1. Find the following limits:
   (a) \( \lim_{x \to 0^+} \frac{\cot x}{\sqrt{-\ln x}} \)
   (b) \( \lim_{x \to 0^+} (3x)^x \)
   (c) \( \lim_{x \to 0} (\csc^2 x - \cot^2 x) \)

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

3. The half-life of Tritium is 12 years. If you start with 50 grams of Tritium, how much will you have after 100 years?

4. Salt water, at a concentration of 2 kg/L, flows into a tank of water at a rate of 5 L/min. Salt water flows out of the tank at a rate of 4 L/min. The tank starts with 10 Liters of water. Find the differential equation describing the amount of salt in the tank after \( t \) minutes. (You don’t have to solve it).

5. Solve the differential equation
   \[ x \frac{dy}{dx} + \ln x = 0 \]
   given \( y(1) = 2 \).

6. Find the convergence set of the power series \( \sum_{n=0}^{\infty} \frac{(n+1)^2}{n!} (x - 1)^n \).

7. Find the first 3 terms of the Taylor series of \( \frac{1}{x^3 + 1} \) at \( x = 0 \).

8. Find the area of the region enclosed by the curve given in polar coordinates by \( r = 2 \cos \theta \sqrt{\sin \theta}, 0 \leq \theta \leq \frac{\pi}{2} \).