Class XI Session 2025-26
Subject - Mathematics
Sample Question Paper - 8

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

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

Section A

1. sin 15° = ? **[1]**

a) $\frac{\sqrt{3}}{2\sqrt{2}}$ b) $\frac{(\sqrt{3}+1)}{2\sqrt{2}}$

c) $\frac{(\sqrt{2}-1)}{\sqrt{2}}$ d) $\frac{(\sqrt{3}-1)}{2\sqrt{2}}$

2. The domain and range of the real function f defined by f (x) $= \frac{4-x}{x-4}$ is given by **[1]**

a) Domain = R - {1}, Range = R b) Clearly, Domain = R - {-4}, Range = {-1 , 1}

c) Domain = R - {4}, Range = {-1} d) Domain = R, Range = {-1, 1}

3. Which one of the following measures is determined only after the construction of cumulative frequency distribution? **[1]**

a) Mode b) Arithmetic mean

c) Geometric mean d) Median

4. $\lim_{x \to 0} x \sin \frac{1}{x}$ is equals to **[1]**

a) 1 b) 1/2

c) does not exist d) 0

5. The centroid of a triangle is (2, 7) and two of its vertices are (4, 8) and (-2, 6). The third vertex is **[1]**

a) (7, 4)
b) (7, 7)
c) (0, 0)
d) (4, 7)

6. Perpendicular distance of the point (3, 4, 5) from the y-axis is, **[1]**

a) $\sqrt{34}$
b) 5
c) 4
d) $\sqrt{41}$

7. Mark the correct answer for (2 - 3i)(-3 + 4i) = ? **[1]**

a) (6 - 17i)
b) (6 + 17i)
c) (6 - 15i)
d) (-6 + 17i)

8. In how many ways can 5 children stand in a queue? **[1]**

a) 25
b) 120
c) 5
d) 60

9. $\lim\limits_{x \to 0} \frac{1-\cos 2x}{x}$ is **[1]**

a) 0
b) 4
c) 1
d) 2

10. $\sin\left(\frac{31\pi}{3}\right)$ = ? **[1]**

a) $\frac{-1}{2}$
b) $\frac{\sqrt{3}}{2}$
c) $\frac{1}{2}$
d) $\frac{-\sqrt{3}}{2}$

11. The number of subsets of a set containing n elements is **[1]**

a) 2^n
b) $2^n - 2$
c) n
d) 2^n-1

12. The 3rd term from the end in the expansion of $\left(x + \frac{1}{x}\right)^6$ is **[1]**

a) $\frac{30}{x^3}$
b) $\frac{24}{x^3}$
c) $\frac{15}{x^2}$
d) $\frac{12}{x^2}$

13. $\left(\sqrt{5}+1\right)^4 + \left(\sqrt{5}-1\right)^4$ is **[1]**

a) a negative integer
b) a rational number
c) a negative real number
d) an irrational number

14. If x < 7 , then **[1]**

a) $-x \leq -7$
b) $-x > -7$
c) $-x \geq -7$
d) $-x < -7$

15. For any two sets A and B, $A \cap (A \cup B) = \ldots.$ **[1]**

a) ϕ
b) B
c) A
d) $\neq \phi$

16. cos 15° - sin 15° = ? **[1]**

a) $\frac{1}{2}$
b) $\frac{1}{\sqrt{2}}$

c) $\frac{(\sqrt{2}+1)}{\sqrt{2}}$

d) $\frac{(\sqrt{2}-1)}{\sqrt{2}}$

17. $\lim\limits_{x \to 0+} \frac{\sqrt{x}}{\sqrt{16+\sqrt{x}}-4}$ is equal to **[1]**

a) does not exist

b) 0

c) 8

d) 2

18. If ${}^nC_r + {}^nC_{r+1} = {}^{n+1}C_x$, then x = ? **[1]**

a) r + 1

b) n

c) r - 1

d) r

19. **Assertion (A):** The set A = {a, b, c, d, e, g} is finite set. **[1]**

Reason (R): The set B = {men living presently in different parts of the world} is finite set.

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 sum of first 6 terms of the GP 4, 16, 64, ... is equal to 5460. **[1]**

Reason (R): Sum of first n terms of the G.P is given by $S_n = \frac{a(r^n-1)}{r-1}$, where a = first term r = common ratio and $|r| > 1$.

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.

Section B

21. Find the domain and the range of the real function: $f(x) = \frac{1}{2-\sin 3x}$ **[2]**

OR

If A and B be two sets such that n(A) = 3, n(B) = 4 and $n(A \cap B) = 2$ then find:

i. $n(A \times B)$

ii. $n(B \times A)$

iii. $n\{(A \times B) \cap (B \times A)\}$

22. If $y = \frac{2x^9}{3} - \frac{5}{7}x^7 + 6x^3 - x$, find $\frac{dy}{dx}$ at x = 1. **[2]**

23. Two coins are tossed once. Find the probability of getting no head. **[2]**

OR

An integer is chosen at random from the numbers ranging from 1 to 50. What is the probability that the integer chosen is a multiple of 2 or 3 or 10?

24. Show that for any sets A and B, A = (A ∩ B) ∩ (A - B). **[2]**

25. A point moves, so that the sum of its distances from (ae, 0) and (-ae, 0) is 2a, prove that the equation to its locus is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where $b^2 = a^2(1 - e^2)$. **[2]**

Section C

26. **[3]**

i. How many different words can be formed with the letters of the word HARYANA?

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

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

27. Three vertices of a parallelogram ABCD are A(3, -1, 2), B(1, 2, -4) and C(-1, 1, 2). Find the coordinates of the fourth vertex. **[3]**

28. Find the 5th term from the end in the expansion of $\left(x-\frac{1}{x}\right)^{12}$. **[3]**

OR

Show that the coefficient of x^4 in the expansion of $\left(\frac{x}{2}-\frac{3}{x^2}\right)^{10}$ is $\frac{405}{256}$.

