1. Evaluate the given integral

   (a) $\int 3xe^{-2x}\,dx$

   (b) $\int \dfrac{x+3}{x^2+3x+2}\,dx$

   (c) $\int \dfrac{3x}{\sqrt{1+x^2}}\,dx$

2. Determine the area bounded by the curves $f(x) = x + 1$ and $g(x) = (x-1)^2$.

3. Determine the volume of the solid formed by rotating the region bounded by $f(x) = x + 1$ and $g(x) = (x-1)^2$ about the x-axis.

4. Determine the volume of the solid formed by rotating the region bounded by $f(x) = x + 1$ and $g(x) = (x-1)^2$ about the y-axis.

5. A parabolic tank with upper radius 2 ft and height 4 ft is full of water. Determine the work required to pump the water out of the tank. (Use the fact that water weighs approximately 62.5 lb/ft^3.)

6. Determine the arclength of the curve $y = 4x^{3/2}$ on $0 \le x \le 2$

7. Evaluate the integral if it converges. Show divergence otherwise.

   (a) $\int_1^3 \dfrac{8}{(x-1)^3}\,dx$

   (b) $\int_0^\infty 3xe^{-2x}\,dx$

8. Solve the initial value differential equation explicitly for $y(t)$:

$$\frac{dy}{dt} = 2t(y-1)^2 \qquad y(0) = 2.$$

9. Solve the initial value first order linear differential equation:

$$y' = y + x \qquad y(0) = 2.$$

10. Use Euler's Method to approximate $y(1)$ if $\dfrac{dy}{dx} = 2y - x$ with $y(0) = 1$ and $\Delta x = \dfrac{1}{2}$.

11. Solve the initial value second order nonhomogeneous differential equation using the method of undetermined coefficients.

$$y'' + 3y' + 2y = \cos x \qquad y(0) = 0 \qquad y'(0) = 1.$$

12. Tell whether the series converges or diverges and justify your answer by showing reason by a valid test.

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^n n}{n^2+1}$

(b) $\displaystyle\sum_{n=0}^{\infty} \frac{2^{3n}}{5^n n^2}$

13. Determine the given sum:

(a) $\displaystyle\sum_{n=1}^{\infty} \frac{5 \cdot 2^n}{7 \cdot 3^n}$

(b) $\displaystyle\sum_{n=0}^{\infty} \frac{1}{n!}$

14. Determine the Taylor Series about $x = 0$ for:

(a) $f(x) = \dfrac{1}{1+3x}$

(b) $g(x) = \dfrac{1}{(1+3x)^2}$

(c) $k(x) = \sqrt{1+3x}$

15. Write out the first four terms to the Taylor series for $f(x) = \sqrt{x}$ about $x = 4$

16. Determine the interval and radius of convergence of the given series:

$$\sum_{n=1}^{\infty} \frac{(x-2)^n}{n^2 3^n}$$

17. Determine the volume of the parallelopiped formed by the vectors:

$$\vec{a} = \langle -1, 2, 2 \rangle \qquad \vec{b} = \langle 2, 0, 4 \rangle \qquad \vec{c} = \langle 3, 1, -1 \rangle$$

18. Given points $P(-1, 4, 6)$ and $Q(-3, 6, 7)$ and $R(-6, 8, 3)$,

    (a) determine the angle θ between $\vec{PQ}$ and $\vec{PR}$.

    (b) determine Π, the equation of the plane which contains the points P, Q, and R.

19. Change coordinates:

    (a) from rectangular coordinates to cylindrical coordinates.

        i. $P(-3, 3, 6)$

        ii. $z = \sqrt{3x^2 + 3y^2}$

    (b) i. from spherical coordinates to rectangular coordinates.
    $P(4, \pi/3, \pi/4)$

        ii. from rectangular to spherical coordinates.
    $x^2 + y^2 + z^2 = 9$