MATHS

BOOKS - MCGROW HILL EDUCATION MATHS (HINGLISH)

APPLICATIONS OF DERIVATIVES

Illustration

1. Find the rate of change of volume of a sphere with respect to its radius when r=4cm

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2. A particle moves along the curve $12y = x^3$. . Which coordinate changes at faster rate at $x = 10$?

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3. A point move in a straight line so that its distance from the start in t sec is equal to $s = \frac{1}{4}t^4 - 4t^3 + 16t^2$. What will be acceleration and at what times is its velocity equal to zero?

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4. A body whose mass is 3kg performs rectilinear motion according to the formula $s = 1 + t + t^2$, where s is measured the kinetic energy $\frac{1}{2}mv^2$ and t in second.

Determine the kinetic energy $\frac{1}{2}mv^2$ of the body in $5\,\text{sec}$ after its start.

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5. Find the increment and differential of the function, $f(x) = 2x^2 - 3x + 2$ when x changes to 1.99 from 2.

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6. Derive the equation of tangent and normal at (x_0, y_0) of the curve y= log x

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7. Verify Rolles theorem for function $f(x) = 4^{\sin x}$ on $[0, \ \pi]$

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8. The number of values of k for which the equation $x^3 - 3x + k = 0$ has two distinct roots lying in the interval $(0, 1)$ is three (b) two (c) infinitely many (d) zero

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9. The function $y = \sqrt{2x - x^2}$ (A) increases in (0,2) (B) increases in (0, 1) but decreases in (1,2) (C) Decreases in (0,2) (D) Increases in (1,2) but decreases in (0,1)

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10. Find the interval of monotonicity of $y = \dfrac{1 - x + x^2}{1 + x + x^2}$

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11. Find the extrema of $y = 2x^3 - 3x^2$. Y is differentiable function and $y' = 6x^2 - 6x = 6x(x - 1)$

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12. Find the greatest and least value of $y = x^3 - 3x^2 + 6x - 2$ on $[-1, 1]$ y is differentiable function of x and

$$y'(x) = 3x^2 - 6x + 6 = 3(x^2 - 2x + 2) = 3(x-1)^2 > 0.$$

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Solved Examples Concept Based Single Correct Answer Type Questions

1. The approximate value of $\cos 31^\circ$ is (Take $1^\circ = 0.0174$)

A. 0.52

B. 0.851

C. 0.641

D. 0.681

Answer: B

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2. The tangent at $A(2, 4)$ on the curve $y = x^3 - 2x^2 + 4$ cuts the x-axis at T then length of AT is

A. (2,0)

B. $\left(\frac{7}{2}, 0\right)$

C. $\left(\frac{11}{9}, 0\right)$

D. $\left(\frac{14}{9}, 0\right)$

Answer: D

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3. The slope of the tangent to the curve $x = t^2 + 3t - 8, y = 2t^2 - 2t - 5$ at the point (2, -1), is

A. $2/3$

B. $6/7$

C. $4/5$

D. $3/2$

Answer: B

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4. The interval in which $y = \dfrac{1}{4x^3 - 9x^2 + 6x}$ is increasing is

A. $(-\infty, \infty)$

B. $(0, 1/2)$

C. $(1/2, 1)$

D. $(1, \infty)$

Answer: C

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5. $y = x - \log(1 + x)$ increasing in

A. 1

B. 0

C. -1

D. $\frac{1}{2}$

Answer: B

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6. A covered box of volume $72cm^3$ and the base sides in a ratio of $1:2$ is to be made. The length all sides so that the total surface area is the least possible is

A. 2,4,9

B. 8,3,3

C. 6,6,2

D. 6,3,4

Answer: D

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7. A point on the curve $y = x^3 - 3x + 5$ at which the tangent line is parallel to $y = -2x$ is

A. (1,3)

B. (0,5)

C. $\left(\frac{1}{\sqrt{3}}, 5 - \frac{8\sqrt{3}}{9}\right)$

D. $\left(\frac{1}{\sqrt{2}}, 0\right)$

Answer: C

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8. The difference between the greatest and the least values of the function $f(x) = \sin 2x - x$ on $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

A. $\frac{\pi}{2}$

B. 1

C. 2

D. $-\frac{\pi}{2}$

Answer: A

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9. The point of inflection of $y = x^3 - 5x^2 + 3x - 5$ is

A. $\frac{1}{2}$

B. $\frac{3}{4}$

C. $\frac{7}{4}$

D. $\frac{5}{3}$

Answer: D

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10. The rate of change of the function $f(x) = 3x^5 - 5x^3 + 5x - 7$is minimum when

A. $\frac{3}{4}$

B. $\frac{5}{4}$

C. $\frac{2}{3}$

D. $\frac{3}{2}$

Answer: B

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Solved Examples Level 1 Single Correct Answer Type Questions

1. A spherical balloon is expanding. If the radius in increasing at the rate of 2 inches per minute the rate at which the volume increases (in cubic inches per minute) when the radius is 5 inches is

A. 100π

B. 1000π

C. 2000π

D. 500π

Answer: C

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2. An object is moving in the clockwise direction around the unit circle $x^2+y^2=1$. As it passes through the point $\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$, its y-coordinate is decreasing at the rate of 3 unit per second. The rate at which the x-coordinate changes at this point is (in unit per second)

A. 2

B. $3\sqrt{3}$

C. $\sqrt{3}$

D. $2\sqrt{3}$

Answer: B

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3. An approximate value of $\cos 40^{\circ}$ is

A. 0.7688

B. 0.7071

C. 0.7117

D. 0.7

Answer: A

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4. The value of x for which the tangents to the curves $y = x \cos x, y = (\sin x)/x$ are parallel to the axis of x are roots of (respectively)

A. $\sin x = x, \tan x = x$

B. $\cot x = x, \sec x = x$

C. $\cot x = x, \tan x = x$

D. $\tan x = x, \cot x = x$

Answer: C

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5. The length of the subtangent to the ellipse $x = a \cos t, y = b \sin t$ at $t = \pi/4$ is

A. a

B. b

C. $b/\sqrt{2}$

D. $a/\sqrt{2}$

Answer: D

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6. Find the angle of intersection of $y=a^x and y=b^x$

A. $\dfrac{\log ab}{1+\log ab}$

B. $\dfrac{\log a/b}{1+(\log a)(\log b)}$

C. $\dfrac{\log ab}{1+(\log a)(\log b)}$

D. none of these

Answer: B

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7. For the parabola $y^2 = 16x$, the ratio of the length of the subtangent to the abscissa is

A. $2:1$

B. $1:1$

C. $x:y$

D. $x^2:y$

Answer: A

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8. If the tangent to the curve $x^3 - y^2 = 0$ at $(m^2, -m^2)$ is parallel to $y = -\frac{1}{m}x - 2m^3$, then the value of m^3 is

A. $(1/3)$

B. $1/6$

C. $2/3$

D. $-2/3$

Answer: C

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9. The function $y = \dfrac{ax+b}{(x-1)(x-4)}$ has turning point at $P(2, 1)$. Then find the value of $a \, and \, b$.

A. $c = 2, d = 0$

B. $c = 1, d = 0$

C. $c = 1, d = -1$

D. $c = 1, d = 1$

Answer: B

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10. The distance between the origin and the normal to the curve $y = e^{2x} + x^2$ at $x = 0$ is

A. $1/\sqrt{5}$

B. $2/\sqrt{5}$

C. $3/\sqrt{5}$

D. $2/\sqrt{3}$

Answer: B

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11. The function f(x) $= (\sin x) + [\cos x], 0 < x \le \pi/2$

A. is continuous on $(0, \pi/2)$

B. is strictly decreasing in $(0, \pi/2)$

C. is stricitly increasing in $(0, \pi / 2)$

D. has global maximum value 2

Answer: A

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12. if f is an increasing function and g is a decreasing function on an interval I such that fog exists then

A. f o g is a decreasing function

B. g o f is an increasing function

C. fog is an increasing function

D. none of these

Answer: A

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13. If a le 0 f(x) =e^(ax)+e^(-ax)` and S={x:f(x) is monotonically increasing then S equals

A. $S = \{x : x > 0\}$

B. $S = \{x : x < 0\}$

C. $S = \{x : x > 1\}$

D. $S = \{x : x < 1\}$

Answer: B

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14. Equation of the horizonatl tangent to the curve $y = e^x + e^{-x}$ is

A. $y = -2$

B. $y = -1$

C. y=2

D. none

Answer: C

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15. If $f(x) and g(x)$ be two function which are defined and differentiable for all $x \geq x_0$. If $f(x_0) = g(x_0) and f'(x) > g'(x)$ for all $f > x_0$, then prove that $f(x) > g(x)$ for all $x > x_0$.

A. $f(x) < g(x)$ for some $x > x_0$

B. f(x) = g(x) for some $x > x_0$

C. $f(x) > g(x)$ for all $x > x_0$

D. none of these

Answer: C

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16. If $f(x) = 2x \cot^{-1} x + \log\left(\sqrt{1+x^2} - x\right.$ then f(x)

A. decreases on $(-\infty, \infty)$

B. decreases on $[0, \infty)$

C. neither decreases nor increases on $[0, \infty]$

D. increases on $(-\infty, \infty)$

Answer: D

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17. The equation $x^4 - 7x + 2 = 0$ has

A. exactly two real and distinct solutions

B. has four real roots

C. no real root

D. all the four roots lie between 0 and 2

Answer: A

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18. The maximum value of $x^{1/x}$ is

A. $(1/e)^e$

B. $e^{1/e}$

C. e

D. $1/e$

Answer: B

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19. Let $P(x) = a_0 + a_1x^2 + a_2x^4 + \ + a_nx^{2n}$ be a polynomial in a real variable x with `0

A. neither a maximum nor a minimum

B. only one maximum

C. only one minimum

D. none of these

Answer: C

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20. $f(x)=\frac{x}{\sin x}$ and $g(x)=\frac{x}{\tan x}$, where $0 < x \leq 1$ then in the interval

A. f(x) and g(x) are increasing functions

B. both f(x) and g(x) are decreasing functions

C. f(x) is an increasing function

D. g(x) is an increasing function

Answer: C

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21. Examine the validity of Lagrange's mean value theorem for the function $f(x) = x^{2/3}$ in the interval $[-1, 1]$.

A. (0,0) is a point of maximum

B. (0,0) is not a point of minimum

C. (0,0) is a critical point

D. There is no crtical point

Answer: C

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22. Let $f(x) = \dfrac{ax+b}{cx+d}$ $(da - cb \neq 0, c \neq 0)$ then f(x) has

A. a critical point

B. no point of inflection

C. a maximum

D. a minimum

Answer: B

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23. If the only point of inflection of the function $f(x) - (x-a)^m (x-b)^n$, m, neN and $m \neq n$ is at $x = a$ then

A. (a,0), (b,0) are the only critical points of f

B. there are m+n critical points of f

C. there are exactly three critical points of f

D. none of these

Answer: C

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24. A ball is dropped from a platform 19.6m high. Its position function is

A. $x = -4.9t^2 + 19.6(0 \leq t \leq 1)$

B. $x = -4.9t^2 + 19.6(0 \leq t \leq 2)$

C. $x = -9.8t^2 + 19.6(0 \leq t \leq 2)$

D. $x = -4.9 + 19.6(0 \leq t \leq 2)$

Answer: B

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25. Let f(n) = $20n - n^2(n = 1, 2, 3 \ldots)$, then

A. $f(n) \rightarrow \infty \text{as} \quad n \rightarrow \infty$

B. f(n) has no maximum

C. The maximum value of f(n) is greater than 200

D. none of these

Answer: D

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26. plot the curve $y = [x]^2$

A. (1,1)

B. (2,4)

C. (2/3, 4/9)

D. (4/3, 16/9)

Answer: A

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27. The smallest value of M such that $\left|x^2 - 3x + 2\right| \le M$ for all x in $\left[1, \frac{5}{2}\right]$

A. $1/4$

B. $3/4$

C. $5/4$

D. $5/16$

Answer: B

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28. The no. of solutions of the equation $a^{f(x)} + g(x) = 0$ where a>0 , and g(x) has minimum value of 1/2 is :-

A. one

B. two

C. infinitely many

D. zero

Answer: D

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29. The minimum value of $f(x) = |3 - x| + |2 + x| + |5 - x|$ is

A. 0

B. 7

C. 8

D. 10

Answer: B

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30. $x(x-2)(x-4), 1 \leq x \leq 4,$ will satisfy mean value theorem at

A. 1

B. 2

C. $5/2$

D. $7/2$

Answer: A

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31. If $\sqrt{x}+\sqrt{y}=\sqrt{a}$ then $\frac{dy}{dx}=$?

