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ERNAKULAM REGION -PRE BOARD EXAMINATION (2026-27)

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.Let R be the equivalence relation in the set $A = \{0,1,2,3,4,5\}$ given by

$R = \{(a, b): 2\ divides\ a - b\}$.Which of the following represent equivalence class [0]?

A. $\{1,3,5\}$ B. $\{0,2,4\}$ C.$\{0,1,2,3,4,5\}$ D. $\{2,4\}$

2. Let $f : [0, \infty) \rightarrow [0, 2]$ be defined by $f(x) = \frac{2x}{1+x}$ then f is

A. one –one and onto B. neither one –one nor onto

C. one –one but not onto D. onto but not one –one

3. If $A = \begin{bmatrix} 1 & 2 & x \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 & y \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $AB = I$ then $x + y$ is

A.-1 B. C. 2 D. 5

4.If $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$, then A^n where $n \epsilon N$ is

A. $\begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix}$ B. $\begin{bmatrix} 1 & 1 \\ 0 & n \end{bmatrix}$ C. $\begin{bmatrix} 1 & 2^n \\ 0 & 1 \end{bmatrix}$ D. $\begin{bmatrix} n & 0 \\ 0 & n \end{bmatrix}$

5. If A is a skew symmetric matrix ,which of the following is necessarily symmetric?

A. A^2 B. A^3 C. $A^2 + A$ D. $A^2 + A^3$

6.If $A = \begin{bmatrix} 1 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$,then $|adj(adjA)|$ is

A. 10^4 B. 12^4 C. 10^6 D. 14^4

7.The maximum value of $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+sin\theta & 1 \\ 1+cos\theta & 1 & 1 \end{vmatrix}$ is (θ is a real number)

A. $\frac{\sqrt{3}}{2}$ $B.\sqrt{2}$ C. $\frac{1}{2}$ D. $\frac{\sqrt{3}}{4}$

8. The domain of $f(x) = \sin^{-1} x + cosx$ is

A. $[-1,1]$ B. R C. $[-1, \pi + 1]$ D. $[0, 1]$

9.The number of points of discontinuity of the function f defined by $f(x) = \begin{cases} x+2\ , & if \quad x < 0 \\ e^x\ , & if\ \ 0 \le x \le 1 \\ 2-x & if \quad x > 0 \end{cases}$

A. 0 B. 1 C. 3 D. 2

10.If $f(x) = |sinx|$, then $f'\left(-\frac{\pi}{6}\right)$ is equal to

A.$-\frac{1}{2}$ B. .$\frac{1}{2}$ C. .$-\frac{\sqrt{3}}{2}$ D. $\frac{\sqrt{3}}{2}$

11. The function $f(x) = x - sinx$ decreases for

A. all x B. $x < \frac{\pi}{2}$ C. $0 < x < \frac{\pi}{4}$ D. no value of x

12.$\int 2^{x+2}\, dx$ is equal to

A. $2^{x+2} + C$ B. $\frac{2^{x+2}}{log2} + C$ C. $2^{x+2} \log 2 + C$ D. $2^{x+1} \log 2 + C$

13.The value of the integral $\int_0^{\pi} \frac{1}{e^{cosx}+1} dx$ is

A. 0 B. $\frac{\pi}{2}$ C. $\pi/4$ D. 2π

14.If $\vec{a}\,.\hat{\imath} = \vec{a}\,.(\hat{\imath} + \hat{\jmath}) = \vec{a}\,.\left(\hat{\imath} + \hat{\jmath} + \hat{k}\right) = 1$,then $\vec{a}$ is

A. 0 B. $\hat{\imath}$ C. $\hat{\jmath}$ D. $\left(\hat{\imath} + \hat{\jmath} + \hat{k}\right)$

15.The value of p for which the vectors $2\,\hat{\imath} + p\hat{\jmath} + \hat{k}$ and $-4\,\hat{\imath} - 6\hat{\jmath} - 2\hat{k}$ are perpendicular to each other is

A. $\frac{17}{3}$ B. $-\frac{17}{3}$ C. $\frac{5}{3}$ D. $-\frac{5}{3}$

16.ABCD is a parallelogram with AC and BD as diagonals. Then $\overrightarrow{AC} - \overrightarrow{BD}$ is

A. $4\overrightarrow{AB}$ B. $3\overrightarrow{AB}$ C. $2\overrightarrow{AB}$ D. $\overrightarrow{AB}$

17.The angle between the lines $\frac{x-1}{3} = \frac{y+1}{-2}, z = 2$ and $\frac{x-1}{1} = \frac{2y+3}{3} = \frac{z+5}{2}$ is

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

18.The straight line $\frac{x-3}{3} = \frac{y-2}{1} = \frac{z-1}{0}$ is

A. parallel to x axis B. perpendicular to y axis

C. parallel to z axis D. perpendicular to z axis

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.