29. Differentiate the function by first principle: tan (2x + 1). **[3]**

OR

Evaluate $\lim\limits_{h\to0}\frac{1}{h}\left\{\frac{1}{\sqrt{x+h}}-\frac{1}{\sqrt{x}}\right\}$

30. How many terms of the G.P. 3, $\frac{3}{2}$, $\frac{3}{4}$, ... are needed to give the sum $\frac{3069}{512}$? **[3]**

OR

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

31. Out of 100 students; 15 passed in English, 12 passed in Mathematics, 8 in Science, 6 in English and Mathematics, 7 in Mathematics and Science, 4 in English and Science, 4 in all the three. Find how many passed **[3]**

i. in English and Mathematics but not in Science
ii. in Mathematics and Science but not in English
iii. in Mathematics only
iv. in more than one subject only

Section D

32. Find the mean deviation about the median for the data: **[5]**

Class	0 -10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Frequency	6	8	11	18	5	2

33. Find the equation of the hyperbola whose foci are (6,4) and (- 4,4) and eccentricity is 2. **[5]**

OR

Find the equation of the ellipse, whose foci are(± 3, 0) and passing through (4, 1).

34. Solve the following system of linear inequalities **[5]**

$\frac{4x}{3}-\frac{9}{4}<x+\frac{3}{4}$ and $\frac{7x-1}{3}-\frac{7x+2}{6}>x$.

35. Prove that: $\sin 20^o \sin 40^o \sin 80^o = \frac{\sqrt{3}}{8}$ **[5]**

OR

Prove that: $4 \sin A \sin (60^o - A) \sin (60^o + A) = \sin 3A$.

Hence deduce that: $\sin 20^o \times \sin 40^o \times \sin 60^o \times \sin 80^o = \frac{3}{16}$

Section E

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

Representation of a Relation

A relation can be represented algebraically by roster form or by set-builder form and visually it can be represented by an arrow diagram which are given below

i. **Roster form** In this form, we represent the relation by the set of all ordered pairs belongs to R.
ii. **Set-builder form** In this form, we represent the relation R from set A to set B as R = {(a, b): a ∈ A, b ∈ B and the rule which relate the elements of A and B}.
iii. **Arrow diagram** To represent a relation by an arrow diagram, we draw arrows from first element to second element of all ordered pairs belonging to relation R.

Questions:

i. If n(A) = 3 and B = {2, 3, 4, 6, 7, 8} then find the number of relations from A to B. (1)

ii. If A = {a, b} and B = {2, 3}, then find the number of relations from A to B. (1)

iii. If A = {a, b} and B = {2, 3}, write the relation in set-builder form. (2)

OR

Express of R = {(a, b): 2a + b = 5; a, b $\in$ W} as the set of ordered pairs (in roster form). (2)

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

On her vacation, Priyanka visits four cities. Delhi, Lucknow, Agra, Meerut in a random order.


Meerut


New Delhi


Agra


Lucknow

i. What is the probability that she visits Delhi before Lucknow? (1)

ii. What is the probability she visit Delhi before Lucknow and Lucknow before Agra? (1)

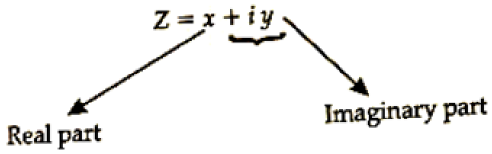
iii. What is the probability she visits Delhi first and Lucknow last? (2)

OR

What is the probability she visits Delhi either first or second? (2)

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

A number of the form Z = x + iy, where x and y are real and i = $\sqrt{-1}$ is called a complex number. Consider the complex number Z_1 = 2 + 3i and Z_2 = 4 - 3i.



i. Find the imaginary part of $Z_1\overline{Z_1}$. (1)

ii. Find the real part of $\frac{z_1}{z_2}$. (1)

iii. Find the imaginary part of Z_1 - Z_2. (2)

OR

Find the real part of Z_1. (2)

Solution

Section A

1.

(d) $\frac{(\sqrt{3}-1)}{2\sqrt{2}}$

Explanation:

sin 15° = sin (45° - 30°) = (sin 45° cos 30° - cos 45° sin 30°)

$=\left(\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}\right)-\left(\frac{1}{\sqrt{2}}\times\frac{1}{2}\right)=\left(\frac{\sqrt{3}}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\right)=\frac{(\sqrt{3}-1)}{2\sqrt{2}}$

2.

(c) Domain = R - {4}, Range = {-1}

Explanation:

We have, f(x) $=\frac{4-x}{x-4}$ = -1, for x$\neq$4

3.

(d) Median

Explanation:

Median

4.

(d) 0

Explanation:

$\lim\limits_{x\to 0} x=0$ and $-1\leq\sin\frac{1}{x}\leq 1$, by Sandwitch Theorem, we have

$\lim\limits_{x\to 0} x\sin\frac{1}{x}=0$

5.

(d) (4, 7)

Explanation:

Let A (4, 78) and B (-2, 6) be the given vertex. Let C(h, k) be the third vertex.

The centroid of $\triangle$ ABC is $\left(\frac{4-2+h}{3},\frac{8+6+k}{3}\right)$

It is given that the centroid of triangle ABC is (2, 7) as obtained from above formula,

$\therefore\frac{4-2+h}{3}=2$, $\frac{8+6+k}{3}=7$

$\Rightarrow$ h = 4, k = 7

Thus, the third vertex is (4, 7)

6. **(a)** $\sqrt{34}$

Explanation:

Distance of (α,β,γ) from y-axis is given by d = $\sqrt{\alpha^2+\gamma^2}$

$\therefore$ Distance (d) of (3, 4, 5) from y-axis is

d = $\sqrt{3^2+5^2}$ = $\sqrt{9+25}$ = $\sqrt{34}$

7.

(b) (6 + 17i)

Explanation:

(2 - 3i)(-3 + 4i) = (-6 + 8i + 9i - 12i^2) = (-6 + 17i + 12) = (6 + 17i)

8.

(b) 120

Explanation:

Required number of ways = ${}^5P_5$ = 5! $= (5 \times 4 \times 3 \times 2 \times 1)$ = 120

9. **(a)** 0

Explanation:

$\lim\limits_{x \to 0} \frac{1-\cos 2x}{x}$

$= \lim\limits_{x \to 0} \frac{2\sin^2 x}{x}$

$= \lim\limits_{x \to 0} 2x \times \frac{\sin^2 x}{x^2}$

= 0

10.

(b) $\frac{\sqrt{3}}{2}$

Explanation:

$\sin\left(\frac{31\pi}{3}\right) = \sin\left(10\pi + \frac{\pi}{3}\right) = \sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}$

11. **(a)** 2^n

Explanation:

2^n

The total number of subsets of a finite set consisting of n elements is 2^n.

12.