A. 2a

B. a

C. a/2

D. $\sqrt{a}$

Answer: B

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32. x and y be two variables such that $x > 0$ and $xy = 1$. Then the minimum value of $x + y$ is

A. 1

B. $1/2$

C. 2

D. $1/4$

Answer: C

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33. if $f(x) = \left(\frac{\sin(x+\alpha)}{\sin(x+\beta), \alpha \neq \beta}\right.$ then f(x) has

A. $\beta - \alpha = k\pi$

B. $\beta - \alpha \neq k\pi$

C. $\beta - \alpha = 2k\pi$

D. none of the abve

Answer: B

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34. The tangent to the curve $y = x^3 - 6x^2 + 9x + 4, 0 \leq x \leq 5$ has maximum slope at x which is equal to

A. 2

B. 3

C. 4

D. none of these

Answer: D

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35. The values of parameter a for which the point of minimum of the function $f(x)=1+a^2x-x^3$ satisfies the inequality $\frac{x^2+x+2}{x^2+5x+6}<0 are$ $(2\sqrt{3}, 3\sqrt{3})$ (b) $-3\sqrt{3}, -2\sqrt{3})$ $(-2\sqrt{3}, 3\sqrt{3})$ (d) $(-2\sqrt{2}, 2\sqrt{3})$

A. an empty set

B. $(-3\sqrt{3}, -2\sqrt{3})$

C. $(2\sqrt{3}, 3\sqrt{3})$

D. $(-3\sqrt{3}, -2\sqrt{3}) \cup (2\sqrt{3}, 3\sqrt{3})$

Answer: C

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36. Find the point of intersection of the tangents drawn to the curve $x^2y = 1 - y$ at the points where it is intersected by the curve $xy = 1 - y$.

A. $(0, \ -1)$

B. (1,1)

C. (0,1)

D. none of these

Answer: C

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37. The equation of the tangent to the curve $y = (2x - 1)e^{2(1-x)}$ at the point of its maximum, is

A. y=1

B. x=1

C. $x + y = 1$

D. $x - y = -1$

Answer: A

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38. If the function $f(x) = x^2 + \alpha / x$ has a local minimum at x=2, then the value of α is

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39. Three normals are drawn to the parabola $y^2 = 4x$ from the point (c,0). These normals are real and distinct when

A. c=0

B. c=1

C. c=2

D. c=3

Answer: D

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40. The function $f(x)=[\log(x-1)]^2(x-1)^2$ has :

A. loca extremum at x=1

B. point of inflection at x=1

C. local extremum at x=2

D. point of inflection at x=2

Answer: C

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41. If $f(x) = \log x$ satisfies Lagrange's theorem on $[1, e]$ then value of $c \in (1, e)$ such that the tangent at c is parallel to line joining $(1, f(1))$ and $(e, f(e))$ is

A. $e - \frac{3}{2}$

B. $\frac{1+e}{2}$

C. $e - 1$

D. $e - \frac{1}{2}$

Answer: C

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42. The value of c for which the conclusion of Lagrange's theorem holds for the function f(x) = $\sqrt{a^2 - x^2}$, $a > 1$ on the interval [1,a] is

A. $\frac{a(a+1)}{2}$

B. $\frac{1+a}{2}$

C. $\frac{\sqrt{a(a+1)}}{2}$

D. $\frac{a(a-1)}{2}$

Answer: C

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43. Let $f(x)\begin{cases} |x-2|+a, & \text{if} x \le 2 \\ 4x^2+3x+1, & \text{if} x > 2 \end{cases}$. If f(x) has a local minimum at x=2, then

A. $a > 21$

B. $a \le 21$

C. $a > 30$

D. $a > 24$

Answer: B

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44. If $y = mx + 2$ is parallel to a tangent to curve $e^{4y} = 1 + 16x^2$ then

A. $|m| < 1$

B. $|m| < 1$

C. $|m| > 1$

D. $|m| \geq 1$

Answer: A

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45. Given the function $f(x) = x^2 e^{-2x}, x > 0$. Then f(x) has the maximum value equal to

A. e^{-2}

B. $(2e)^{-1}$

C. e^{-1}

D. none of these

Answer: A

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46. if f(x)=(x -4) (x-5) (x-6) (x-7) then.

A. f'(x) = 0 has four real roots

B. three roots of f'(x) = 0 lie in $(4, 5) \cup (5, 6) \cup (6, 7)$

C. the equation f'(x) = has only two roots

D. three roots of f'(x) = 0 lie $(3, 4) \cup (4, 5) \cup (5, 6)$

Answer: B

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47. If $f(x) = \frac{x^2 - 1}{x^2 + 1}$. For every real number x, then the minimum value of f. does not exist because f is unbounded is not attained even through f is bounded is equal to 1 is equal to -1

A. does not exist because f is unbounded

B. is not attained even though f is bounded

C. is equal to 1

D. is equal to -1

Answer: D

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48. For all $x \in (0, 1)$

A. $e^x < 1 + x$

B. $\log_e(1 + x) < x$

C. $\sin x > x$

D. $\log_e x > x$

Answer: B

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49. Let $h(x) = f(x) - (f(x))^2 + (f(x))^3$ for every real x. Then,

A. h increases whenever f decreases

B. h decreases whenever f increases

C. h increases or decreases accordingly as f increases or decreases

D. nothing can be claimed in general

Answer: C

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50. Let $f(x) = ax^3 + bx^2 + cx + d$, $b^2 - 3ac > 0$, $a > 0$, $c < 0$. Then f(x) has

A. local maximum at some $x \in R^+$

B. a local maximum at some $x \in R^-$

C. a local minima at x=0

D. local minima at some $x \in R^-$ ltbr.

$R^+ = (0, \infty), R^- = (-\infty, 0)$

Answer: B

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51. If $f(x) = \begin{cases} 3 - x^2, & x \le 2 \\ \sqrt{a+14} - |x - 48|, & x > 2 \end{cases}$ and if f(x) has a local maxima at x = 2, then greatest value of a is

A. a cannot be determined

B. least value of a is 2011

C. greater value of a is 2011

D. `a ge 3010

Answer: C

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52. The total number of local maxima and local minima of the function

f(x) = $\begin{cases} (2+x)^3, & -3 < x \le -1 \\ x^{2/3}, & -1 < x < 2 \end{cases}$ is

A. 0

B. 1

C. 2

D. 3

Answer: C

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53. If the function $g:(-\infty, \infty) \to \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ is given by $g(u) = 2\tan^{-1}(e^u) - \frac{\pi}{2}$. Then, g is

A. even and is strictly increasing in $(0, \infty)$

B. odd and is strictly decreasing in $(-\infty, \infty)$

C. odd and is strictly increasing in $(-\infty, \infty)$

D. neither even nor odd, but is strictly increasing in $(-\infty, \infty)$

Answer: C

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54. If $f(x) = x^a \log x$ and $f(0) = 0$ then the value of α for which Rolle's theorem can be applied in [0,1] is

A. -1

B. $-1/2$

C. 0

D. $1/2$

Answer: D

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55. Suppose the cubic $x^3 - px + q$ has three distinct real roots, where $p > 0$ and $q > 0$. Then which one of the following holds?

A. f(x) has minima at $\sqrt{\frac{p}{3}}$ and maxima at $-\sqrt{\frac{p}{3}}$

B. f(x) has minima at $-\sqrt{\frac{p}{3}}$ and maxima at $\sqrt{\frac{p}{3}}$.

C. f(x) has minima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

D. f(x) has maxima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

Answer: A

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56. Given P(x) $= x^4 + ax^3 + bx^2 + cx + d$ such that x=0 is the only real root of P'(x) =0 . If P(-1) lt P(1),$then \in the \int erval$[-1,1]`

A. $P(-1)$ is the minimum but P(1) is not the maximum of P

B. neither $P(-1)$ is the minimum nor P(1) is the maximum of P

C. $P(-1)$ is the minimum and P(1) is the maximum of P

D. $P(-1)$ is not minimum but P(1) is the maximum of P

Answer: D

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57. Let $f : R\vec{R}$ be defined by $f(x) = \{k - 2x, \quad \text{if} \quad x \leq -12x + 3, fx \succ 1\}$. If f has a local minimum at $x = 1$, then a possible value of k is (1) 0 (2) $-\frac{1}{2}$ (3) -1 (4) 1

A. $-1/2$

B. -1

C. 1

D. 0

Answer: B

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58. The value of K in order that $f(x) = \sin x - \cos x - Kx + 5$ decreases for all positive real value of x is given by

A. $a \geq \sqrt{2}$

B. $a < \sqrt{2}$

C. $a \geq 1$

D. $a < 1$

Answer: A

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59. The curve that passes through the point $(2, 3)$ and has the property that the segment of any tangent to it lying between the coordinate axes is bisected by the point of contact, is given by

A. $2y - 3x = 0$

B. $y = \frac{6}{x}$

C. $x^2 + y^2 + 13$

D. $\left(\frac{x}{2}\right)^2 + \left(\frac{y}{3}\right)^2 = 2$

Answer: B

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60. A spherical balloon is filled with 4500p cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of 72π cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is (1) $\frac{9}{7}$ (2) $\frac{7}{9}$ (3) $\frac{2}{9}$ (4) $\frac{9}{2}$

A. $7/9$

B. $2/9$

C. $9/2$

D. $9/7$

Answer: B

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Solved Examples Level 2 Single Correct Answer Type Questions

1. The point M (x,y) of the graph of the function $y = e^{-|x|}$ so that area bounded by the tangent at M and the coordinate axes is greatest is

A. $(1, e^{-1})$

B. $(2, e^{-2})$

C. $(-2, e^{2})$

D. $(0, 1)$

Answer: A

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2. The abscissa of the point on the curve $ay^2 = x^3$, the normal at which cuts off equal intercepts from the coordinate axes is

A. 2

B. 4

C. -4

D. -2

Answer: B

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3. v24

A. (0.4/3)

B. (0,2/3)

C. (1,2/3)

D. (2,4/3)

Answer: A

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4. If the tangent to the curve $2y^3 = ax^2 + x^3$ at the point (a,a) cuts off intercept α and β on the co-ordinate axes , (where $\alpha^2 + \beta^2 = 61$) then a^2 equals _____

A. 16

B. 28

C. 30

D. 31

Answer: C

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5. The co-ordinates of the points on the barabola $y^2 = 8x$, which is at minium distance from the circle $x^2 + (y+6)^2 = 1$ are

A. $(2, -4)$

B. $(18, -12)$

C. (2,4)

D. none of these

Answer: A

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6. The equation $e^{x-8} + 2x - 17 = 0$ has :-

A. two real roots

B. one real root

C. eight real roots

D. four real roots

Answer: B

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7. The maximum and minimum value of f(x) $= ab\sin x + b\sqrt{1-a^2}\cos x + c$ lie in the interval (assuming $|a| < 1, b > 0$)

A. $[b-c, b+c]$

B. $(b-c, b+c)$

C. $[c-b, b+c]$

D. none of these

Answer: C

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8. The maximum area of the rectangle whose sides pass through the vertices of a given rectangle of sides $a and b$ is $2(ab)$ (b) $\frac{1}{2}(a+b)^2$ $\frac{1}{2}(a^2+b^2)$ (d) $none of these$

A. $(1/2)(ab)^2$

B. $(1/2)(a+b)$

C. $(1/2)(a+b)^2$

D. none of these

Answer: C

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9. Find the image of interval $[-1, 3]$ under the mapping specified by the function $f(x) = 4x^3 - 12x$.

