12PB25MAT03

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ERNAKULAM REGION -PRE BOARD EXAMINATION (2025-26)

CLASS XII MATHEMATICS SUBJECT CODE :041

DURATION: 3 Hours MAX MARKS :80

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:
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) with only one correct option 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 calculator is not allowed.

SECTION A

This section comprises of multiple choice questions (MCQs) of 1 mark each.

Select the correct option (Question 1 - Question 18)

1.The value of $\sin(\tan^{-1} x)$ where $|x| < 1$ is

A. $\frac{x}{\sqrt{1-x^2}}$ B. $\frac{1}{\sqrt{1-x^2}}$ C. $\frac{x}{\sqrt{1+x^2}}$ D. $\frac{1}{\sqrt{1+x^2}}$

2. If $A = \begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is such that $A^2 = I$ ,then

A. $1 + \alpha^2 + \beta\gamma = 0$ B. $1 - \alpha^2 + \beta\gamma = 0$ C. $1 - \alpha^2 - \beta\gamma = 0$ D. $1 + \alpha^2 - \beta\gamma = 0$

3. The value of $|A|$ , if $A = \begin{bmatrix} 0 & 2x-1 & \sqrt{x} \\ 1-2x & 0 & 2\sqrt{x} \\ -\sqrt{x} & -2\sqrt{x} & 0 \end{bmatrix}$ ,where $x \in R^+$ is

A. $(2x+1)^3$ B. $(2x+1)^2$ C. $-8x^2$ D. $0$

4. A and B are square matrices of same order . If $(A+B)^2 = A^2 + B^2$ , then

A. $AB = BA$ B. $AB = -BA$ C. $AB = 0$ D. $BA = 0$

5. In the interval $\frac{\pi}{2} < x < \pi$ the value of $x$ for which the matrix $\begin{bmatrix} 2sinx & 3 \\ 1 & 2sinx \end{bmatrix}$ is singular is

A .$\frac{2\pi}{3}$ B. $\frac{3\pi}{4}$ C. $\frac{5\pi}{6}$ D. $\frac{3\pi}{5}$

6. If $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ , B = $\begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ , then

A. $A^{-1} = B$ B. $A^{-1} = 6B$ C. $B^{-1} = B$ D. $B^{-1} = \frac{1}{6} A$

7.If a function is defined by $f(x) = \begin{cases} \frac{1-cos4x}{x^2} & ,x \neq 0 \\ p, x = 0 \end{cases}$ is continuous at $x = 0$,then the value of $p$ is

A. 0 B. 8 C. 4 D. 2

8. If $x^2 + y^2 = t - \frac{1}{t}$ and $x^4 + y^4 = t^2 + \frac{1}{t^2}$, then $\frac{dy}{dx}$ is equal to

A . $\frac{x}{y}$ B. $-\frac{y}{x}$ C. $\frac{1}{x^3 y}$ D. $-\frac{1}{x^3 y}$

9. A function $f(x) = 10 - x - 2x^2$ is increasing on the interval

A. $(-\infty, -\frac{1}{4}]$ B. $(-\infty, \frac{1}{4})$ C. $[-\frac{1}{4}, \infty)$ D. $[-\frac{1}{4}, \frac{1}{4}]$

10. What is the sum of the order and the degree of the differential equation $\frac{d}{dx}\left[(\frac{dy}{dx})^4\right] = 0$ is

A. 2 B. 3 C. 4 D. 5

11. $\int_{-1}^{1} log\left(\frac{2-x}{2+x}\right) dx$ is equal to

A. 2 log2 B . $\frac{2}{3}$ C. 0 D. $-\log 2$

12. $\int \frac{1}{x^2+4x+8} dx$ is equal to

A. $\sin^{-1}\frac{x+2}{2} + C$ B. $\frac{1}{4}\log\left|\frac{x}{x+4}\right| + C$ C. $\frac{1}{4}\log\left|\frac{x+4}{2-x}\right| + C$ D. $\frac{1}{2}\tan^{-1}\left(\frac{x+2}{2}\right) + C$

13. Let $\vec{a} = \hat{\imath} - 2\hat{\jmath} + 3\hat{k}$.If $\vec{b}$ is a vector such that $\vec{a}.\vec{b} = |\vec{b}|^2$ and $|\vec{a} - \vec{b}| = \sqrt{7}$ ,then $|\vec{b}|$ is equal to

A. $\sqrt{7}$ B. 14 C.21 D.7

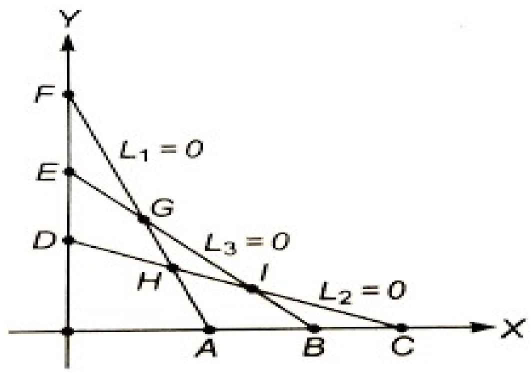
14. For any vector $\vec{a}$ ,the value of $(\vec{a} \times \hat{\imath})^2 + ((\vec{a} \times \hat{\jmath})^2 + ((\vec{a} \times \hat{k})^2$ is