(c) $\frac{15}{x^2}$

Explanation:

Here,it is given expansion is $\left(x + \frac{1}{x}\right)^6$

pth term from the end = (n - p + 2)th term from the beginning.

3rd term from the end = (6 - 3 + 2)th term = 5th term.

$T_{r+1} = {}^6C_r\, x^{(6-r)} \cdot \left(\frac{1}{x}\right)^r$

$\Rightarrow T_5 = T_{4+1} = {}^6C_4 \,.\, x^{(6-4)} \cdot \left(\frac{1}{x}\right)^4 = {}^6C_2 \cdot x^2 \cdot \frac{1}{x^4} = \frac{6\times5}{2\times1} \times \frac{1}{x^2} = \frac{15}{x^2}$

13.

(b) a rational number

Explanation:

We have $(a + b)^n + (a - b)^n$

$= \left[{}^nC_0 a^n + {}^nC_1 a^{n-1}b + {}^nC_2 a^{n-2}b^2 + {}^nC_3 \quad a^{n-3}b^3 + \ldots + {}^nC_n b^n\right] + \left[{}^nC_0 a^n - {}^nC_1 a^{n-1}b + {}^nC_2 a^{n-2}b^2 - {}^nC_3 a^{n-3}b^3 + \ldots + (-1)^n \cdot {}^nC_n \quad b^n\right]$

$= 2[{}^nC_0 \quad a^n + {}^nC_2 \quad a^{n-2}b^2 + \ldots]$

Let a = $\sqrt{5}$ and b = 1 and n = 4

Now we get $(\sqrt{5}+1)^4 + (\sqrt{5}-1)^4 = 2\left[{}^4C_0(\sqrt{5})^4 + {}^4C_2(\sqrt{5})^2 1^2 + {}^4C_4(\sqrt{5})^0 1^4\right]$

= 2[25 + 30 + 1] = 112

14.

(b) -x > -7

Explanation:

x < 7

We know that when we change the sign of inequalities then greater tan changes to less than and vice versa also true.

$\Rightarrow$ -x > -7

15.

(c) A

Explanation:

Since, $A \subseteq A \cup B$, therefore, $A \cap (A \cup B)$ = A

16.

(b) $\frac{1}{\sqrt{2}}$

Explanation:

cos 15° - sin 15° = cos(45° - 30°) - sin (45° - 30°)

= (cos 45° cos 30° + sin 45° sin 30°) - (sin 45° cos 30° - cos 45° sin 30°)

$= \left\{\left(\frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2}\right) + \left(\frac{1}{\sqrt{2}} \times \frac{1}{2}\right)\right\} - \left\{\left(\frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2}\right) - \left(\frac{1}{\sqrt{2}} \times \frac{1}{2}\right)\right\}$

$= \frac{(\sqrt{3}+1)}{2\sqrt{2}} - \frac{(\sqrt{3}-1)}{2\sqrt{2}} = \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$

17.

(c) 8

Explanation:

$\lim_{x \to 0^+} \frac{1}{\frac{\sqrt{16+\sqrt{x}}-\sqrt{16}}{(16+\sqrt{x})-(16)}}$

$\Rightarrow \lim_{x \to 0^+} lim 2(\sqrt{16+\sqrt{x}})$

= 8

18. **(a)** r + 1

Explanation:

We know that, ${}^{n}C_{r} + {}^{n}C_{r+1} = {}^{n+1}C_{r+1}$

$\therefore$ x = r + 1

19.

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

Explanation:

Assertion: We know that, a set which is empty or consists of a definite number of elements, is called finite, otherwise the set is called infinite. Since, set A contains finite number of elements. So, it is a finite set.

Reason: We do not know the number of elements in B, but it is some natural number. So, B is also finite.

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

Explanation:

Assertion: Given GP 4, 16, 64, ...

$\therefore$ a = 4, r = $\frac{16}{4}$ = 4 > 1

$\therefore S_6 = \frac{4\left((4)^6-1\right)}{4-1} = \frac{4(4095)}{3}$ = 5460

Hence, Assertion and Reason both are true and Reason is the correct explanation of Assertion.

Section B

21. Here we have, f(x) = $\frac{1}{2-\sin 3x}$

We need to find where the function is defined.

The maximum value of an angle is 2π

So, the maximum value of x = $\frac{2\pi}{3}$

Whereas, the minimum value of x is 0

Therefore, the domain of the function, $D_{f\{x\}} = (0, \frac{2\pi}{3})$

Now, the minimum value of sin θ = 0 and the maximum value of sin θ = 1. So, the minimum value of the denominator is 1, and the maximum value of the denominator is 2

The range of the function, $R_{f(x)} = (\frac{1}{2}, 1)$

OR

Here we have, n(A) = 3, n(B) = 4 and $n(A \cap B) = 2$

i. To find: $n(A \times B)$

As we know that $n(A \times B) = n(A) \times n(B)$

$\Rightarrow n(A \times B) = 3 \times 4 = 12$

ii. To find: $n(B \times A)$

As we know that $n(B \times A) = n(B) \times n(A)$

$\Rightarrow n(B \times A) = 4 \times 3 = 12$

iii. To find: $n((A \times B) \cap (B \times A))$

As we know that $n((A \times B) \cap (B \times A)) = n(A \times B) + n(B \times A) - n((A \times B) \cup (B \times A))$

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

$n((A \times B) \cap (B \times A)) = 0$

22. We have given that

$y = \frac{2x^9}{3} - \frac{5}{7}x^7 + 6x^3 - x$

$\frac{dy}{dx} = \frac{d}{dx}\left(\frac{2x^9}{3} - \frac{5}{7}x^7 + 6x^3 - x\right)$

$= \frac{2}{3}\frac{dx^9}{dx} - \frac{5}{7}\frac{dx^7}{dx} + 6\frac{dx^3}{dx} - \frac{dx}{dx}$

$= \frac{2}{3} \cdot 9x^8 - \frac{5}{7} \cdot 7x^6 + 18x^2 - 1$

$\therefore \frac{dy}{dx}$ at x = 1

$= 6(1)^8 - 5(1)^6 + 18(1)^2 - 1$

= 6 - 5 + 18 - 1

= 18

23. When two coins are tossed once, then the sample space of the event is given by

S = {HH, HT, TH, TT} and, therefore,n(S) = 4.

Let E_3 = event of getting no head. Then,

E_3 = {TT} and, therefore, $n(E_3) = 1$.