A. $[-2, 0]$

B. $[-8, 72]$

C. $[-8, 0]$

D. $[8, 72]$

Answer: B

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10. The difference between the greatest and the least value of the function $f(x) = \cos x + \frac{1}{2}\cos 2x - \frac{1}{3}\cos 3x$

A. $3/8$

B. $2/3$

C. $8/7$

D. $9/4$

Answer: D

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11. The maximum distance of the point (a, 0) from the curve $2x^2 + y^2 - 2x = 0$ is -

A. $\sqrt{1 - 2a + 2a^2}$

B. $\sqrt{1-2a+a^2}$

C. $\sqrt{1+2a+2a^2}$

D. $\sqrt{1+a+a^2}$

Answer: A

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12. The sides of the rectangle of the greatest area, that can be inscribed in the ellipse $x^2+2y^2=8$, are given by

A. $4\sqrt{2}, 4$

B. $4, 2\sqrt{2}$

C. $2, \sqrt{2}$

D. $2\sqrt{2}, 2$

Answer: B

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13. The area of the region bounded by the curve $y = x^3$, its tangent at (1, 1) and x-axis is

A. $x^2 + y^2 + 24x - 28y + 2 = 0$

B. $2(x^2 + y^2) + 12x - 8y - 8 = 0$

C. $3(x^2 + y^2) - 24x + 10y + 8 = 0$

D. none of these

Answer: D

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14. Let $f(x) = 6x^{4/3} - 3x^{1/2}, x \in [-1, 1]$. Then

A. The maximum value of f(x) on $[-1, 1]$ is 3

B. The maximum value of f(x) on $[-1, 1]$ is 9

C. The maximum value of f(x) on $[-1, 1]$ is 0

D. none of these

Answer: B

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15. Let $g(x) = (\log(1+x))^{-1} - x^{-1}, x > 0$ then

A. $1 < g(x) < 2$

B. $-1 < g(x) < 0$

C. $0 < g(x) < 1$

D. none of these

Answer: C

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16. Range of $\dfrac{x^2 - x + 1}{x^2 + x + 1}$ is

A. $1/2$

B. 1

C. 2

D. 3

Answer: D

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17. If the tangent at $(1, 1)$ on $y^2 = x(2 - x)^2$ meets the curve again at P, then find coordinates of P.

A. (4,4)

B. $(-1, 2)$

C. (9/4,3/8)

D. none of these

Answer: C

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18. If the curves $y^2 = 6x, 9x^2 + by^2 = 16$ intersect each other at right angles then the value of b is: (1) 6 (2) $\frac{7}{2}$ (3) 4 (4) $\frac{9}{2}$

A. 2

B. 4

C. $9/2$

D. none of these

Answer: C

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19. Find the distance of the point on $y = x^4 + 3x^2 + 2x$ which is nearest to the line $y = 2x - 1$

A. $4/\sqrt{5}$

B. $3/\sqrt{5}$

C. $2/\sqrt{5}$

D. $1/\sqrt{5}$

Answer: D

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20. A given right cone has volume p, and the largest right circular cylinder that can be inscribed in the cone has volume q. Then $p:q$ is 9:4 (b) 8:3 (c) 7:2 (d) none of these

A. $9:4$

B. $8:3$

C. $7:2$

D. none of these

Answer: A

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21. The set of all values of a for which the function $f(x) = (a^2 - 3a + 2)\left(\cos^2\frac{x}{4} - \sin^2\frac{x}{4}\right) + (a-1)x + \sin 1$ does not possess critical points is (A) $[1, \infty)$ (B) $(0, 1) \cup (1, 4)$ (C) $(-2, 4)$ (D) $(1, 3) \cup (3, 5)$

A. $[1, \infty)$

B. $(-2, 4)$

C. $(1, 3) \cup (3, 5)$

D. $(0, 1) \cup (1, 4)$

Answer: D

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22. Let $x, p \in R, x+1>0, p \neq 0, 1$. Then

A. $(1+x)^p > 1px \text{for} p > 0$

B. $(1+x)^p > 1+px \text{for} p \in (-\infty, 0) \cup (1, \infty)$

C. $(1+x)^p > 1+px \text{for} 0 < p < 1$

D. $(1+x)^p < 1+px \text{for} p < 1$

Answer: B

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23. If $f(x) = \dfrac{a \sin x + b \cos x}{c \sin x + d \cos x}$ is decreasing for all x, then

A. $ad - bc < 0$

B. $ad - bc > 0$

C. $ab - cd > 0$

D. $ab - cd < 0$

Answer: A

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24. In the interval $[0, 1]$, the function $x^{25}(1-x)^{75}$ takes its maximum value at the point 0 (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{3}$

A. 0

B. $1/3$

C. $1/2$

D. $1/4$

Answer: D

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25. The set of values of p for which the equation $px^2 = \ln x$ possess a single root is

A. $1/2$

B. $1/2e$

C. $1/e$

D. $2e^{-1}$

Answer: B

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Solved Examples Numerical Answer Type Questions

1. If $f(x) = |x-7| + |x-10| + |x-12|$ has a minimum at x=k, then the value of k is _____

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2. Let $f\left(x - = \tan^{-1}\left(\frac{1-x}{1+x}\right)\right.$. Then difference of the greatest and least value of $f(x)$ on $[0, 1]$ is:

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3. The absolute maximum value of $f(x) = \frac{5}{3x^4 + 8x^3 - 18x^2 + 60}$

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4. Number of real roots of the equation $3x^5 + 15x - 8 = 0$ is

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5. If the value of greater of $\sin x + \tan x$ and $2x (0 < x < \pi / 2)$ at$\pi / 4$ is $g(\pi / 4)$ then $g(\pi / 4)$ is equal to

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6. If the greatest value of $y = \dfrac{x}{\log x}$ on $\left[e, e^3\right]$ is u then u is equal to (given e= 2.71)

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7. If (u,v) are the coordinates of the point on the curve $x^3 = y(x-4)^2$ where the ordinate is minimum then uv is equal to

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8. If A gt 0 ,B gt 0 and A+B=$\frac{\pi}{3}$,then the maximum value of tan A tan B , is

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9. If $f(\theta) = 64 \sec\theta + 27 \cos ec\theta$ when θ lies in $(0, \pi/4)$ then min $f(\theta)$ is equal to

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10. Show that the area of the triangle formed by the pósitive x-axis and the normal and tangent to the circle $x^2 + y^2 = 4$ at $(1, \sqrt{3})$ is $2\sqrt{3}$

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11. A curve is represented by the equations $x = \sec^2 tandy = \cot t$, where t is a parameter. If the tangent at the point P on the curve where $t=\frac{\pi}{4}$ meets the curve again at the point Q, then $|PQ|$ is equal to $\frac{5\sqrt{3}}{2}$ (b) $\frac{5\sqrt{5}}{2}$ (c) $\frac{2\sqrt{5}}{3}$ (d) $\frac{3\sqrt{5}}{2}$

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12. If the slope of line through the origin which is tangent to the curve $y=x^3+x+16$ is m, then the value of $m-4$ is____.

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13. If the point on $y=x\tan\alpha-\frac{ax^2}{24^2\cos^2\alpha}(\alpha>0)$ where the tangent is parallel to y=x has an ordinate $u^2/4a$, then $\cos^2\alpha$ is equal to

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14. $f: R \to R$ be defined as $f(x) = |x| + |x^2 - 1|$. The total number of points at which f attains either local maximum or a level minimum is

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15. The number of non-zero integral solution of K for which the equation $\frac{x^3}{3} - 4x = K$ has three distinct solution is

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16. The least integral value of x where $f(x) = (\log)_{\frac{1}{2}}(x^2 - 2x - 3)$ is monotonically decreasing is_______

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17. Let P(x) be a polynomial of degree 5 having extremum at $x = -1, 1$ and $\lim_{x \to 0}\left(\frac{P(x)}{x^3} - 1\right) = 7$. The value of |P(7)| is

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18. Let $f(x) = \begin{cases} |x^2 - 2x| + a, & 0 \le x < 5/2 \\ -2x + 5, & x \ge 5/2 \end{cases}$. If f(x) has a maximum at x= 5/2, then the greatest value of |a| is

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Exercise Concept Based Single Correct Answer Type Questions

1. The length of the tangent to the curve $x = a\sin^3 t, y = a\cos^3 t (a > 0)$ at an arbitrary is

A. $a\cos^2 t$

B. $a \sin^2 t$

C. $\dfrac{a \sin^2 t}{\cot t}$

D. $\dfrac{a \cos^2 t}{\sin t}$

Answer: A

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2. Equation of normal to $x = 2e^t, y = e^{-t}$ at $t = 0$ is

A. $x + y - 4 = 0$

B. $x + 2y - 4 = 0$

C. $2x - y - 3 = 0$

D. $x - 2y - 3 = 0$

Answer: C

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3. A point moves according $s = \frac{2}{9}\sin\frac{\pi}{2}t + s_0$. The acceleration at the end of first second is

A. $-\frac{\pi}{18}$

B. $-\frac{\pi^2}{18}$

C. $\frac{\pi}{18}$

D. $\frac{\pi^2}{18}$

Answer: B

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4. Let f(x) = x log x $+1$ then the set {x : $f(x) > 0$} is equal to

A. $(1, \infty)$

B. $(1/e, \infty)$

C. $[e, \infty)$

D. $(0, 1) \cup (1, \infty)$

Answer: D

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5. On the curve $y = x^3$, the point at which the tangent line is parallel to the chord through the point $(-1, -1)$ and (2,8) is

A. (1,1)

B. $\left(\frac{1}{2}, \frac{1}{8}\right)$

C. $\left(\frac{1}{3}, \frac{1}{27}\right)$

D. $\left(\frac{1}{2}, -\frac{1}{8}\right)$

Answer: A

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6. Let $f(x) = 2x^2 - \log x$, then

A. f increases on $(0, \infty)$

B. f decrease on $\left(\frac{1}{2}, \infty\right)$

C. f increases on $\left(\frac{1}{2}, \infty\right)$

D. f decreases on (0,1)

Answer:

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7. Let $f(x) = \frac{3}{4}x^4 - x^3 - 9x^2 + 7$, then the number of critical points in $[-1, 4]$ is

A. 4

B. 3

C. 2

D. 1

Answer: C

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8. On the curve $x^3 = 12y$, find the interval at which the abscissa changes at a faster rate than the ordinate.

A. $(-2, 2)$~$\{0\}$

B. $(-3, 3)$~$\{0\}$

C. (1,4)

D. (2,4)

Answer: A

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9. Find the value of a if the curves $\frac{x^2}{a^2} + \frac{y^2}{4} = 1 and y^3 = 16x$ cut orthogonally.

