1. Approximate the sum of the series correct to four decimal places. Cite relevant test(s).
\[\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n 4^n}\]

2. Determine whether the series \[\sum_{n=2}^{\infty} \frac{(-1)^n}{n \ln n}\] is absolutely convergent, conditionally convergent, or divergent. Cite relevant test(s).

3. Find the radius of convergence of the series \[\sum_{n=1}^{\infty} \frac{n^2 x^n}{2^n n!}\]. Cite relevant test(s).

4. Find the radius and interval of convergence of the series \[\sum_{n=1}^{\infty} \frac{(x - 3)^n}{n}\]. Cite relevant test(s).
5. Find a power series representation for \( f(x) = \frac{2}{3-x} \) and determine the interval of convergence.

7. Find the Taylor series for \( f(x) = \sin x \) centered at \( a = \pi \). Compute its radius of convergence.

6. Evaluate the indefinite integral \( \int \frac{t}{1+t^3} \, dt \) as a power series. What is its radius of convergence?

8. Use series to evaluate the limit \( \lim_{x \to 0} \frac{x^3 - 3x + 3 \tan^{-1} x}{x^5} \).
9. Use the Alternating Series Estimation Theorem to estimate the range of values of \( x \) for which the approximation is accurate to within the stated error.

\[
\tan^{-1} x \approx x - \frac{x^3}{3} + \frac{x^5}{5} \quad (|\text{error}| < 0.05)
\]

10. A car is moving with speed 20 m/s and acceleration 2 m/s\(^2\) at a given instant. Using a second-degree Taylor polynomial, estimate how far the car moves in the next second. Would it be reasonable to use this polynomial to estimate the distance traveled in the next minute? Explain.

11. Find an equation of the sphere with center \((-3, 2, 5)\) and radius 4. What is the intersection of this sphere with the \(yz\)-plane?

12. Find the distance between the spheres \(x^2 + y^2 + z^2 = 4\) and \(x^2 + y^2 + z^2 = 4x + 4y + 4z - 11\).
13. A wagon is pulled a distance of 100 m along a horizontal path by a constant force of 70 N. The handle of the wagon is held at an angle of 35° above the horizontal. Find the work done by the force.

14. Find the scalar and vector projections of \( \mathbf{b} = [2, 4, -1] \) onto \( \mathbf{a} = [3, -3, 1] \).

15. Find the volume of the parallelepiped (sheared box) with adjacent edges \( PQ, PR, \) and \( PS \).

\[
P(3, 0, 1) \quad Q(-1, 2, 5) \quad R(5, 1, -1) \quad S(0, 4, 2)
\]

16. Determine all vectors \( \mathbf{v} = [v_1, v_2, v_3] \) such that

\[
[1, 2, 1] \times \mathbf{v} = [3, 1, -5].
\]

(There are infinitely many of them. Express your answer in terms of the parameter \( t \).)
17. Find an equation of the plane through the origin and the points \((2, -4, 6)\) and \((5, 1, 3)\).

18. Determine whether the lines \(L_1\) and \(L_2\) are parallel, skew, or intersecting. If they are intersecting, find the point of intersection.

\[
L_1(t) = \begin{bmatrix} 5 - 12t, \; 3 + 9t, \; 1 - 3t \end{bmatrix}
\]

\[
L_2(s) = \begin{bmatrix} 3 + 8s, \; -6s, \; 7 + 2s \end{bmatrix}
\]

19. Find the slope of the tangent line to the polar curve \(r = 2 + \sin 3\theta\) at the point corresponding to \(\theta = \pi/4\).

20. Find the length of the polar curve, both exactly and approximately: \(r = 5^\theta, \quad 0 \leq \theta \leq 2\pi\).
• Work by hand and/or calculator, showing your steps.
• Lengths are in centimeters. Work is in joules.
• Write small and legibly. Box final answers.