1. Evaluate \( \int \frac{\ln^2 x + 2 \ln x + 7}{x} \, dx \)

(a) \( \frac{\ln^3 x}{3} + \ln^2 x + 7x \, x^2 + C \)

(b) \( \frac{\ln^3 x}{3} + \ln^2 x + 7x + C \)

(c) \( \frac{\ln^3 x}{3} + \ln^2 x + 7 \ln x + C \)

(d) \( 2 \ln x + \frac{2}{x} + C \)

2. The arc length of the graph of \( y = \sin x, 0 \leq x \leq \pi \), is given by the integral

(a) \( \int_0^\pi \sqrt{1 + \sin x} \, dx \)

(b) \( \int_0^\pi \sqrt{1 + \cos x} \, dx \)

(c) \( \int_0^\pi \sqrt{1 + \sin^2 x} \, dx \)

(d) \( \int_0^\pi \sqrt{1 + \cos^2 x} \, dx \)

3. A particle moves along the x-axis with a constant acceleration of \( a = 2 \) units per second per second. At time \( t = 0 \) it is at the point \( x = 5 \) and has a velocity \( v(0) = 4 \) units per second. What is its velocity, in units per second, when it reaches the point \( x = 17 \)?

(a) \( 8 \)

(b) \( 17 \)

(c) \( 4 \)

(d) Impossible to calculate from this information
4. The region bounded by the graphs of $y = x^2$ and $y = 4 - x^2$ is revolved about the $x$-axis. The integral for the volume of the solid of revolution is

(a) $\pi \int_{0}^{\sqrt{2}} \left[ (4 - x^2)^2 - x^4 \right] dx$

(b) $\pi \int_{0}^{\sqrt{2}} \left[ (4 - x^2)^2 - x^4 \right] dx$

(c) $\pi \int_{-\sqrt{2}}^{\sqrt{2}} \left[ (4 - x^2)^2 - x^4 \right] dx$

(d) $\pi \int_{-\sqrt{2}}^{\sqrt{2}} \left[ (4 - x^2)^2 - x^4 \right] dx$

5. The region bounded by the graphs of $y = x^2$ and $y = 4 - x^2$ is revolved about the line $x = -4$. The integral for the volume of the solid of revolution is

(a) $2\pi \int_{0}^{\sqrt{2}} x(4 - 2x^2) dx$

(b) $2\pi \int_{-\sqrt{2}}^{\sqrt{2}} (x - 4)(4 - 2x^2) dx$

(c) $2\pi \int_{-\sqrt{2}}^{\sqrt{2}} (x + 4)(4 - 2x^2) dx$

(d) None of the above

6. The Fundamental Theorem of Calculus states that $\frac{d}{dx} \int_{x^2}^{1} \sqrt{t^3 + 1} dt$ equals

(a) $\sqrt{x^3 + 1}$

(b) $-\sqrt{x^3 + 1}$

(c) $2x\sqrt{x^6 + 1}$

(d) $-2x\sqrt{x^6 + 1}$

7. It took 2 pounds of force to stretch a spring one inch beyond its natural length of 20 inches. How much work (in inch-pounds) is needed to stretch it one inch further?

(a) $\int_{1}^{2} 2x \, dx$

(b) $\int_{21}^{22} 2x \, dx$

(c) $\int_{1}^{2} \frac{2x}{21} \, dx$

(d) $\int_{21}^{22} \frac{2x}{21} \, dx$
8. A lamina with constant density $\rho$ lies on the closed region bounded by the graphs of $y = x$ and $y = x^2$. Here are some results given by students:

1. $M_y = \rho \int_0^1 (x - x^2) \, dx$; $\bar{x} = \frac{M_x}{\text{Mass}}$

2. $M_y = \rho \int_0^1 x(x - x^2) \, dx$; $\bar{x} = \frac{M_y}{\text{Mass}}$

3. $M_y = \rho \int_0^1 (x^2 - x^4) \, dx$; $\bar{x} = \frac{M_y}{\text{Mass}}$

4. $M_x = \rho \int_0^1 (x^2 - x^4) \, dx$; $\bar{x} = \frac{M_y}{\text{Mass}}$

which are correct?

(a) 2 and 3  (b) only 1  (c) Only 2  (d) 2 and 4

9. The tank shown in the figure is initially full of water weighing 62.5 pounds per cubic foot. How much work is done in pumping all of the water to a point 2 feet above the top of the tank?

(a) $4\pi (62.5) \int_0^{12} y \, dy$  (b) $4\pi (62.5) \int_0^{12} (12 - y) \, dy$

(c) $4\pi (62.5) \int_0^{10} y \, dy$  (d) $4\pi (62.5) \int_0^{10} (12 - y) \, dy$

10. The value of $\int_0^{\infty} \frac{dx}{x^2 + 1}$ is

(a) $\pi$  (b) 1  (c) $\frac{3\pi}{4}$  (d) Infinite

11. Use L’Hospital’s Rule to calculate the limit: $\lim_{x \to \infty} \frac{\ln \ln x}{\ln x}$.

(a) $e$  (b) 0  (c) 1  (d) Cannot be calculated from L’Hospital’s Rule
12. \( \int \frac{5x + 4}{x^2 + x - 2} \, dx = \)

(a) \( 5 \ln \left| x^2 + x - 2 \right| + 4 \tan^{-1} \left( \frac{x - 1}{x + 2} \right) + C \)  
(b) \( 3 \ln |x - 1| + 2 \ln |x + 2| + C \)

(c) \( 5 \ln \left| x^2 + x - 2 \right| + C \)  
(d) \( 3 \ln |x - 1| - 2 \ln |x + 2| + C \)

13. \( \int \frac{dx}{x^2 + 6x + 10} = \)

(a) \( 2x \left( x^2 + 6x + 10 \right)^{-2} + C \)  
(b) \( \ln \left( x^2 + 6x + 10 \right) + C \)

(c) \( \tan^{-1} (x + 3) + C \)  
(d) \( \frac{1}{2} \ln |x + 2| + \frac{1}{2} \ln |x + 5| + C \)

14. \( \int x^2 e^x \, dx = \)

(a) \( x^2 e^x + 2xe^x + 2e^x + C \)  
(b) \( x^2 e^x - 2xe^x + 2e^x + C \)

(c) \( x^2 e^x + xe^x + e^x + C \)  
(d) \( x^2 e^x - xe^x + e^x + C \)

15. \( \lim_{x \to \infty} \left( 1 + \frac{3}{x} \right)^{5x} = \)

(a) 15  
(b) \( e^{15} \)  
(c) 5/3  
(d) \( e^{5/3} \)

16. The Simpson’s Rule approximation for \( \int_1^3 \ln x \, dx \) with 4 subdivisions is

(a) \( \frac{1}{6} \left[ \ln 1 + 4 \ln \frac{3}{2} + 2 \ln 2 + 4 \ln \frac{5}{2} + \ln 3 \right] \)

(b) \( \frac{1}{6} \left[ \ln 1 - 4 \ln \frac{3}{2} + 2 \ln 2 - 4 \ln \frac{5}{2} + \ln 3 \right] \)

(c) \( \frac{1}{2} \left[ \ln 1 + 2 \ln \frac{3}{2} + 2 \ln 2 + 2 \ln \frac{5}{2} + \ln 3 \right] \)

(d) \( \frac{1}{2} \left[ \ln 1 - 2 \ln \frac{3}{2} + 2 \ln 2 - 2 \ln \frac{5}{2} + \ln 3 \right] \)