A. 1

B. $\frac{2\sqrt{3}}{3}$

C. $3\sqrt{3}$

D. $5\sqrt{5})$

Answer: B

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10. The least value of $g(t) = 8t - t^4$ on [-2, 1]` is

A. -16

B. -20

C. -32

D. 7

Answer: C

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Exercise Level 1 Single Correct Answer Type Questions

1. Let $f(x) = \tan^{-1} x \text{ and } g(x) = \frac{x}{1+x^2}, x > 0$ then

A. $f(x) < g(x), \quad \text{on} \quad (0, \infty)$

B. $f(x) \leq g(x) \quad \text{on} \quad [1, \infty)$

C. $g(x) < f(x) \quad \text{on} \quad (0, \infty)$

D. none of these

Answer: C

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2. Let $f(x) = (x-2)(x-3)(x-4)(x-5)(x-6)$ then

A. f'(x) = 0 has five real roots

B. four roots of f'(x) = 0 lie in $(2, 3) \cup (3, 4) \cup (4, 5) \cup (5, 6)$

C. the equation f'(x) has only three roots

D. four roots of f'(x) = 0 lie in $(1, 2) \cup (2, 3) \cup (3, 4) \cup (4, 5)$

Answer: B

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3. Let $f(x) = (x-3)^5(x+1)^4$ then

A. $x = -1$ is point of minima

B. $x = -1$ is point of maxima

C. $x = 7/9$ is a point of maxima

D. $x = -1$ is neither a point of maxima and minima

Answer: B

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4. The normal to the curve $x = a(\cos\theta - \theta\sin\theta), y = a(\sin\theta - \theta\cos\theta)$ at any point , θ , is such that

A. makes a constant angle with the x-axis

B. is at a constant distance from the origin

C. does not touch a fixed circle

D. passes through the origin

Answer: B

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5. The number of values of k for which the equation $x^3 - 3x + k = 0$ has two distinct roots lying in the interval $(0, 1)$ is three (b) two (c) infinitely many (d) zero

A. -1

B. 1

C. 3

D. none of these

Answer: D

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6. If the sum of the squares of the intercepts on the axes cut off by tangent to the curve $x^{\frac{1}{3}} + y^{\frac{1}{3}} = a^{\frac{1}{3}},\ a > 0$ at $\left(\frac{a}{8}, \frac{a}{8}\right)$ is 2, then $a =$ 1 (b) 2 (c) 4 (d) 8

A. 1

B. 2

C. 4

D. 8

Answer: C

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7. If the area of the triangle included between the axes and any tangent to the curve $x^n y = a^n$ is constant, then find the value of n.

A. $1/2$

B. 1

C. $3/2$

D. 2

Answer: B

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8. If the tangent at any point on the curve $x^4 + y^4 = c^4$ cuts off intercepts a and b on the coordinate axes, the value of $a^{-\frac{4}{3}} + b^{-\frac{4}{3}}$ is

A. $a^{-4/3}$

B. $a^{-1/2}$

C. $a^{1/2}$

D. none of these

Answer: A

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9. The interval of increase of the function $y = x - 2\sin x \quad \text{if} \quad 0 \le x \le 2\pi$, is

A. $(0, \pi)$

B. $\left(0, \frac{\pi}{2}\right)$

C. $(\pi/2, \pi)$

D. $(\pi/3, 5\pi/3)$

Answer: D

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10. All possible value of $f(x) = (x+1)^{\frac{1}{3}} - (x-1)^{\frac{1}{3}}$ on [0,1] is 1 (b) 2 (c) 3 (d) $\frac{1}{3}$

A. 1

B. 2

C. `3

D. $2^{1/3}$

Answer: C

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11. Let f be a function defined by $f(x) = 2x^2 - \log|x|, x \neq 0$ then

A. f increases on $[-1/2, 0] \cup [1/2, \infty)$

B. f decrease on $(-\infty, 0)$

C. f increases on $(-\infty, -1/2)$

D. f decreases on $[1/2, \infty]$

Answer:

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12. The shortest distance of $(0, 0)$ from the curve $y = \dfrac{e^x + e^{-x}}{2}$ is

A. $1/2$

B. $1/3$

C. 2

D. none of these

Answer: D

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13. The normal to the circle $x^2 + y^2 - 2x - 2y = 0$ passing through (2,2) is

A. x=y

B. $2x + y - 6 = 0$

C. $x + 2y - 6 = 0$

D. $x + y - 4 = 0$

Answer: A

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14. If $f(x) = x \text{for} x \leq 0$

$= 0 \text{for} \quad x > 0$ then f(x) at x=0 is

A. decreases on $(0, \infty)$

B. increases on $(0, \infty)$

C. decreases on $(1, \infty)$

D. neither increases nor decreases on $(0, \infty)$

Answer: B

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15. The value of k so that the equation $x^3 - 12x + k = 0$ has distinct roots in $[0, 2]$ is

A. 4

B. 2

C. -2

D. none of these

Answer: D

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16. Let $f(x) = 6x^{4/3} - 3x^{1/3}$ defined on $[-1, 1]$ then

A. maximum value of f is 7

B. maximum value of f is 5

C. maximum value of f is 9

D. minimum value of f is $-3/2$

Answer: C

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17. An equation of tangent line at an inflection point of $f(x) = x^4 - 6x^3 + 12x^2 - 8x + 3$ is

A. $y = 3x + 4$

B. $y = 4$

C. $y = 3x + 2$

D. none of these

Answer: D

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18. The number of real roots of the equation $2x^3 - 3x^2 + 6x + 6 = 0$ is

A. 1

B. 2

C. 3

D. none of these

Answer: A

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19. Let f(x) $= (x-2)(x^4 - 4x^3 + 6x^2 - 4x + 1)$ then value of local minimum of f is

A. $-2/3$

B. $-(4/5)^4$

C. $-4^4/5^5$

D. $-(4/5)^5$

Answer: C

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20. Let $f(x) = x^2 - 2|x| + 2,\ x \in [-1/2, 3/2]$ then

A. min $f(x) = 1/2x \in [-1/2, 3/2]$

B. min $f(x) = 1x \in [-1/2, 3/2]$

C. max $f(x) = 3/2x \in [-1/2, 3/2]$

D. none of these

Answer:

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21. The function $f(x) = \dfrac{|x-1|}{x^2}$ is

A. -1

B. 3

C. 2

D. $1/2$

Answer: C

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22. The function $f(x) = x^x$ decreases on the interval (a) $(0, e)$ (b) $(0, 1)$ (c) $(0, 1/e)$ (d) $(1/e, e)$

A. (0,e)

B. (0,1)

C. (0, 1/e)

D. none of these

Answer: C

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23. The interval of increase of the function $f(x) = x - e^x + \tan(2\pi/7)$ is (a) $(0, \infty)$ (b) $(-\infty, 0)$ (c) $(1, \infty)$ (d) $(-\infty, 1)$

A. $(-\infty, 1)$

B. $(0, \infty)$

C. $(-\infty, 0)$

D. $(1, \infty)$

Answer: C

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24. Let $f(x) = x^2 + px + q$. The value of(p, q) so that f(1) =3 is an extreme value of f on [0, 2] is

A. $(-2, 2)$

B. $(1, 4)$

C. $(-2, 4)$

D. $(-2, 3)$

Answer: C

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25. The number of inflection points of a function given by a third degree polynomial is exactly

A. 2

B. 1

C. 3

D. 0

Answer: B

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26. Let $f(x) = 2\tan^{-1}x + \sin^{-1}\frac{2x}{1+x^2}$ then

A. max f(x) $= \pi/2$

B. min f(x) $= \pi/4$

C. max f(x) =2π

D. none of these

Answer: C

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27. If the normal to the curve $x^3 = y^2$ at the point $(m^2, -m^3)$ is $y = mx - 2m^3$, then the value of m^2 is

A. 1

B. $1/2$

C. $1/3$

D. $2/3$

Answer: D

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28. Let $f(x) = 2\sin x + \cos 2x (0 \leq x \leq 2\pi)$ and $g(x) = x + \cos x$ then

A. g is a decreasing function

B. f increases on $(0, \pi/2)$

C. f increases on $(0, \pi/6) \cup (\pi/2, 5\pi/6)$

D. f decreases on $(0, \pi/2)$

Answer: C

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29. In the interval $(0\pi/2)$ the fucntion $f(x) = \tan^n x \cot^n$ attains

A. 1

B. 0

C. 2

D. $1/2$

Answer: C

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30. Find the number of points of local extrema of $f(x) = 3x^4 - 4x^3 + 6x^2 + ax + b$ where $a, b \in R$

A. 4

B. 3

C. 1

D. 2

Answer: C

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31. The shortest distance between line y-x=1 and curve $x = y^2$ is

A. $3/8$

B. $3\sqrt{2}/4$

C. $3/4$

D. $3\sqrt{2}/8$

Answer: D

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32. The set of values of p for which the points of extremum of the function, $f(x) = x^3 - 3px^2 + 3(p^2 - 1)x + 1$ lin in the interval $(-2, 4)$ is

A. $(-1, 0)$

B. $(-2, 4)$

C. $(-1, 5)$

D. $(-1, 3)$

Answer: D

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33. If A gt 0 ,B gt 0 and A+B=$\frac{\pi}{3}$,then the maximum value of tan A tan B , is

A. $1/3$

B. $1/2$

C. $1/\sqrt{2}$

D. $\sqrt{3}/2$

Answer: A

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34. The maximum value of |x log x| for $0 < x \leq 1$ is

A. 0

B. $1/e$

C. $2e^{-1}$

D. none of these

Answer: B

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35. The greatest value of the function $\log_x 1/9 - \log_3 x^2 (x > 1)$ is

A. 2

B. 0

C. -4

D. -2

Answer: C

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36. Let f be differentiable for all x, If $f(1) = -2 and f'(x) \geq 2$ for all $x \in [1, 6]$, then find the range of values of $f(6)$.

A. $f(6) < 8$

B. $f(6) \geq 8$

C. $f(6) \geq 10$

D. $f(6) \geq 5$

Answer: B

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37. An extremum value of the function $f(x) = (\sin^{-1} x)^3 + (\cos^{-1} x)^3 (-1 \leq x \leq 1)$ is

A. $7\pi^3/8$

B. $\pi^3/8$

C. $\pi^3/32$

D. $\pi^3/16$

Answer: C

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38. Let $f(x) = x \log x + 3x$. Then

A. f increases in $\left(e^{-4}, \infty\right)$

B. f increases in $(0, \infty)$

C. f decreases in $(0, \infty)$

D. f decreases in $\left(0, e^{-2}\right)$

Answer: A

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39. Let $f(x) = x^2 . e^{-x^2}$ then which one is incorrect? (A) $f(x)$ has local maxima at $x = -1$ and $x = 1$ (B) $f(x)$ has local minima at $x = 0$ (C) $f(x)$ is strictly decreasing on $x \in R$ (D) Range of $f(x)$ is $\left[0. \frac{1}{e}\right]$,

A. max f(x) =e^{-1}

B. max $f(x) = 4e^{-2}$

C. min $f(x) = e^{-1}$

D. min $f(x) > 0$

Answer: B

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40. The minimum value of $f(x) = |3 - x| + |2 + x| + |5 - x|$ is

A. 0

B. 7

C. 8

D. 10

Answer: B

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41. Let $f(x) = 2 + 2x - 3x^{2/3}$ on $[-1, 10/3]$. Then f has

A. Absolute maximum at an end point

B. Absolute minimum at an interior point

C. Absolute minimum is $f(10/3)$

D. Absolute minimum is $f(-1)$

Answer: D

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42. If f and g are defined on $[0, \infty)$ by $f(x) = \lim_{n \to \infty} \dfrac{x^n - 1}{x^n + 1}$ and $g(x) = \int_0^x f(t)dt$. Then

A. g has local maximum at x=1

B. g has local minimum at x=1

C. g is an increasing function on $(0, \infty)$

D. g is a decreasing function on $(0, \infty)$

Answer: B

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43. Let the function $f(x) = \sin x + \cos x$, be defined in $[0, 2\pi]$, then $f(x)$

A. $x = 17\pi/4$ is a point of minima

B. $x = 13\pi/4$ is a point of maxima

C. $x = 21\pi/4$ is a point of minima

D. $x = 29\pi/4$ is a point of maxima

Answer: C

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44. If $f(x) = xe^{x(1-x)}$, then f(x) is

