Class XI Session 2024-25
Subject - 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 are internal choices 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)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

Section A

1. cos 20° cos 40° cos 80° = ? **[1]**

   a) $\frac{1}{16}$ b) $\frac{1}{8}$

   c) $\frac{\sqrt{3}}{8}$ d) $\frac{\sqrt{3}}{16}$

2. If R is a relation from a non – empty set A to a non – empty set B, then **[1]**

   a) $R \subseteq A \times B$ b) $R = A \cap B$

   c) $R = A \cup B$ d) $R = A \times B$

3. If two squares are chosen at random on a chess board, the probability that they have a side common is **[1]**

   a) $\frac{2}{7}$ b) $\frac{1}{18}$

   c) $\frac{1}{9}$ d) $\frac{4}{9}$

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

   a) 1 b) does not exist

   c) 1/2 d) 0

5. 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

6. Given the sets A = {1, 2, 3}, B = {3, 4}, C = {4, 5, 6}, then A ∪(B ∩ C) is **[1]**

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

c) {1, 2, 3, 4, 5, 6}
d) {1, 2, 3, 4}

7. The multiplicative inverse of $(3 + 2i)^2$ is **[1]**

a) $\left(\frac{-4}{169} + \frac{12}{169}i\right)$
b) $\left(\frac{5}{169} - \frac{12}{169}i\right)$
c) $\left(\frac{-5}{169} + \frac{12}{169}i\right)$
d) $\left(\frac{5}{169} + \frac{12}{169}i\right)$

8. Let A = {a, b, c}, then the range of the relation R = {(a, b), (a, c), (b, c)} defined on A is **[1]**

a) {b, c}
b) {c}
c) {a, b}
d) {a, b, c}

9. If x is a real number and |x| < 5, then **[1]**

a) $-5 < x < 5$
b) $-5 \leq x \leq 5$
c) $x \geq 5$
d) $x \leq -5$

10. sin 75° = ? **[1]**

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

11. If A = {x : x is a multiple of 3, x natural no., x < 30} and B = {x : x is a multiple of 5, x is natural no., x < 30} then A - B is **[1]**

a) {3, 6, 9, 12, 15, 18, 21, 24, 27, 30}
b) {3, 6, 9, 12, 18, 21, 24, 27}
c) {3, 5, 6, 9, 10, 12, 15, 18, 20, 21, 25, 27, 30}
d) {3, 6, 9, 12, 18, 21, 24, 27, 30}

12. The arithmetic mean of two numbers is 34 and their geometric mean is 16. The numbers are **[1]**

a) 56 and 12
b) 64 and 4
c) 60 and 8
d) 52 and 16

13. $\sum_{r=0}^{n} 4^r . {}^nC_r$ is equal to **[1]**

a) 6^n
b) 5^{-n}
c) 4^n
d) 5^n

14. If a, b, c are real numbers such that a > b, c < 0 **[1]**

a) ac > bc
b) ac < bc
c) $ac \geq bc$
d) $ac \neq bc$

15. If A and B are two sets, then A ∩ (A ∪ B) equals **[1]**

a) B
b) ϕ
c) A
d) A ∩ B

16. If sin x $= \frac{-2\sqrt{6}}{5}$ and x lies in quadrant III, then cot x ? **[1]**

a) $\frac{3}{2\sqrt{6}}$
b) $\frac{1}{2\sqrt{6}}$
c) $\frac{-1}{2\sqrt{6}}$
d) $\frac{-3}{2\sqrt{6}}$

[1]

17. Mark the correct answer for: i^{-38} = ?

a) i
b) -i
c) -1
d) 1

18. How many diagonals are there in an octagon? **[1]**

a) 24
b) 28
c) 20
d) 36

19. **Assertion (A):** The expansion of $(1 + x)^n = n_{c_0} + n_{c_1}x + n_{c_2}x^2 \ldots + n_{c_n}x^n$. **[1]**

Reason (R): If x = -1, then the above expansion is zero.

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. Consider the following data **[1]**

x_i	4	8	11	17	20	24	32
f_i	3	5	9	5	4	3	1

Assertion (A): The variance of the data is 45.8.

Reason (R): The standard deviation of the data is 6.77.

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 A = (1, 2, 3), B = {4}, C = {5}, then verify that $A \times (B - C) = (A \times B) - (A \times C)$. **[2]**

OR

If f(x) = x + $\frac{1}{x}$, show that $\{f(x)\}^3 = f(x^3) + 3f(\frac{1}{x})$

22. Evaluate: $\lim\limits_{x \to \frac{1}{2}} \frac{8x^3 - 1}{16x^4 - 1}$. **[2]**

23. Find the equation of hyperbola having Foci $(\pm 3\sqrt{5}, 0)$, the latus rectum is of length 8. **[2]**

OR

Find the lengths of major and minor axes, coordinates of foci, vertices and the eccentricity: $3x^2 + 2y^2 = 6$.

24. For all sets A, B and C **[2]**

Is $(A \cap B) \cup C = A \cap (B \cup C)$?

Justify your statement.

25. Three vertices of a parallelogram, taken in order, are (-1, -6), (2, -5) and (7, 2). Write the coordinates of its fourth vertex. **[2]**

Section C

26. Determine the domain and range of the relation R defined by R = {(x, x + 5) : x ∈ (0, 1, 2, 3, 4, 5)} **[3]**

27. The longest side of a triangle is 3 times the shortest side and the third side is 2 cm shorter than the longest side. If the perimeter of the triangle is at least 61 cm. Find the minimum length of the shortest side. **[3]**

28. Show that the points (-2, 3, 5), (1, 2, 3) and (7, 0, -1) are collinear. **[3]**

OR

Find the distance between the following pairs of points:

(i) (2, 3, 5) and (4, 3, 1)

(ii) (-3, 7, 2) and (2, 4, -1)

(iii) (-1, 3, -4) and (1, -3, 4)

(iv) (2, -1, 3) and (-2, 1, 3)

29. Expand the given expression $\left(\frac{2}{x}-\frac{x}{2}\right)^5$ **[3]**

OR

Find a, b and n in the expansion of $(a + b)^n$ if the first three terms of the expansion are 729, 7290 and 30375 respectively.