19.Assertion (A): The value of $\int_0^{\frac{\pi}{2}} \frac{1}{1+\sqrt{tanx}} dx = \frac{\pi}{4}$

Reason (R) : $\int_0^a f(x)dx = \int_0^a f(a-x)dx$

20.Assertion (A): The order of the differential equation associated with the primitive

$y = C_1 + C_2 e^x + C_3 e^{-2x+C_4}$ where C_1, C_2, C_3 and C_4 are arbitrary constants, is 4

Reason (R) : The order of the differential equation representing a family of curves is same as the number of arbitrary constants in its primitive.

SECTION B

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

21A. $\int \frac{sinx-xcos}{x(x+sin\ )} dx$

OR

21B. $\int \frac{1}{x(x^3+8)} dx$

22.Find the value of $tan^2(\sec^{-1} 2) + cot^2(cosec^{-1} 3)$

23.Position vectors of the points A ,B and C as shown in the figure below are $\vec{a}, \vec{b}$, and $\vec{c}$ respectively .If $\overrightarrow{AC} = \frac{5}{4}\overrightarrow{AB}$,then express $\vec{c}$ in terms of $\vec{a}$ and $\vec{b}$.

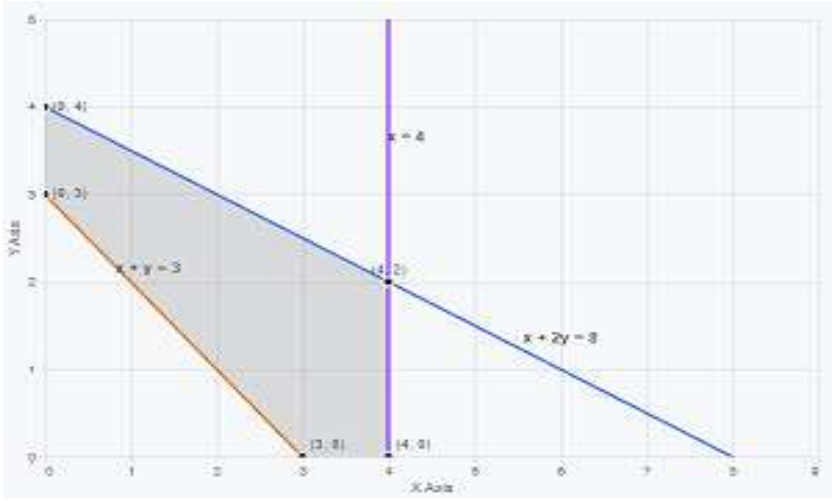


24A.The Cartesian equation of the line are $2x - 5 = 3y + 1 = 7 - 5z$.Write the direction cosines of the line.

OR

24B. A line passes through (2, –1, 3) and is perpendicular to the lines $\vec{r} = \hat{\imath} + \hat{\jmath} - \hat{k} + \lambda(2\hat{\imath} - 2\hat{\jmath} + \hat{k})$ and $\vec{r} = 2\hat{\imath} - \hat{\jmath} - 3\hat{k} + \mu(\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$. Obtain its equation in vector form .

25. The feasible region of a linear programming problem is shown in the given figure.



SECTION C

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

26.Prove that the product of the matrices $A = \begin{bmatrix} cos^2x & cosxsinx \\ cosxsinx & sin^2x \end{bmatrix}$ and $B = \begin{bmatrix} cos^2y & cosysiny \\ cosysiny & sin^2y \end{bmatrix}$ is a the null matrix when x and y differ by an odd multiple of $\frac{\pi}{2}$

27 A.If $y = x^{cotx} + \frac{2x^2-3}{x^2+x+2}$,find $\frac{dy}{dx}$

OR

27B.If $x + y = t + \frac{1}{t}$ and $x^3 + y^3 = t^3 + \frac{1}{t^3}$,then prove that $\frac{dy}{dx} = -\frac{1}{x^2}$

28 A kite is moving horizontally at the height of $151.m$.If the speed of the kite is $10m/s$,then how fast is the string being let out ,when the kite is $250m$ away from the boy who is flying the kite ,if the height of the boy is $1.5m$.