A. increasing on $[-1/2, 1]$

B. decreases on R

C. increasing on R

D. decreasing on $[-1/2, 1]$

Answer: A

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45. The tangent to the curve $y = e^x$ drawn at the point (c, e^c) intersects the line joining $(c-1, e^{c-1})$ and $(c+1, e^{c+1})$ (a) on the left of $n = c$ (b) on the right of $n = c$ (c) at no points (d) at all points

A. on the left of x=c

B. on the right of x=c

C. at no point

D. at all points

Answer: A

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Exercise Level 2 Single Correct Answer Type Questions

1. Find the critical points(s) and stationary points (s) of the function $f(x)=(x-2)^{2/3}(2x+1)$

A. -1 and 2

B. 1

C. 1 and $-1/2$

D. 1 and $1/2$

Answer: B

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2. The function $f(x) = \frac{x^3}{4} - \sin \pi x + 3$ on $[-2, 2]$ takes the value

A. 1

B. $16/3$

C. 6

D. 8

Answer: A

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3. The greatest value of the function $f(x) = \tan^{-1} x - \frac{1}{2}\log x$ in $\left[\frac{1}{\sqrt{3}}, \sqrt{3}\right]$ is

A. $\pi/2 + (1/2)\log 3$

B. $\pi/6 + (1/4)\log 3$

C. $\pi/6 + (1/2)\log 3$

D. $\pi/4-(1/4)\log 3$

Answer: B

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4. Equations of those tangents to $4x^2-9y^2=36$ which are prependicular to the straight line $2y+5x=10$, are

A. $5(y-3)=\left(x-\sqrt{117/4}\right)$

B. $5(y-2)=2\left(x-\sqrt{18}\right)$

C. $5(y+2)=2\left(x-\sqrt{18}\right)$

D. none of these

Answer: D

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5. if a,b,c are real then find the intervial in which $f(x) = \begin{vmatrix} x+a^2 & ab & ac \\ ab & x+b^2 & bc \\ ac & bc & x+c^2 \end{vmatrix}$ is decreasing.

A. $\left(-(2/3)\left(a^2+b^2+c^2\right), 0\right)$

B. $\left(0, (2/3)\left(a^2+b^2+c^2\right)\right)$

C. $\left((1/3)\left(a^2+b^2+c^2\right), 0\right)$

D. none of these

Answer: A

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6. A channel 27m wide falls at a right angle into another channel 64m wide. The greatest length of the log that can be floated along this system of channels is

A. 120

B. 125

C. 100

D. 110

Answer: B

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7. For $a \in [\pi, 2\pi]$ and $n \in Z$ the critical points of g

$f(x) = \frac{1}{3}\sin a \tan^3 x + (\sin a - 1)\tan x + \frac{\sqrt{a-2}}{8-a}$ are

A. $x = n\pi (n \in I)$ as critical points

B. no critical points

C. $x = 2n\pi (n \in I)$ as critical points

D. $x = (2n+1)\pi (n \in I)$ as critical points

Answer: B

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8. The value of a for which the function $f(x) = (4a - 3)(x + \log 5) + 2(a - 7)\frac{\cot x}{2}\frac{\sin^2 x}{2}$ does not possess critical points is $\left(-\infty, -\frac{4}{3}\right)$ (b) $(-\infty, -1)$ $[1, \infty)$ (d) $(2, \infty)$

A. $(-\infty, -4/3]$

B. $(-\infty, -1)$

C. $[1, \infty)$

D. $(0, 00)$

Answer: A

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9. The interval to which a may belong so that the function $f(x)=\left(1-\frac{\sqrt{21-4a-a^2}}{a+1}\right)x^3+5x+100$ is increasing for $x \in R$

A. $[-7, 0]$

B. $[-6, 0]$

C. $[1, 4]$

D. $[2, 3]$

Answer: D

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10. The muinimum area of the triangle formed by the tangent to $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and the coordinate axes is

A. ab

B. $\dfrac{a^2+b^2}{2}$

C. $(a+b)^2/4$

D. 2ab

Answer: A

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11. The set of all x for which $\log(1+x) \leq x$ is equal to ....

A. $(1, \infty)$

B. $(0, \infty)$

C. $(-1, \infty)$

D. none of these

Answer: C

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12. The minimum value of 2^{x^2-3} ^ $(3+27)$ is 2^{27} (b) 2 (c) 1 (d) none of these

A. 2^{27}

B. 2

C. 1

D. none of these

Answer: D

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13. If $f(x)=\begin{cases}|x|, & \text{for} \quad 0<|x|\leq 2\\ 1, & f\ \text{or} \quad x=0\end{cases}$. Then, at x = 0, f has

A. a local maximum

B. no local maximum

C. a local minimum

D. no extremum

Answer: A

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14. If $f(x) = xe^{x(1-x)}$, then f(x) is

A. increasing on $[-1/2, 1]$

B. decreases on R

C. increasing on R

D. decreasing on $[-1/2, 1]$

Answer: A

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15. If $f(x)=\begin{cases}x^{\alpha}\log x & x>0\\ 0 & x=0\end{cases}$ and Rolle's theorem is applicable to $f(x)$ for $x\in[0,1]$ then α may equal to (A) -2 (B) -1 (C) 0 (D) $\frac{1}{2}$

A. -1

B. $-1/2$

C. 0

D. $1/2$

Answer: D

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16. A cone is made from a circular sheet of radius $\sqrt{3}$ by cutting out a sector and giving the cut edges of the remaining piece together. The maximum volume attainable for the cone is (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{2\pi}{3}$ (D) $3\sqrt{3}\pi$

A. $\pi/3$

B. $\pi / 6$

C. $2\pi / 3$

D. $3\sqrt{3}\pi$

Answer: C

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17. The dimension of the rectangle of maximum area that can be inscribed in the ellipse $(x / 4)^2 + (y / 3)^2 = 1$ are

A. $\sqrt{8}, \sqrt{2}$

B. 4, 3

C. $2\sqrt{8}, 3\sqrt{2}$

D. none of these

Answer: C

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18. Consider $f(x) = ax^4 + cx^2 + dx + e$ has no point o inflection

Then which of the following is/are possible?

A. $b^2 - 4ac > 0$

B. $3b^2 - 8ac = 0$

C. $3b^2 - 8ac > 0$

D. $3b^2 - 8ac < 0$

Answer: C

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19. The smallest value of M such that $\left|x^2 - 3x + 2\right| \leq M$ for all x in $\left[1, \frac{5}{2}\right]$

A. $3/4$

B. $3/8$

C. $3/16$

D. $7/4$

Answer: C

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20. The point in the interval $[0, \pi]$ for which the curve y $= (1/2)x$ and $y = \sin x$ are farthest apart is

A. $\pi/2$

B. $\pi/4$

C. $\pi/6$

D. π

Answer: D

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21. The points at which the tangents to the curve $ax^2 + 2hxy + by^2 = 1$ is parallel to y-axis is

A. (0,0)

B. where $hx + by = 0$ meets it

C. where $ax + hy$ meets it

D. none of these

Answer: B

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22. If the point on $y = x \tan\alpha - \dfrac{ax^2}{32\cos^2\alpha}, (\alpha > 0)$ where the tangent is parallel to $y = x$ has an ordinate $\dfrac{4}{a}$ then $4\sin^2\alpha$ equals to:

A. $\pi / 2$

B. $\pi/6$

C. $\pi/3$

D. none of these

Answer: D

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23. Let $f(x) = \begin{cases} |x-1| + a, & x \le 1 \\ 2x+3, & x > 1 \end{cases}$. If f(x) has local minimum at x=1 and $a \ge 5$ then the value of a is

A. 5

B. 6

C. $11/2$

D. $15/2$

Answer: A

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24. Let $g(x)=\int_0^x f(t)dt \text{ and } f(x)$ satisfies the equation $f(x+y)=f(x)+f(y)+2xy-1$ for all $x, y \in R$ and f'(0) =2 then

A. g increases on $(0, \infty)$ and decreases on $(-\infty, 0)$

B. g increases on $(0, \infty)$

C. g decreases on $(0, \infty)$ and increases $(-\infty, 0)$

D. g decreases on $(-\infty, \infty)$

Answer: B

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25. The area of the triangle formed by the positive x-axis with the normal and the tangent to the circle $x^2+y^2=4$ at $(1, \sqrt{3})$ is

A. $2\sqrt{3}$

B. $\sqrt{3}$

C. $4\sqrt{3}$

D. `3

Answer: A

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26. The interval in which the function $y = f(x) = \frac{x-1}{x^2-3x+3}$ transforms the real line is

A. $[1/3, 2]$

B. $[-1/3, 2]$

C. $[-1/3, 1]$

D. none of these

Answer: D

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27. Angle at which the circle $x^2 + y^2 = 16$ can be seen from $(8, 0)$ is

A. $\pi/6$

B. $\pi/4$

C. $\pi/2$

D. $\pi/3$

Answer: D

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28. The critical points of the function $f(x) = (x+2)^{2/3}(2x-1)$ are

A. $-1 \text{ and } 2$

B. 1

C. $1 \text{ and } -1/2$

D. -1 and -2

Answer: D

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29. The function $f(x) = \dfrac{\log(\pi + x)}{\log(e + x)}$s is

A. increasing on $[0, \infty)$

B. decreasing on $[0, \infty)$

C. increasing on $[0, \pi / e)$ and decreasing on $[\pi / e, \infty)$

D. decreasing on $[0, \pi / e)$ and increasing on $[\pi / e, \infty)$

Answer: B

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30. A rectangle with perimeter 32 cm has greatest area if its length is

A. 12

B. 10

C. 8

D. 14

Answer: C

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31. The greatest vaue of the function

$f(x) = \cot^{-1} x + (1/2) \log x$ on $[1, \sqrt{3}]$ is

A. $(\pi/6) + 0.25 \log 3$

B. $(\pi/3) - 0.25 \log 3$

C. $\pi/4$

D. $\tan^{-1} e - 1/2$

Answer: A

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32. A particle is moving along the parabola $y^2 = 4(x + 2)$. As it passes through the point (7,6) its y-coordinate is increasing at the rate of 3 units per second. The rate at which x-coordinate change at this instant is (in units/sec)

A. 4

B. 6

C. 8

D. 9

Answer: D

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33. The perimeter of a rectangle is fixed at 24cm. If the length l of the rectangle is increasing at the rate of 1 cm per second, the value of l for which the area of rectangle start to decrease is

A. 2cm

B. 6cm

C. 4cm

D. 8cm

Answer: B

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34. The rate at which fluid level inside vertical cylindrical tank of radius r drop if we pump fluid out at the rate of $3cm^3$ /min is

A. $-\frac{1}{\pi r^2}$

B. $\frac{3}{\pi r^2}$

C. $\frac{2}{\pi r^2}$

D. $\frac{4}{\pi r}$

Answer: B

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35. The length x of a rectangle is increasing at the rate of 3 cm/sec. and the width y is increasing at the rate of 2 cm/sec. If x=10 cm and y=6 cm, then the rate of change of its area is

A. 14

B. 12

C. 8

D. 4

Answer: A

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36. if f(x) be a twice differentiable function such that $f(x) = x^2$ for $x = 1, 2, 3,$ then

A. $f''(x) = 2 \forall x \in (1, 3)$

B. f''(x) = 2 for some $x \in (1, 3)$

C. $f''(x) = 3 \forall x \in (2, 3)$

D. f''(x) = f'(x) for some `x in (2,3)

Answer: B

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37. A tangent drawn to the curve $y = f(x)$ at $P(x, y)$ cuts the x-axis and y-axis at A and B respectively such that $BP : AP = 2 : 1$. Given that $f(1) = 1$. Answer the question: Equation of curve is (A) $y = \frac{1}{x}$ (B) $y = \frac{1}{x^2}$ (C) $y = \frac{1}{x^3}$ (D) none of these

A. equation of the curve is $x\frac{dy}{dx} - 3y = 0$

B. normal at (1,1) is $x + 3y = 4$

C. curve passes through $(2, 1/8)$

D. equation of the curve is $x\frac{dy}{dx} + 4y = 0$

Answer: C

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38. If $f(x) = x^3 + bx^2 + cx + d$ and $0 < b^2 < c$.then in $(-\infty, \infty)$

A. has no local minima

B. has no local maxima

C. is strictly increasing on R

D. is strictly decreasing on R

Answer: C

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Exercise Numerical Answer Type Questions

1. If the tangent at (16,64) on the curve $y^2 = x^3$ meets the curve again at Q(u, v) then uv is equal to_____

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2. If $f(x) = \begin{cases} 3, & x = 0 \\ -x^2 + 3x + k, & 0 < x < 1 \\ ax + b, & 1 \le x \le 2 \end{cases}$ satisfies the hypothesis of the Lagrange's theorem then (a+b)/k is equal to

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3. If the slope of a line that passes through the origin which is tangent to $y = x^3 + x + 54$ is m, then m is equal to

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4. If A is the area of triangle formed by positive x-axis and the normal and the tangents to $x^2 + y^2 = 9$ at $(1, \sqrt{8})$ then A is equal to $(\sqrt{2} = 1.41)$

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5. Let $f(x) = \begin{bmatrix} x^{3/5}, & \text{if } x \leq 1 \\ -(x-2)^3 & \text{if } x > 1 \end{bmatrix}$, then the number of critical points on the graph of the function are....... .