30. If $(x + iy)^{1/3} = a + ib$, where x, y, a, b $\in$ R, then show that $\frac{x}{a}-\frac{y}{b} = -2(a^2 + b^2)$. **[3]**

OR

Show that a real value of x will satisfy the equation $\frac{1-ix}{1+ix}=a-i$ if $a^2 + b^2 = 1$ where a and b are real

31. If u = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 24} **[3]**

A = {x : x is prime and x $\leq$ 10}

B = {x : x is a factor of 24}

Verify the following result

i. A - B = A $\cap B'$

ii. $(A \cup B)' = A' \cap B'$

iii. $(A \cap B)' = A' \cup B'$

Section D

32. Two dice are thrown. The events A, B, C, D, E and F are described as follows: **[5]**

A = Getting an even number on the first die.

B = Getting an odd number on the first die.

C = Getting at most 5 as a sum of the numbers on the two dice.

D = Getting the sum of the numbers on the dice greater than 5 but less than 10.

E = Getting at least 10 as the sum of the numbers on the dice.

F = Getting an odd number on one of the dice.

Describe the following events: A and B, B or C, B and C, A and E, A or F, A and F.

33. Find the derivative of (sinx + cosx) from first principle. **[5]**

OR

i. If $f(x)=\begin{cases}|x|+1, & x<0\\ 0, & x=0\\ |x|-1, & x>0\end{cases}$, for what values (s) of a does $\lim_{x\to a} f(x)$ exist?

ii. Find the derivative of the function $\cos\left(x-\frac{\pi}{8}\right)$ from the first principle.

34. The Sum of two no. is 6 times their geometric mean, show that no. are in the ratio $(3 + 3\sqrt{2}) : (3 - 2\sqrt{2})$ **[5]**

35. Prove that $\cos\frac{2\pi}{15}\cdot\cos\frac{4\pi}{15}\cdot\cos\frac{8\pi}{15}\cdot\cos\frac{16\pi}{15}=\frac{1}{16}$ **[5]**

OR

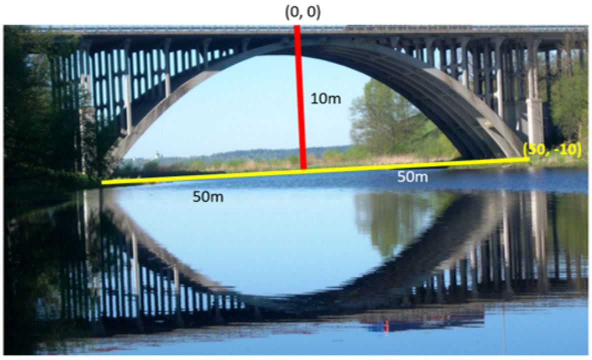
Prove that: $4 \sin A \sin(60^o - A) \sin(60^o + A) = \sin 3A$.

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]**

The girder of a railway bridge is a parabola with its vertex at the highest point, 10 m above the ends. Its span is 100 m.



i. Find the coordinates of the focus of the parabola. (1)

ii. Find the equation of girder of bridge and find the length of latus rectum of girder of bridge. (1)

iii. Find the height of the bridge at 20m from the mid-point. (2)

OR

Find the radius of circle with centre at focus of the parabola and passes through the vertex of parabola. (2)

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

An analysis of monthly wages paid to workers in two firms A and B, belonging to the same industry, gives the following results:

Particulars	Firm A	Firm B
No. of wage earners	586	648
Mean of monthly wages	₹ 5253	₹ 5253
Variance of the distribution of wages	100	121

i. Which firm A or B shows greater variability in individual wages? (1)

ii. Find the standard deviation of the distribution of wages for frim B. (1)

iii. Find the coefficient of variation of the distribution of wages for firm A. (2)

OR

Find the amount paid by firm A. (2)

38. A permutation is **an act of arranging the objects or numbers in order**. Combinations are the way of selecting the objects or numbers from a group of objects or collections, in such a way that the order of the objects does not matter. **[4]**

How many words, with or without meaning can be made from the letters of the word, MONDAY, assuming that no letter is repeated if

(i) 4 letters are used at a time

(ii) all letters are used at a time

Solution

Section A

1.
(b) $\frac{1}{8}$
Explanation: Given exp. $= \frac{1}{2}$ (2 cos 20° cos 80°) cos 40°
$= \frac{1}{2}$ [cos (80° + 20°)+ cos(80° - 20°)] cos 40°
$= \frac{1}{2}$ [(cos 100° + cos 60°) cos 40°] $= \frac{1}{2}\left[\left(\cos 100^{\circ}+\frac{1}{2}\right)\cos 40^{\circ}\right]$
$= \frac{1}{4}$ (2 cos 100° cos 40°) + $\frac{1}{4}$ cos 40°
$= \frac{1}{4}$ cos (100° + 40°) + cos (100° - 40°)] + $\frac{1}{4}$ cos 40°
$= \frac{1}{4}$ cos 140° + cos 60°) + $\frac{1}{4}$ cos 40° = $\frac{1}{4}$ (cos 140° + cos 40°) + $\left(\frac{1}{4}\times\frac{1}{2}\right)$
$= \frac{1}{4}$ [cos(180° - 40°) + cos 40°] $+\frac{1}{8} = \frac{1}{4}$ (-cos 40°+ cos 40°) $+\frac{1}{8} = \frac{1}{8}$.

