(iii) In **Section A,** Questions no. **1** to **18** are multiple
questions number **19** and **20** are Assertion-Reason based questions
each.

(iv) In **Section B,** Questions no. **21** to **25** are very short answer (V
questions, carrying **2** marks each.

(v) In **Section C,** Questions no. **26** to **31** are short answer (SA) type q
carrying **3** marks each.

(vi) In **Section D,** Questions no. **32** to **35** are long answer (LA) type q
carrying **5** marks each.

(vii) In **Section E,** Questions no. **36** to **38** are case study based questions c
**4** marks each.

(viii) There is no overall choice. However, an internal choice has been prov
2 questions in Section B, 3 questions in Section C, 2 questions in Sectio
2 questions in Section E.

(ix) Use of calculators is **not** allowed.

## SECTION A

*This section comprises multiple choice questions (MCQs) of 1 mark each.*

**1.** If $y = \cos^{-1}(e^x)$, then $\frac{dy}{dx}$ is :

(A) $\frac{1}{\sqrt{e^{-2x}+1}}$ (B) $-\frac{1}{\sqrt{e^{-2x}+1}}$

(C) $\frac{1}{\sqrt{e^{-2x}-1}}$ (D) $-\frac{1}{\sqrt{e^{-2x}-1}}$

2. The degree and order of differential equation $y''^2 + \log(y') = x^5$ respectively are :

(A) not defined, 5 (B) not defined, 2

(C) 5, not defined (D) 2, 2

3. The unit vector perpendicular to both vectors $\hat{i} + \hat{k}$ and $\hat{i} - \hat{k}$ is :

(A) $2\hat{j}$ (B) $\hat{j}$

(C) $\frac{\hat{i} - \hat{k}}{\sqrt{2}}$ (D) $\frac{\hat{i} + \hat{k}}{\sqrt{2}}$

4. Direction ratios of a vector parallel to line $\frac{x-1}{2} = -y = \frac{2z+1}{6}$ are :

(A) 2, – 1, 6 (B) 2, 1, 6

(C) 2, 1, 3 (D) 2, – 1, 3

5. If for the matrix $A = \begin{bmatrix} \tan x & 1 \\ -1 & \tan x \end{bmatrix}$, $A + A' = 2\sqrt{3}\, I$, then the value of $x \in \left[0, \frac{\pi}{2}\right]$ is :

(A) 0 (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$

6. If a line makes an angle of 30° with the positive direction of x-axis, 120° with the positive direction of y-axis, then the angle which it makes with the positive direction of z-axis is :

(A) 90° (B) 120°

(C) 60° (D) 0°

7. If the sum of all the elements of a $3 \times 3$ scalar matrix is 9, then the product of all its elements is :

(A) 0 (B) 9

(C) 27 (D) 729

8. Let $f : R_+ \to [-5, \infty)$ be defined as $f(x) = 9x^2 + 6x - 5$, where $R_+$ is the set of all non-negative real numbers. Then, f is :

(A) one-one

(B) onto

(C) bijective

(D) neither one-one nor onto

9. If $\begin{vmatrix} -a & b & c \\ a & -b & c \\ a & b & -c \end{vmatrix} = kabc$, then the value of k is :

(A) 0 (B) 1

(C) 2 (D) 4

10. The number of points of discontinuity of $f(x) = \begin{cases} |x|+3, & \text{if } x \leq -3 \\ -2x, & \text{if } -3 < x < 3 \\ 6x+2, & \text{if } x \geq 3 \end{cases}$ is :

(A) 0 (B) 1

(C) 2 (D) infinite

11. The function $f(x) = x^3 - 3x^2 + 12x - 18$ is :

(A) strictly decreasing on R

(B) strictly increasing on R

(C) neither strictly increasing nor strictly decreasing on R

(D) strictly decreasing on $(-\infty, 0)$

12. Anti-derivative of $\sqrt{1 + \sin 2x}$, $x \in \left[0, \frac{\pi}{4}\right]$ is :

(A) $\cos x + \sin x$ (B) $-\cos x + \sin x$

(C) $\cos x - \sin x$ (D) $-\cos x - \sin x$

13. The differential equation $\frac{dy}{dx} = F(x, y)$ will not be a homogeneous differential equation, if $F(x, y)$ is :

(A) $\cos x - \sin\left(\frac{y}{x}\right)$ (B) $\frac{y}{x}$

(C) $\frac{x^2+y^2}{xy}$ (D) $\cos^2\left(\frac{x}{y}\right)$

14. For any two vectors $\vec{a}$ and $\vec{b}$, which of the following statements is always true ?

(A) $\vec{a} \cdot \vec{b} \geq |\vec{a}||\vec{b}|$ (B) $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|$

(C) $\vec{a} \cdot \vec{b} \leq |\vec{a}||\vec{b}|$ (D) $\vec{a} \cdot \vec{b} < |\vec{a}||\vec{b}|$

15. The coordinates of the foot of the perpendicular drawn from the point $(0, 1, 2)$ on the x-axis are given by :

(A) $(1, 0, 0)$ (B) $(2, 0, 0)$

(C) $(\sqrt{5}, 0, 0)$ (D) $(0, 0, 0)$

16. The common region determined by all the constraints of a linear programming problem is called :

(A) an unbounded region (B) an optimal region

(C) a bounded region (D) a feasible region

17. Let E be an event of a sample space S of an experiment, then $P(S \mid E)$ =

(A) $P(S \cap E)$ (B) $P(E)$

(C) 1 (D) 0

18. If $A = [a_{ij}]$ be a $3 \times 3$ matrix, where $a_{ij} = i - 3j$, then which of the following is ***false*** ?

(A) $a_{11} < 0$ (B) $a_{12} + a_{21} = -6$

(C) $a_{13} > a_{31}$ (D) $a_{31} = 0$

*Questions number **19** and **20** are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.*

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. *Assertion (A) :* For any symmetric matrix A, $B'AB$ is a skew-symmetric matrix.

*Reason (R) :* A square matrix P is skew-symmetric if $P' = -P$.

20. *Assertion (A) :* $(\vec{b} \cdot \vec{c})\,\vec{a}$ is a scalar quantity.

*Reason (R) :* Dot product of two vectors is a scalar quantity.