



I. Choose The Correct Answer:

[8 x 1 = 8]

- If $\vec{a}, \vec{b}, \vec{c}$ are three unit vectors such that \vec{a} is perpendicular to \vec{b} and parallel to \vec{c} then $\vec{a} \times (\vec{b} \times \vec{c})$ is equal to?
(a) \vec{a} (b) \vec{b} (c) \vec{c} (d) 0
- If \vec{a} and \vec{b} are parallel vector then $[\vec{a}, \vec{b}, \vec{c}]$ is equal to?
(a) 2 (b) -1 (c) 1 (d) 0
- The point on the curve $6y = x^3 + 2$ at which y-coordinate changes 8 times as fast as x-coordinate is
(a) (4, 11) (b) (4, -11) (c) (-4, 11) (d) (-4, -11)
- The tangent to the curve $y^2 - xy + 9 = 0$ is vertical when?
(a) $y = 0$ (b) $y = \pm \sqrt{3}$ (c) $y = \frac{1}{2}$ (d) $y = \pm 3$
- The percentage error of fifth root of 31 is approximately how many times the percentage error in 31?
(a) $\frac{1}{31}$ (b) $\frac{1}{5}$ (c) 5 (d) 31
- If $w(x,y) = \log(e^x + e^y)$, then $\frac{\partial w}{\partial x}$ is equal to?
(a) $e^x + e^y$ (b) $\frac{1}{e^x + e^y}$ (c) 2 (d) 1
- The operation $*$ defined by $a * b = \frac{ab}{7}$ is not a binary operation on?
(a) \mathbb{Q}^+ (b) \mathbb{Z} (c) \mathbb{R} (d) \mathbb{C}
- If a compound statement involves 3 simple statements, then the number of rows in the truth table is
(a) 9 (b) 8 (c) 6 (d) 3

II. Answer any 5 of the following questions:

[5 x 2 = 10]

- Show that $[\neg p \vee \neg q] \vee p$ is tautology.
- Prove by vector method that an angle in a semi-circle is a right angle.
- Find approximately value of $\sqrt[3]{123}$

12. Find the slope of tangent to a curve $y = x^4 - x^3 + x^2 - 1$ at $x = 1$
13. Prove that a line is drawn from centre of circle to the mid-point of chord is perpendicular.
14. Show that the two curves $x^2 - y^2 = r^2$ and $xy = c^2$ where c, r are constants, cut orthogonally.

III. Answer any 4 of the following questions:

[4 x 3 = 12]

15. Find angle between rectangular hyperbola $xy = 2$ and parabola $x^2 + 4y = 0$.
16. Using vector method, prove that if the diagonals of a parallelogram are equal, then it is a rectangle.
17. Find the equation of tangent and normal to the curve given by $x = 7 \cos t$ and $y = 2 \sin t$, $t \in \mathbb{R}$ at any point on the curve.
18. Show that the percentage error in the n^{th} root of a number is approximately $\frac{1}{n}$ times the percentage error in the number

19. Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three Boolean matrices of the same type.

Find (i) $A \vee B$ (ii) $A \wedge B$ (iii) $(A \vee B) \wedge C$ (iv) $(A \wedge B) \vee C$.

IV. Answer any 4 of the following questions:

[4 x 5 = 20]

20. Prove that $\cos(\alpha + \beta) = \cos\alpha \cos\beta - \sin\alpha \sin\beta$ by vector method.
21. Prove that $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} \mid x \in \mathbb{R} - \{0\} \right\}^*$ be matrix multiplication examine.
- (i) Closure property (ii) commutative property
- (iii) Associative property (iv) Existence of identity
22. Prove that de Morgan's laws (i) $\neg(p \wedge q) \equiv \neg p \vee \neg q$ (ii) $\neg(p \vee q) \equiv \neg p \wedge \neg q$
23. A conical water tank with vertex down of 12 metres height has a radius of 5 metres at the top. If water flows into the tank at a rate 10 cubic m/min, how fast is the depth of the water increases when the water is 8 metres deep?
24. Find a linear approximation for the following functions at the indicated points.

(i) $f(x) = x^3 - 5x + 12$, $x_0 = 2$ (ii) $g(x) = \sqrt{x^2 + 9}$, $x_0 = -4$