2. **(a)** $R \subseteq A \times B$
Explanation: Let A and B be two sets. Then a relation R from set A to set B is a subset of A×B.Thus, R is a relation from A to B ⇔ $R \subseteq A \times B$.

3.
(b) $\frac{1}{18}$
Explanation: Total number of squares = 64.
Two squares can be selected in $^{64}C_2$ ways.
In each column, there are 7 pairs of adjacent squares where each pair share 1 side in common.
Total such pairs = 8 × 7 = 56.
In each row, there are 7 pairs of adjacent squares where each pair share 1 side in common.
Total such pairs = 8 × 7 = 56.
Therefore, favourable cases = 56 + 56 = 112.
Required probability = $\frac{112}{^{64}C_2} = \frac{112}{2016} = \frac{1}{18}$

4.
(d) 0
Explanation: $\lim_{x\to 0} x = 0$ and $-1 \leq \sin\frac{1}{x} \leq 1$, by Sandwitch Theorem, we have
$\lim_{x\to 0} x \sin\frac{1}{x} = 0$

5.
(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

6.
(d) {1, 2, 3, 4}
Explanation: Given A = {1, 2, 3}, B = {3, 4} and C = {4, 5, 6}
B ∩ C = {4}
A ∪ (B ∩ C) = {1, 2, 3, 4}

7.
(b) $\left(\frac{5}{169} - \frac{12}{169}i\right)$
Explanation: z = $(3 + 2i)^2 = (9 + 4i^2 + 12i)$ = (9 - 4 + 12i) = (5 + 120)
⇒ $z^{-1} = \frac{1}{(5+12i)} \times \frac{(5-12i)}{(5-12i)} = \frac{(5-12i)}{(25-144i^2)} = \frac{(5-12i)}{(25+144)} = \frac{(5-12i)}{(169)}$
⇒ $z^{-1} = \left(\frac{5}{169} - \frac{12}{169}i\right)$

8. **(a)** {b, c}
Explanation: Since the range is represented by the y- coordinate of the ordered pair (x, y). Therefore, the range of the given relation is { b, c }.

9. **(a)** - 5 < x < 5
Explanation: |x| < 5
⇒ -5 < x < 5

10.
(c) $\frac{(\sqrt{3}+1)}{2\sqrt{2}}$
Explanation: sin75° = sin(90°-15°) = cos 15° $= \frac{(\sqrt{3}+1)}{2\sqrt{2}}$

11.
(b) {3, 6, 9, 12, 18, 21, 24, 27}
Explanation: Since set B represent multiple of 5 so from Set A common multiple of 3 and 5 are excluded.

12.
(b) 64 and 4
Explanation: Let the required numbers be a and b. Then,
$\left(\frac{a+b}{2} = 34 \Rightarrow a + b = 68\right)$ and $\sqrt{ab} = 16 \Rightarrow ab = (16)^2$ = 256
$(a - b)^2 = (a + b)^2 - 4ab = (68)^2 - 4 \times 256$ = (4624 - 1024)= 3600
$\Rightarrow a - b = \sqrt{3600} = 60$

On solving a + b = 68 and a - b = 60, we obtain a = 64, & b= 4.
∴ the required numbers are 64 and 4.

13.

(d) 5^n

Explanation: $\sum_{r=0}^{n} 4^r \cdot {}^n C_r = 4^0 \cdot {}^n C_0 + 4^1 \cdot {}^n C_1 + 4^2 \cdot {}^n C_2 + ... + 4^n \cdot {}^n C_n$

$= 1 + 4 \cdot {}^n C_1 + 4^2 \cdot {}^n C_2 + ... + 4^n \cdot {}^n C_n$

$= (1 + 4)^n = 5^n$

14.

(b) ac < bc

Explanation: The sign of the inequality is to be reversed (< to > or > to <) if both sides of an inequality are multiplied by the same negative real number.

15.

(c) A

Explanation: Let us assume that x ∈ A ∩ (A ∪ B)

⇒ x ∈ A and x ∈ (A ∪ B)

⇒ x ∈ A and (x ∈ A or x ∈ B)

⇒ (x ∈ A and x ∈ A) or (x ∈ A and x ∈ B)

⇒ x ∈ A or x ∈ A ∩ B

⇒ x ∈ A

Therefore, A ∩ (A ∪ B) = A

16.

(b) $\frac{1}{2\sqrt{6}}$

Explanation: we know that $\cos^2 x = (1 - \sin^2 x) = \left(1 - \frac{24}{25}\right) = \frac{1}{25} \Rightarrow \cos x = \frac{-1}{5}$ [In quadrant III, cos x is negative]

$\therefore \cot x = \frac{\cos x}{\sin x} = \frac{-1}{5} \times \frac{5}{-2\sqrt{6}} = \frac{1}{2\sqrt{6}}$

17.

(c) -1

Explanation: $i^{-38} = \frac{1}{i^{38}} \times \frac{i^2}{i^2} = \frac{-1}{i^{-40}} = \frac{-1}{(i^4)^{10}} = \frac{-1}{i^{10}} = \frac{-1}{1} = -1$

18.

(c) 20

Explanation: No. of diagonals in a polygon of n sides = $\frac{1}{2}n(n-3)$,

Put n = 8, we get 20.

19.

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

Explanation: Assertion:

$(1 + x)^n = n_{c_0} + n_{c_1}x + n_{c_2}x^2 \ldots + n_{c_n}x^n$

Reason:

$(1 + (-1))^n = n_{c_0}1^n + n_{c_1}(1)^{n-1}(-1)^1 + n_{c_2}(1)^{n-2}(-1)^2 + ... + {}^n c_n(1)^{n-n}(-1)^n$

$= n_{c_8} - n_{c_1} + n_{c_2} - n_{c_3} + ... (-1)^n n_{c_n}$

Each term will cancel each other

$\therefore (1 + (-1))^n = 0$

Reason is also the but not the correct explanation of Assertion.

