1. Use logarithmic differentiation to find the derivative of \( y = x^{\cos x} \).

2. Strontium-90 has half life of 28 days. A sample has a mass of 50 mg initially. Find a formula for the mass remaining after \( t \) days.

3. Prove that \( \cos(\sin^{-1} x) = \sqrt{1 - x^2} \).

4. Find the derivative of the following functions:
   (i). \( y = \tan^{-1}(x^2) \)
   (ii). \( y = \sin^{-1}(\cos x) \)

5. Compute the following limits:
   (i). \( \lim_{x \to 0} \frac{e^x - 1 - x}{x^2} \)
   (ii). \( \lim_{x \to \infty} \frac{2^x}{x} \)
   (iii). \( \lim_{x \to 0^+} (\sin x)(\ln x) \)
   (iv). \( \lim_{x \to 0^+} (\tan 2x)^x \)
   (v). \( \lim_{x \to \infty} (1 + \frac{a}{x})^{bx} \)