31 Mth 10/25

2025

MATHEMATICS

Full Marks : 100

Pass Marks : 33

Time : Three hours

Attempt all Questions.

The figures in the right margin indicate full marks for the questions.

For Question Nos. 1 – 10, write the letter associated with the correct answer and Question Nos. 11 and 12 are Assertion and Reason bassed questions of 1 mark each.

1. The number of non-empty proper subsets of the set A containing n elements is 1

(A) 2^n (B) 2^n-1

(C) 2^n+1 (D) 2^{n+1}

2. If A = {1, 2, 3, 4, 5}, B = {2, 4, 6} and C = {3, 4, 6} then $(A \cup B) \cap C$ is 1

(A) {3, 4, 6} (B) {1, 2, 3}

(C) {1, 3, 4} (D) {2, 4, 6}

3. If $\sin x = 0$, then 1

(A) $x = n\frac{\pi}{2}, n \in I$ (B) $x = n\pi, n \in I$

(C) $x = (2n+1)\frac{\pi}{2}, n \in I$ (D) $x = (2n+1)\pi, n \in I$

P.T.O.

4. The length of an arc of a circle of a diameter 20cm which subtends an angle of 45° at the centre is 1

(A) 7 cm (B) 7.56 cm

(C) 7.76 cm (D) 7.86 cm

5. The value of ${}^nC_r$ is equal to 1

(A) $\frac{n!}{(n-r)!}$ (B) $\frac{n!}{{}^nP_r}$

(C) $\frac{{}^nP_r}{r!}$ (D) $\frac{(n-r)!r!}{n!}$

6. The sum of infinity of the G.P. $1, \frac{1}{3}, \frac{1}{9}, \ldots\ldots$ is 1

(A) Infinity (B) 0

(C) $\frac{1}{3}$ (D) $\frac{3}{2}$

7. If a, b, c are in A.P. then the straight line $ax + by + c = 0$ will always pass through 1

(A) (1, 2) (B) (–1, 2)

(C) (1, –2) (D) (–1, –2)

8. $\lim\limits_{x \to \frac{\pi}{4}} \frac{\sin x - \cos x}{x - \frac{\pi}{4}}$ is equal to 1

(A) –2 (B) 2

(C) $\sqrt{2}$ (D) $-\sqrt{2}$

9. The distance of the point P (x, y, z) from x - axis is 1

(A) $\sqrt{x^2+y^2+z^2}$ (B) $\sqrt{x^2+y^2}$

(C) $\sqrt{y^2+z^2}$ (D) $\sqrt{z^2+x^2}$

10. Which one of the following is not true ? 1

(A) For an impossible event A, P (A) = 0

(B) Any subset E of a sample space S is called an event

(C) For any event A, P (A) + P (A') = 0

(D) Simple events of a sample space are always mutually exclusive

Questions numbers 11 and 12 are assertion and reason based questions. Two statements are given, one lebelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason(R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is false.

11. Assertion (A) : For $x = \pm 1$, the numbers $\frac{-2}{7}$, x, $\frac{-7}{2}$ are in G.P.

Reason (R) : Three numbers a, b, c are in G.P if $b^2 = ac$. 1

12. Assertion (A) : Let $A = \{1, 2, 3\}$, $B = \{1, 2, 3, 4\}$ then $B \subset A$.

Reason (R) : If every element of X is also an element of Y, then X is a subset of Y. 1

13. Define 1 (one) radian. 1

14. Solve : $3x + 8 > 2$, when x is real. 1

15. What is a series ? 1

16. Find the slope of the line which makes an angle of 30° with the positive direction of y - axis measured anticlockwise. 1

17. Write the equation of the directrices of the hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$. 1

18. Define limit of a function $f(x)$ as x tends to a. 1

19. Find the mean of first n natural numbers. 1

20. Two dice are thrown. What is the probability of getting a doublet ? 1

21. Define modulus and conjugate of a complex number. 2

22. Express the expression $\frac{(3+i\sqrt{5})(3-i\sqrt{5})}{(\sqrt{3}+i\sqrt{2})-(\sqrt{3}-i\sqrt{2})}$ in the form of $a + ib$. 2