$\therefore$ P(getting no head) = $P(E_3) = \frac{n(E_3)}{n(S)} = \frac{1}{4}$.

OR

We have to find the probability that the integer is chosen is a multiple of 2 or 3 or 10

Out of 50 integers an integer can be chosen in ${}^{50}C_1$ ways.

Total number of elementary events = ${}^{50}C_1 = 50$

Consider the following events:

A = Getting a multiple of 2, B = Getting a multiple of 3 and, C = Getting a multiple of 10

Clearly, A = {2, 4,..., 50}, B = {3, 6,..., 48}, C = {10, 20,..., 50}

A n B = {6,12,..., 48}, B n C = {30}, A n C = {10, 20,..., 50} and, A n B n C = {30}

$\therefore P(A) = \frac{25}{50}, P(B) = \frac{16}{50}, P(C) = \frac{5}{50}, P(A \cap B) = \frac{8}{50}, P(B \cap C) = \frac{1}{50}$

$P(A \cap C) = \frac{5}{50}$ and $P(A \cap B \cap C) = \frac{1}{50}$

Required probability = $P(A \cap B \cap C)$

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

$= \frac{25}{50} + \frac{16}{50} + \frac{5}{50} - \frac{8}{50} - \frac{1}{50} - \frac{5}{50} + \frac{1}{50} = \frac{33}{50}$

24. We know that $(A \cap B) \subset A$ and $(A - B) \subset A$

$\Rightarrow (A \cap B) \cap (A - B) \subset A$....(1)

Suppose $x \in (A \cap B) \cap (A - B)$

$\Rightarrow x \in (A \cap B)$ and $x \in (A - B)$

$\Rightarrow x \in A$ and $x \in B$ and $x \in A$ and $x \notin B$

$\Rightarrow x \in A$ and $x \in A$ [$\because x \in B$ and $x \notin B$ are not possible simultaneously]

$\Rightarrow x \in A$,now we have

$\therefore (A \cap B) \cap (A - B) \subset A$...(2)

From (1) and (2), we obtain

A = (A ∩ B) ∩ (A - B).

25. Let, P(h, k) be the moving point such that the sum of its distances from A(ae, 0) and B(-ae, 0) is 2a.

Then, PA + PB = 2a

$\Rightarrow \sqrt{(h-ae)^2+(k-0)^2}+\sqrt{(h+ae)^2+(k-0)^2}=2a$ $\left[\because \text{ distance } = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}\right]$

$\Rightarrow \sqrt{(h-ae)^2+k^2}=2a-\sqrt{(h+ae)^2+k^2}$

$\Rightarrow (h-ae)^2+k^2=4a^2+(h+ae)^2+k^2-4a\sqrt{(h+ae)^2+k^2}$ [squaring on both sides]

$\Rightarrow -4aeh-4a^2=-4a\sqrt{(b+ae)^2+k^2}$

$\Rightarrow (eh+a)=\sqrt{(h+ae)^2+k^2}$

$\Rightarrow (eh+a)^2=(h+ae)^2+k^2$ [again, squaring on both sides]

$\Rightarrow e^2h^2+2aeh+a^2=h^2+a^2e^2+2aeh+k^2$

$\Rightarrow h^2(1-e^2)+k^2=a^2(1-e^2)$

$\Rightarrow \frac{h^2}{a^2}+\frac{k^2}{a^2(1-e^2)}=1$

Hence, locus of point P (h, k) is

$\frac{x^2}{a^2}+\frac{y^2}{a^2(1-e^2)}=1$

or $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, where $b^2=a^2(1-e^2)$

Section C

26. 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.

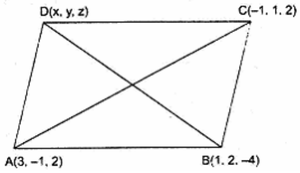
So, total number of words = $\frac{5!}{3!}=20$

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 = $\frac{6!}{3!}\times 2!=120\times 2=240$

27. Let D (x, y, z) be the fourth vertex of parallelogram ABCD.

We know that diagonals of a parallelogram bisect each other. So the mid points of AC and BD coincide.



$\therefore$ Coordinates of mid point of AC $\left(\frac{3-1}{2},\frac{-1+1}{2},\frac{2+2}{2}\right)$

= (1, 0, 2)

Also coordinates of mid point of BD $\left(\frac{x+1}{2},\frac{y+2}{2},\frac{z-4}{2}\right)$

$\therefore \frac{x+1}{2}=1 \Rightarrow x+1=2 \Rightarrow x=1$

$\frac{y+2}{2}=0 \Rightarrow y+2=0 \Rightarrow y=-2$

$\frac{z-4}{2}=2 \Rightarrow z-4=4 \Rightarrow z=8$

Thus the coordinates of point D are (1, -2, 8)

28. To find: 5th term from the end

We use the Formula: $t_{r+1}=\binom{n}{r}a^{n-r}b^r$

$\binom{n}{r}=\binom{n}{n-r}$

For $\left(x-\frac{1}{x}\right)^{12}$

We have, a = x, $b=\frac{-1}{x}$ and n = 12

As n = 12 ,therefore there will be total (12 + 1) = 13 terms in the expansion

Therefore,

5^{th} term from the end = $(13-5+1)^{th}$ i.e. 9^{th} term from the starting.

We have a formula,

$t_{r+1} = \binom{n}{r} a^{n-r} b^r$

For t_9, r = 8

$\therefore$ $t_9 = t_{8+1}$

$= \binom{12}{8}(x)^{12-8}\left(\frac{-1}{x}\right)^8$

$= \binom{12}{4}(x)^4(x)^{-8}$ .....$\left[\therefore \binom{n}{r} = \binom{n}{n-r}\right]$

$= \frac{12\times11\times10\times9}{4\times3\times2\times1}(x)^{4-8}$

$= 495\ (x)^{-4}$

Therefore, 5th term from the end = $495(x)^{-4}$

OR

Formula Used:

General term, T_{r+1} of binomial expansion $(x + y)^n$ is given by,

$T_{r+1} = {}^nC_r\, x^{n-r}\, y^r$ where

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

Now, finding the general term of the expression, $\left(\frac{x}{2} - \frac{3}{x^2}\right)^{10}$, we get

$T_{r+1} = {}^{10}C_r \times \left(\frac{x}{2}\right)^{10-r} \times \left(\frac{-3}{x^2}\right)^r$

For finding the term which has x^4 in it, is given by

10 - 3r = 4

3r = 6

r = 2

Thus, the term which has x^4, in it isT_3

$T_3 = {}^{10}C_2 \times \left(\frac{x}{2}\right)^8 \times \left(\frac{-3}{x^2}\right)^2$

$T_3 = \frac{10!\times9}{2!\times8!\times2^8}$

$T_3 = \frac{10\times9\times81\times9}{2\times8!\times2^8}$

$T_3 = \frac{405}{256}$

Thus, the coefficient of x^4 in the expansion of $\left(\frac{x}{2} - \frac{3}{x^2}\right)^{10}$ is $\frac{405}{256}$.

