1. Short Answer and/or Examples...

2. Set up \textbf{(but do not evaluate)} the integral to find the following.

   (a) The volume of the solid obtained by rotating the region bounded by \( y = x \) and \( y = \sqrt{x} \) about the line \( x = -1 \).
   
   \[
   V = \int_{0}^{1} 2\pi(1 + x)(\sqrt{x} - x) \, dx
   \]
   
   or
   
   \[
   V = \int_{0}^{1} \pi[(1 + y)^2 - (1 + y^2)^2] \, dy
   \]

   (b) Find the area of the surface obtained by rotating the curve given by \( x = 1 + 2y^2 \) for \( 1 \leq y \leq 2 \) about the \( x \)-axis.
   
   \[
   SA = \int_{1}^{2} 2\pi y\sqrt{1 + (4y)^2} \, dy
   \]

3. The graphs of \( y = x^3 - x \) and \( y = 3x \) are shown below. Find the area of the shaded region.

   \[ A = 8 \]

4. Compute the following integrals.

   (a) \[
   \int_{1}^{2} \frac{\ln x}{x^2} \, dx = \frac{1 - \ln 2}{2}
   \]

   (b) \[
   \int \frac{\sqrt{9 - x^2}}{x} \, dx = 3 \ln \left| \frac{3 - \sqrt{9 - x^2}}{x} \right| + \sqrt{9 - x^2} + C
   \]

   (c) \[
   \int_{0}^{\frac{\pi}{2}} \sec^4 x \tan^3 x \, dx = \frac{5}{12}
   \]

   (d) \[
   \int \frac{x + 6}{x^2 + 3x} \, dx = 2 \ln |x| - \ln |x + 3| + C
   \]

   (e) \[
   \int \sin \sqrt{x} \, dx = 2 \sin \sqrt{x} - 2\sqrt{x} \cos \sqrt{x} + C
   \]

5. Find the length of the curve \( x = 1 + 3t^2, \ y = 4 + 2t^3 \) for \( 0 \leq t \leq 1 \).

   \[ l = 4\sqrt{2} - 2 \]

6. Find the equation of the tangent line to the curve given by \( x = e^t, \ y = (t - 1)^2 \) at the point \((1, 1)\).

   \[ y = -2x + 3 \]

7. Give two different sets of polar coordinates for the point with Cartesian coordinates \((1, -\sqrt{3})\).

   There are lots of possibilities here. I’ll give three: \((2, -\frac{\pi}{3}), \ (-2, \frac{2\pi}{3}), \ (2, \frac{5\pi}{3})\)
8. Give Cartesian coordinates for the point with polar coordinates \( \left( 2, \frac{5\pi}{6} \right) \).

\((-\sqrt{3}, 1)\)

9. Determine whether the following series converge or diverge. If it converges, find the sum.

(a) \( \sum_{n=1}^{\infty} \frac{2n}{3n+5} \) Diverge

(b) \( \sum_{n=1}^{\infty} \frac{(-3)^n}{2^{3n}} \) Converge, \( s = -\frac{3}{11} \)

(c) \( \sum_{n=2}^{\infty} \frac{1}{n \ln n} \) Diverge

10. Determine whether the series \( \sum_{n=1}^{\infty} \frac{(-1)^n(3n+5)}{4n^2 - n + 1} \) is absolutely convergent, conditionally convergent or divergent.

11. Find the interval of convergence for \( \sum_{n=1}^{\infty} \frac{(-1)^nx^n}{3^{2n}n} \).

\((-9, 9]\)

12. Express the following functions as power series.

(a) \( f(x) = \frac{3}{1+x^4} = \sum_{n=0}^{\infty} (-1)^n 3x^{4n} \)

(b) \( f(x) = e^{-x^2} = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{n!} \)

(c) \( f(x) = \frac{\sin(x^3)}{x} = \sum_{n=0}^{\infty} \frac{(-1)^n x^{6n+2}}{(2n+1)!} \)

13. Find the Taylor series centered at 1 for the function \( f(x) = \frac{1}{\sqrt{x}} \)

\( \sum_{n=0}^{\infty} \frac{(-1)^n 1 \cdot 3 \cdot 5 \cdots (2n - 1)}{2^n n!} (x-1)^n \)

14. Use the power series representation (found in problem 12b) for \( f(x) = e^{-x^2} \) to compute \( \int_0^{.5} e^{-x^2} \, dx \) correct to within .001.

\( \int_0^{.5} e^{-x^2} \, dx \approx .461 \)