A. $\vec{a}^{\,2}$ B. $2\vec{a}^{\,2}$ C. $3\vec{a}^{\,2}$ D. $4\vec{a}^{\,2}$

15. The equation of the line passing through the point$(2, -1, 0)$ and parallel to the line $\frac{x}{1} = \frac{y-1}{2} = \frac{2-z}{2}$ is

A. $\frac{x+2}{1} = \frac{y-1}{2} = \frac{z}{2}$ B. $\frac{x-2}{1} = \frac{y-1}{2} = \frac{z}{2}$ C. $\frac{x+2}{1} = \frac{y-1}{2} = \frac{z}{-2}$ D. $\frac{x-2}{1} = \frac{y+1}{2} = \frac{z}{-2}$

16. The feasible region for the following constraints $L_1 \leq 0, L_2 \geq 0, L_3 = 0, x \geq 0, y \geq 0$ in the diagram shown




A. Area DHF B. area AHC C. line segment EG D. line segment GI

17. The corner points of the feasible region determined by the system of linear constraints are $(0,3), (1,1)$ and $(3,0)$.Let $Z = px + qy$ where $p, q > 0$.Then the condition on $p$ and $q$ so that minimum of $Z$ occurs at (3,0) and (1,1) is

A. $2q = p$ B. $2p = q$ C. $p = q$ D. $3q = p$

18. If A and B are two events such that $P(A) = \frac{1}{4}$ , $P(B) = \frac{1}{6}$ and $P(A \cap B) = \frac{1}{7}$ then $P\left(\frac{\bar{B}}{\bar{A}}\right)$is

A. $\frac{61}{63}$ B. $\frac{9}{10}$ C. $\frac{23}{84}$ D. $\frac{23}{70}$

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each.

Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) as given below.)

(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.ue.

19. Assertion (A) : The range of the function $f(x) = 2\sin^{-1} x + \frac{3\pi}{2}$ , $x \in [-1,1]$ is $[\frac{\pi}{2}, \frac{5\pi}{2}]$

Reason ( R) : The range of the principal value branch of $\sin^{-1} x$ is $[0, \pi]$

20. Assertion (A) : The projection of the vector $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$ on the vector $\vec{b} = \hat{\imath} + 2\hat{\jmath} + \hat{k}$ is $\frac{5\sqrt{6}}{3}$

Reason (R) : The projection of vector $\vec{a}$ on vector $\vec{b}$ is $\frac{\vec{a}.\vec{b}}{|\vec{a}|}$

SECTION B

(This section comprises of 5 very short answer type-questions (VSA) of 2 marks each)

21A. Find the domain of $y = \sin^{-1}(x^2 - 4)$

OR

21B. Find the value of $\sin^{-1}\{\sin\frac{13\pi}{7}\}$

22. If $e^y(x+1)=1$, show that $\frac{d^2y}{dx^2}=(\frac{dy}{dx})^2$

23. Find the number of points of discontinuity of f defined by $f(x)=|x|-|x+1|$

24A. Find $\int cos^3xe^{logsinx}dx$

OR

24B. Find the area of region bounded by the curve $y=cosx$ between $x=0$ and $x=\pi$

25. Write a unit vector in the direction of the sum of vectors $\vec{a}=2\hat{\imath}+2\hat{\jmath}-5\hat{k}$ and $\vec{b}=2\hat{\imath}+\hat{\jmath}-7\hat{k}$

SECTION C

This section comprises of 6 short answer (SA) type questions of 3 marks each.

26A. If $(cosx)^y=(cosy)^x$ ,then find $\frac{dy}{dx}$

OR

26B . Find the value of $\frac{dy}{dx}$ at $\theta=\frac{\pi}{3}$ if $x=a(2\theta-sin2\theta)$ and $y=a(1-cos2\theta)$

27. The two equal sides of an isosceles triangle with fixed base b are decreasing at the rate of 3 cm per second. How fast is the area decreasing when the two equal sides are equal to the base ?

28A. Find the area of the region bounded by the curve $4x^2+y^2=36$ using integration

OR

28B. Using integration find the area of region bounded by the curves

$y=|x+1|+1,\ x=-3,\ x=3$ and $y=0$

29A. Find the equation of the equation of the line passing through the point (2,1.3) and perpendicular to the lines $\frac{x-1}{1}=\frac{y-2}{2}=\frac{z-3}{3}$ and $\frac{x}{-3}=\frac{y}{2}=\frac{z}{5}$

OR

29B. Find the shortest distance between the lines

$\vec{r}=4\hat{\imath}-\hat{\jmath}+s(\hat{\imath}+2\hat{\jmath}-3\hat{k})$ and $\vec{r}=\hat{\imath}-\hat{\jmath}+2\hat{k}+t(2\hat{\imath}+4\hat{\jmath}-5\hat{k})$