23. Mohon obtained 65 and 75 marks in the first two unit test. Find the minimum marks he should get in the third test to have an average of at least 60 marks. 2

24. (a) Find n if ${}^{n-1}P_3 : {}^nP_4 = 1 : 9$ 2

Or

(b) Prove that $\sum_{r=0}^{n} 3^r \cdot {}^nC_r = 4^n$

25. How many 4 - digit numbers are there with no digit repeated ? 2

26. Find the equation of a line intersecting the y - axis at a distance of 2 units above the origin and making an angle of 30^0 with the positive direction of the x - axis. 2

27. (a) Prove that $\frac{\cos 4x + \cos 3x + \cos 2x}{\sin 4x + \sin 3x + \sin 2x} = \cot 3x$ 3

Or

(b) Prove that $\cos^2 2x - \cos^2 6x = \sin 4x \sin 8x$

28. (a) If $z_1 = a + ib$ and $z_2 = c + id$, prove that $\overline{\left(\frac{z_1}{z_2}\right)} = \frac{\bar{z}_1}{\bar{z}_2}$. 3

Or

(b) For any two complex number z_1 and z_2 show that $\left|\frac{z_1}{z_2}\right| = \frac{|z_1|}{|z_2|}$.

29. If $(x+iy)^3 = u+iv$, then prove that $\frac{u}{x} + \frac{v}{y} = 4(x^2 - y^2)$. 3

30. In a class of 60 students, 23 opted for NCC, 32 opted for NSS and 15 opted for both NCC and NSS. If one of these students is selected at random, find the probability that the student opted for NCC or NSS. 3

31. Draw the graph of the greatest integer function $f(x) = [x]$ in the interval $[-3, 3]$. (Graph paper will not be supplied). 4

32. Find the value of $\tan\frac{\pi}{8}$. 4

33. A committe of 7 has to be formed from 9 boys and 4 girls. In how many ways can this be done when the committe consists of (i) exactly 3 girls (ii) at least 3 girls. 4

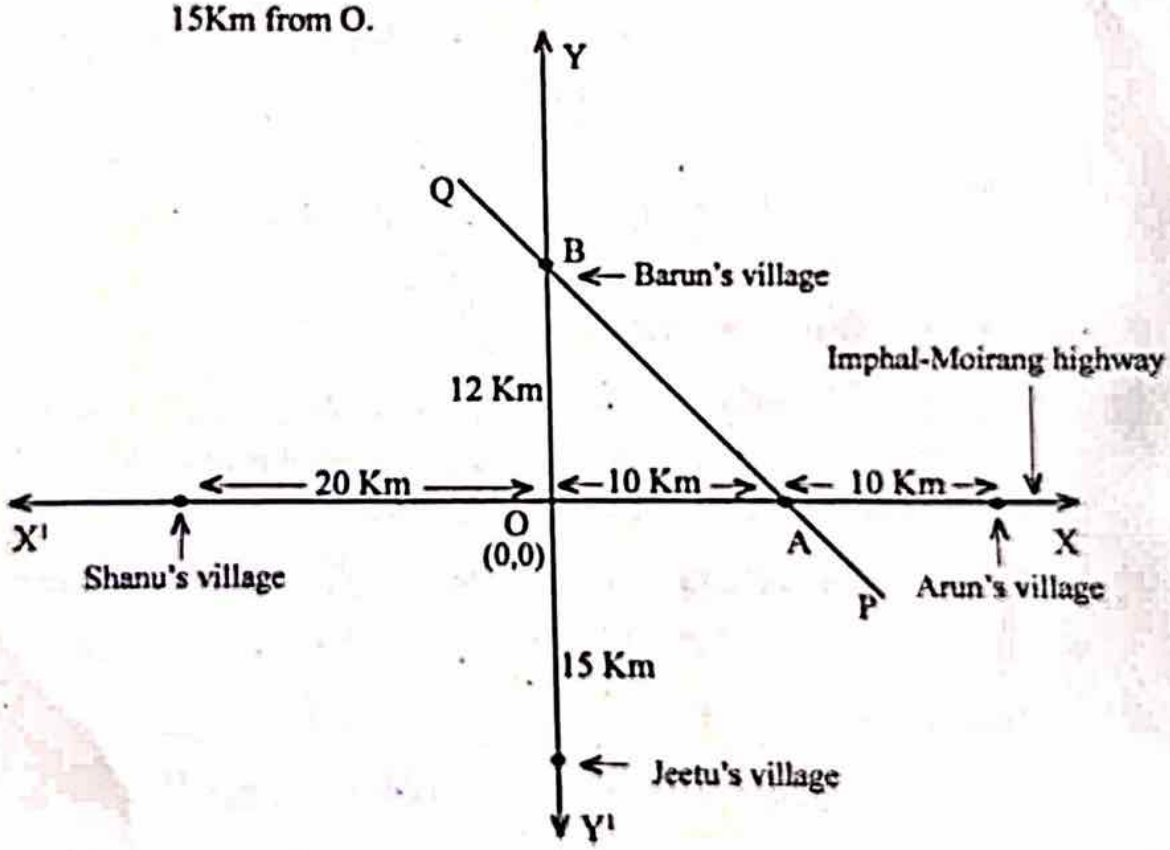
34. (a) Evaluate $\lim_{x \to 0} \frac{\tan x - \sin x}{x^3}$. 4

