2 SAMPLE PAPER [SOLVED]

Time allowed: 3 hours **Maximum marks: 80**

General Instructions: *Same as CBSE Sample Question Paper-2024 (Solved).*

SECTION–A

Multiple Choice Questions

Each question carries 1 mark.

1. **If $[m \ \ n]\begin{bmatrix} m \\ n \end{bmatrix} = [25]$ and $m < n$, then (m, n) is equal to**

   (*a*) (2, 3) (*b*) (3, 4) (*c*) (4, 3) (*d*) None of these

2. **The area of a triangle with vertices (–3, 0), (3, 0) and (0, *k*) is 9 sq. units. The value of *k* will be**

   (*a*) 9 (*b*) ±3 (*c*) –9 (*d*) 6

3. **The magnitude of vector $6\hat{i} + 2\hat{j} + 3\hat{k}$ is**

   (*a*) 5 (*b*) 7 (*c*) 12 (*d*) 1

4. **The value of *a* if the function *f*(*x*) defined by $f(x) = \begin{cases} 2x - 1, & x < 2 \\ a, & x = 2 \\ x + 1, & x > 2 \end{cases}$ is continuous at $x = 2$ is**

   (*a*) 3 (*b*) – 3 (*c*) 0 (*d*) 4

5. **If $f'(x) = -\dfrac{1}{x^2}$, then *f*(*x*) is**

   (*a*) $-\dfrac{1}{x} + C$ (*b*) $\dfrac{1}{x} + C$ (*c*) $\log x + C$ (*d*) $\log\left(\dfrac{1}{x}\right) + C$

6. **The degree of the differential equation $\left(\dfrac{d^2y}{dx^2}\right)^2 + \left(\dfrac{dy}{dx}\right)^2 = x \sin\left(\dfrac{dy}{dx}\right)$ is**

   (*a*) 1 (*b*) 2 (*c*) 3 (*d*) not defined

7. **Which of the following statements is correct?**

(*a*) Every LPP admits an optimal selection.

(*b*) A LPP admits unique optimal solution.

(*c*) If a LPP admits two optimal solutions then it has infinite solutions.

(*d*) The set of all feasible solutions of a LPP is not a convex set.

8. **The projection of vector $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ along $\vec{b} = \hat{i} + 2\hat{j} + 2\hat{k}$ is**

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

9. **The value of $\int_{-\pi/2}^{\pi/2} (x^3 + x\cos x + \tan^5 x + 1)\,dx$ is**

(*a*) 0 (*b*) 2 (*c*) π (*d*) 1

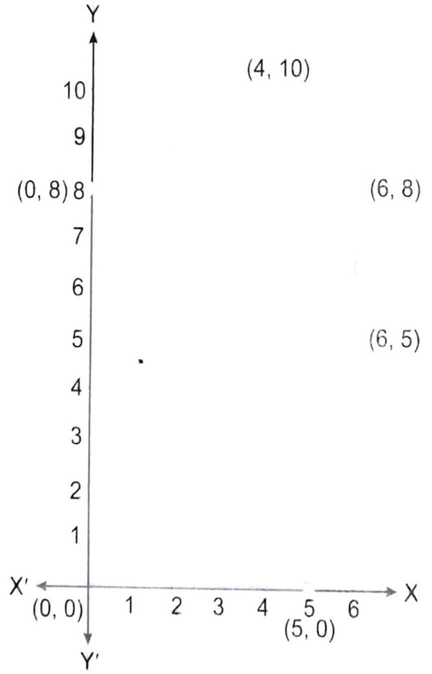
10. **Which is true about matrix multiplication?**

(*a*) It is commutative (*b*) It is associative

(*c*) Both (*a*) and (*b*) (*d*) None of these

11. **The feasible region for an LPP is shown below:**

Let $Z = 3x - 4y$ be the objective function. Minimum of Z occurs at



(*a*) (0, 0) (*b*) (0, 8) (*c*) (5, 0) (*d*) (4, 10)

12. **Which one of the following is correct?**

(*a*) Skew - symmetric matrix of odd order is non-singular.

(*b*) Skew - symmetric matrix of odd order is singular.

(*c*) Skew - symmetric matrix of even order is always singular.

(*d*) None of these

13. If A is a square matrix of order 3 such that $|A| = 2$, then the value of $|adj(adj\ A)|$ is

(*a*) –16 (*b*) 16 (*c*) 0 (*d*) 2

14. If two events are independent, then

(*a*) they must be mutually exclusive.

(*b*) the sum of their probabilities must be equal to 1.

(*c*) Both (*a*) and (*b*) are correct.

(*d*) None of the above is correct.

