1. A radioactive isotope has a half-life of 8 days. If the initial amount is 5 grams, how long will it take for the amount to decrease to 2 grams?

2. Find the derivatives of
   (a) \( \cos(1 + e^{2x}) \)  
   (b) \( \frac{\ln x}{2x + 1} \)

3. For the Ricker model for fish population \( x_{t+1} = r x_t e^{-2x_t} \) find the equilibria. For which values of \( r \) is each equilibrium stable? Unstable?

4. Let \( f(t) = t - t^3 \). Find all the critical points of \( f \) on the interval \( 0 \leq t \leq 2 \). Use the second derivative to determine concavity at the critical points. Find the global minimum and the global maximum of \( f \) on the interval. Where do they occur?

5. Find indefinite integrals of the following functions
   (a) \( \frac{1}{x \ln x} \)  
   (b) \( t^2 \sin(3t) \)

6. Determine whether the improper integral \( \int_0^1 \frac{1}{\sqrt{x} + \sqrt{x}} \, dx \) converges by comparing it to an integral which can be computed explicitly.

7. For the autonomous differential equation \( \frac{dx}{dt} = x - ax^3 \), where \( a \) is a positive constant, draw the phase-line diagram, find the equilibria, and determine their stability, both from the diagram and by using the stability theorem.

8. Solve the differential equation \( \frac{dh}{dt} = -h^2 \) with initial condition \( h(0) = 3 \). Sketch a graph of the solution \( h(t) \) for \( t \geq 0 \). What is the limit of \( h(t) \) as \( t \to \infty \)?

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