Or

(b) Find the derivative of $\sin\sqrt{x}$ with respect to x from first principle. 4

Case study – based question

35. (a) Villages of Shanu and Arun are 40 km apart and are situated on Imphal-Moirang highway as shown in the following picture. Another highway YY' crosses Moirang-Imphal highway at O (0.0). A small local road P Q crosses both the highways at points A and B such that OA = 10Km and OB = 12Km. Also the villages of Barun and Jeetu are on the similar highway YY^1. Barun's village B is 12Km from O and that of Jeetu is 15Km from O.



Base on the above information, answer the following questions : 2+1+1=4

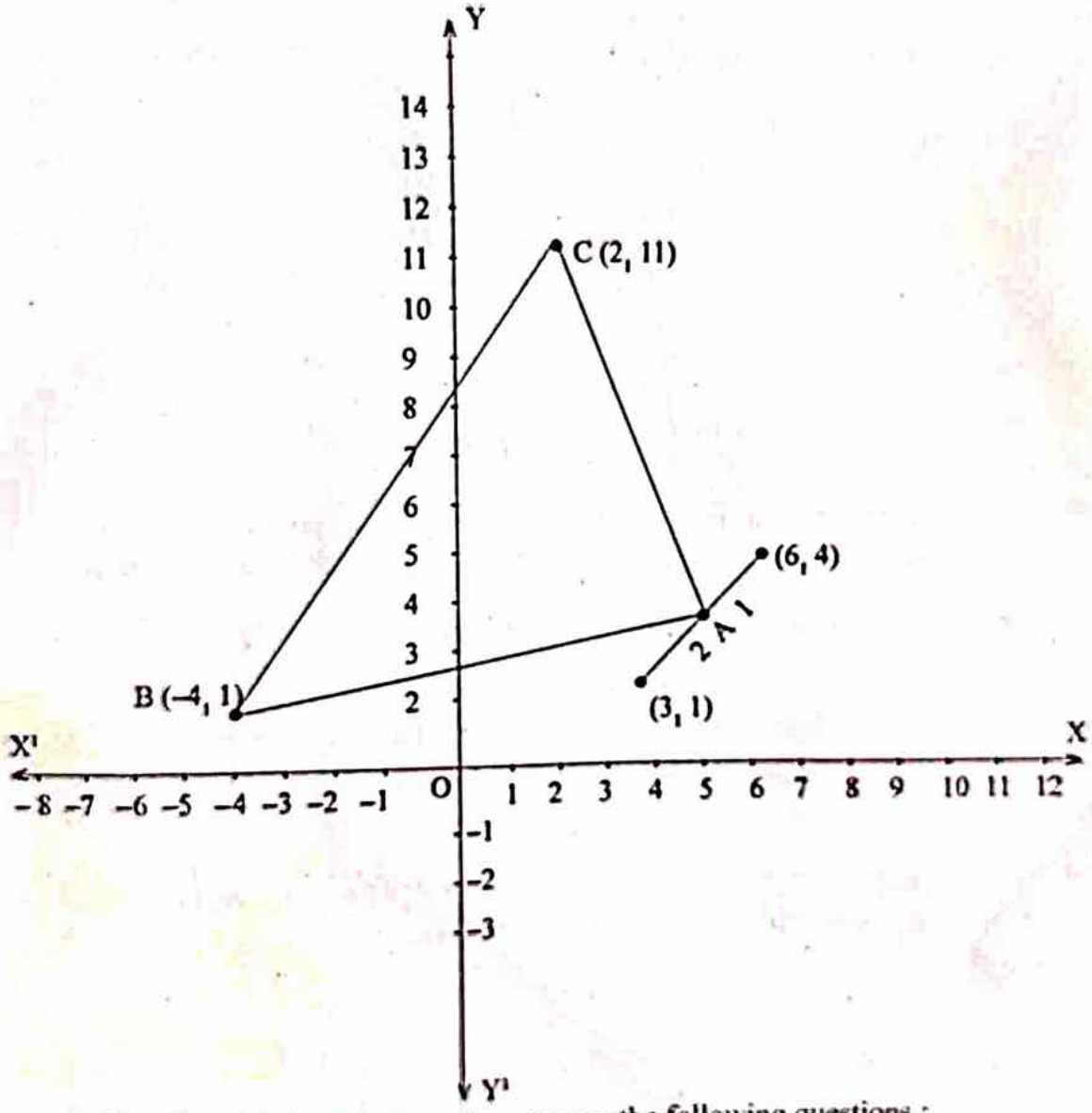
Find (i) the equation of line A B.

