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Mock Test -2

Senior Secondary Examination, 2023

Mathematics

Time : 3

Max. Marks : 80

General Instructions to the Examinees:

- (1) Candidate must write first his/her Roll No. on the question paper compulsorily.
- (2) All the questions are compulsory.
- (3) Write the answer to each question in the given answer book only.
- (4) For question having more than one part the answers to those part are to be written together in continuity.
- (5) Write down the serial number of the question before attempting it.

Section - A

1. $\int_0^{\pi/2} \sin^2 x dx = ?$ [1]
(1) $\frac{\pi}{3}$ (2) $\frac{\pi}{2}$
(3) $\frac{2\pi}{3}$ (4) $\frac{\pi}{4}$
2. Let P be a point on $\vec{r} = 5\hat{i} + 7\hat{j} - 2\hat{k} + s(3\hat{i} - \hat{j} + \hat{k})$ and Q be a point on the line $\vec{r} = -3\hat{i} + 3\hat{j} + 6\hat{k} + t(-3\hat{i} + 2\hat{j} + 4\hat{k})$. [1]
(1) $2\sqrt{78}$
(2) $\sqrt{78}$
(3) $4\sqrt{78}$
(4) $3\sqrt{78}$
3. The area of the region bounded by the curve $y = x^2$ and the line $y = 16$ [1]
(1) $\frac{128}{3}$ (2) $\frac{64}{3}$
(3) $\frac{32}{3}$ (4) $\frac{256}{3}$
4. The area bounded by the curves $y = |x - 1|$ and $y = 1$ is given by [1]
(1) 1
(2) $\frac{1}{2}$
(3) 2
(4) None of these
5. If $\vec{a}$ and $\vec{b}$ are mutually perpendicular unit vectors then $(3\vec{a} + 2\vec{b}) \cdot (5\vec{a} - 6\vec{b}) = ?$ [1]
(1) 6 (2) 12
(3) 5 (4) 3

6. Let A and B be two events such that $P(A) = 0.6$, $P(B) = 0.2$, and $P(A | B) = 0.5$. Then $P(A|B)$ equals **[1]**

- (1) $\frac{3}{10}$ (2) $\frac{6}{7}$
(3) $\frac{3}{8}$ (4) $\frac{1}{10}$

7. An unbiased die is tossed twice. What is the probability of getting a 4, 5 or 6 on the first toss and a 1, 2, 3 or 4 on the second toss? **[1]**

- (1) $\frac{2}{3}$ (2) $\frac{3}{4}$
(3) $\frac{1}{3}$ (4) $\frac{5}{6}$

8. For any vector $\vec{a}$, the value of $(\vec{a} \times \hat{i})^2 + (\vec{a} \times \hat{j})^2 + (\vec{a} \times \hat{k})^2$ is equal to **[1]**

- (1) $3\vec{a}^2$ (2) $4\vec{a}^2$
(3) $\vec{a}^2$ (4) $2\vec{a}^2$

9. Maximise the function $Z = 11x + 7y$, subject to the constraints : $x \leq 3, y \leq 2, x \geq 0, y \geq 0$. **[1]**

- (1) 50 (2) 48
(3) 49 (4) 47

10. General solution of $\frac{dy}{dx} + y \tan x = \sec x$ is : **[1]**

- (1) $y \tan x = \sec x + c$
(2) $y \sec x = \tan x + c$
(3) $\tan x = y \tan x + c$
(4) $x \sec x = \tan y + c$

11. What is the solution of the differential equation

$$\frac{ydx - xdy}{y^2} = 0?$$

- (1) $x + y = C$ (2) $x - y = C$
(3) $xy = C$ (4) $y = Cx$

12. $\int \frac{dx}{\sqrt{2-4x+x^2}} = ?$ **[1]**

- (1) $\log |(x-2) + \sqrt{x^2 - 4x + 2}| + C$
(2) $\log |(x+3) + \sqrt{x^2 + 6x + 5}| + C$
(3) $\log |x + \sqrt{x^2 - 4x + 2}| + C$
(4) None of these

13. The solution of the differential equation

$$\frac{dy}{dx} = \frac{y}{x} + \phi\left(\frac{y}{x}\right)$$

[1]

