Name: ____________________________

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

1. Let \( f(t) = t^4 - 2t^2 \). Find all the critical points of \( f \) on the interval \(-2 \leq x \leq 2\). 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?

2. Find indefinite integrals of the following functions
   
   \( (a) \ e^{2t}(1 + e^{2t})^5 \quad (b) \ t \cos(2t) \)

3. Show that the improper integral \( \int_{1}^{\infty} \frac{1}{\sqrt{x} + x^2} \, dx \) converges and find an upper bound.

4. For the autonomous differential equation \( \frac{dx}{dt} = ax^2 \), where \( a \) is a positive constant, draw the phase-line diagram, find the equilibria, and determine their stability.

5. Solve the Torricelli equation \( \frac{dh}{dt} = -\sqrt{h} \) with initial condition \( h(0) = 1 \). When is \( h = 0 \)?

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