(ii) the perpendicular distance of A B from O (0, 0).

(iii) the distance between Shanu's village and Jeetu's village.

Or

(b) A triangular park has two of its vertices as B (– 4, 1) and C (2, 11). The third vertex A is a point dividing the line joining the points (3.1) and (6.7) in the ratio 2:1.



Based on the above information, answer the following questions :

Find (i) the co-ordinates of A,

(ii) the lenght of the median drawn from vertex A on the side BC.

(iii) the area of triangular park ABC. 1+1+2=4

36. If $U = \{1, 2, 3, ..., 10\}$, $A = \{2, 3, 4, 5\}$ and $B = \{1, 2, 3, 4, 5, 6\}$. Verify that 6

(i) $A \cup A' = U$ and $B \cap B' = \phi$

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

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

37. (a) Prove that $\sin^3 x + \sin^3\left(\frac{2\pi}{3} + x\right) + \sin^3\left(\frac{4\pi}{3} + x\right) = -\frac{3}{4}\sin 3x$ 6

Or

(b) Prove that $\tan x + \tan\left(\frac{2\pi}{3} + x\right) - \tan\left(\frac{\pi}{3} - x\right) = 3\tan 3x$.

38. Define a permutation. Prove that the number of permutation of n different objects taken r at a time, when $0 < r \leq n$ and the objects do not repeat is ${}^nP_r = n(n-1)(n-2).....(n-r+1)$. Hence deduce that ${}^nP_r = \frac{n!}{(n-r)!}$ 6

39. The lengths of three unequal edges of a rectangular solid block are in G.P. The volume of the block is 216 cm^3 and its surface area is 252 cm^2. Find the length of the longest edge. 6

40. (a) Find the equation of the circle passing through the points (4, 1) and (6, 5) and whose centre is on the line $4x + y = 16$ 6

Or

(b) Find the co-ordinates of the foci, the vertices, the length of major axis, the minor axis, the eccentricity and length of latus-rectum of the ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$

41. (a) Find the mean deviation about the median for the following frequency distribution : 6

Class	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60
Frequency	6	7	15	12	6	4

Or

(b) Calculate the mean and variance for the following data :

Class	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
Frequency	15	20	22	27	16