20.

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

Explanation: Assertion: Presenting the data in tabular form, we get

x_i	f_i	$f_i x_i$	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
4	3	12	-10	100	300
8	5	40	-6	36	180
11	9	99	-3	9	81
17	5	85	3	9	45
20	4	80	6	36	144
24	3	72	10	100	300
32	1	32	18	324	324
	30	**420**			**1374**

$N = 30, \sum_{i=1}^{7} f_i x_i = 420, \sum_{i=1}^{7} f_i(x_i - \bar{x})^2 = 1374$

Therefore, $\bar{x} = \frac{\sum_{i=1}^{7} f_i x_i}{N} = \frac{1}{30} \times 420 = 14$

$\therefore$ Variance $(\sigma^2) = \frac{1}{N}\sum_{i=1}^{7} f_i(x_i - \bar{x})^2$

$\frac{1}{30} \times 1374 = 458$

Reason: Standard deviation $(\sigma) = \sqrt{45.8} = 6.77$

Section B

21. As given in the question we have, A = {1, 2, 3}, B = {4} and C = {5}

From set theory, (B - C) = {4}

$\therefore \quad A \times (B - C) = \{1, 2, 3\} \times \{4\}$ = {(1, 4), (2, 4), (3, 4)}........(i)

Now,

$A \times B = \{1, 2, 3\} \times \{4\}$ = {(1, 4), (2, 4), (3, 4)}

and, $A \times C = \{1, 2, 3\} \times \{5\}$ = {(1,5), (2, 5), (3, 5)}

$\therefore \quad (A \times B) - (A \times C)$= {(1, 4), (2, 4), (3, 4)}.......(ii)

From equation (i) and equation (ii), we get

$A \times (B - C) = (A \times B) - (A \times C)$

We can see the equations (i) and (ii) have same ordered pairs.

Hence verified.

OR

We have, f(x) = x + $\frac{1}{x}$ ....(i)

To prove: $\{f(x)\}^3 = f(x^3) + 3f(\frac{1}{x})$

Proof: On cubing both sides of (i), we get

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

$= \left(x^3 + \frac{1}{x^3}\right) + 3\left(\frac{1}{x} + x\right)$

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

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

Hence, $\{f(x)\}^3 = f(x^3) + 3f(\frac{1}{x})$

22. We have to find the value of

$\lim\limits_{x \to \frac{1}{2}} \frac{8x^3 - 1}{16x^4 - 1}$

When x = $\frac{1}{2}$, the expression $\frac{8x^3-1}{16x^4-1}$ assumes the for n $\frac{0}{0}$.

Therefore, $(x - \frac{1}{2})$ or, 2x - 1 is a factor common to numerator and denominator.

Factorizing the numerator and denominator, we obtain;

$\lim\limits_{x \to \frac{1}{2}} \frac{8x^3 - 1}{16x^4 - 1}$ ($\frac{0}{0}$ form)

$= \lim\limits_{x \to \frac{1}{2}} \frac{(2x)^3 - 1^3}{(4x^2)^2 - 1^2}$

$= \lim\limits_{x \to \frac{1}{2}} \frac{(2x-1)(4x^2+2x+1)}{(4x^2+1)(4x^2-1)}$ ($\frac{0}{0}$ form)

$= \lim\limits_{x \to \frac{1}{2}} \frac{(2x-1)(4x^2+2x+1)}{(4x^2+1)(2x-1)(2x+1)}$

$= \lim\limits_{x \to \frac{1}{2}} \frac{4x^2+2x+1}{(4x^2+1)(2x+1)} = \frac{3}{4}$

23. Here foci are $(\pm 3\sqrt{5}, 0)$ which lie on x-axis.

So the equation of hyperbola in standard form is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$\therefore$ foci $(\pm c, 0)$ is $(\pm 3\sqrt{5}, 0)$

$\Rightarrow c = 3\sqrt{5}$

Length of latus rectum $\frac{2b^2}{a} = 8 \Rightarrow b^2 = 4a$

We know that $c^2 = a^2 + b^2$

$\therefore (3\sqrt{5})^2 = a^2 + 4a$

$\Rightarrow a^2 + 4a - 45 = 0$

$\Rightarrow (a + 9)(a - 5) = 0$

$\Rightarrow$ a = 5 ($\because$ a = -9 is not possible)

Also a = 5

$\Rightarrow b^2 = 4 \times 5 = 20$

Thus required equation of hyperbola is

$\frac{x^2}{25} - \frac{y^2}{20} = 1$

OR

We have,

$3x^2 + 2y^2 = 6$

$\Rightarrow \frac{x^2}{2} + \frac{y^2}{3} = 1$

This equation is of the form $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where $a^2 = 2$ and $b^2 = 3$ i.e. a = $\sqrt{2}$ and b = $\sqrt{3}$.

Clearly, a < b, so the major and minor axes of the given ellipse are along y and x-axes respectively.

$\therefore$ Length of the major axis = 2b = $2\sqrt{3}$

and Length of the minor axis = 2b = $2\sqrt{2}$

The coordinates of the vertices = (0, b) and (0, -b) = (0, $\sqrt{3}$) and (0, - $\sqrt{3}$)

The eccentricity e of the ellipse is $e = \sqrt{1 - \frac{a^2}{b^2}} = \sqrt{1 - \frac{2}{3}} = \frac{1}{\sqrt{3}}$

The coordinates of the foci = (0, be) and (0, -be) = (0, 1) and (0, -1).