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6. The minimum value of $\sqrt{e^{x^2} - 1}$ is

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7. Let $f(x) = \begin{cases} |x-1| + a, & x \leq 1 \\ 2x+3, & x > 1 \end{cases}$. If f(x) has local minimum x=1 and $a \geq 5$ then a is equal to

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8. Let P be a variable point on the elipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ with foci F_1 and F_2. If A is the area of the triangle PF_1F_2, then maximum value of A is

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9. The maximum value of |x log x| for $0 < x \leq 1$ is (e= 2.71)

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10. If f(x) = $\log_x 1/9 - \log_3 x^2 (x > 1)$ then |max f(x)| is equal to

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11. Let $f(x) = \cos^2 x + \cos x + 3$ then greatest value of f(x) + least value of f(x) is equal to

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12. The greatest value of the function $y = \sin^2 x - 20 \cos x + 1$ is

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13. If $f(x) = a \log|x| + bx^2 + x$ has its extremum values at $x = -1 and x = 2,$ then $a = 2, b = -1$ $a = 2, b = -1/2$ $a = -2, b = 1/2$ (d) none of these

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14. If V(x) is larger of $e^x - 1$ and $(1+x)\log(1+x)$ for $x \in (0, \infty)$ then log (V (8) + 1) is equal to

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15. A cylindrical vessel of volume $25\frac{1}{7}$ cu metres, open at the top is to be manufactured from a sheet of metal. If r and h are the radius and height of the vessel so that amount of metal I sused in the least possible then rh is equal to

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16. The altitude of a cylinder of the greatest possible volume which can be inscribed in a sphere of radius $3\sqrt{3}$ is

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17. A straight line l with negative slope passes through (8,2) and cuts the coordinate axes at P and Q. Find absolute minimum value of "OP+OQ where O is the origin-

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Question For Previous Year S Aieee Jee Main Paper

1. If $2a+3b+6c+0(a, b, c \in R)$ then the quadractic equation $ax^2+bx+c=0$ has

A. at least one root in [0,1]

B. at least one root in [2,3]

C. at least one root

D. none of these

Answer: A

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2. The maximum distance from origin of a point on the curve $x = a\sin t - b\sin\left(\frac{at}{b}\right), y = a\cos t - b\cos\left(\frac{at}{b}\right)$, borth a,b>0 is

A. $a - b$

B. $a + b$

C. $\sqrt{a^2 + b^2}$

D. $\sqrt{a^2 - b^2}$

Answer: B

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3. If the function $f(x) = 2x^3 - 9ax^2 + 12x^2x + 1, wherea > 0,$ attains its maximum and minimum at $pandq$, respectively, such that $p^2 = q,$ then a equal to 1 (b) 2 (c) $\frac{1}{2}$ (d) 3

A. 1

B. 2

C. $1/2$

D. 3

Answer: B

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4. If $u=\sqrt{a^2\cos^2\theta+b^2\sin^2\theta}+\sqrt{a^2\sin^2\theta+b^2\cos^2\theta}$, then the difference between maximum and minimum values of u^2 is

A. $(a+b)^2$

B. $2\sqrt{a^2+b^2}$

C. $2(a^2+b^2)$

D. $(a-b)^2$

Answer: A

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5. A function $y = f(x)$ has a second order derivative $f(x) = 6(x - 1)$. If its graph passes through the point $(2, 1)$ and at that point the tangent to the graph is $y = 3x - 5$ then the function is

A. $(x + 1)^3$

B. $(x - 1)^3$

C. $(x - 1)^2$

D. $(x + 1)^2$

Answer: B

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6. The normal to the curve $x = a(1 + \cos\theta), y = a\sin\theta$ at $'\theta'$ always passes through the fixed point

A. (0,0)

B. (0,a)

C. (a,0)

D. (a,a)

Answer: C

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7. A function is matched below against an interval, where it is supposed to be increasing. Which of the following pairs is incorrectly matched?

A. $\begin{array}{ll} \text{Interval} & \text{Function} \\ (-\infty, 1/3) & (3x^2 - 2x + 1) \end{array}$

B. $\begin{array}{ll} \text{Interval} & \text{Function} \\ (-\infty, -4) & (x^3 - 6x^2 + 6) \end{array}$

C. $\begin{array}{ll} \text{Interval} & \text{Function} \\ (-\infty, \infty) & (x^3 - 3x^2) \end{array}$

D. $\begin{array}{ll} \text{Interval} & \text{Function} \\ (2, \infty) & (2x^3 - 3x^2 - 12x + 6) \end{array}$

Answer: A

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8. The normal to the curve $x = a(\cos\theta + \theta\sin\theta), y = a(\sin\theta - \theta\cos\theta)$ at any θ is such that

A. it passes through $\left(\frac{a\pi}{2}, -a\right)$

B. it is at constant distance from origin

C. it passes through origin

D. it makes angle $\frac{\pi}{2} + \theta$ which the x-axis

Answer: B

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9. Let f be differentiable for all x, If $f(1) = -2 and f'(x) \geq 2$ for all $x \in [1, 6]$, then find the range of values of $f(6)$.

A. $f(6) < 5$

B. $f(6) = 5$

C. $f(6) \geq 8$

D. $f(6) < 8$

Answer: C

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10. A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of $50 cm^3 / \min$. When the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases, is:

A. $1/54\pi$ cm/min

B. $5/6\pi$ cm/min

C. $1/36\pi$ cm/min

D. $1/8\pi$ cm/min

Answer: D

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11. The function $f(x)=\frac{x}{2}+\frac{2}{x}$ has a local minimum at $x=2$ (b) $x=-2$ $x=0$ (d) $x=1$

A. x=1

B. x=2

C. $x=-2$

D. x=0

Answer: B

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12. A value of c for which the conclusion of Mean value theorem holds for the function $f(x) = \log_e x$ on the interval [1, 3] is

A. $2\log_3 e$

B. $(1/2)\log 3$

C. $\log_3 c$

D. log 3

Answer: A

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13. The function $f(x) = tan^{-1}(\sin x + \cos x)$ is an increasing function in (1) $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ (2) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$ (3) $\left(0, \frac{\pi}{2}\right)$ (4) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

A. $(\pi/4, \pi/2)$

B. $(-\pi/2, \pi/4)$

C. $(0, \pi/2)$

D. $(-\pi/2, \pi/2)$

Answer: B

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14. Suppose the cubic $x^3 - px + q$ has three distinct real roots, where $p > 0$ and $q > 0$. Then which one of the following holds?

A. The cubic has minima at $\sqrt{\frac{p}{3}}$ and maxima at $-\sqrt{\frac{p}{3}}$

B. The cubic has minima at $-\sqrt{\frac{p}{3}}$ and maxima at $\sqrt{\frac{p}{3}}$

C. The cubic has minima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

D. The cubic has maxima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

Answer: A

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15. Given P(x) $= x^4 + ax^3 + bx^2 + cx + d$ such that x=0 is the only real root of P'(x) =0 . If P(-1) lt P(1),$then \in the \int erval$[-1,1]`

A. $P(-1)$ is the minimum but P(1) is not the maximum of P

B. neither $P(-1)$ is the minimum nor P(1) is the maximum of P

C. $P(-1)$ is the minimum and P(1) is the maximum of P

D. $P(-1)$ is not minimum but P(1) is the maximum of P

Answer: D

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16. Let $f: R\vec{R}$ be defined by $f(x) = \{k - 2x, \quad \text{if} \quad x \leq -12x + 3, fx \succ 1\}$. If f has a local minimum at $x = 1$, then a possible value of k is (1) 0 (2) $-\frac{1}{2}$ (3) -1 (4) 1

A. $-1/2$

B. -1

C. 1

D. 0

Answer: B

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17. The curve that passes through the point $(2, 3)$ and has the property that the segment of any tangent to it lying between the coordinate axes is bisected by the point of contact, is given by

A. $2y - 3x = 0$

B. $y = 6/x$

C. $x^2 + y^2 + 13$

D. $\left(\frac{x}{2}\right)^2 + \left(\frac{y}{3}\right)^2 = 2$

Answer: B

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18. Let be a function defined by $f(x) = \begin{cases} \frac{\tan x}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$

Statement-1: x=0 is a point on minima of f

Statement-2: f'(0)=0

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19. Let a, b R be such that the function f given by $f(x) = \ln|x| + bx^2 + ax, x \neq 0$ has extreme values at $x = 1$ and $x = 2$. Statement 1: f has local maximum at $x = 1$ and at $x = 2$. Statement 2: $a = \frac{1}{2} \text{and} b = \frac{-1}{4}$ (1) Statement 1 is false, statement 2 is true (2) Statement 1 is true, statement 2 is true; statement 2 is a correct explanation for statement 1 (3) Statement 1 is true, statement 2 is true; statement 2 is not a correct explanation for statement 1 (4) Statement 1 is true, statement 2 is false

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20. A spherical balloon is filled with 4500p cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of 72π cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is (1) $\frac{9}{7}$ (2) $\frac{7}{9}$ (3) $\frac{2}{9}$ (4) $\frac{9}{2}$

A. $7/9$

B. $2/9$

C. $9/2$

D. $9/7$

Answer: B

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21. The cost of running a bus from A to B, is Rs. $\left(av + \frac{b}{v}\right)$, where v km/h is the average speed of the bus. When the bus travels at 30 km/h, the cost comes out to be Rs. 75 while at 40 km/h, it is Rs. 65.Then the most economical speed (in km/h) of the bus is :

A. 45

B. 50

C. 60

D. 40

Answer: C

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22. If the surface area of a sphere of radius r is increasing uniformly at the rate $8\frac{(cm)^2}{s}$, then the rate of change of its volume is:

A. constant

B. proportional to $\sqrt{r}$

C. proportional to r^2

D. proportional to r

Answer: D

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23. The real number k for which the equation, $2x^3 + 3x + k = 0$ has two distinct real roots in [0, 1] (1) lies between 2 and 3 (2) lies between -1 and 0 (3) does not exist (4) lies between 1 and 2

A. lies between 2 and 3

B. lies between 1 and 0

C. does not exist

D. lies between 1 and 2

Answer: C

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24. The maximum area of a right angled triangle with hypotenuse h is

A. $\frac{h^2}{2\sqrt{2}}$

B. $\frac{h^2}{2}$

C. $\frac{h^2}{\sqrt{2}}$

D. $\frac{h^2}{4}$

Answer: C

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25. Statement-1: The equation x log x= $2-x$ is satisfied by at least one value of x lying between 1 and 2

Statement-2: The function f(x) = x log x is an increasing function in [1,2] and g(x) = 2-x is a decreasing function in [1, 2] and the graphs represented by these functions intersect at a point in [1,2]

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26. Statement 1 : The function $x^2(e^x + e^{-x})$ is increasing for all $x > 0$

Statement 2: The functions x^2e^x and x^2e^{-x} are increasing for all $x > 0$ and the sum of two infunctions in any interval (a, b) is an increasing function in (a, b).