(1) $\phi\left(\frac{y}{x}\right)ky$ (2) $x\phi\left(\frac{y}{x}\right) = k$

(3) $y\phi\left(\frac{y}{x}\right) = k$ (4) $\phi\left(\frac{y}{x}\right) = kx$

14. If $A = \frac{1}{3} \begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & -2 \\ x & 2 & y \end{bmatrix}$ satisfies $A^T A = I$, then $x + y =$ **[1]**

- (1) -3
(2) none of these
(3) 0
(4) 3

15. $\lim_{x \rightarrow 0} \frac{x(e^{\sin x} - 1)}{1 - \cos x}$ is equal to **[1]**

- (1) 2 (2) 1
(3) $\frac{1}{2}$ (4) 0

16. The solution of $x \frac{dy}{dx} + y = e^x$ is : **[1]**

(1) $x = \frac{e^y}{y} + \frac{k}{y}$

(2) $y = \frac{e^x}{x} + \frac{k}{x}$

(3) $y = xe^x + k$

(4) $y = xe^x + cx$

17. If a line makes angles α, β and γ with the axes respectively, then $\cos 2\alpha + \cos 2\beta + \cos 2\gamma =$ **[1]**

- (1) -2 (2) 2
(3) -1 (4) 1

18. The value of $\sin(2\tan^{-1}(0.75))$ is equal to

- (1) 1.5 (2) $\sin(1.5)$
(3) 0.75 (4) 0.96

19. **Assertion (A)** : Maximum value of $Z = 3x + 2y$, subject to the constraints $x + 2y \leq 2$; $x \geq 0$; $y \geq 0$ will be obtained at point (2, 0). [1]

Reason (R) : In a bounded feasible region, it always exist a maximum and minimum value.

- (1) Both A and R are true and R is the correct explanation of A.
(2) Both A and R are true but R is not the correct explanation of A
(3) A is true but R is false.
(4) A is false but R is true.
20. **Assertion (A)** : Every differentiable function is continuous but converse is not true. [1]
Reason (R) : Function $f(x) = |x|$ is continuous.
(1) Both A and R are true and R is the correct explanation of A.
(2) Both A and R are true R is not the correct explanation of A.
(3) A is true but R is false.
(4) A is false but R is true.

Section - B

21. Differentiate the function $\cos x \cdot \cos 2x \cdot \cos 3x$ w.r.t. x . [2]
22. Find the angle between the pairs of lines : [2]

$$\frac{x-5}{1} = \frac{2y+6}{-2} = \frac{z-3}{1} \text{ and } \frac{x-2}{3} = \frac{y+1}{4} = \frac{z-6}{5}$$

OR

Find the cartesian and vector equations of a line which passes through the point (1, 2, 3) and is parallel to

$$\text{the line } \frac{-x-2}{1} = \frac{y+3}{7} = \frac{2z-6}{3}.$$

23. A fair die is rolled. Consider events $E = \{1, 3, 5\}$, $F = \{2, 3\}$ and $G = \{2, 3, 4, 5\}$. Find $P(E|G)$ and $P(G|E)$ [2]
24. Solve : $y dx - (x + 2y^2) dy = 0$ [2]
25. For the principal values, evaluate $\sin^{-1}[\cos\{2\operatorname{cosec}^{-1}(-2)\}]$ [2]

Section - C

26. Solve the Linear Programming Problem graphically :
Minimize $Z = 2x + 4y$ Subject to [3]
 $x + y \geq 8$
 $x + 4y \geq 12$
 $x > 3, y \geq 2$

27. Evaluate : $\int \frac{1}{x(x^4-1)} dx$ [3]

OR

$$\text{Evaluate : } \int \frac{2x+1}{\sqrt{x^2+2x-1}} dx$$

28. Find the area of the region between the parabola $x - y^2 - 6y$ and the line $x = -y$. [3]

Or

Find the area bounded by the curve $y^2 = 4a^2(x-1)$ and the lines $x = 1$ and $y = 4a$.

