1. A company estimates that the cost (in dollars) of producing of producing x items is given by $C(x) = 2600 + 2x + 0.001x^2$. Given that the marginal cost is defined to be the first derivative of the cost function, find the marginal cost (in dollars) for producing 1000 items.

(a) 4 (b) 3 (c) 22 (d) 12 (e) NOTA

2. The position of a particle moving along a straight line is given by $s(t) = t^3 - 6t^2 + 12t - 8$. Find the time interval where the particle's velocity is decreasing.
(a) $(2,\infty)$ (b) $(-\infty,\infty)$ (c) $(-\infty,3)$ (d) $(-\infty,1)\cup(2,\infty)$ (e) NOTA

3. A particle moves along the parabola $x = 3y - y^2$, so that $\dfrac{dy}{dt} = 3$ at all times *t*. The speed of the particle when it is at position (2, 1) is equal to
(a) 0 (b) 3 (c) $\sqrt{13}$ (d) $3\sqrt{2}$ (e) NOTA

4. Find the slope of the curve $y^3 - xy^2 = 4$ at the point where y = 2.
(a) –2 (b) ½ (c) –½ (d) ¼ (e) NOTA

5. The position vector of a moving object is given by $P(t) = 3t\hat{i} + e^t\hat{j}$. Its acceleration is constant in neither
(a) magnitude nor direction (b)constant in both magnitude and direction
(c) constant in magnitude only (d) constant in direction only (e) NOTA

6. Approximate the value of the expression $\sin 3 - \cos 3$, using only the 3rd order Maclaurin Series expansions for $\sin x$ and $\cos x$.
(a) 2 (b) –5 (c) 13 (d) 11 (e) NOTA

7. The coefficient of x^3 in the Maclaurin series for $f(x) = e^{-x/2}$ is

(a)–1/8 (b) 1/8 (c) –1/48 (d) 1/16 (e) NOTA

8. The average area in cubic inches of all circles with radii between 2 and 5 inches is

(a) 7π (b) 11π (c) 13π (d) 29π/2 (e) NOTA

9. Evaluate $\lim\limits_{x\to 1}\left(\arcsin\left(\dfrac{1-\sqrt{x}}{1-x}\right)\right)$.
(a) Does not exist (b) π/3 (c) 0 (d) π/6 (e) NOTA

10. Evaluate $\displaystyle\int_{\ln 3}^{\ln 5} \frac{e^{3x-3}}{e^{x-4}}\,dx$.
(a) 16*e* (b) 10*e* (c) 12*e* (d) 14*e* (e) NOTA

11. If $y = x - x^2$, then $\dfrac{d(y^{1/2})}{d(x^{1/2})}$ equals which of the following?

(a) 1 – 2x (b) $\dfrac{2x}{\sqrt{x-x^2}}$ (c) $\dfrac{\sqrt{x}(1-2x)}{\sqrt{x-x^2}}$ (d) $\dfrac{1-2x}{\sqrt{x}}$ (e) NOTA

12. The diagonal of a cube is increasing at a rate of 5 feet per second. At what rate, in cubic feet per second, is the volume of the cube increasing when the length of one side of the cube is 2 feet?

(a) $20\sqrt{3}$ (b) $30\sqrt{2}$ (c) $\dfrac{20\sqrt{3}}{3}$ (d) $40\sqrt{3}$ (e) NOTA

13. Given the hyperbolic function $\sinh x = \dfrac{e^x - e^{-x}}{2}$, evaluate $\int_0^{\ln 2} (\sinh x)dx$.

(a) 1/4 (b) 5/4 (c) 9/4 (d) 3/4 (e) NOTA

14. Let $y = x^{x^2}$. Find $\dfrac{dy}{dx}$ at x = 2.

(a) 4 ln2 + 2 (b) 64 ln2 + 2 (c) 16 ln8 + 32 (d) 64 ln2 + 32 (e) NOTA

15. Evaluate $\lim_{x\to 0} \dfrac{\sqrt{6+2x} - \sqrt{6+x^2}}{\sqrt{3+4x} - \sqrt{3-x^3}}$.

(a) 1 (b) $\dfrac{3\sqrt{2}}{4}$ (c) $\dfrac{\sqrt{2}}{4}$ (d) $\sqrt{2}$ (e) NOTA

16. Evaluate $\int_{-\pi/4}^{\pi/4} (1+\tan^2 x)dx$

(a) It does not exist (b) 0 (c) 2 (d) -2 (e) NOTA

17. Find the maximum value of the function $f(x) = \sqrt{3}\cos x + 5\sin x$ over the interval [0, π].

(a) 3π/2 (b) 5 (c) $3\sqrt{5}$ (d) $2\sqrt{7}$ (e) NOTA

18. A thin rod of length L lies along that part of the x-axis with 0 ≤ x ≤ L. Its density, ρ, at (x, 0) is x^4 grams per unit length. The mass of the rod is given by the integral $\int_0^L pdx$, and the x-coordinate of the rod's center of mass is given by the integral $\dfrac{1}{mass}\int_0^L xpdx$. Find the x-coordinate of the rod's center of mass.