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27. If f and g are differentiable functions in [0, 1] satisfying $f(0) = 2 = g(1), g(0) = 0$ and $f(1) = 6$, then for some $c \in]0, 1[$ (1) $2f'(c) = g'(c)$ (2) $2f'(c) = 3g'(c)$ (3) $f'(c) = g'(c)$ (4) $f'(c) = 2g'(c)$

A. $2f'(c) = g'(c)$

B. $2f'(c) = 3g'(c)$

C. $f'(c) = g'(c)$

D. $f'(c) = 2g'(c)$

Answer: D

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28. If x = -1 and x = 2 are extreme points of f(x) = $\alpha \log|x| + \beta x^2 + x$, then

A. $\alpha = -6, \beta = \frac{1}{2}$

B. $\alpha - 6, \beta = -\frac{1}{2}$

C. $\alpha = 2, \beta = -\frac{1}{2}$

D. $\alpha = 2, \beta = \frac{1}{2}$

Answer: C

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29. If the volume of a sphere increase at the rate of , $2\pi cm^3 / \sec$, then the rate of increase of its radius (in cm/sec), when the volume is $288\pi cm^3$ is :

A. $\frac{1}{9}$

B. $\frac{1}{6}$

C. $\frac{1}{36}$

D. $\frac{1}{24}$

Answer: C

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30. If non-zero real number b and c are such that min $f(x) >$ max g(x)

where f(x)

$= x^2 + 2bx + 2c^2$ and $g(x) = -x^2 - 2cx + b^2 (x \in R)$ then $\left|\frac{c}{b}\right|$

lies in the interval

A. $\left[\frac{1}{\sqrt{2}}, \sqrt{2}\right]$

B. $\left[0, \frac{1}{2}\right]$

C. $\left[\frac{1}{2}, \frac{1}{\sqrt{2}}\right]$

D. $\left[\sqrt{2}, \infty\right]$

Answer: D

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31. Let $f'(x) > 0$ and $g'(x) < 0$ for all $x \in R$ Then

A. $g(f(x)) > g(f(x-1))$

B. $f(g(x)) > f(g(x+1))$

C. $f(g(x)) > f(g(x-1))$

D. $g(f(x)) < g(f(x+1))$

Answer: B

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32. If Rolle's theorem holds for the function $f(x) = 2x^3 + ax^2 + bx$ in the interval $[-1, 1]$ for the point $c = \frac{1}{2}$, then the value of 2a +b is

A. 1

B. -1

C. 2

D. -2

Answer: B

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33. Let f(x) be a polynomial of degree four having extreme values at $x=1$ and $x=2$. If $\left(\lim\right)_{x \to 0}\left[1+\frac{f(x)}{x^2}\right]=3$, then f(2) is equal to :

(1) -8 (2) -4 (3) 0 (4) 4

A. -8

B. -4

C. 0

D. 4

Answer: C

Watch Video Solution

34. The equation of a normal to the curve, $\sin y = x\left(\frac{\sin \pi}{3}+y\right)$ at x=0 is

A. $2x+\sqrt{3}y=0$

B. $2y-\sqrt{3}x=0$

C. $2y+\sqrt{3}=0$

D. $2x-\sqrt{3}y=0$

Answer: A

Watch Video Solution

35. Let k and K be the minimum and the maximum values of the function $f(x)=\frac{(1+x)^{0.6}}{1+x^{0.6}}$, and $x\in[0,1]$ respectively,then the ordered pair (k, K) is equal to

A. $(1, 2^{0.6})$

B. $(2^{-0.4}, 2^{0.6})$

C. $(2^{-0.6}, 1)$

D. $(2^{-0.4}, 1)$

Answer: D

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36. From the top of a 64 metres high tower, a stone is thrown upward vertically with the velocity of 48m/s. The greatest height (in metres) attained by stone, assuming the value of the gravitational acceleration $g - 32m/s^2$, is

A. 100

B. 88

C. 128

D. 112

Answer: A

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37. If $x = 2\cos t + \cos 2t, y = 2\sin t - \sin 2t, then$ at $t = \frac{\pi}{4}, \frac{dy}{dx}$

A. 4

B. $2\sqrt{2}$

C. 2

D. $\sqrt{2}$

Answer: C

Watch Video Solution

38. Tangents are drawn to $x^2 + y^2 = 16$ from the point $P(0, h)$. These tangents meet the $x - a\xi s$ at $AandB$. If the area of triangle PAB is minimum, then $h = 12\sqrt{2}$ (b) $h = 6\sqrt{2}\, h = 8\sqrt{2}$ (d) $h = 4\sqrt{2}$

A. $4\sqrt{3}$

B. $3\sqrt{3}$

C. $3\sqrt{2}$

D. $4\sqrt{2}$

Answer: D

Watch Video Solution

39. Consider $f(x) = \tan^{-1}\left(\sqrt{\frac{1+\sin x}{1-\sin x}}\right), x \in \left(0, \frac{\pi}{2}\right)$. A normal to $y = f(x)$ at $x = \frac{\pi}{6}$ also passes through the point: (1) (0, 0) (2) $\left(0, \frac{2\pi}{3}\right)$ (3) $\left(\frac{\pi}{6}, 0\right)$ (4) $\left(\frac{\pi}{4}, 0\right)$

A. (0,0)

B. $\left(0, \frac{2\pi}{3}\right)$

C. $\left(\frac{\pi}{6}, 0\right)$

D. $\left(\frac{\pi}{4}, 0\right)$

Answer: B

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40. If m and M are the minimum and the maximum values of $4+\frac{1}{2}\sin^2 2x-2\cos^4 x, x\in R$ then

A. $\frac{9}{4}$

B. $\frac{15}{4}$

C. $\frac{7}{4}$

D. $\frac{1}{4}$

Answer: A

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41. If the tangent at a point P with parameter t, on the curve $x=4t^2+3, y=8t^3-1\ t\in R$ meets the curve again at a point Q, then the coordinates of Q are

A. $(16t^2+3, -64t^3-1)$

B. $\left(4t^2 + 3, \ -8t^3 - 1\right)$

C. $\left(t^2 + 3, t^3 - 1\right)$

D. $\left(t^2 + 3, \ -t^3 - 1\right)$

Answer: D

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42. Let $f(x) = \sin^4 x + \cos^4 x$. Then f is increasing function in the interval

A. $\left]\frac{5\pi}{8}, \frac{3\pi}{4}\right[$

B. $\left]\frac{\pi}{2}, \frac{5\pi}{8}\right[$

C. $\left]\frac{\pi}{4}, \frac{\pi}{2}\right[$

D. $\left]0, \frac{\pi}{4}\right[$

Answer: C

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43. Let C be a curve given by $y = 1 + \sqrt{4x - 3}, x > \frac{3}{4}$. If P is a point on C such that the tangent at P has slope $\frac{2}{3}$, then a point through which the normal at P passes, is

A. (1,7)

B. $(3, \; - 4)$

C. $(4, \; - 3)$

D. $(2, 3)$

Answer: A

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44. The normal to the curve $y(x - 2)(x - 3) = x + 6$ at the point where the curve intersects the $y - a\xi s,$ passes through the point :

$\left(\frac{1}{2}, -\frac{1}{3}\right)$ (2) $\left(\frac{1}{2}, \frac{1}{3}\right)$ (3) $\left(-\frac{1}{2}, -\frac{1}{2}\right)$ (4) $\left(\frac{\frac{1}{2,1}}{2}\right)$

A. $\left(\frac{1}{2}, \frac{1}{3}\right)$

B. $\left(-\frac{1}{2}, -\frac{1}{2}\right)$

C. $\left(\frac{1}{2}, \frac{1}{2}\right)$

D. $\left(\frac{1}{2}, -\frac{1}{3}\right)$

Answer: C

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45. The tangent at the point $(2, -2)$ to the curve, $x^2y^2 - 2x = 4(1 - y)$ does not pass through the point :

A. $(4, 1/3)$

B. (8,5)

C. $(-4, -9)$

D. $(-2, -7)$

Answer: D

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46. A tangent drawn to the curve y = f(x) at P(x, y) cuts the x and y axes at A and B, respectively, such that AP : PB = 1 : 3. If f(1) = 1 then the curve passes through $\left(k, \frac{1}{8}\right)$ where k is

A. $\left(\frac{1}{3}, 24\right)$

B. $\left(\frac{1}{2}, 4\right)$

C. $\left(2, \frac{1}{8}\right)$

D. $\left(3, \frac{1}{28}\right)$

Answer: C

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47. If a point P has co-ordinates $(0, -2)$ and Q is any point on the circle$x^2 + y^2 - 5x - y + 5 = 0,$ then the maximum value of $(PQ)^2$ is : (a) $\frac{25+\sqrt{6}}{2}$ (b) $14+5\sqrt{3}$ (c) $\frac{47+10\sqrt{6}}{2}$ (d) $8+5\sqrt{3}$

A. $\frac{25+\sqrt{6}}{2}$

B. $14+5\sqrt{3}$

C. $\frac{47+10\sqrt{6}}{2}$

D. $8+5\sqrt{3}$

Answer: B

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48. The function f defined by

$f(x) = x^3 - 6x^2 - 36x + 7$ is increasing , if

A. increasing on R

B. decreasing on R

C. decreasing on $(0, \infty)$ and increasing on $(-\infty, 0)$

D. increasing on $(0, \infty)$ and decreasing on $(-\infty, 0)$

Answer: A

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49. Twenty metres of wire is available for fencing off a flower-bed in the form of a circular sector. Then the maximum area (in $sq\dot{m}$) of the flower-bed is: 25 (2) 30 (3) 12.5 (4) 10

A. 30

B. 12.5

C. 10

D. 25

Answer: D

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50. Let f(x) be a polynomial of degree four having extreme values at x=1 and x=2. If $\lim_{x \to 0} \left(1 + \frac{f(x)}{x^2}\right) = 3,$ then f(2) is equal to

A. $5/2$

B. $9/2$

C. $1/2$

D. $3/2$

Answer: B

Watch Video Solution

51. If the curves $y^2 = 6x, 9x^2 + by^2 = 16$ intersect each other at right angles then the value of b is: (1) 6 (2) $\frac{7}{2}$ (3) 4 (4) $\frac{9}{2}$

A. 6

B. $7/2$

C. 4

D. $9/2$

Answer: D

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52. If a right circular cone, having maximum volume is inscribed in a sphere of radius 3cm, then the curved surface area (in cm^2) of this cone is

A. $6\sqrt{3\pi}$

B. $6\sqrt{2}\pi$

C. $8\sqrt{2}\pi$

D. $8\sqrt{3}\pi$

Answer: D

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53. Let $f(x) = x^2 + \left(\frac{1}{x^2}\right)$ and $g(x) = x - \frac{1}{x} \xi nR - \{-1, 0, 1\}$. If $h(x) = \left(\frac{f(x)}{g(x)}\right)$ then the local minimum value of $h(x)$ is: (1) 3 (2) -3 (3) $-2\sqrt{2}$ (4) $2\sqrt{2}$

A. -3

B. $-2\sqrt{2}$

C. $2\sqrt{2}$

D. 3

Answer: C

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54. if θ denotes the acute angle between the curves, $y = 10 - x^2$ and $y = 2 + x^2$ at a point of their intersection, then $|\tan\theta|$ is equal to

A. $4/9$

B. $7/17$

C. $8/17$

D. $8/15$

Answer: D

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55. The tangent to the curve $yt = xe^{x^2}$ passing through the point (1,e) also passes through the point

A. (4/3, 2e)

B. (2, 3e)

C. (5/3, 2e)

D. (3, 6e)

Answer: A

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56. The tangent to the curve $y = x^2 - 5x + 5.$ parallel to the line $2y = 4x + 1,$ also passes through the point :

A. (1/4, 7/2)

B. (7/2, 1/4)

C. $(- 1/8), 7)$

D. $(1/8, \ -7)$

Answer: D

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57. The equation of a tangent to the parabola, $x^2 = 8y$, which makes an angle θ with the positive direction of x-axis, is:

A. $x = y\cot\theta + 2\tan\theta$

B. $x = y\cot\theta - 2\tan\theta$

C. $y = x\tan\theta - 2\cot\theta$

D. $y = x\tan\theta + 2\cot\theta$

Answer: A

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58. Let $f(x) = -\frac{x}{\sqrt{a^2+x^2}} - \frac{d-x}{\sqrt{b^2+(d-x)^2}}$, $x \in R$, where a, b and d are non-zero real constants. Then,

A. f is decreasing function of x

B. f is neither increasing nor decreasing function of x

C. f' is not a continuous function of x

D. f is an increasing function of x

Answer: D

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59. Find the area of the largest rectangle with lower base on the x-axis and upper vertices on the curve $y = 12 - x^2$.