29. We need to find derivative of f(x) = tan (2x + 1) by first principle.

Derivative of a function f(x) is given by –

$f'(x) = \lim_{h\to0}\frac{f(x+h)-f(x)}{h}$ [where h is a very small positive number]

$\therefore$ Derivative of f(x) = tan (2x + 1) is given as –

$f'(x) = \lim_{h\to0}\frac{\tan(2(x+h)+1)-\tan(2x+1)}{h}$

$\Rightarrow f'(x) = \lim_{h\to0}\frac{\tan(2x+2h+1)-\tan(2x+1)}{h}$

$\Rightarrow f'(x) = \lim_{h\to0}\frac{\frac{\sin(2x+2h+1)}{\cos(2x+2h+1)} - \frac{\sin(2x+1)}{\cos(2x+1)}}{h}$

$\Rightarrow f'(x) = \lim_{h\to0}\frac{\cos(2x+1)\sin(2x+2h+1)-\sin(2x+1)\cos(2x+2h+1)}{h\{\cos(2x+1)\cos(2x+2h+1)\}}$

Using: sin A cos B – cos A sin B = sin (A – B)

$\Rightarrow f(x) = \lim_{h\to0}\frac{\sin(2x+2h+1-2x-1)}{h\{\cos(2x+1)\cos(2x+2h+1)\}}$

Using algebra of limits we have –

$\therefore f'(x) = \lim_{h\to0}\frac{\sin(2h)}{h} \times \lim_{h\to0}\frac{1}{\{\cos(2x+1)\cos(2x+2h+1)\}}$

$\therefore f'(x) = 2\lim_{h\to0}\frac{\sin(2h)}{h} \times \lim_{h\to0}\frac{1}{\{\cos(2x+1)\cos(2x+2h+1)\}}$

$\Rightarrow f'(x) = 2\times\frac{1}{\cos^2(2x+1)}$

$\therefore f'(x) = 2\sec^2(2x + 1)$

Therefore,

Derivative of f(x) = tan(2x + 1) is $2\sec^2(2x + 1)$

OR

To evaluate: $\lim\limits_{h \to 0} \frac{1}{h}\left\{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right\}$

Formula used:

L'Hospital's rule

Let f(x) and g(x) be two functions which are differentiable on an open interval I except at a point a where

$\lim\limits_{x \to a} f(x) = \lim\limits_{x \to a} g(x) = 0$ or $\pm\infty$ then

$\lim\limits_{x \to a} \frac{f(x)}{g(x)} = \lim\limits_{x \to a} \frac{f'(x)}{g'(x)}$

As x $\to$ 0, we have

$\lim\limits_{h \to 0} \frac{1}{h}\left\{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right\} = \frac{0}{0}$

This represents an indeterminate form. Thus applying L'Hospital's rule, we get

$$\lim_{h \to 0} \frac{1}{h}\left\{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right\} = \lim_{h \to 0} \frac{\frac{d}{dh}\left(\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right)}{\frac{d}{dh}(h)}$$

$$\lim_{h \to 0} \frac{1}{h}\left\{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right\} = \lim_{h \to 0} \frac{\frac{-1}{2\sqrt{x+h}} + \frac{1}{2\sqrt{x}}}{1} = \frac{-\frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{x}}}{1}$$

$$\lim_{h \to 0} \frac{1}{h}\left\{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}\right\} = 0$$

30. Given GP is 3, $\frac{3}{2}$, $\frac{3}{4}$, ...

Here, a = 3, r = $\frac{3}{2} \div 3 = \frac{1}{2}$

Let n be the number of terms needed.

Then, $S_n = \frac{3069}{512}$

$\Rightarrow \frac{a(1-r^n)}{1-r} = \frac{3069}{512}$ [$\because$ r < 1]

$\Rightarrow \frac{3\left\{1-\frac{1}{2^n}\right\}}{1-\frac{1}{2}} = \frac{3069}{512}$

$\Rightarrow 6\left(1 - \frac{1}{2^n}\right) = \frac{3069}{512}$

$\Rightarrow 1 - \frac{1}{2^n} = \frac{3069}{3072}$

$\Rightarrow \frac{1}{2^n} = 1 - \frac{3069}{3072} = \frac{3072-3069}{3072}$

$\Rightarrow \frac{1}{2^n} = \frac{3}{3072} = \frac{1}{1024}$

$\Rightarrow 2^n = 1024 \Rightarrow 2^n = 2^{10}$

On comparing the powers, we get

n = 10

Hence, 10 terms are needed to give the sum $\frac{3069}{512}$.

OR

Given: a = 729 and $a_7 = 64$

$\Rightarrow ar^6 = 64$

$\Rightarrow 729r^6 = 64$

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

$\Rightarrow r = \frac{2}{3}$

$\Rightarrow S_n = \frac{a(1-r^n)}{1-r}$ when r < 1 $r < 1$

$$\Rightarrow S_7 = \frac{729\left[1-\left(\frac{2}{3}\right)^7\right]}{1-\frac{2}{3}} = \frac{729\left[1-\frac{128}{2187}\right]}{\frac{3-2}{3}}$$

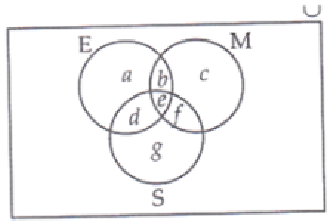
$\Rightarrow S_7 = 729 \times 3\left(\frac{2187-128}{2187}\right)$

$\Rightarrow S_7 = \frac{729 \times 3 \times 2059}{2187} = 2059$

31. Let the set of students who passed in Mathematics be M, the set of students who passed in English be E and the set of students who passed in Science be S.