29. Find the area of the region bounded by the line $y = 3x + 2$, the x -axis and the ordinates $x = -1$ and $x = 1$ [3]

30. Differentiate the function with respect to

$$x : \tan^{-1}\left(\frac{5x}{1-6x^2}\right), \frac{1}{\sqrt{6}} < x < \frac{1}{\sqrt{6}}.$$
 [3]

31. Find the angle between the lines whose direction cosines are given by the equations $1 + 2m + 3n = 0$ and $3lm - 4ln + mn = 0$ [3]

Or

Find the angle between the lines whose direction ratios are 3, 2, -6 and 1, 2, 2.

Section - D

32. Find the matrix A satisfying the matrix equation

$$\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}.$$
 [5]

OR

$$\text{If } A = \begin{bmatrix} \cos \alpha & -\sin \alpha & 0 \\ \sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}, \text{ find adj } A \text{ and verify that } A$$

$$(\operatorname{adj} A) = (\operatorname{adj} A) A = |A| I_3.$$

33. If with reference to the right handed system of mutually $\perp$ unit vectors $\hat{i}, \hat{j}, \hat{k}$ and $\vec{\alpha} = 3\hat{i} - \hat{j}, \vec{\beta} = 2\hat{i} + \hat{j} - 3\hat{k}$ then express $\vec{\beta}$ in the form $\vec{\beta} = \vec{\beta}_1 + \vec{\beta}_2$, where $\vec{\beta}_1$ is $\parallel$ to $\vec{\alpha}$ and $\vec{\beta}_2$ is $\perp$ to $\vec{\alpha}$ [5]

34. Integrate the function : $\frac{1}{1-\tan x}$ [5]

35. Let $A = \mathbb{R} - \{R\}$ and $B = \mathbb{R} - \{1\}$. Consider the function

$f: A \rightarrow B$ defined by $f(x) = \left(\frac{x-2}{x-3} \right)$. Is f one-one and

onto? Justify your answer.

[5]

OR

Show that the function

$f: \mathbb{R} \rightarrow \{x \in \mathbb{R} : -1 < x < 1\}$ defined by

$f(x) = \frac{x}{1+|x|}, x \in \mathbb{R}$ is one-one and onto function.

Section - E

36. Read the text carefully and answer the questions:

[4]

The nut and bolt manufacturing business has gained popularity due to the rapid Industrialization and introduction of the Capital-Intensive Techniques in the Industries that are used as the Industrial fasteners to connect various machines and structures. Mr. Suresh is in Manufacturing business of Nuts and bolts. He produces three types of bolts, x, y, and z which he sells in two markets. Annual sales



Markets	Products		
	X	Y	Z
I	10000	2000	18000
II	6000	20000	8000

- If unit sales prices of x, y and z are Rs. 2.50, Rs. 1.50 and Rs. 1.00 respectively, then find the total revenue collected from Market-I & II.
- If the unit costs of the above three commodities are Rs. 2.00, Rs. 1.00 and Rs. 50 paise respectively, then find the cost price in Market I and Market II.
- If the unit costs of the above three commodities are Rs. 2.00, Rs. 1.00 and 50 paise respectively, then find gross profit from both the markets.

OR

If matrix $A = [a_{ij}]_{2 \times 2}$ where $a_{ij} = 1$, if $i \neq j$ and $a_{ij} = 0$, if $i = j$ then find A^2 .

37. Read the text carefully and answer the questions:

[4]

A tin can manufacturer designs a cylindrical tin can for a company making sanitizer and disinfectors. The tin can is made to hold 3 litres of sanitizer or disinfectant. The cost of the material used to manufacture the tin can is Rs. 100/m².



- If r cm be the radius and h cm be the height of the cylindrical tin can, then express the surface area as a function of radius (r)
- Find the radius of the can that will minimize the cost of tin used for making can?
- Find the height that will minimize the cost of tin used for making can?

OR

Find the minimum cost of material used to manufacture the tin can.

38. Read the text carefully and answer the questions:

[4]

Family photography is all about capturing groups of people that have family ties. These range from the small group, such as parents and their children. New-born photography also falls under this umbrella. Mr Ramesh, His wife Mrs Saroj, their daughter Sonu and son Ashish line up to random for a family photograph, as shown in figure.



- Find the probability that daughter is at one end, given that father and mother are in the middle.
- Find the probability that mother is at right end, given that son and daughter are together.