A. $20\sqrt{2}$

B. $18\sqrt{3}$

C. 32

D. 36

Answer: C

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60. The maximum values of $3\cos\theta + 5\sin\left(\theta - \frac{\pi}{6}\right)$ for any real value of θ is:

A. $\sqrt{19}$

B. $\sqrt{\frac{79}{2}}$

C. $\sqrt{31}$

D. $\sqrt{34}$

Answer: A

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61. Let $f(x) = x^3 - 3(a-2)x^2 + 3ax + 7$ and $f(x)$ is increasing in $(0, 1]$ and decreasing is $[1, 5)$, then roots of the equation $\frac{f(x) - 14}{(x-1)^2} = 0$ is (A) 1 (B) 3 (C) 7 (D) -2

A. 6

B. 5

C. 7

D. -7

Answer: C

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62. The maximum value of the function $f(x) = 3x^3 - 18x^2 + 27x - 40$ on the set $S = \{x \in R : x^2 + 30 \leq 11x\}$ is:

A. 122

B. -222

C. -122

D. 222

Answer: A

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63. A helicopter flying along the path $y = 7 + x^{\frac{3}{2}}$, A soldier standint at point $\left(\frac{1}{2}, 7\right)$ wants to hit the helicopter when it is closest from him, then minimum distance is equal to (a) $\frac{1}{6}\frac{\sqrt{2}}{3}$ (b) $\frac{1}{2}$ (c) $\frac{1}{3}\sqrt{\frac{2}{3}}$ (d) $\sqrt{\frac{5}{2}}$

A. $\frac{1}{2}$

B. $\frac{1}{3}\sqrt{\frac{7}{3}}$

C. $\frac{1}{6}\sqrt{\frac{7}{3}}$

D. $\frac{\sqrt{5}}{6}$

Answer: C

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64. The shortest distance between the point $\left(\frac{3}{2}, 0\right)$ and the curve $y = \sqrt{x}, (x > 0)$, is

A. $\frac{\sqrt{5}}{2}$

B. $\frac{5}{4}$

C. $\frac{3}{2}$

D. $\frac{\sqrt{3}}{2}$

Answer: A

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65. The maximum volume (in cu.m) of the right circular cone having slant height 3 m is

A. $3\sqrt{3}\pi$

B. 6π

C. $2\sqrt{3}\pi$

D. $\frac{4}{3}\pi$

Answer: C

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Question For Previous Year S B Architecture Entrance Examination Papers

1. The slope of the normal to curve $y = x^3 - 4x^2$ at $(2, -1)$ is

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. 4

D. -4

Answer: A

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2. For the curve $x = t^2 - 1, y = t^2 - t,$ the tangent line is perpendicular to x-axis, then $t =$ (i)0 (ii)∞ (iii) $\frac{1}{\sqrt{3}}$ (iv) $-\frac{1}{\sqrt{3}}$

A. $t = 0$

B. $t = 1$

C. $t = \frac{1}{\sqrt{3}}$

D. $t = \frac{1}{2}$

Answer: B

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3. If $f(x) = 4^{\sin x}$ satisfies the Rolle's theorem on $[0, \pi]$, then the value of $c \in (0, \pi)$ for which f'(c) = 0 is

A. $c = \frac{\pi}{6}$

B. $c = \frac{\pi}{4}$

C. $c = \frac{\pi}{2}$

D. $c = \frac{\pi}{3}$

Answer: C

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4. $f(x) = \sqrt{25 - x^2}$ in $[1, 5]$

A. $\sqrt{3}$

B. $\sqrt{5}$

C. $\sqrt{15}$

D. 2

Answer: C

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5. Let $f(x) = \begin{cases} |x-1| + a & \text{if } x \leq 1 \\ 2x + 3 & \text{if } x > 1 \end{cases}$. If f(x) has a local minimum at x=1, then

A. $a > 5$

B. $0 < a \leq 5$

C. $a \leq 5$

D. $a = 5$

Answer: C

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6. If m be the slope of the tangent to the curve $e^{2y} = 1 + 4x^2$, then

A. $|m| \leq 1$

B. $|m| > 1$

C. $|m| \geq 1$

D. $|m| < 1$

Answer: A

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7. Let $f:(-\infty, \infty) \to (-\infty, \infty)$ be acontinuous and differentiable function and let f'(.) denote the derivative of f(.).If f(0) $= -2$ and f'(x) ≤ 3 for each $x \in [0, 2]$, then the largest possible value of f(2) is

A. 1

B. 2

C. 3

D. 4

Answer: D

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8. Let $f[1, 2] \to (-\infty, \infty)$ be given by $f(x) = \frac{x^4 + 3x^2 + 1}{x^2 + 1}$ then find value of in $[f_{\max}]$ in $[-1, 2]$ where [.] is greatest integer function :

A. 1

B. $\frac{29}{5}$

C. $\frac{21}{5}$

D. $\frac{28}{5}$

Answer: B

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9. Let y= f(x) be a curve which passes through (3,1) and is such that normal at any point on it passes through (1,1). Then y= f(x) describes

A. a circle of area π

B. an ellipse of area 2π

C. an ellipse of area 3π

D. a circle of area 4π

Answer: D

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10. Let $f(x) = \begin{cases} x\sin\frac{\pi}{x}, & 0 < x \leq 1 \\ 0 & x = 0 \end{cases}$. Then f'(x) = 0 for

A. exactly two value of x

B. no value of x

C. infinitely many values of x

D. exactly one value of x

Answer: C

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11. Let $f(x) = \left[1 - x^2\right], x \in R,$ where [] is the greatest integer function. Then

A. f is increasing

B. x= 0 is the point of maxima of f

C. f is continuous at x=0

D. f is decreasing

Answer: D

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12. A particle is constrained to move along the curve $y = \sqrt{x}$ starting at the origin at time t=0. The point on the curve where the abscissa and the ordinate are changing at the same rate is

A. $\left(\frac{1}{2}, \frac{1}{\sqrt{2}}\right)$

B. $\left(\frac{1}{8}, \frac{1}{2\sqrt{2}}\right)$

C. $\left(\frac{1}{4}, \frac{1}{2}\right)$

D. (1,1)

Answer: C

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13. If the tangent and the normal to $x^2 - y^2 = 4$ at a point cut off intercepts a_1, a_2 on the x-axis respectively & b_1, b_2 on the y-axis respectively. Then the value of $a_1a_2 + b_1b_2$ is equal to:

A. -1

B. 0

C. 4

D. 1

Answer: B

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14. Let f be a differentiable function defined on R such that f(0) $= -3$. If f'(x) ≤ 5 for all x then

A. $f(2) > 7$

B. $f(2) \leq 7$

C. $f(2) > 8$

D. $f(2) = 8$

Answer: B

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15. Let f be a function defined on $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ by f(x) = $3\cos^4 x - 6\cos^3 x - 6\cos^2 x - 3$. Then the range of f(x) is

A. $[-12, -3]$

B. $[-6, -3]$

C. $[-6, 3]$

D. $(-12, 3]$

Answer: A

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16. The function f(x) = xe^{-x} has

A. neither a maximum nor a minimum at x= 1

B. a minimum at x=1

C. a maximum at x= 1

D. a maximum at $x = -1$

Answer: C

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17. Each side of a square is increasing at the uniform rate of 1m/sec. If after sometime the area of the square is increasing at the rate of $8m^2$ /sec, then the area of square at that time in sq. meters is

A. 4

B. 9

C. 16

D. 25

Answer: C

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18. Find the rate of change of the volume of a sphere with respect to its surface area when the radius is 2cm.

A. 4

B. 3

C. 2

D. 1

Answer: D

Watch Video Solution

19. If m is the slope of the tangent to the curve $e^y = 1 + x^2$, then

A. $[0, 1]$

B. $(1, \infty)$

C. $(-\infty, -1)$

D. $[-1, 1]$

Answer: D

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20. f(x) = $|x \log x|, x > 0$ is monotonically decreasing in

A. $\left(0, \frac{1}{e}\right)$

B. $\left[\frac{1}{e}, 1\right]$

C. (1, e)

D. (e, ∞)

Answer: B

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21. Let $f(x) = |x - x_1| + |x - x_2|$, where x_1 and x_2 are distinct real numbers. Then the number of points at which f(x) is minimum

A. 1

B. 2

C. 3

D. more than 3

Answer: B

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22. The maximum value of f(x) $= 2\sin x + \sin 2x$, in the interval $\left[0, \frac{3}{2}\pi\right]$ is

A. $\sqrt{2} + 1$

B. $2\sqrt{3}$

C. $\frac{3\sqrt{3}}{2}$

D. $\sqrt{3}$

Answer: C

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23. The abscissae of a point, tangent at which to the curve $y = e^x \sin x, x \in [0, \pi]$ has maximum slope is

A. $\frac{\pi}{4}$

B. $\frac{\pi}{2}$

C. π

D. 0

Answer: B

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24. Let p (x) be a real polynomial of degree 4 having extreme values $x = 1$ and $x = 2$. if $\lim_{x \to 0} \frac{p(x)}{x^2} = 1$, then $p(4)$ is equal to

A. 16

B. 32

C. 64

D. 8

Answer: A

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25. Water is running into an underground right circular conical reservoir, which is 10m deep and radius of the base is 5m. If the rate of change in the volume of water in the reservoir is $\frac{3}{\sqrt{2}}\pi m^3$//min, then the rate (in m/min) at which water rises in it, when the water level is 4m is

A. $3/2$

B. $3/8$

C. $1/8$

D. $1/4$

Answer: A

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26. If $f(x) = |x^2 - 16|$ for all $x \in R$, then the total number of points of R at which f: $R \to R$ attains local extreme values of

A. 1

B. 2

C. 3

D. 4

Answer: C

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27. A real valued function $f(x) = C \log|x| + Dx^3 + x, x \neq 0$ where C and D are constant, has critical points at $x = -1$ and $x = 2$. Then the ordered pair (C,D) is

A. $\left(\frac{2}{3}, -\frac{1}{9}\right)$

B. $\left(-\frac{1}{9}, \frac{2}{3}\right)$

C. $\left(-\frac{2}{3}, \frac{1}{9}\right)$

D. $\left(-\frac{1}{9}, \frac{2}{3}\right)$

Answer: A

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