15. The integrating factor of differential equation $\cos x \frac{dy}{dx} + y \sin x = 1$ is

(*a*) $\cos x$ (*b*) $\tan x$ (*c*) $\sec x$ (*d*) $\sin x$

16. If $y = \cos^{-1} x$, then $(1 - x^2)y_2$ is equal to

(*a*) xy_1 (*b*) $-xy_1$ (*c*) x (*d*) $-x$

17. If $|\vec{a}| = 8, |\vec{b}| = 3$ and $|\vec{a} \times \vec{b}| = 12$, then value of $\vec{a} . \vec{b}$ is

(*a*) $6\sqrt{3}$ (*b*) $8\sqrt{3}$ (*c*) $12\sqrt{3}$ (*d*) None of these

18. If a line makes angles $\frac{\pi}{2}, \frac{3\pi}{4}$, and $\frac{\pi}{4}$ with x, y, z axes, respectively, then the direction cosines are

(*a*) $\pm(1, 1, 1)$ (*b*) $\pm\left(0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ (*c*) $\pm\left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$ (*d*) $\pm\left(\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}\right)$

Assertion-Reason Based Questions

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(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*) :** Domain of $f(x) = \sin^{-1} x + \cos x$ is $[-1, 1]$.

Reason (*R*) : Domain of a function is the set of all possible values for which function will be defined.

20. **Assertion (*A*) :** The angle between the lines whose direction cosines are $\frac{-\sqrt{3}}{4}, \frac{1}{4}, \frac{-\sqrt{3}}{2}; \frac{-\sqrt{3}}{4}, \frac{1}{4}, \frac{\sqrt{3}}{2}$ is 120°.

Reason (*R*) : The angle between two lines whose direction ratios are l_1, m_1, n_1 and l_2, m_2, n_2 is given by $\cos\theta = l_1 l_2 + m_1 m_2 + n_1 n_2$.

SECTION–B

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

21. Find the value of $\sin^{-1}\left(\sin\left(\frac{43\pi}{5}\right)\right)$.

OR

Consider $f: \mathbb{R}_+ \to [4, \infty)$ given by $f(x) = x^2 + 4$. Show that f is invertible.

22. If $A = \begin{bmatrix} 1 & -2 & 3 \\ 0 & -1 & 4 \\ -2 & 2 & 1 \end{bmatrix}$, find $(A')^{-1}$.

23. Find the area of the parallelogram whose one side and a diagonal are represented by coinitial vectors $\hat{i} - \hat{j} + \hat{k}$ and $4\hat{i} + 5\hat{k}$ respectively.

OR

Show that the line through the points $(1, -1, 2)$, $(3, 4, -2)$ is perpendicular to the line through the points $(0, 3, 2)$ and $(3, 5, 6)$.

24. If $y = \log(\cos e^x)$ then find $\frac{dy}{dx}$.

25. Find a unit vector in the direction opposite to $-\frac{3}{4}\hat{j}$.

SECTION–C

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

26. Find: $\int \frac{x^2 + 1}{(x^2 + 2)(x^2 + 3)} dx$

27. A refrigerator box contains 2 milk chocolates and 4 dark chocolates. Two chocolates are drawn at random. Find the probability distribution of the number of milk chocolates. What is the most likely outcome?

OR

Given that E and F are events such that $P(E) = 0.8$, $P(F) = 0.7$, $P(E \cap F) = 0.6$. Find $P(\bar{E} \mid \bar{F})$.

28. Evaluate: $\int_0^{\frac{\pi}{2}} \frac{\sin^2 x}{\sin x + \cos x} dx$

OR

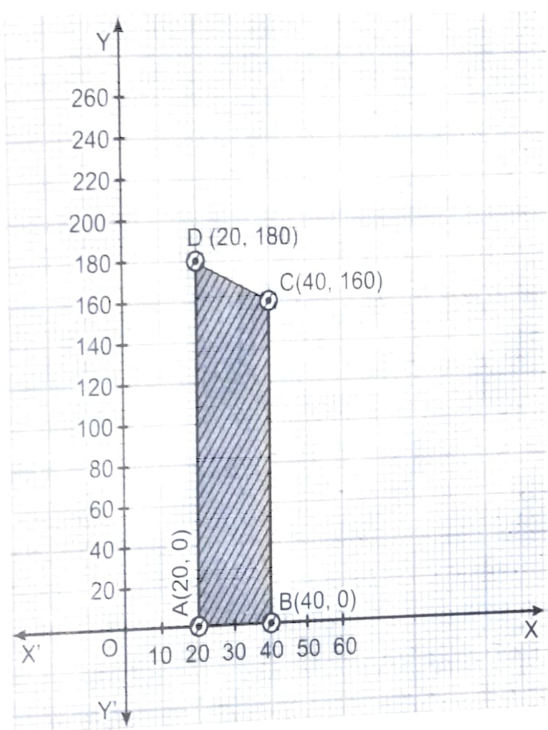
Evaluate: $\int_0^{\frac{3}{2}} |x \cos \pi x| \, dx$

29. Solve the differential equation $(1+x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$, subject to the initial condition $y(0) = 0$.

