

Paper Prepared by

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1 mark each

- Which of the following represents a function $f : \mathbb{R} \rightarrow \mathbb{R}$? why?
(a) $y = x^2$ (b) $y^2 = x$
- Find the principal value of $\cos^{-1}\left(\cos\frac{2\pi}{3}\right) + \sin^{-1}\left(\sin\frac{2\pi}{3}\right)$?
- Construct a 1×2 matrix A, if $A = [a_{ij}]$, where $a_{ij} = \frac{2i}{j}$
- Let $\begin{vmatrix} 3 & x \\ x & 1 \end{vmatrix} = \begin{vmatrix} 3 & 4 \\ 2 & 1 \end{vmatrix}$, find x
- Find the abscissa for which, the tangent to the curve $y = x^2 - 5$ is parallel to the line $y = -x + 6$
- If \vec{a} is a unit vector and $(\vec{x} - \vec{a}) \cdot (\vec{x} + \vec{a}) = 8$, find $|\vec{x}|$
- Cartesian equations of a line AB are $\frac{2x-1}{2} = \frac{4-y}{7} = \frac{z+1}{2}$. Write the directions ratios of a line parallel to AB.
- Evaluate $\int (7^x)^4 dx$.
- Evaluate $i \cdot (\hat{j} \times \hat{k})$
- If $A = [3 \ -1]$, $B = \begin{bmatrix} 2 \\ 7 \end{bmatrix}$. Find BA.

4 marks each

11. Define a binary operation*on the set $\{0, 1, 2, 3, 4, 5\}$ as $a \times b = (a+b) \text{ mod } 6$. Show that '0' is the identity for this operation and each element 'a' of the set is invertible with $6 - a$, being the inverse of a.

Or

Show that the function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \frac{1}{x^2 + 1}$, $x \in \mathbb{R}$ is one-one and onto function. Also find the inverse of the function f.

12. Solve for x, $\tan^{-1} 3x = \frac{\pi}{4}$.

13. If $A = \begin{pmatrix} 1 & 3 \\ 2 & -1 \end{pmatrix}$ and $f(x) = 2x^2 + 3x + 7$, find $f(A)$.

14. For the curve $y = 4x^3 - 2x^5$, find all the points at which tangent passes through origin.

15. If $x^p y^q = (x + y)^{p+q}$, prove that $\frac{dy}{dx} = \frac{y}{x}$.

Or

Find $\frac{dy}{dx}$, if $y = \tan^{-1} \left[\frac{\sqrt{1+x^2} + \sqrt{1-x^2}}{\sqrt{1+x^2} - \sqrt{1-x^2}} \right]$, $0 < |x| < 1$.

16. Evaluate $\int \frac{x^2 - 1}{x^4 + 1} dx$.

17. The area of expanding rectangle is increasing at the rate of $48 \text{ cm}^2 \text{ s}^{-1}$. The length of rectangle is always equal to square of breadth. At what rate the length is increasing when breath is 4.5 cm?

18. Evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1 + \sqrt{\tan x}}$

19. Evaluate $\int \frac{dx}{(\sin x - 2 \cos x)(2 \sin x + \cos x)}$.

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20. Find the angle between the lines

$$\vec{r} = (3 + \lambda)\hat{i} + 2(1 + \lambda)\hat{j} + 2(1 - 2\lambda)\hat{k} \text{ and } \vec{r} = 5\hat{j} - 2\hat{k} + \mu(3\hat{i} + 2\hat{j} - 6\hat{k})$$

21. Find the coordinates of a point where the line through A(3, 4, 1) and B(5, 1, 6) crosses the xy plane.

22. 3 cards are accidentally dropped from a pack of 52 cards. What is probability that only 2 are hearts? What is probability that all three are hearts?

Or

A hockey match may be either won, drawn or lost by host club's team. So there are three ways of forecasting the result of any one match, one correct and two incorrect. Find the probability of forecasting at least three correct results for four matches.

6 marks each

23. Solve using matrix method, $5x + 3y + z = 16$, $2x + y + 3z = 19$, $x + 2y + 4z = 25$.

24. Show that the height of a cone of maximum volume that can be inscribed in a sphere of radius 12 cm is 16cm.

Or

An open rectangular tank with square base and vertical sides is to be constructed from a metal sheet to hold a given quantity of water. Show that the material will be least when the depth of the tank is half of the width.

25. Calculate the area of the region enclosed between the circles $x^2 + y^2 = 1$ and

$$\left(x - \frac{1}{2}\right)^2 + y^2 = 1.$$

26. Solve the differential equation: $\frac{dy}{dx} + \frac{2}{x}y = \frac{1}{x^2}$ satisfying the condition

$$y(2) = 2y(-1)$$

27. Sum of numbers a, b, c is 2. If twice b is added to a and c, the sum is 1. By adding b and c to five times the first number, we get 6. Find a, b, c using matrices.

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28. State the conditions under which probability distribution is a binomial distribution. The mean and variance of a binomial distribution are 10 and $\frac{5}{3}$ respectively. Find $p(x \leq 1)$.

Or

The items produced by a company contain 10% defective items. Show that the probability of getting 2 defective items in a sample of 8 items is $\frac{28 \times 9^6}{10^8}$.

29. If a person drives his car at 25km/h, he has to spend Rs. 2/km on petrol. If he drives it at a faster speed of 40km/h, the petrol cost increases to Rs. 5/km. He has Rs. 100 to spend on petrol and wishes to find what is the maximum distance he can travel with in one hour. Express this as a L.P.P. and solve it.

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