(a) 5L/6 (b) 4L/5 (c) 3L/4 (d) 2L/3 (e) NOTA

19. Use Newton's Method to approximate the real root of the polynomial function $f(x) = x^3 - x^2 - 1$. Given that the initial estimate, x_0, is 1, what is the approximated result, x_2, after two iterations? Subsequent iterations of Newton's method are given by $x_n = x_{n-1} - \dfrac{f(x_{n-1})}{f'(x_{n-1})}$.

(a) 2 (b) 13/8 (c) 3/2 (d) 1 (e) NOTA

20. Evaluate $\lim\limits_{x \to 0} \dfrac{1}{2 + 10^{1/x}}$

(a) 0 (b) ½ (c) 1/12 (d) Limit does not exist (e) NOTA

21. If $\int x^2 \cos x dx = f(x) - \int 2x \sin x dx$, then $f(x) =$

(a) $2\sin x + 2x\cos x + C$ (b) $x^2 \sin x + C$
(c) $2x\cos x - x^2 \sin x + C$ (d) $4\cos x - 2x\sin x + C$ (e) NOTA

22. Given two lines, $y = bx$ and $y = 3bx$, find a value of b which maximizes θ, the acute angle between the two lines.

(a) $\dfrac{\sqrt{3}}{6}$ (b) ½ (c) π/6 (d) $\dfrac{\sqrt{3}}{3}$ (e) NOTA

23. Evaluate $\int \dfrac{x^2}{\sqrt{4 - x^2}} dx$ using the substitution $x = 2\sin\theta$ $(-\dfrac{\pi}{2} < \theta < \dfrac{\pi}{2})$.

(a) $2\cos^{-1}\dfrac{x}{2} - \dfrac{x\sqrt{4-x^2}}{2} + C$ (b) $2\sin^{-1}\dfrac{x}{2} - \dfrac{x\sqrt{4-x^2}}{2} + C$
(c) $\cos^{-1}\dfrac{x}{2} - \dfrac{x\sqrt{4-x^2}}{2} + C$ (d) $\sin^{-1}\dfrac{x}{2} - \dfrac{x\sqrt{4-x^2}}{2} + C$ (e) NOTA

24. Evaluate $\lim\limits_{n \to \infty} \sum\limits_{k=1}^{n} \dfrac{2n^2 + 2kn + k^2}{n^3}$ (Hint: Consider the limit as a Riemann Sum).

(a) 5/3 (b) 2 (c) 8/3 (d) 10/3 (e) NOTA

25. Find the arc length of the parametric curve given by the equations $x(t) = 2(\cos t + t\sin t)$ and $y(t) = 2(\sin t - t\cos t)$ on the interval $0 \le t \le \pi$. The arc length of a parametric curve is given by $\int_a^b \sqrt{(dx/dt)^2 + (dy/dt)^2}\, dt$.

(a) π/2 (b) $\pi^2/2$ (c) π^2 (d) π (e) NOTA

26. The curvature of a function *f(x)* is a relative measure of how quickly the curve changes at a specified point, and is given by $\kappa(x) = \dfrac{|f''(x)|}{[1+(f'(x))^2]^{3/2}}$. The radius of curvature is defined to be the reciprocal of the curvature at a given point. Find the radius of curvature of the function $y = x^3$ when $x = 1$.

(a) $\dfrac{10^{3/2}}{6}$ (b) $\dfrac{6}{4^{3/2}}$ (c) $\dfrac{5}{3}$ (d) $\dfrac{6}{10^{3/2}}$ (e) NOTA

27. Let $y = 1 + \cfrac{x}{2 + \cfrac{x}{1 + \cfrac{x}{2 + \cfrac{x}{1 + \ldots}}}}$, where y > 0. Evaluate $\dfrac{dy}{dx}$ at x = 4.

(a) ½ (b) ¼ (c) 1/6 (d) 1/8 (e) NOTA

28. A and B are real numbers such that $0 \le A \le 10$ and $0 \le B \le 5$. If values for A and B are randomly chosen, what is the probability that $\dfrac{A}{9 - B^2} \le 1$? (Hint: Graph the inequality in the specified range and domain).

(a) 0.36 (b) 0.32 (c) 0.18 (d) 0.40 (e) NOTA

29. Which of the following is the correct integral for finding the surface area of the region bounded by the x-axis and the function $f(x) = x^2 + 2x + 2$ from x = 1 to x = 3 when revolved about the x-axis?

(a) $2\pi\int_1^3 (x^2 + 2x + 2)\sqrt{4x^2 + 8x + 6}\,dx$ (b) $\pi\int_1^3 (x^2 + 2x + 2)^2\,dx$

(c) $2\pi\int_1^3 (x^2 + 2x + 2)\sqrt{4x^2 + 8x + 5}\,dx$ (d) $\pi\int_1^3 x(x^2 + 2x + 2)\,dx$ (e) NOTA

30. According to the Theorem of Pappus, the volume of a solid of revolution generated by revolving a region about an external axis is equal to the product of the area of the region and the distance traveled by the region's centroid during one revolution. Find the volume of the solid generated when the ellipse given by the equation $9x^2 + 16y^2 = 144$ is rotated about the line $3x + 4y = 25$.

(a) $144\pi^2$ (b) $120\pi^2$ (c) $300\pi^2$ (d) $225\pi^2$ (e) NOTA