1. Determine whether series (a) converges or diverges, and give the radius of convergence for series (b). (Be sure to justify your answer.)

\[ (a) \sum_{n=1}^{\infty} \frac{1}{n} \sin \left( \frac{1}{\pi n} \right) \]

\[ (b) \sum_{n=1}^{\infty} \frac{n!x^n}{n^n} \]

2. Compute the following limit, or show that it does not exist:

\[ \lim_{x \to 1} \left( \frac{x}{x - 1} - \frac{1}{\ln(x)} \right) \]

3. Compute the first four terms \( a_0 + a_1x + a_2x^2 + a_3x^3 \) of the Maclaurin series (i.e. the Taylor series at 0) for

\[ f(x) = \ln(1 - x + x^2) \]

4. Find the equation of a plane that contains the points \( P_1 = (1, 3, 4) \) and \( P_2 = (1, 2, 3) \) and also forms a \( 60^\circ \) angle with the plane \( x + y - 2z = 6 \). (There are two correct answers; you need find only one.)

5. Find the point \( (x, y) \) on the ellipse \( x^2 + 4y^2 = 74 \) where the function \( F(x, y) = (x + 12y) + (x + 12y)^3 \) is largest.