Name: _____

1. [**10 parts, 2 points each**] Differentiate the following functions.

(a) $f(x) = 8$

(f) $f(x) = 7\sqrt{x}$

(b) $f(x) = 5x^2 - 2x + 1$

(g) $f(x) = 4\ln(x)$

(c) $f(x) = \frac{3}{x^2}$

(h) $f(x) = e^{-x}$

(d) $f(x) = 6^x$

(i) $f(x) = x^{\ln(4)}$

(e) $f(x) = e^{0.2x}$

(j) $f(x) = e^{\sqrt{5}-1}$

2. A pharmaceutical company finds that the cost C (in thousands of dollars) for producing q kilograms of a drug is given by the equation $C(q) = 2.2q^3 + 14.1q + 250$. The total revenue R (in thousands of dollars) received by the company when q kilograms are produced is given by the equation $R(q) = 8.2q^2 + 200q$.

   (a) [**4 points**] Find the marginal cost when the production q is 6 kilograms. Round your answer to 3 decimal places and include units.

   (b) [**4 points**] Find the marginal revenue when the production q is 6 kilograms. Round your answer to 3 decimal places and include units.

   (c) [**2 points**] If 6 kilograms of the drug have already been produced, should the company produce more of the drug? Explain.

3. Let $g(t) = \ln\left(1 + t^2\right)$.

   (a) [**5 points**] Find $g'(t)$.

   (b) [**5 points**] Find the equation of the tangent line to $g(t)$ at $t = 4$ exactly. Your answer may involve exponential functions, logarithmic functions, or both.

4. [**4 parts, 5 points each**] Differentiate the following functions.

(a) $f(x) = \dfrac{x^3 - 8x + 2}{x^2 + 1}$

(b) $f(x) = 2^{(x^3 + 4x)}$

(c) $f(x) = (4x + \ln(x))^{-5}$

(d) $f(x) = \ln(\ln(x))$

5. [**5 parts, 4 points each**]

   (a) Complete: a point p is a critical point of a function f if _____
       or if _____.

   (b) Let $f(x) = -2x^3 + 8x^2 - 8x$. Find $f'(x)$.

   (c) Find the critical points of f.

   (d) Find $f''(x)$.

   (e) Using either the First Derivative Test or the Second Derivative Test, classify each critical point as a local minimum, a local maximum, or neither.

6. Let $f(x) = (x-2)^3 e^x$.

   (a) [**7 points**] Find $f'(x)$.

   (b) [**7 points**] Find the critical points of f.

   (c) [**6 points**] Use the <u>First Derivative Test</u> to classify each critical point as a local minimum, a local maximum, or neither.

$$\boxed{\text{Do not turn the page until instructed.}}$$

Directions:

1. Write your name on this page and, after the test begins, <u>on the first page of the test</u>.

2. Round all numerical answers to three (3) decimal places.

3. <u>Show your work</u> unless you are instructed otherwise. No credit for answers without work.

4. You may use a calculator provided it is not equipped with a Computer Algebra System (CAS).

5. Turn off and put away all other electronic equipment (especially cell phones), notes, and books.

6. Good luck!