24. Let us consider the following sets A, B and C such that

A = {1, 2, 3}

B = {2, 3, 5}

C = {4, 5, 6}

Now (A ∩ B) ∪ C = ({1, 2, 3} ∩ {2, 3, 5}) ∪ {4, 5, 6}

= {2, 3} ∪ {4, 5, 6}

= {2, 3, 4, 5, 6}

And A ∩ (B ∪ C) = {1, 2, 3} ∩ [{2, 3, 5} ∪ {4, 5, 6}

= {1, 2, 3} ∩ {2, 3, 4, 5, 6}

= {2, 3}

Thus, (A ∩ B) ∪ C ≠ A ∩ (B ∪ C)

25. Let A(-1, -6), B(2, -5) and C(7, 2) be the vertices of the parallelogram ABCD and D be the fourth vertex of the parallelogram.

Let the coordinates of D be (x, y).

Since, diagonals of a parallelogram bisect each other.

$\frac{-1+7}{2}=\frac{2+x}{2}$ and $\frac{-6+2}{2}=\frac{-5+y}{2}$

⇒ x = 4 and y = 1

Therefore, the coordinates of the fourth vertex D are (4, 1).

Section C

26. Here R = {(x, x + 5) : $x \in$ (0, 1, 2, 3, 4, 5)}

= {(a, b): a = 0, 1, 2, 3, 4, 5}

Now a = x and b = x + 5

Putting a = 0, 1, 2, 3, 4, 5 we get b = 5, 6, 7, 8, 9, 10

∴ Domain of R = {0, 1, 2, 3, 4, 5}

Range of R = {5, 6, 7, 8, 9, 10}

27. Let the length of the shortest side be x cm.

Then length of longest side = 3x cm

length of third side = (3x - 2)cm

Perimeter of triangle = x + 3x + 3x - 2

= (7x - 2)cm

Now $7x-2\geqslant 61$

$\Rightarrow 7x\geqslant 61+2\Rightarrow 7x\geqslant 63\Rightarrow x\geqslant 9$

Thus the minimum length of shortest side = 9 cm

28. Let A(-2, 3, 5), B (1, 2, 3) and C(7, 0, -1) be three given points.

Then $AB=\sqrt{(1+2)^2+(2-3)^2+(3-5)^2}=\sqrt{9+1+4}=\sqrt{14}$

$BC=\sqrt{(7-1)^2+(0-2)^2+(-1-3)^2}=\sqrt{36+4+16}=\sqrt{56}=2\sqrt{14}$

$AC=\sqrt{(7+2)^2+(0-3)^2+(-1-5)^2}=\sqrt{81+9+36}=\sqrt{126}=3\sqrt{14}$

Now AC = AB + BC

Therefore,A,B,C are collinear.

OR

Let A(2, 3, 5) and B(4, 3, 1) be two points. Then

$AB=\sqrt{(4-2)^2+(3-3)^2+(1-5)^2}=\sqrt{4+0+16}=\sqrt{20}=2\sqrt{5}$ units

(ii) Let A(-3, 7, 2) and B(2, 4, -1) be two points. Then

$AB=\sqrt{[2-(-3)]^2+(4-7)^2+(-1-2)^2}$

$=\sqrt{(2+3)^2+(4-7)^2+(-1-2)^2}=\sqrt{25+9+9}=\sqrt{43}$ units

(iii) Let A(-1, 3, -4) and B(1, -3, 4) be two points. Then

$AB=\sqrt{[1-(-1)]^2+(-3-3)^2+[4-(-4)]^2}$

$=\sqrt{4+36+64}=\sqrt{104}=2\sqrt{26}$

(iv) Let A(2, -1, 3) and B(-2, 1, 3) be two points. Then

$AB=\sqrt{(-2-2)^2+[1-(-1)]^2+(3-3)^2}$

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

$=\sqrt{16+4+0}=\sqrt{20}=2\sqrt{5}$ units

29. Using binomial theorem for the expansion of $\left(\frac{2}{x}-\frac{x}{2}\right)^5$ we have

$\left(\frac{2}{x}-\frac{x}{2}\right)^5={}^5C_0\left(\frac{2}{x}\right)^5+{}^5C_1\left(\frac{2}{x}\right)^4\left(\frac{-x}{2}\right)+{}^5C_2\left(\frac{2}{x}\right)^3\left(\frac{-x}{2}\right)^2+{}^5C_3\left(\frac{2}{x}\right)^2\left(\frac{-x}{2}\right)^3$

$+{}^5C_4\left(\frac{2}{x}\right)\left(\frac{-x}{2}\right)^4+{}^5C_5\left(\frac{-x}{2}\right)^5$

$=\frac{32}{x^5}+5\cdot\frac{16}{x^4}\cdot\frac{-x}{2}+10\cdot\frac{8}{x^3}\cdot\frac{x^2}{4}+10\cdot\frac{4}{x^2}\cdot\frac{-x^3}{8}+5\cdot\frac{2}{x}\cdot\frac{x^4}{16}+\frac{-x^5}{32}$

$=\frac{32}{x^5}-\frac{40}{x^3}+\frac{20}{x}-5x+\frac{5}{8}x^3-\frac{x^5}{32}$

OR

We have $T_1={}^nC_0a^nb^0=729\ \ldots$ (i)

$T_2={}^nC_1a^{n-1}b=7290\ \ldots$ (ii)

$T_3={}^nC_2a^{n-2}b^2=30375\ \ldots$ (iii)

From (i) $a^n = 729$ . . . (iv)

From (ii) $na^{n-1}b = 7290$ . . . (v)

From (iii) $\frac{n(n-1)}{2}a^{n-2}b^2 = 30375$ . . . (vi)

Multiplying (iv) and (vi), we get

$\frac{n(n-1)}{2}a^{2n-2}b^2=729\times 30375\ \ldots$ (vii)

Squaring both sides of (v) we get

$n^2a^{2n-2}b^2 = (7290)(7290)$(viii)

Dividing (vii) by (viii), we get

$\frac{n(n-1)a^{2n-2}b^2}{2n^2a^{2n-2}b^2}=\frac{729\times 30375}{7290\times 7290}$

$\Rightarrow\frac{(n-1)}{2n}=\frac{30375}{72900}\Rightarrow\frac{n-1}{2n}=\frac{5}{12}\ \Rightarrow 12n-12=10n$

$\Rightarrow 2n=12\ \Rightarrow n=6$

From (iv) $a^6=729\Rightarrow a^6=(3)^6\Rightarrow a=3$

From (v) $6\times 3^5\times b=7290\Rightarrow b=5$

Thus a = 3, b = 5 and n = 6.

