Shiksha Classes Bhandara

Mathematics **Topic : Application of Derivatives** **MM 100**

Q.1 For the function $f(x) = 2x^2 - \ln|x|$
(A) set of critical points is $\{-1/2, 0, 1/2\}$
(B) $f(x)$ is increasing in $(-\infty, -1/2] \cup (0, 1/2]$
(C) $f(x)$ is decreasing in $[-1/2, 0) \cup [1/2, \infty)$
(D) None of these

Q.2 The value of c in Lagrange's theorem for the function

$$f(x) = \begin{cases} x\cos\left(\frac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$$ in the interval $[-1, 1]$ is

(A) 0 (B) 1/2
(C) –1/2 (D) not existent in the interval

Q.3 If $27a + 9b + 3c + d = 0$ then the equation $4ax^3 + 3bx^2 + 2cx + d = 0$ has atleast one real root lying between –
(A) 0 and 1 (B) 1 and 3
(C) 0 and 3 (D) None of these

Q.4 The maximum value of $(x - p)^2 + (x - q)^2 + (x - r)^2$ will be at x equal to-
(A) $\frac{p+q+r}{3}$ (B) $3\sqrt{qpr}$
(C) qpr (D) $p^2 + q^2 + r^2$

Q.5 Let the function f (x) be defined as follows :

$$f(x) = \begin{cases} x^3 + x^2 - 10x, & -1 \le x < 0 \\ \cos x, & 0 \le x < \frac{\pi}{2} \\ 1 + \sin x, & \frac{\pi}{2} \le x \le \pi \end{cases}$$. Then f (x) has –

(A) a local minimum at $x = \pi/2$
(B) a local maximum at $x = \pi/2$
(C) absolute minimum at $x = -1$
(D) absolute maximum at $x = \pi$

Q.6 If $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (a > b) and $x^2 - y^2 = c^2$ cut each other at right angles, then –
(A) $a^2 + b^2 = 2c^2$ (B) $b^2 - a^2 = 2c^2$
(C) $a^2 - b^2 = 2c^2$ (D) $a^2 b^2 = 2c^2$

Q.7 $f(x) = \begin{cases} \sin\frac{\pi x}{2}, & 0 \le x < 1 \\ 3 - 2x, & x \ge 1 \end{cases}$, then
(A) f (x) has a local minimum at x = 1
(B) f (x) has a local maximum at x = 1
(C) f (x) does not have any local maximum or minimum at x = 1
(D) f (x) has a global minimum at x = 1

Q.8 For the curves, $x^3 + 2 = 3xy^2$ and $y^3 + 2 = 3x^2y$ which of the following are true?
(i) They are orthogonal.
(ii) They are symmetric with respect to the axes of coordinates.
(iii) They are reflections of each other with respect to y=x.
(A) (i) Only (B) (ii) and (iii) Only
(C) (i) and (iii) Only (D) (i), (ii) and (iii)

Q.9 A curve y = f (x) passes through the point (4, 3) and the normal to the curve at the point happens to be a tangent to the circle $x^2 + y^2 = 25$. The value of f ' (4) is
(A) –3/4 (B) 3/4
(C) 4/3 (D) – 4/3

Q.10 The equation $x + e^x = 0$ has –
(A) only one real root (B) only two real roots
(C) no real root (D) None of these

Q.11 The largest possible value of the expression $y = \sqrt{x-2} + 2\sqrt{3-x}$ is –
(A) 3 (B) $\sqrt{5}$
(C) 2 (D) 17

Q.12 The function $f(x) = \begin{vmatrix} x-1 & x+1 & 2x+1 \\ x+1 & x+3 & 2x+3 \\ 2x+1 & 2x-1 & 4x+1 \end{vmatrix}$ has –
(A) one point of maximum and one point of minimum
(B) one point of maximum only
(C) one point of minimum only
(D) none of the above

Q.13 The normal at 2, 6 to the curve x = 1 + t, y = 2 + 4t has the intercepts on the axes given by
(A) 50, 25/4 (B) 50, 25/2
(C) 48, 25 (D) None of these

Q.14 If $f(x) = x^3 + ax^2 + bx - 5\cos^2 x$ is an increasing function for all real values of x, then a and b satisfy the condition
(A) $a^2 - 3b - 15 < 0$ (B) $a^2 - 3b - 15 > 0$
(C) $a^2 - 3b + 15 < 0$ (D) $a^2 - 3b + 15 > 0$

Q.15 For a differentiable curve y = f (x) having atleast two extremum in the interval [a, b]
(A) two of its maximum values occurs successively
(B) two of its minimum values occurs successively
(C) maximum and minimum values occurs alternatively
(D) None of the above

Q.16 A truck is to be driven 300 km. on a highway at a constant speed of x kmph. Speed rules of the highway required that $30 \le x \le 60$. The fuel costs Rs. 10 per litre and is consumed at the rate of $2 + \frac{x^2}{600}$ litres per hour. The wages of the driver are Rs. 200 per hour. The most economical speed to drive the truck, in kmph, is –
(A) 30 (B) 60
(C) $30\sqrt{3.3}$ (D) $20\sqrt{3.3}$

Q.17 The radius of a right circular cylinder increases at the rate of 0.1 cm/min, and the height decreases at the rate of 0.2 cm/min. The rate of change of the volume of the cylinder, in cm^3/min, when the radius is 2 cm and the height is 3 cm is
(A) -2π (B) $-8\pi/5$
(C) $-3\pi/5$ (D) $2\pi/5$

Q.18 Let $x_1 = (\tan\theta)^{\cot\theta}, x_2 = (\cot\theta)^{\cot\theta}, x_3 = (\tan\theta)^{\tan\theta}$ and $x_4 = (\cot\theta)^{\tan\theta}$ where $0 < \theta < \pi/4$, then
(A) $x_1 < x_2 < x_3 < x_4$ (B) $x_1 < x_3 < x_4 < x_2$
(C) $x_1 < x_4 < x_3 < x_2$ (D) $x_1 < x_2 < x_4 < x_3$

Q.19 Maximum value of $x^2 \ln(1/x)$ is –

(A) 2e (B) e

(C) 1/e (D) 1/2e

Q.20 Length of the tangent at $t = \pi/4$ to the curve $x = a(\cos t + t \sin t)$, $y = a(\sin t - t \cos t)$ $(a > 0)$ is

(A) $a\left(1-\frac{\pi}{4}\right)$ (B) $a\left(\frac{\pi}{4}-1\right)$

(C) $a(\pi - 4)$ (D) None of these

For Q.21-Q.25 :

The answer to each question is a NUMERICAL VALUE.

Q.21 The length of the subtangent to the curve $x^2 + xy + y^2 = 7$ at (1, 3) is –

Q.22 The greatest area of the rectangular plot which can be laid out within a triangle of base 36ft. & altitude 12ft. equals (Assume that one side of the rectangle lies on the base of the triangle)

Q.23 If the normal to the curve $y = f(x)$ at the point (3, 4) makes an angle $3\pi/4$ with the positive x-axis, then $f'(3) =$

Q.24 If the function $f(x) = 2x^3 - 9ax^2 + 12a^2x + 1$ attains its maximum and minimum at p and q respectively such that $p^2 = q$, then a equals.

Q.25 The shortest distance of the point (0, 0) from the curve $y = \frac{1}{2}(e^x + e^{-x})$ is –


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