29A.Find the general solution of the differential equation $x^2dy + (xy + y^2)dx = 0$

OR

29B.Find the particular solution of the differential equation $(1 + x^2)\frac{dy}{dx} + y = e^{m\,\mathrm{ta}\ ^{-1}x}$,given that $y = 1$ when $x = 0$

30A.Show that the area of parallelogram whose diagonals are represented by $\vec{a}$ and $\vec{b}$ is given by $\frac{1}{2}|\vec{a} \times \vec{b}|$.Also find the area of parallelogram whose diagonals are $2\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\hat{\imath} + 3\hat{\jmath} - \hat{k}$.

OR

30B.The position vectors pf vertices of ΔABC are A$(2\hat{\imath} - \hat{\jmath} + \hat{k})$, B$(\hat{\imath} - 3\hat{\jmath} - 5\hat{k})$ and C$(3\hat{\imath} - 4\hat{\jmath} - 4\hat{k})$.Find all the angles of ΔABC.

31 .Maximise $Z = 105x + 90y$ subject to the constraints

$$x + y \leq 50$$

$$2x + y \leq 80$$

$$x \geq 20$$

$$x \geq 0, y \geq 0$$

SECTION D

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

32. $\int_0^{\frac{\pi}{2}} \frac{x}{sinx+cosx}\, dx$

33A.Show that the function $f: R \to R$ defined by $f(x) = \frac{2x}{1+x^2}$ is neither one one nor on to .Further find set A so that $f: R \to A$ becomes an on to function .

OR

33B.Show that relation R define on set $A = \{-4, -3, -2, -1, 0, 1, 2, 3, 4\}$ as

$R = \{(x, y): x + y \ is \ an \ \ integer \ divisible \ by \ 2\}$is an equivalence relation.Also write the equivalence class [2].

34. If $(x-a)^2+(y-b)^2=c^2$.Prove that $\frac{[1+(y')^2]^{\frac{3}{2}}}{y''}$ is a constant and independent of a and b.

35A. Draw a rough sketch of the curve $y=1+|x+1|, x=-3, x=3$ and $y=0$.Find the area of the region bounded by them ,using integration.

OR

35B. Using integration, find the area of the region bounded by the line $x-y+2=0$, the curve $x=\sqrt{y}$ and Y-axis

SECTION E

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

36. In analytical coordinate geometry, a straight line on a Cartesian plane can be modelled using various geometric constraints. Because lines can be defined by different parameters, there are various forms of equations of lines including the slope-intercept form ,the point-slope form and the two-point form. When a line crosses the coordinate axes, it defines specific markers known as intercepts. The intercept of a line is the distance from the origin point $(0,0)$ to the exact point where the straight line cuts either the horizontal (X) axis or the vertical (Y) axis.

The Optimization Challenge

A straight line is drawn through $(P(1,4)$. Determine the least value of the sum of the intercepts on the coordinate axes

I. Write the equation of the line passing through $P(1,4)$ with slope m ?

II .Write the x-intercept and y intercept of the line in terms of m

III A. Write the function $S(m)$ for the sum of the x and y intercept .Find the value of m for which $S(m)$ is minimum.

OR

IIIB. Find the minimum Sum of distances from origin to the point where line meets the two axes?

37. A district planning authority is constructing an overpass junction to connect two major expressways. For precision mapping, a structural architect sets up a localized 3D rectangular Cartesian coordinate frame. The centre lines of the two traffic channels are treated as infinitely long straight lines in space.

Path of the Elevated Flyover(L_1): Given by the vector equation: $\vec{r}=\widehat{3\imath}+5\hat{\jmath}+8\hat{k}+\lambda(2\hat{\imath}+3\hat{\jmath}+\hat{k})$

Path of the Ground Highway (L_2): Given by the vector equation $\vec{r}=\hat{\imath}+2\hat{\jmath}+2\hat{k}+\mu(\hat{\imath}+\hat{\jmath}+2\hat{k})$.

Where λ and are μ scalar parameters representing arbitrary points on the paths, and the dimensions are calculated in meters.



I .Write the direction ratios and the direction cosines of L_1

II. Write the Cartesian equation of L_2

III A. Write the shortest distance between L_1 and L_2

OR

III B. write the length of perpendicular from $P(1,2,2)$ to the line L_1

38. A school organises a Mathematics exhibition and sells three types of entry tickets: Student, Parent and Guest at ₹60, ₹75 and ₹90 per ticket, respectively. On a particular day, a total of 130 tickets were sold and the school collected ₹10200. The organisers observed that the number of Parent and Guest tickets together was 40 more than twice the number of Student tickets. Based on the above information answer the following.



I. Let the number of Student, Parent and Guest tickets sold be x , y and z, respectively. Write the matrix form of the equation involved in this situation and find the adjoint of the coefficient matrix involved.

II. Using inverse of matrix ,find the number of student ,parent and guest tickets sold.