MATH 210
RULES FOR DIFFERENTIATION, PART 1

Atomic Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\, x^{\alpha} = \alpha x^{\alpha-1}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, e^{x} = e^{x}$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \sin x = \cos x$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \cos x = -\sin x$$

Combination Rules

$$\frac{\mathrm{d}}{\mathrm{d}x}\, c \cdot f(x) = c \cdot f'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \big(f(x) + g(x)\big) = f'(x) + g'(x)$$

$$\frac{\mathrm{d}}{\mathrm{d}x}\, \big(f(x) - g(x)\big) = f'(x) - g'(x)$$

Differentiate the following functions:

- $a(x) = 9001$
- $b(x) = x^7 - 4x^5 + 3x^4 - x^2 + 10x - 8$
- $c(x) = e^x - x^e$
- $d(x) = 6\sqrt[3]{x}$
- $f(x) = \dfrac{1}{x} - \dfrac{3}{x^3}$
- $g(x) = \dfrac{2}{\sqrt{x^5}} - e^2 \cdot e^x$
- $h(x) = 2 - \sin x$
- $i(x) = \pi \cos x + \dfrac{x}{\pi}$
- $j(x) = \cos x + \sin x + 3ex^2$

Using your previous work, determine the derivatives at specific inputs:

- $b'(1)$
- $c'(0)$
- $f'(3)$
- $h'(\pi/3)$
- $j'(0)$

(1) Use the definition of the derivative to explain why the differentiation rule for multiplication by a constant works.
(2) Use the definition of the derivative to explain why the differentiation rule for addition works.
(3) Use the rules for multiplication by a constant and addition to explain why the differentiation rule for subtraction works.