Then n(U) =100, n(M) = 12, n(E) = 15, n(S) =8, n(E ∩ M) = 6, n(M ∩ S) = 7, n(E ∩ S) = 4 and n(E ∩ M ∩ S) = 4

Let us draw a Venn diagram



According to the Venn diagram,

n(E ∩ S) = 4 ⇒ e = 4

n(E ∩ M) = 6 ⇒ b + e = 6 ⇒ b + 4 = 6 ⇒ b = 2

n(M ∩ S) = 7 ⇒ e + f = 7 ⇒ 4 + f = 7 ⇒ f = 3

n(E ∩ S) = 4 ⇒ d + e = 4 ⇒ d + 4 = 4 ⇒ d = 0

n(E) = 15 ⇒ a + b + d + e = 15 ⇒ a + 2 + 0 + 4 = 15 ⇒ a = 9

n(M) = 12 ⇒ b + c + e + f = 12 ⇒ 2 + c + 4 + 3 = 12 ⇒ c = 3

n(S) = 8 ⇒ d + e + f + g = 8 ⇒ 0 + 4 + 3 + g = 8 ⇒ g = 1

Hence we get,

i. Number of students who passed in English and Mathematics but not in Science, b = 2.
ii. Number of students who passed in Mathematics and Science but not in English, f = 3.
iii. Number of students who passed in Mathematics only, c = 3.
iv. Number of students who passed in more than one subject = b + e + d + f = 2 + 4 + 0 + 3 = 9.

Section D

32. Given data:

Class	Frequency f_i
0 - 10	6
10 - 20	8
20 - 30	11
30 - 40	18
40 - 50	5
50 - 60	2

we get following table from the given data by adding some more columns as below.

Class	Frequency f_i	Cumulative frequency e.f	Mid-points x_i
0 - 10	6	6	5
10 - 20	8	14	15
20 - 30	11	25	25
30 - 40	18	43	35
40 - 50	5	48	45
50 - 60	2	50	55
	50		

The Class interval containing $\frac{N^{th}}{2}$ or 25th item is 20 - 30. Therefore 20 - 30 is the median class.

As we know that

$\text{Median} = 1 + \frac{\frac{N}{2} - C}{f} \times h$

Here, I = 20, C = 14, f = 11, h = 10 and N = 50

Therefore,

$\text{Median} = 20 + \frac{\frac{50}{2} - 14}{11} \times 10$ = 20 + 10 = 30

Class	Frequency f_i	Cumulative frequency e.f	Mid-points x_i	$[x_i - M]$	$f_i[x_i - M]$

0 - 10	6	6	5	25	150
10 - 20	8	14	15	15	120
20 - 30	11	25	25	5	55
30 - 40	18	43	35	5	90
40 - 50	5	48	45	15	75
50 - 60	2	50	55	25	50
	50				540

From above table, we get,

$\sum_{i=1}^{6} f_1 = 50$ and $\sum_{i=1}^{6} f_1$ $[x_i - M] = 540$

Therefore, Mean Deviation (M) $= \frac{\sum_{i=1}^{6} f_1 [x_i - M]}{\sum_{i=1}^{6} f_1} = \frac{540}{50}$ = 10.80

33. The centre of the hyperbola is the mid-point of the line joining the two foci.

So, the coordinates of the centre are $\left(\frac{6-4}{2}, \frac{4+4}{2}\right)$ i.e., (1, 4).

Let 2a and 2b be the length of transverse and conjugate axes and let e be the eccentricity. Then, the equation of the hyperbola is,

$\frac{(x-1)^2}{a^2} - \frac{(y-4)^2}{b^2} = 1$ ....(i)

Now, the distance between two foci = 2ae

$\Rightarrow \sqrt{(6+4)^2 + (4-4)^2} = 2ae$ [$\because$ Foci = (6, 4) and (-4, 4)]

$\Rightarrow \sqrt{(10)^2} = 2ae$

$\Rightarrow 10 = 2ae$

$\Rightarrow 2ae = 10$

$\Rightarrow 2a \times 2 = 10$ [$\because$ e = 2]

$\Rightarrow a = \frac{10}{4}$

$\Rightarrow a = \frac{5}{2}$

$\Rightarrow a^2 = \frac{25}{4}$

Now,

$b^2 = a^2 (e^2 - 1)$

$\Rightarrow b^2 = \frac{25}{4}(2^2 - 1)$

$= \frac{25}{4} (4 - 1)$

$= \frac{25}{4} \times 3 = \frac{75}{4}$

Putting $a^2 = \frac{25}{4}$ and $b^2 = \frac{75}{4}$ in equation (i), we get

$\frac{(x-1)^2}{\frac{25}{4}} - \frac{(y-4)^2}{\frac{75}{4}} = 1$

$\Rightarrow \frac{4(x-1)^2}{25} - \frac{4(y-4)^2}{75} = 1$

$\Rightarrow \frac{4 \times 3(x-1)^2 - 4(y-4)^2}{75} = 1$

$\Rightarrow 12 (x - 1)^2 - 4(y - 4)^2 = 75$

$\Rightarrow 12[x^2 + 1 - 2x] - 4 [y^2 + 16 - 8y] = 75$

$\Rightarrow 12x^2 + 12 - 24x - 4y^2 - 64 + 32y = 75$

$\Rightarrow 12x^2 - 4y^2 - 24x + 32y - 52 - 75 = 0$

$\Rightarrow 12x^2 - 4y^2 - 24x + 32y - 127 = 0$

This is the equation of the required hyperbola.

OR

We have, foci of ellipse at (± 3, 0) which are on X-axis.