30. We have, $(x + iy)^{1/3} = a + ib$

⇒ $x + iy = (a + ib)^3$ [cubing on both sides]

$\Rightarrow$ x + iy = $a^3 + i^3 b^3 + 3$ iab (a + ib)

$\Rightarrow$ x + iy = $a^3 - ib^3 + i\, 3a^2 b - 3ab^2$

$\Rightarrow$ x + iy = $a^3 - 3ab^2 + i\,(3a^2 b - b^3)$

On equating real and imaginary parts from both sides, we get

$x = a^3 - 3ab^2$ and $y = 3a^2b - b^3$

$\Rightarrow \frac{x}{a} = a^2 - 3b^2$ and $\frac{y}{b} = 3a^2 - b^2$

Now, $\frac{x}{a} - \frac{y}{b} = a^2 - 3b^2 - 3a^2 + b^2$

$= -2a^2 - 2b^2 = -2(a^2 + b^2)$

Hence proved.

OR

Here $\frac{1-ix}{1+ix} = a - ib$

By componendo and dividendo, we have

$\frac{1-ix+1+ix}{1-ix-1-ix} = \frac{a-ib+1}{a-ib-1}$

$\Rightarrow \frac{2}{-2ix} = \frac{1-a-ib}{-(1-a+ib)}$

$\Rightarrow \frac{1}{ix} = \frac{1+a-ib}{1-a+ib}$

$\Rightarrow ix = \frac{1-a+ib}{1+a-ib} \times \frac{1+a+ib}{1+a+ib}$

$\Rightarrow ix = \frac{1-a^2-b^2+2ib}{(1+a)^1-i^2b^1}$

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

$= \frac{1-a^2-b^2}{(1+a)^2+b^2} + \frac{2b}{(1+a)^2+b^2}i$

If $a^2 + b^2 = 1$ then

$x = \frac{2b}{(1+a)^2+b^2}$ which is real.

31. Given, U = {1,2,3,4,5,6,7,8,9,10,12,24}

A = {2,3,5,7} B = {1,2,3,4,5,6,8,12,24}

Now, A’ = {1,4,6,8,9,10,12,24} B’ = {5,7,9,10}

A ∪ B = {1,2,3,4,5,6,7,8,12,24}

(A ∪ B)’ = {9,10}

A ∩ B = {2,3} (A ∪ B)’ = {1,4,5,6,7,8,9,10,12,24}

(i) A – B = A ∩ B’

L.H.S = A – B = {2,3,5,7} – {1,2,3,4,6,8,12,24} = {5,7} R.H.S = A ∩ B’ = {2,3,5,7} ∩ {5,7,9,10} = {5,7}

∴ L.H.S = R.H.S,

(ii) (A ∪ B)’ = A ∩ B’

L.H.S = (A ∪ B)’ = {9,10}

R.H.S = A’∩ B’ = {1,4,6,8,9,10,12,24} ∩ {5,7,9,10}

= {9,10}

∴ L.H.S = R.H.S,

(iii) (A ∩ B)’ = A’ ∩ B’

L.H.S = (A ∩ B)’ = {1,4,5,6,7,8,9,10,12,24}

R.H.S = A’ ∩ B’ = {1,4,6,8,9,10,12,24} ∩ {5,7,9,10}

= {1,4,5,6,7,8,9,10,12,34}

∴ L.H.S = R.H.S

Section D

32. **A = Getting an even number on the first die.**

A = $\{(2,1),(2,2),(2,3),(2,4),(2,5),(2,6),(4,1),(4,2),(4,3),(4,4),(4,5),(4,6),(6,1),(6,2),(6,3),(6,4),(6,5),(6,6)\}$

B = Getting an odd number on the first die.

B = $\{(1,1),(1,2),(1,3),(1,4),(1,5),(1,6),(3,1),(3,2),(3,3),(3,4),(3,5),(3,6),(5,1),(5,2),(5,3),(5,4),(5,5),(5,6)\}$

C = Getting at most 5 as sum of the numbers on the two dice.

C = $\{(1,1),(1,2),(1,3),(1,4),(2,1),(2,2),(2,3),(3,1),(3,2),(4,1)\}$

D = Getting the sum of the numbers on the dice >5 but <10.

D = $\{(1,5),(1,6),(2,4),(2,5),(2,6),(3,3),(3,4),(3,5),(3,6),(4,2),(4,3),(4,4),(4,5),(5,1),(5,2),(5,4),(6,1),(6,2),(6,2),(6,3)\}$

E = Getting at least 10 as the sum of the numbers on the dice.

E = $\{(4,6),(5,5),(5,6),(6,4),(6,5),(6,6)\}$

F = Getting an odd number on one of the dice.

