1. Find the area between \( y = \frac{1}{2}x \) and \( y = 2x^3 + x^2 - 5x \). Draw a diagram.

2. Find the volume of the region bounded by \( y = -x^3 + 5x^2 - 2x \) in the 1st quadrant, which is then rotated about the y-axis.

3. Find the volume of the region bounded by \( y = 5 - x^2 \), \( y = 2x \), & the y-axis which is then rotated about the \( y = 1 \) line.

4. Find the arc length of \( y = t^4 + 1 \), \( x = -t^3 - 4 \), \( 0 \leq t \leq 2 \).
5. Find the length of the curve \( y = \frac{1}{6}(x^2 + 4)^{3/2} \), \( 0 \leq x \leq 3 \).

6. Find the average value of \( f(x) = x^2 \sqrt{1+x^2} \) on the interval \([0, 2]\).

7. Let \( f(x) = x^3 - 4x + 2 \) on the interval \([-1, 5]\)
   a) find the average value of \( f(x) \),
   b) find \( c \) such that \( f(c) = f_{\text{ave}} \), where \( 1 \leq c \leq 5 \).

8. A force of 30N is required to maintain a spring stretched from its natural length of 12cm to a length of 15cm. How much work is done in stretching the spring from 12cm to 20cm?
9. A hemispherical tank (see diagram) is full of water, and has a radius of 4 m. Find the amount of work needed to pump water out of the tank until only a height of 50 cm Water is left in the tank. Use the density of water is 1000 kg/m³.

10. Find the centroid of a semicircle with \( r = 2 \).
11. Find the center of mass of the given points, and graph the system. 
\( P_1(1,1) \), \( P_2(-3,0) \), \( P_3(2,1) \), \( P_4(1,-2) \) with associated masses: \( m_1 = 1 \), 
\( m_2 = 5 \), \( m_3 = 7 \), \( m_4 = 2 \).

12. Consider the sequence \( 1, 5, 9, 13, 17, \ldots \).
   a) Find the next 2 terms in the sequence.
   b) Find the general term \( a_n \).

13. Consider the sequence \( -6, 18, -54, 162, -486, \ldots \).
   a) Find the next term in the sequence.
   b) Find the general term \( a_n \).

14. Find the radius of convergence of \( \sum_{n=0}^{\infty} \frac{n(x-1)^n}{5^n} \) and the interval of convergence.
15. Find the radius of convergence & the interval of convergence of \( \sum_{n=0}^{\infty} \frac{(3x)^n}{n!} \).

For the remaining questions, determine whether the series converges or diverges by using an appropriate test for convergence. If the series is geometric and convergent, find the sum of the series as well.

16. \( \sum_{n=1}^{\infty} \frac{n}{n^3 + 1} \)

17. \( \sum_{n=1}^{\infty} \frac{n^3}{5^n} \)

18. \( \sum_{n=1}^{\infty} \frac{2^{2n+1}}{5^n} \)

19. \( \sum_{n=1}^{\infty} \frac{3}{n^2 + n - 1} \)

20. \( \sum_{n=1}^{\infty} (-1)^n \frac{\sqrt{n}}{4n + 1} \)

21. \( \sum_{n=1}^{\infty} \frac{n^{3/5}}{n} \)