1. Consider the region bounded by \( y = x^2, \) \( y = 4, \) and the \( y \)-axis. Set up (but do not solve) integrals to find
   (a) The volume of the solid generated by rotating this region about the \( x \)-axis using washers.
   (b) The volume of the solid generated by rotating this region about the line \( x = 5 \) using shells.

2. Graph \( r = 3(1 - \sin(\theta)) \) and set up an integral to find the area enclosed by the graph.

3. A spring whose natural length is 2 ft exerts a force of 100 lb when stretched to a length of 2.25 ft. Set up an integral to find the work done in stretching the spring 1 ft beyond its natural length.

4. Evaluate the following integrals.
   (a) \( \int x e^{3x} \, dx \)
   (b) \( \int \frac{1}{\sqrt{4 + x^2}} \, dx \)
   (c) \( \int \frac{4x - 3}{(x + 2)(x - 3)} \, dx \)
   (d) \( \int \sin^2(3x) \, dx \)

5. Indicate if the following series converge or diverge. You must identify all the tests you use and show all the work needed to apply them.
   (a) \( \sum_{k=1}^{\infty} \frac{3}{2^k} \)
   (b) \( \sum_{k=3}^{\infty} \frac{k}{\ln k} \)
   (c) \( \sum_{k=0}^{\infty} \frac{(k + 2)!}{(2k)!} \)
   (d) \( \sum_{k=2}^{\infty} \frac{2 + \sqrt{k}}{k} \)

6. Find all values of \( x \) so that \( \sum_{k=1}^{\infty} \frac{1}{\sqrt{k}3^k(x - 7)^k} \) converges

7. If \( a_k > 0 \) and \( a_{k+1} = 3a_k \) for all \( k > 1 \), does \( \sum_{k=1}^{\infty} a_k \) converge? Why or why not?

8. Find the first 3 terms of the Taylor series for \( f(x) = \sqrt{x + 2} \) centered at \( x = 7 \).

9. Let \( \mathbf{u} = <2, 1, 0> \) and \( \mathbf{v} = <-3, 0, 4> \).
   (a) Find \( ||\mathbf{u} - 2\mathbf{v}|| \).
   (b) Find a vector orthogonal to both \( \mathbf{u} \) and \( \mathbf{v} \).
   (c) Find the cosine of the angle between \( \mathbf{u} \) and \( \mathbf{v} \).