

MA121 Elements of Calculus

Exam 2 Form 22

23 February, 2009

Instructions: Show all work relevant to the solution of each problem. i.e. no credit will be given for “just the answers.” Please do *all* work in the Blue Books! There are **eight** problems which carry a total of 104 points. You will have until the end of class to complete this exam. Good luck!

(15 pts) **Problem 1.** Definitions and Concepts.

- a. True or False. If $f(x)$ is continuous at every point x on its domain, I can compute $f'(x)$ for every x .
- b. True or False. A function can be both concave down and increasing on its domain.
- c. Draw the graph of a function which has no critical points.
- d. Draw the graph of a function which satisfies the condition $f'(x) \leq 0$ for all x .
- e. Which of the three statements below is **false**? (Multiple answers possible).

I.
$$\frac{d}{dx}(f(x) + g(x)) = \frac{d}{dx}f(x) + \frac{d}{dx}g(x).$$

II.
$$\frac{d}{dx}(f(x)g(x)) = \frac{d}{dx}f(x)\frac{d}{dx}g(x).$$

III.
$$\frac{d}{dx}(af(x)) = a\frac{d}{dx}f(x), \text{ where } a \text{ is constant.}$$

- f. Which of the three statements below is **false**? (Multiple answers possible).

I. If $f(x) = k$ for some constant k , then $f'(x) = 0$.

II. If $f'(x) > 0$ then $f(x) > 0$.

III. If $f''(x) > 0$ then $f'(x) > 0$.

(10 pts) **Problem 2.** Using **the limit definition of the derivative**, find $f'(x)$ where $f(x) = x^2 - 1$.

(15 pts) **Problem 3.** Compute $f'(x)$ using the **method prescribed**. Show all steps in your work.

a. $f(x) = 4x^3 + 4x^2 + 99$ using **power rule**.

b. $f(x) = x^{21}(x^2 - 1)$ using **product rule**.

c. $f(x) = \frac{x-1}{x+1}$ using **quotient rule**.

(10 pts) **Problem 4.** Compute $f'(x)$ using any means. Show all steps in your work.

a. $f(x) = (9x^3 + 3)^9$.

b. $f(x) = \frac{1}{\sqrt{x^9+3}}$.

(10 pts) **Problem 5.** Determine $f''(x)$ (the second derivative) of $f(x)$ where $f(x) = (x + 1)^8$.

(10 pts) **Problem 6.** If $f(x) = x^3 + 1$, Find the *equation* of the tangent line at $x = 2$.

(20 pts) **Problem 7.** Let $f(x) = x^3 - 12x + 16$.

- Locate the critical points of $f(x)$.
- On what interval(s) is $f(x)$ increasing?
- Locate the inflection points of $f(x)$.
- On what interval(s) is $f(x)$ concave up?

(14 pts) **Problem 8.** The graph of $g(x)$ is given below.

- At which points is $g(x)$ *not* continuous?
- At which points is $g(x)$ *not* differentiable?
- At which points is the slope of the line tangent to $g(x)$ horizontal?
- Which points, if any, are the critical points?
- Which points, if any, are relative extrema?
- Which points, if any, are relative maxima?
- Which point, if any, is the relative minima?

