

Name: _____

Please show all work. Supply brief narration with your solutions and draw conclusions.

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

$$(a) \cos(1 + e^{2x}) \quad (b) \frac{\ln x}{2x + 1}$$

3. For the Ricker model for fish population $x_{t+1} = rx_t e^{-2x_t}$ 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

$$(a) \frac{1}{x \ln x} \quad (b) t^2 \sin(3t)$$

6. Determine whether the improper integral $\int_0^1 \frac{1}{\sqrt[3]{x} + \sqrt{x}} dx$ converges by comparing it to an integral which can be computed explicitly.
7. For the autonomous differential equation $dx/dt = x - ax^3$, 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 $dh/dt = -h^2$ 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 $t \rightarrow \infty$?

1	2	3	4	5	6	7	8	total (80)