1. Find the area below \( y = 3 \sin(2x) \) above the \( x \)-axis for \( 0 \leq x \leq \frac{\pi}{2} \).

a. \( \frac{1}{2} \)

b. \( \frac{3}{2} \)

c. \( \frac{\pi}{2} \)

d. \( \frac{3\pi}{2} \)

e. 3

2. The region below \( y = 3 \sin(2x) \) above the \( x \)-axis for \( 0 \leq x \leq \frac{\pi}{2} \) is rotated about the \( y \)-axis. (See the figure in problem 1.) Which formula will give the volume of the solid of revolution?

a. \( A = \int_{0}^{\pi/2} x^2 \sin(2x) \, dx \)

b. \( A = \int_{0}^{\pi/2} 3x \sin(2x) \, dx \)

c. \( A = \int_{0}^{\pi/2} 6\pi x \sin(2x) \, dx \)

d. \( A = \int_{0}^{\pi/2} 9\pi \sin^2(2x) \, dx \)

e. \( A = \int_{0}^{\pi/2} 18\pi \sin^2(2x) \, dx \)
3. A 1 m bar has linear mass density \( \rho = \frac{1}{1 + x^2} \) kg/m where \( x \) is measured from one end. Find the total mass.

   a. \( M = \frac{\pi}{4} \) kg
   b. \( M = \frac{\pi}{2} \) kg
   c. \( M = \frac{1}{2} \) kg
   d. \( M = 45 \) kg
   e. \( M = 90 \) kg

4. A 1 m bar has linear mass density \( \rho = \frac{1}{1 + x^2} \) kg/m where \( x \) is measured from one end. Find the center of mass.

   a. \( \bar{x} = \frac{\ln 2}{90} \) m
   b. \( \bar{x} = \frac{\ln 2}{2} \) m
   c. \( \bar{x} = \frac{2\ln 2}{\pi} \) m
   d. \( \bar{x} = \frac{\ln 2}{2\pi} \) m
   e. \( \bar{x} = \frac{1}{2} \) m

5. Compute \( \int_{\pi/2}^{\pi/2} \sin^6 \theta \cos \theta d\theta \)

   a. \( -\frac{2}{7} \)
   b. \( -\frac{1}{7} \)
   c. 0
   d. \( \frac{1}{7} \)
   e. \( \frac{2}{7} \)

6. The curve \( y = x^3 \) for \( 0 \leq x \leq 3 \) is rotated about the x-axis. Which formula will give the area of the surface of revolution?

   a. \( A = \int_{0}^{3} 2\pi x \sqrt{1 + 9x^4} \) dx
   b. \( A = \int_{0}^{3} 2\pi x^3 \sqrt{1 + 9x^4} \) dx
   c. \( A = \int_{0}^{3} 2\pi x^3 \) dx
   d. \( A = \int_{0}^{3} 2\pi x(3x^2) \) dx
   e. \( A = \int_{0}^{3} \pi x \sqrt{1 + 9x^4} \) dx
7. Compute \[ \int_0^2 \frac{2x}{4-x^2} \, dx \]

a. \(-\infty\)
b. \(-\ln 4\)
c. \(\frac{\pi}{4}\)
d. \(\ln 4\)
e. \(\infty\)

8. If it requires 24 J of work to stretch a spring from rest to 4 m, how much work will it take to stretch it from 2 m to 6 m?

a. 6 J
b. 12 J
c. 24 J
d. 48 J
e. 96 J

9. Which term is incorrect in the following partial fraction expansion?

\[ \frac{x^3 - 2x + 3}{(x-2)^2(x-3)(x^2+4)} = \frac{A}{x-2} + \frac{Bx+C}{(x-2)^2} + \frac{D}{x-3} + \frac{Ex+F}{x^2+4} \]

a. 
b. 
c. 
d. 
e. They are all correct.

10. Find the radius of convergence of the series \[ \sum_{n=1}^{\infty} \frac{n^2}{3^n} (x-2)^n. \]

a. 0
b. \(\frac{1}{3}\)
c. 3
d. 9
e. \(\infty\)
11. (10 points) Compute \[ \int_0^{\pi/2} 3x \cos(2x) \, dx \]

12. (10 points) Find the length of the parametric curve given by \[ x = t^2, \quad y = \frac{2}{3} t^3, \quad z = \frac{1}{4} t^4 \] for \( 0 \leq t \leq 2 \).

HINT: Factor the quantity in the square root.
13. (10 points) Find the volume of the solid whose base is the semi-circle \( x^2 + y^2 = 9 \) for \( y \geq 0 \) and whose crosssections perpendicular to the x-axis are squares.

14. (10 points) Solve the differential equation \( \frac{dy}{dx} = 1 + x^2 + y^2 + y^2x^2 \) with the initial condition \( y(3) = 0 \).
15. (10 points) Given the series \( e^x = 1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \cdots \),

a. (5 pts) compute the series for \( e^{2x} \)

b. (5 pts) and use it to compute \( \lim_{x \to 0} \frac{e^{2x} - 1 - 2x}{x^2} \).

(2 pts only for l'Hospital's Rule.)