F = {

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

A and B are mutually exclusive events, thus A ∩ B = ∅

B ∪ C = {(1,1),(1,2),(1,3),(1,4),(1,5),(1,6),(3,1),(3,2),(3,3),(3,4),(3,5),(3,6),(5,1),(5,2),(5,3),(5,4),(5,5),(5,6),(2,1),(2,2),(2,3),(4,1)}

B ∩ C = {(1,1),(1,2),(1,3),(1,4),(3,1),(3,2)}

A ∩ E = {(4,6),(6,4),(6,5),(6,6)}

A ∪ F = {(2,1),(2,2),(2,3),(2,4),(2,5),(2,6), (4,1),(4,2),(4,3),(4,4),(4,5),(4,6), (6,1),(6,2),(6,3),(6,4),(6,5),(6,6), (1,1),(1,2),(1,3),(1,4),(1,5),(1,6), (3,1),(3,2),(3,3),(3,4),(3,5),(3,6), (5,1),(5,2), (5,3),(5,4),(5,5),(5,6)}

A ∩ F={(2,1),(2,3),(2,5),(4,1),(4,3),(4,5),(6,1),(6,3),(6,5)}

33. We have, f(x) = sinx + cosx

By using first principle of derivative

$f'(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$

$\therefore f'(x) = \lim_{h \to 0} \frac{\sin(x+h)+\cos(x+h)-\sin x-\cos x}{h}$

$= \lim_{h \to 0} \frac{[\sin x \cdot \cos h+\cos x \cdot \sin h+\cos x \cdot \cos h-\sin x \cdot \sin h-\sin x-\cos x]}{h}$ [∵ sin (x + y) = sin x cos y + cos x sin y and cos (x + y) = cos x cos y - sin x sin y]

$= \lim_{h \to 0} \frac{[(\cos x \cdot \sin h-\sin x \cdot \sin h)+(\sin x \cdot \cos h-\sin x)+(cosx \cdot cosh-cosx)]}{h}$

$= \lim_{h\to 0} \frac{\sin h(\cos x - \sin x) + \sin x(\cos h - 1) + \cos x(\cos h - 1)}{h}$

$= \lim_{h\to 0} \frac{\sin h}{h}(\cos x - \sin x) + \lim_{h\to 0} \frac{\sin x(\cos h-1)}{h} + \lim_{h\to 0} \frac{\cos x(\cos h-1)}{h}$

$= 1 \cdot (\cos x - \sin x) + \lim_{h\to 0} \sin x \left[\frac{-(1-\cos h)}{h}\right] + \lim_{h\to 0} \cos x \left[\frac{-(1-\cos h)}{h}\right] \left[\because \lim_{x\to 0} \frac{\sin x}{x} = 1\right]$

$= (\cos x - \sin x) - \sin x \cdot \lim_{h\to 0}\left(\frac{1-\cos h}{h}\right) - \cos x \cdot \lim_{h\to 0}\left(\frac{1-\cos h}{h}\right)$

$= (\cos x - \sin x) - \sin x \cdot \lim_{h\to 0} \frac{2\sin^2 \frac{h}{2}}{h \times \frac{h}{4}} \times \frac{h}{4} - \cos x \cdot \lim_{h\to 0} \frac{2\sin^2 \frac{h}{2}}{h \times \frac{h}{4}} \times \frac{h}{4}$

$= (\cos x - \sin x) - \sin x \cdot 2 \cdot \frac{1}{4} \lim_{\frac{h}{2}\to 0} \left(\frac{\sin \frac{h}{2}}{\frac{h}{2}}\right)^2 \times h - \cos x \cdot 2 \cdot \frac{1}{4} \lim_{\frac{h}{2}\to 0} \left(\frac{\sin \frac{h}{2}}{\frac{h}{2}}\right)^2 h$

$= (\cos x - \sin x) - \frac{1}{2} \cdot \sin x \cdot (1) \times 0 - \cos x \cdot \frac{1}{2} \cdot (1) \times 0 \left[\because \lim_{x\to 0} \frac{\sin x}{x} = 1\right]$

= (cos x - sin x) - 0 - 0

= cos x - sin x

OR

i. $f(x) = \begin{cases} |x| + 1, & x < 0 \\ 0, & x = 0 \\ |x| - 1, & x > 0 \end{cases}$

At x = 0,

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

$= \lim_{h\to 0} |0+h| - 1$

= - 1

LHL $= \lim_{h\to 0^-} f(x) = \lim_{h\to 0} f|0-h|$

$= \lim_{h\to 0} |0-h| + 1$

$= \lim_{h\to 0} -(0-h) + 1$

$= \lim_{h\to 0} h + 1$

= 0 + 1 = 1

$\Rightarrow$ RHL $\neq$ LHL

$\Rightarrow$ At x = 0, limi does not exist.

Hence, $\lim_{x\to a} f(x)$ exists for all a $\neq$ 0.

ii. Let $f(x) = \cos\left(x - \frac{\pi}{8}\right)$

By using first principle of derivative

We have,

$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$

$\Rightarrow f'(x) = \lim_{h\to 0} \frac{\cos\left(x+h-\frac{\pi}{8}\right) - \cos\left(x-\frac{\pi}{8}\right)}{b} \left[\because f(x) = \cos\left(x - \frac{\pi}{8}\right)\right]$

$= \lim_{h\to 0} \frac{-2\sin\left(\frac{x+h-\frac{\pi}{8}+x-\frac{\pi}{8})}{2}\right)\sin\left(\frac{x+h-\frac{\pi}{8}-x+\frac{\pi}{8}}{2}\right)}{h}$

$\left[\because \cos C - \cos D = -2\sin\left(\frac{C+D}{2}\right)\sin\left(\frac{C-D}{2}\right)\right]$

$= \lim_{h\to 0} \frac{-2\sin\frac{2x-2\left(\frac{\pi}{8}\right)+h}{2}}{2\times\frac{h}{2}}$

$= -\sin\frac{2x-2\left(\frac{\pi}{8}\right)+0}{2} \times 1 \left[\therefore \lim_{x\to 0} \frac{\sin\frac{h}{2}}{\frac{h}{2}} = 1\right]$

