Name: _____

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

1. Carbon-14 is a radioactive isotope of carbon (used for dating organic remains) with a half-life of 5,730 years. If you start with a sample of 50 mg of carbon-14 now, when will the amount decrease to 48 mg?

2. Find the derivatives of

$$\text{(a) } 2^{3t}\cos(t^4) \qquad \text{(b) } \sqrt{1+\frac{\ln(2t)}{t^3}}$$

3. Find the second derivative of $f(t)=\frac{2t}{3+t}$ and use it to describe the curvature of the graph of f for $t \geq 0$.

4. A population x_t has *per capita* production $0.7x_t$. Write down the discrete dynamical system for x_t. Find equilibria and use the slope criterion to determine their stability. Describe in words what happens in the long run.

5. Find all critical points of $f(x)=3x-x^4$ in the interval $0 \leq x \leq 2$. Use f'' to determine whether they are local minima or maxima. Find the global minimum and maximum of f of the interval and state where they occur. Sketch.

6. Find antiderivatives of the following functions

$$\text{(a) } \frac{\sin(-3x)}{[1+\cos(-3x)]^2} \qquad \text{(b) } (t^2+t+1)\,e^{3t}$$

7. Find the area enclosed by graphs of $\sqrt{x}$ and x^2 for $0 \leq x \leq 4$.

8. Determine whether the improper integral $\displaystyle\int_0^1 \frac{dx}{x^{\frac{3}{4}}+x^{\frac{5}{4}}}$ converges or diverges. Justify your assertion by comparison to an integral whose convergence or divergence can be determined directly.

9. The concentration of a medication $h(t)$ as a function of time (in hours) is metabolized at a rate proportional to the cube of the concentration: $dh/dt=-2h^3$. If the initial concentration is 5 mg/cc, find the concentration as a function of time, sketch its graph, and describe its long-term behavior. When will the concentration drop below 1 mg/cc?

1	2	3	4	5	6	7	8	9	total (90)