30. Solve the following LPP graphically

Maximize$Z=60x+40y$ subject to the constraints

$x+2y\le 12$

$2x+y\le 12$

$4x+5y\ge 20$ and $x\ge 0, y\ge 0$

31.A can hit a target 4 times out of 5 times, B can hit the target 3 times out of 4timesand C can hit the target 2 times out of 3 times .They fire simultaneously. Find the probability that any two out of A ,B and C hit the target

## SECTION D

(This section comprises of 4 long answer type questions (LA) of 5 marks each)

32. Find $A^{-1}$ where $A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & 3 & 2 \\ 3 & -3 & -4 \end{bmatrix}$. Hence solve the system of equations

$x + 2y - 3z = -4$

$2x + 3y + 2z = 2$ and

$3x - 3y - 4z = 11$

33A. Find $\int \frac{x \tan^{-1} x}{(1+x^2)^{\frac{3}{2}}} dx$

OR

33B. Evaluate $\int_0^{\pi} \frac{x}{a^2 cos^2 x + b^2 sin^2 x} dx$

34A. Solve the differential equation $x^2 dy + (xy + y^2) dx = 0$, given $y = 1$ when $x = 1$.

OR

34B . Solve the differential equation $(\tan^{-1} x - y) dx = (1 + x^2) dy$

35. An aeroplane is flying along the line $\vec{r} = \lambda(\hat{\imath} - \hat{\jmath} + \hat{k})$ where $\lambda$ is a scalar and another aeroplane is flying along the line $\vec{r} = \hat{\imath} - \hat{\jmath} + \mu(-2\hat{\jmath} + \hat{k})$, where $\mu$ is a scalar .At what points on the lines should they reach , so that distance between them is the shortest ? Find the shortest possible distance between them.

## SECTION E

(This section comprises of 3 case study/passage-based questions of 4 marks).

36. An organization conducted bike race under 2 different categories-boys and girls. In all, there were 250 participants. Among all of them finally three from Category 1 and two from Category 2 were selected for the final race. Sourav forms two sets *B* and *G* with these participants for his college project.

Let $B = \{b_1, b_2, b_3\}$ , $G = \{g_1, g_2\}$ where *B* represents the set of boys selected and *G* the set of girls who were selected for the final race. Sourav decides to explore these sets for various types of relations and functions.On the basis of the above information, answer the following questions:

I . Sourav wishes to form all the relations possible from *B* to *G*. How many such relations are possible?

II. Write the smallest equivalence relation on G.

IIIA. Sourav defines a relation from B to B as $R_1 = \{(b_1, b_2), (b_2, b_3)\}$. Write the minimum ordered pairs to be added in $R_1$ so that it

(a) reflexive but not symmetric

(b) reflexive and symmetric but not transitive.

OR

III B. If the track of the final race (for the biker $b_1$ ) follows the curve $x^2 = 4y$; where $0 \leq x \leq 20\sqrt{2}$ & $0 \leq y \leq 200$, then state whether the track represents a one-one and onto function or not. Justify.

37.The Government declare that farmer can get Rs 300 per quintal for their onions on 1st July and after that the price will be dropped by Rs 3 per quintal per extra day. Pranav's father has 80 quintal of onions in the field on 1st July and he estimates that crop is increasing at the rate of 1 quintal per day. Based on the above information ,answer the following.

I .If $x$ is the number of days after 1st July, then express the price and quantity of onion respectively in terms of $x$.

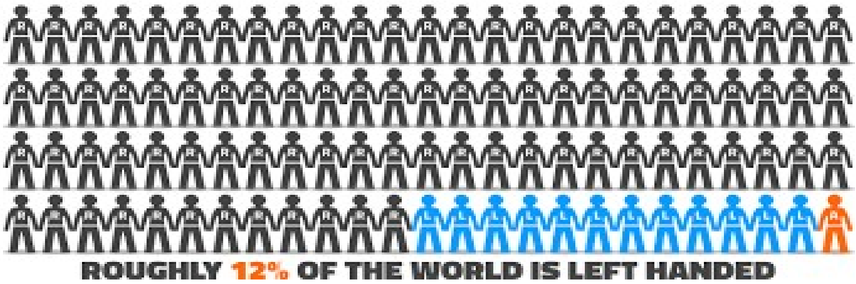
II .Express revenue R as a function of $x$

III A. Find the number of days after 1st July , when Pranav's father attain maximum Revenue.

OR

III B. On which day should Pranav's father harvest the onions to maximise his revenue and what is the maximum revenue?

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




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

A: When both father and mother are left handed ,chances of left handed child is 24%

B: When father is right handed and mother is left handed , chances of left handed child is 22%

C: When father is left handed and mother is right handed , chances of left handed child is 17%

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

Assuming $P(A) = P(B) = P(C) = P(D) = \frac{1}{4}$ and L denotes the child is left handed.Based on the above information answer the following questions

I. Find $P(A/L)$

II. Find the probability that a randomly selected child is left handed given that exactly one of the parent is left handed.