$= -\sin\frac{2\left(x-\frac{\pi}{8}\right)}{2}$

$\Rightarrow f'(x) = -\sin\left(x - \frac{\pi}{8}\right)$

34. a + b = 6 $\sqrt{ab}$

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

by C and D

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

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

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

again by C and D

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

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

$\frac{a}{b} = \frac{(\sqrt{2}+1)^2}{(\sqrt{2}-1)^2}$ (on squaring both sides)

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

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

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

35. **LHS** = $\cos\frac{2\pi}{15} \cdot \cos\frac{4\pi}{15} \cdot \cos\frac{8\pi}{15} \cdot \cos\frac{16\pi}{15}$

$= cos\ \frac{2\pi}{15}\ cos2\left(\frac{2\pi}{15}\right) cos4\left(\frac{2\pi}{15}\right)\ cos8\left(\frac{2\pi}{15}\right)$

Put $\frac{2\pi}{15} = \alpha$

$\Rightarrow$LHS = $\cos\alpha \cdot \cos 2\alpha \cdot \cos 4\alpha \cdot \cos 8\alpha$

= $\frac{2\sin\alpha[\cos\alpha\cdot\cos 2\alpha\cdot\cos 4\alpha\cdot\cos 8\alpha]}{2\sin\alpha}$ [multiplying numerator and denominator by $2sin\ \alpha$]

$= \frac{(2\sin\alpha\cdot\cos\alpha)\cdot\cos 2\alpha\cdot\cos 4\alpha\cdot\cos 8\alpha}{2\sin\alpha}$

$= \frac{2(\sin 2\alpha\cdot\cos 2\alpha\cdot\cos 4\alpha\cdot\cos 8\alpha)}{2(2\sin\alpha)}$ [$\because 2sin\alpha\ cos\alpha = sin2\alpha$ and multiplying numerator and denominator by 2]

$= \frac{(2\sin 2\alpha\cdot\cos 2\alpha)\cdot\cos 4\alpha\cdot\cos 8\alpha}{4\sin\alpha}$

$= \frac{2(\sin 4\alpha\cdot\cos 4\alpha)\cos 8\alpha}{2(4\sin\alpha)}$ [$\because 2sin\alpha\ cos\alpha = sin2\alpha$ and multiplying numerator and denominator by 2]

$= \frac{2(\sin 8\alpha\cdot\cos 8\alpha)}{2(8\sin\alpha)}$

$= \frac{\sin 16\alpha}{16\sin\alpha} = \frac{\sin(15\alpha+\alpha)}{16\sin\alpha}$

Now, $15\alpha = 2\pi$,

$= \frac{\sin(2\pi+\alpha)}{16\sin\alpha} = \frac{\sin\alpha}{16\sin\alpha}$ = $\frac{1}{16}$ = RHS

$\therefore$ **LHS = 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^o - A) - (60^o + A)} - cos {(60^o - A) + (60^o + 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^o = $-\frac{1}{2}$]

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

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

$\therefore$ LHS = RHS

Hence proved.

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

On putting A = 20^o, we get

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

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

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

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

[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^o]

Section E

36. i. From the diagram equation of parabola is x^2 = -4ay

Vertex is 10m hight and spam is 100m

parabola passes through (50, -10)

Hence, 50^2 = -4a(-10)

$\Rightarrow$ 2500 = 40a

$\Rightarrow$ a = $\frac{2500}{40} = 62.5$

Hence coordinates of focus = (-a, 0) = (-62.5, 0)

ii. Equation of parabola is x^2 = -4ay and $a = \frac{2500}{40} = 62.5$

Equation is $x^2 = -4\left(\frac{2500}{40}\right)$ y

$\Rightarrow$ x^2 = -250y

Length of latus rectum is 4a = 4 $\times$ 62.5 = 250m

iii. Equation parabola x^2 = -250y

Coordinates of the point at 20 m from mid point = (20, y)

Substituting in the equation of parabola

$\Rightarrow$ 400 = -250y

$\Rightarrow$ y = $\frac{-400}{250}$ = -1.6

height of the bridge = 10 - 1.6 = 8.4m

OR

vertex of parabola is (0, 0) and focus is (0, -62.5)

$\Rightarrow$ (0, -62.5) is center and (0, 0) is on the circle

$\Rightarrow$ r = 0 - (-62.5) = 62.5 m

37. i. coefficient of variation of wages, of firm A = 0.19

coefficient of variation of wages, of firm B = $\frac{121}{5253} \times 100$ = 0.21

$\therefore$ Firm B shows greater variability in individual wages.

ii. Standard deviation, $\sigma = \sqrt{\sigma^2} = \sqrt{121}$ = 11

iii. Variance of distribution of wages, σ^2 = 100

Standard deviation, $\sigma = \sqrt{\sigma^2}$ = $\sqrt{100}$ = 10

coefficient of Variation = $\frac{\sigma}{\bar{x}} \times 100$

= $\frac{10}{5,253} \times 100$

= 0.19

OR

No. of wage earners = 586

Mean of monthly wages, $\bar{x}$ = ₹5253

Amount paid by firm A = ₹(586 $\times$ 5253) = ₹3078258

38. Total number of letters in word MONDAY = 6

Number of vowels in word MONDAY = 2

(i) Number of letters used = 4

$\therefore$ Number of permutations $= {}^6P_4 = \frac{6!}{(6-4)!}$

$= \frac{6!}{2!} = \frac{6\times5\times4\times3\times2!}{2!} = 360$

(ii) Number of letters used = 6

$\therefore$ Number of permutations $= {}^6P_6$

$= \frac{6!}{0!} = 6\times5\times4\times3\times2\times1 = 720$