H.L. = $\lim_{x \to 2^+} f(x) = \lim_{x \to 2^+} (3x + 2)$

$= 3 \times 2 + 2 = 8$

Since $\lim_{x \to 2} f(x)$ exists,

$\therefore \lim_{x \to 2^-} f(x) = \lim_{x \to 2^+} f(x)$

$\Rightarrow 2a + b + 4 = 8$

$\Rightarrow 2a + b = 4$ ...(1)

To find $\lim_{x \to 4} f(x)$.

L.H.L = $\lim_{x \to 4^-} f(x) = \lim_{x \to 4^-} (3x + 2)$

$= 3 \times 4 + 2 = 14$

and

R.H.L. = $\lim_{x \to 4^+} f(x) = \lim_{x \to 4^+} (2ax + 5b)$

$= 2a \times 4 + 5b = 8a + 5b$

Since $\lim_{x \to 4} f(x)$ exists.

$\lim_{x \to 4^-} f(x) = \lim_{x \to 4^+} f(x)$

$\Rightarrow 8a + 5b = 14$ ...(2)

From (1) and (2),

$\therefore a = 3, b = -2$

34. Since the classes are of uniform width 30, we use the step deviation method with assumed mean A = 105 and $t_i = \frac{x_i - A}{c} = \frac{x_i - 105}{30}$

We construct the table as under :

Classes	Midpoints x_i	Frequency f_i	$t_i = \frac{x_i - 105}{30}$	t_i^2	$f_i t_i$	$f_i t_i^2$

0 - 30	15	2	-3	9	-6	18
30 - 60	45	3	-2	4	-6	12
60 - 90	75	5	-1	1	-5	5
90 - 120	105	10	0	0	0	0
120 - 150	135	3	1	1	3	3
150 - 180	165	5	2	4	10	20
180 - 210	195	2	3	9	6	18
Total		30			2	76

Here $\Sigma f_i = 30$, $\Sigma f_i t_i = 2$ and $\Sigma f_i t_i^2 = 76$

$\therefore$ Mean = A + c $\times \frac{\Sigma f_i t_i}{\Sigma f_i}$ = 105 + 30 $\times \frac{2}{30}$ = 105 + 2 = 107

Variance = $c^2 \left[\frac{\Sigma f_i t_i^2}{\Sigma f_i} - \left(\frac{\Sigma f_i t_i}{\Sigma f_i}\right)^2\right] = (30)^2 \left[\frac{76}{30} - \left(\frac{2}{30}\right)^2\right]$ = 76 $\times$ 30 - 4 = 2276

Standard deviation = $\sqrt{2276}$ = 47.71 (approx.)

OR

C.I.	**f**	**c.f.**
5 - 15	6	6
15 - 25	11	17
25 - 35	21	38 $\leftarrow Q_1$
35 - 45	23	61 $\leftarrow Q_2, Q_3$
45 - 55	14	75
55 - 65	5	80
	N = 80	

For Q_1: $\frac{N}{4} = \frac{80}{4}$ = 20

Q_1 class is 25 - 35

$\therefore Q_1 = l + \frac{\frac{N}{4} - c}{f} \times h$ = 25 + $\frac{20-17}{21} \times 10$ = 25 + $\frac{30}{21}$ = 25 + 1.43 = 26.43

For Q_2: $\frac{N}{4} = \frac{80}{4}$ = 40

Q_2 class is 35 - 45

$\therefore Q_2 = l + \frac{\frac{N}{2} - c}{f} \times h$ = 35 + $\frac{40-38}{23} \times 10$ = 35 + $\frac{20}{23}$ = 35 + 0.87 = 35.87

For Q_3: $\frac{3N}{4} = \frac{3\times 80}{4}$ = 60

Q_3 class is 35 - 45

$\therefore Q_3 = l + \frac{\frac{3N}{4} - c}{f} \times h$ = 35 + $\frac{60-38}{23} \times 10$ = 35 + $\frac{220}{23}$ = 35 + 9.57 = 44.57

$\therefore S_b = \frac{Q_3 + Q_1 - 2Q_2}{Q_3 - Q_1} = \frac{44.57 + 26.43 - 2\times 35.87}{44.57 - 26.43} = \frac{71 - 71.74}{18.14} = \frac{-0.74}{18.14}$ = -0.04

35. Point of intersection of the lines 5x + 7y = 3
and 2x - 3y = 7 is (2, - 1).
Centre is (3, - 2).
Therefore, r = $\sqrt{(3-2)^2 + (-2+1)^2} = \sqrt{2}$
$\therefore$ Circle is $(x - 3)^2 + (y + 2)^2 = 2$
i.e. $x^2 + y^2 - 6x + 4y + 11 = 0$

Section E

36. **Read the text carefully and answer the questions:**
Children always keep of thinking something new, sometimes reaching a destination they say we will go by longer sometimes by shorter route, etc.

A child is standing at the point A(2, 3) and far away he can notice a straight road path represented by the equation 3x - 4y - 12 = 0. He wants to reach path in the minimum possible time.

(i) $m \times \frac{3}{4} = -1 \Rightarrow m = \frac{-4}{3}$

(ii) Equation of line through (2, 3) and having shope $\frac{-4}{3}$ is

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

$\Rightarrow 3y - 9 = -4x + 8$

$\Rightarrow 4x + 3y - 17 = 0$

(iii) Distance $= \left|\frac{6-12-12}{\sqrt{9+16}}\right|$

$= \left|\frac{-18}{5}\right| = \frac{18}{5}$ units

OR

Equation of path joining (2, 3) and (4, 0) is

$y - 0 = \frac{0-3}{4-2}(x - 4)$

$\Rightarrow 2y = -3x + 12$

$\Rightarrow 3x + 2y - 12 = 0$

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:**

Out of 7 boys and 5 girls a team of 7 students is to be made.

(i) 7 boys, 5 girls

ways to select at least 3 girls

= 3 girls 4 boys or 4 girls 3 boys or 5 girls 2 boys

$= {}^5C_3 \times {}^7C_4 + {}^5C_4 \times {}^7C_3 + {}^5C_5 \times {}^7C_2$

$= 10 \times 35 + 5 \times 35 + 1 \times 21$

$= 350 + 175 + 21$

$= 546$

(ii) Ways to select exactly three girls

= 3 girls 4 boys

$= {}^5C_3 \times {}^7C_4 = 350$

(iii) Ways of arranging 3 girls and 4 boys if all girls and boys stand together

$= 2! \times 3! \times 4!$

$= 2 \times 6 \times 24$

$= 288$

Total ways of selecting and arranging

$= 288 \times 350$

$= 100800$

(iv) Ways to arrange boys = 4!

B _ B _ B _ B

Ways to arrange girls = 3!

Total ways of selecting and arranging

$= 4! \times 3! \times 350$

$= 24 \times 6 \times 350$

$= 50400$

OR

Read the text carefully and answer the questions:

Out of 7 boys and 5 girls a team of 7 students is to be made.

(i) Sunil can choose four cards from same suit in $4 \times {}^{13}C_4$ ways

$= 4 \times \frac{13!}{9! \times 4!}$

$= 4715 = 2860$

(ii) Here one card to be selected from each suit therefore, he can select in ${}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1$ ways

$= ({}^{13}C_1)^4 = 28561$

(iii) There are 12 face cards and 4 are to be selected out of these 12 cards. This can be done in ${}^{12}C_4$ ways

$= \frac{12!}{8!4!} 495$

(iv) Anita can select two cards of same colour in ${}^{26}C_2 + {}^{26}C_2$ ways = 325 + 325 = 650