Therefore, equation of the ellipse is of the form

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ...(i)

Its foci are (± ae, 0) = (± 3, 0)

$\therefore$ ae = 3

Now, $b^2 = a^2 (1 - e^2)$

$\Rightarrow a^2 e^2 = a^2 - b^2$

$\Rightarrow 9 = a^2 - b^2$ [$\because$ ae = 3] ...(ii)

Since, Eq. (i) passes through (4, 1)

$\therefore \frac{16}{a^2} + \frac{1}{b^2} = 1$

$\Rightarrow \frac{16}{9+b^2} + \frac{1}{b^2} = 1$ [putting Eq. (ii)]

$\Rightarrow 16 b^2 + 9 + b^2 = b^2 (9 + b^2)$

$\Rightarrow 17 b^2 + 9 = 9 b^2 + b^4$

$\Rightarrow b^4 - 8b^2 - 9 = 0$

$\Rightarrow (b^2 - 9)(b^2 + 1) = 0$

$\Rightarrow b^2 = 9, -1$

But $b^2 \neq -1$

$\therefore b^2 = 9$

From Eq. (ii), we get

$a^2 = 9 + b^2$

$\Rightarrow a^2 = 9 + 9$

$\Rightarrow a^2 = 18$

On putting the values of a^2 and b^2 in Eq. (i), we get

$\frac{x^2}{18} + \frac{y^2}{9} = 1$

$\Rightarrow x^2 + 2y^2 = 18$

This is the required equation of the ellipse

34. We have, $\frac{4x}{3} - \frac{9}{4} < x + \frac{3}{4}$ ... (i)

and $\frac{7x-1}{3} - \frac{7x+2}{6} > x$ ... (ii)

From inequality (i), we get

$\frac{4x}{3} - \frac{9}{4} < x + \frac{3}{4} \Rightarrow \frac{16x-27}{12} < \frac{4x+3}{4}$

$\Rightarrow 16x - 27 < 12x + 9$ [multiplying both sides by 12]

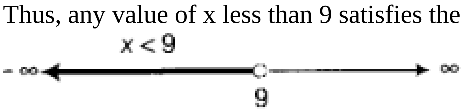
$\Rightarrow 16x - 27 + 27 < 12x + 9 + 27$ [adding 27 on both sides]

$\Rightarrow 16x < 12x + 36$

$\Rightarrow 16x - 12x < 12x + 36 - 12x$ [subtracting 12x from bot sides]

$\Rightarrow 4x < 36 \Rightarrow x < 9$ [dividing both sides by 4]

Thus, any value of x less than 9 satisfies the inequality. So, the solution of inequality (i) is given by $x \in (-\infty, 9)$



From inequality (ii) we get,

$\frac{7x-1}{3} - \frac{7x+2}{6} > x \Rightarrow \frac{14x-2-7x-2}{6} > x$

$\Rightarrow 7x - 4 > 6x$ [multiplying by 6 on both sides]

$\Rightarrow 7x - 4 + 4 > 6x + 4$ [adding 4 on both sides]

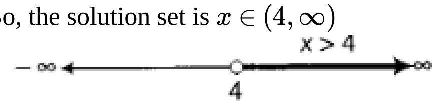
$\Rightarrow 7x > 6x + 4$

$\Rightarrow 7x - 6x > 6x + 4 - 6x$ [subtracting 6x from both sides]

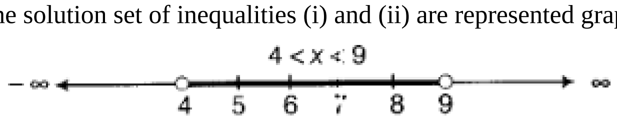
$\therefore x > 4$

Thus, any value of x greater than 4 satisfies the inequality.

So, the solution set is $x \in (4, \infty)$



The solution set of inequalities (i) and (ii) are represented graphically on number line as given below:



Clearly, the common value of x lie between 4 and 9.

Hence, the solution of the given system is, 4 < x < 9 i.e., $x \in (4, 9)$

35. Given, LHS $= sin20^o sin40^o sin80^o$

$= \frac{1}{2}$ [2 sin 20° · sin 40°] sin 80° [multiplying and dividing by 2]

$= \frac{1}{2}[cos(20^o - 40^o) - cos(20^o + 40^o)] \cdot \sin 80^\circ$ [$\because 2\sin x \cdot \sin y$ = cos (x - y) - cos (x + y)]

$= \frac{1}{2}\ [cos(-20^o) - cos60^o]sin80^o$

$= \frac{1}{2}$ [cos 20° - $\frac{1}{2}$]· sin 80° [$\because$ cos (- θ) = cos θ and cos 60° = $\frac{1}{2}$]

$= \frac{1}{2} \times \frac{1}{2}\left[2\left(\cos 20^\circ - \frac{1}{2}\right) \cdot \sin 80^\circ\right]$ [again multiplying and dividing by 2]

$= \frac{1}{4}[2\cos 20^\circ \cdot \sin 80^\circ - \sin 80^\circ]$

$= \frac{1}{4}[sin(20^o + 80^o) - sin(20^o - 80^o) - sin80^o]$ $[\because 2\cos x \cdot \sin y = sin(x + y) - sin(x - y)]$

$= \frac{1}{4}\ [sin100^o - sin(-60^o) - sin80^o]$

$= \frac{1}{4}$ [sin 100° + sin 60° - sin 80°] [$\because$ sin (- θ) = - sin θ]

$= \frac{1}{4}$ [sin (180° - 80°) + sin 60° - sin 80°] [$\because$ sin 100° = sin (180° - 80°)]

$= \frac{1}{4}$ [sin 80° + sin 60° - sin 80°] [$\because$ sin ($\pi - \theta$) = sin θ]

$= \frac{1}{4} \times$ sin 60° = $\frac{1}{4} \times \frac{\sqrt{3}}{2}$ [$\because$ sin 60° = $\frac{\sqrt{3}}{2}$]

$= \frac{\sqrt{3}}{8}$ = RHS

Hence proved.

OR

$LHS = 4sinA \times sin(60^o - A) \times sin(60^o + A)$

$= 2sinA[2sin(60^o - A)sin(60^o + A)]$

= 2 sin A [cos {(60° - A) - (60° + A)} - cos {(60° - A) + (60° + A)}]

[$\because$ 2 sin A $\times$ sin B = cos (A - B) - cos (A + B)]

$= 2sinA[cos(-2A) - cos120^o]$

$= 2sinA[cos2A - cos120^o]$ [$\because$ cos (- θ) = cos θ]

$= 2sinA \times cos2A - 2sinA \times cos120^o$

= [sin (A + 2A) + sin (A - 2A)] - 2 sin A $\left(-\frac{1}{2}\right)$

[$\because 2sinA \times cosB = sin(A + B) + sin(A - B)$ and cos 120° = $-\frac{1}{2}$]

$= sin3A + sin(-A) + sinA$

$= sin3A - sinA + sinA = sin3A =$ RHS [$\because$ sin (- θ) = - sin θ]

$\therefore$ LHS = RHS

Hence proved.

