1. Find the only critical point of

\[ f(x) = e^{-4x} - e^{-x}. \]

Use the Second Derivative Test to determine if this critical point gives a local maximum or a local minimum.

ANSWER: \( x = \frac{1}{3} \ln(4) \) gives a local minimum

2. Let \( f(x) = x^3 - \frac{3}{2} x^2 - 6x + 3 \). Sketch a rough graph of \( f(x) \).

HINT: \( f(x) \) is increasing on the intervals \((-\infty, -1)\) and \((2, \infty)\). \( f(x) \) is decreasing on the interval \((-1, 2)\). \( f(x) \) is concave up on the interval \((\infty, \frac{1}{2})\) and concave down on the interval \((\frac{1}{2}, \infty)\).

ANSWER:

3. A farmer wants to enclose a rectangular pasture along one side of a barn. The farmer has 1200 feet of fencing with which to construct the remaining three sides of the pasture. What is the largest area the farmer can enclose?

ANSWER: 180,000 square feet

4. If \( x \) milligrams of a drug are administered to a patient, the resulting change in the patient’s temperature (in millionths of a degree) is given by the function

\[ T(x) = 75x^2 - \frac{1}{3}x^3. \]

(a) What dosage \( x \) maximizes the change in the patient’s temperature and what is the maximum temperature change that can result from the administration of this drug?

ANSWER: A dose of 150 mg will maximize the change in temp. The max change in temp is 562,500 millionths of a degree OR 0.5625 degrees.
(b) The derivative $T'(x)$ is the patient’s sensitivity to the drug (measured in units of millionths of a degree per milligram). What dosage $x$ maximizes the patient’s sensitivity?

ANSWER: A dose of 75 mg maximizes sensitivity.