OR

Solve the differential equation $ye^{x/y}\,dx = (xe^{x/y} + y^2)\,dy\ (y \neq 0)$.

30. The corner points of the feasible region determined by the system of linear constraints are as shown below:



Answer each of the following.

(i) Let $Z = 400x + 300y$ be the objective function. Find the maximum and minimum value of Z and also the corresponding points at which the maximum and minimum value occurs.

(ii) Let $Z = px + qy$, where $p, q > 0$ be the objective function. Find the condition on p and q so that maximum value of Z occurs at C (40, 160) and D (20, 180). Also mention the number of optimal solution in this case.

31. Evaluate: $\int \frac{5x+3}{\sqrt{x^2+4x+10}}\,dx$

SECTION–D

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

32. Find the area of the region $\{(x, y) : 0 \le y \le x^2 + 1, 0 \le y \le x + 1, 0 \le x \le 2\}$

33. Show that the relation R on the set Z of all integers, given by $R = \{(a, b) : 2 \text{ divides } (a - b)\}$ is an equivalence relation.

OR

Let $A = \{1, 2, 3, ..., 9\}$ and R be the relation in $A \times A$ defined by $(a, b)\ R\ (c, d)$ if $a + d = b + c$ for $(a, b), (c, d)$ in $A \times A$. Prove that R is an equivalence relation and also obtain the equivalence class $[(2, 5)]$.

34. Find the vector and cartesian equations 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

Show that the lines $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ intersect. Also find their point of intersection.

35. Evaluate the product AB, where

$$A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$$

Hence solve the system of linear equations

$x - y = 3$

$2x + 3y + 4z = 17$

$y + 2z = 7$

SECTION–E

(This section comprises of 3 case-Study/passage-based questions of 4 marks each. First two case study questions have three sub-parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub-parts of 2 marks each.)

36. **Case-Study 1:** Read the following passage and answer the questions given below.

The total cost $C(x)$ in rupees, associated with the production of x unit by a factory is given by

$C(x) = 0.005\,x^2 - mx + 5000,\ 0 \le x \le 15$, where m is a constant.

(i) Is this function differentiable in (0, 15)?

(ii) If 5 is the critical point of the function, then find the value of m.

(iii) Find the interval in which function is strictly increasing/decreasing.

OR

Find the points of local maxima/minima, in the interval (0, 15) as well as the point of absolute maxima/minima in the interval [0, 15]. Also find local maxima/local minima and the absolute maximum/absolute minimum values of the function.

37. **Case-Study 2:** Read the following passage and answer the questions given below.

In an elliptical sport field the authority wants to design a rectangular soccer field with maximum possible area. The sport field is given by $\frac{x^2}{6^2} + \frac{y^2}{4^2} = 1$.

(*i*) If length and breadth of rectangular field be $2x$ and $2y$ respectively, then find the area function in terms of x.

(*ii*) Find the critical point of the function.

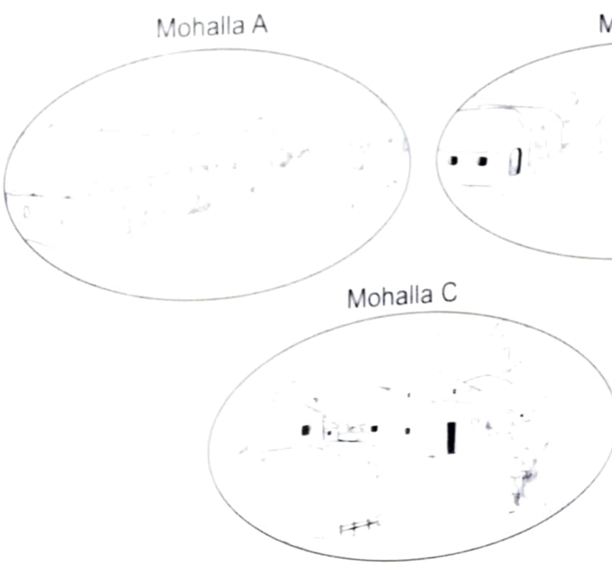
(*iii*) Use First Derivative Test to find the length $2x$ and $2y$ of the shocker field that maximize the area.

OR

Use Second Derivative Test to find the length $2x$ and $2y$ of the soccer field that maximise its area.

38. **Case-Study 3:** Read the following passage and answer the questions given below.

In a village there are three mohallas A, B and C. In A, 60% farmers believe in new technology of agriculture, while in B, 70% and in C, 80%. A farmer is selected at random from village.



(*i*) Find the total probability that a farmer believe in new technology of agriculture.

(*ii*) District agriculture officer selects a farmer at random in village and he found that selected farmer believe in new technology of agriculture. Find the probability that the farmer belongs mohalla 'B'.