Now, 4 sin A sin (60° - A) $\times$ sin (60° + A) = sin 3A

On putting A = 20°, we get

4 sin 20° $\times$ sin (60° - 20°) sin (60° + 20°) = sin 3 $\times$ (20°)

$\Rightarrow$ 4 sin 20° $\times$ sin 40° $\times$ sin 80° = sin 60° = $\frac{\sqrt{3}}{2}$

$\Rightarrow sin20^o \times sin40^o \times sin80^o = \frac{\sqrt{3}}{8}$

$\Rightarrow$ sin 20° $\times$ sin 40° $\times \frac{\sqrt{3}}{2} \times$ sin 80° = $\frac{\sqrt{3}}{8} \times \frac{\sqrt{3}}{2}$

[multiplying both sides by $\frac{\sqrt{3}}{2}$]

$\therefore sin20^o \times sin40^o \times sin60^o \times sin80^o = \frac{3}{16}$ [$\because \frac{\sqrt{3}}{2}$ = sin 60°]

Section E

36. i. Number of relations = 2^{mn}

$= 2^{3\times 6} = 2^{18}$

ii. Number of relations = 2^{mn}

$= 2^{2\times 2} = 2^4 = 16$

iii. R = {(x, y): x $\in$ P, y $\in$ Q and x is the square of y}

OR

Here, W denotes the set of whole numbers.

We have 2a + b = 5 where a, b $\in$ W

$\therefore$ a = 0 $\Rightarrow$ b = 5

$\Rightarrow$ a = 1 $\Rightarrow$ b = 5 − 2 = 3

and a = 2 $\Rightarrow$ b = 1

For a > 3, the values of b given by the above relation are not whole numbers.

$\therefore$ A = {(0, 5), (1, 3), (2, 1)}

37. i. Let the Priyanka visits four cities Delhi, Lucknow, Agra, Meerut are respectively A, B, C and D. Number of way's in which Priyanka can visit four cities A, B, C and D is 4! i.e. 24

$\therefore$ n(S) = 24

Clearly, sample space for this experiment is

$$S = \left\{\begin{array}{l} ABCD, ABDC, ACBD, ACDB, ADBC, ADCB \\ BACD, BADC, BCAD, BCDA, BDAC, BDCA \\ CABD, CADB, CBAD, CBDA, CDAB, CDBA, \\ DABC, DACB, DCAB, DCBA, DBAC, DBCA \end{array}\right\}$$

Let E_1 be the event that Priyanka visits A before B.

Then,

E_1 = {ABCD, ABDC, ACBD, ACDB, ADBC, ADCB, CABD, CADB, CDAB, DABC, DACB, DCAB}

$\Rightarrow$ $n(E_1) = 12$

$\therefore$ P(she visits A before B) = $P(E_1) = \frac{n(E_1)}{n(S)} = \frac{12}{24} = \frac{1}{2}$

ii. Let the Priyanka visits four cities Delhi, Lucknow, Agra, Meerut are respectively A, B, C and D. Number of way's in which Priyanka can visit four cities A, B, C and D is 4! i.e. 24

$\therefore$ n(S) = 24

Clearly, sample space for this experiment is

$$S = \left\{\begin{array}{l} ABCD, ABDC, ACBD, ACDB, ADBC, ADCB \\ BACD, BADC, BCAD, BCDA, BDAC, BDCA \\ CABD, CADB, CBAD, CBDA, CDAB, CDBA, \\ DABC, DACB, DCAB, DCBA, DBAC, DBCA \end{array}\right\}$$

E_1 = {ABCD, ABDC, ACBD, ACDB, ADBC, ADCB, CABD, CADB, CDAB, DABC, DACB, DCAB}

$\Rightarrow$ $n(E_1) = 12$

$\therefore$ P(she visits A before B) $= P(E_1) = \frac{n(E_1)}{n(S)} = \frac{12}{24} = \frac{1}{2}$

iii. Let the Priyanka visits four cities Delhi, Lucknow, Agra, Meerut are respectively A, B, C and D. Number of way's in which Priyanka can visit four cities A, B, C and D is 4! i.e. 24

$\therefore$ n(S) = 24

Clearly, sample space for this experiment is

$$S = \left\{\begin{array}{l} ABCD, ABDC, ACBD, ACDB, ADBC, ADCB \\ BACD, BADC, BCAD, BCDA, BDAC, BDCA \\ CABD, CADB, CBAD, CBDA, CDAB, CDBA, \\ DABC, DACB, DCAB, DCBA, DBAC, DBCA \end{array}\right\}$$

Let E_3 be the event that she visits A first and B last.

Then,

E_3 = {ACDB, ADCB}

$n(E_3) = 2$

$\because$ P(she visits A first and B last) = $P(E_3)$

$= \frac{n(E_3)}{n(S)} = \frac{2}{24} = \frac{1}{12}$

OR

Let the Priyanka visits four cities Delhi, Lucknow, Agra, Meerut are respectively A, B, C and D. Number of way's in which Priyanka can visit four cities A, B, C and D is 4! i.e. 24

$\therefore$ n(S) = 24

Clearly, sample space for this experiment is

$$S = \left\{\begin{array}{l} ABCD, ABDC, ACBD, ACDB, ADBC, ADCB \\ BACD, BADC, BCAD, BCDA, BDAC, BDCA \\ CABD, CADB, CBAD, CBDA, CDAB, CDBA, \\ DABC, DACB, DCAB, DCBA, DBAC, DBCA \end{array}\right\}$$

Let E_4 be the event that she visits A either first or second. Then,

E_4 = {ABCD, ABDC, ACBD, ACDB, ADBC, ADCB, BACD, BADC, CABD, CADB, DABC, DACB}

$\Rightarrow n(E_4) = 12$

Hence, P(she visits A either first or second)

$= P(E_4) = \frac{n(E_4)}{n(S)} = \frac{12}{24} = \frac{1}{2}$

38. i. $Z_1\overline{Z_1} = (2 + 3i)(2 - 3i)$

$= 4 - 9i^2 = 4 + 9 = 13$

Imaginary part = 0

ii. $\frac{Z_1}{Z_2} = \frac{2+3i}{4-3i} \times \frac{4+3i}{4+3i}$

$= \frac{8+6i+12i-9}{16+9}$

$= \frac{-1+18i}{25}$

Real part = $\frac{-1}{25}$

iii. $Z_1 - Z_2 = (2 + 3i) - (4 - 3i)$

$= -2 + 6i$

Imaginary part = 6

OR

The real part of $Z_1 = 2$.