

Name: _____

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

1. Find all critical points of $f(x) = x^2 - x^4$ in the interval $-2 \leq x \leq 2$. 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.
2. Find indefinite integrals of the following functions

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

3. Determine whether the improper integral $\int_0^1 \frac{dx}{x^{\frac{1}{4}} + x^{\frac{5}{4}}}$ converges or diverges. Justify your assertion by comparison to an integral whose convergence or divergence can be determined directly.
4. For the autonomous differential equation $dx/dt = a^2x - x^3$, where a is a positive constant, draw the phase-line diagram, find the equilibria, and determine their stability.
5. Solve the Torricelli differential equation $dh/dt = -\sqrt{h}$ with initial condition $h(0) = 2$. Sketch the solution and describe its long-term behavior.

1	2	3	4	5	total (50)	%

Prelim. course grade: %