

### Quiz No. 3

Show all of your work, label your answers clearly, and do not use a calculator.

**Problem 1** State the following rules for derivatives:

a *The constant rule*

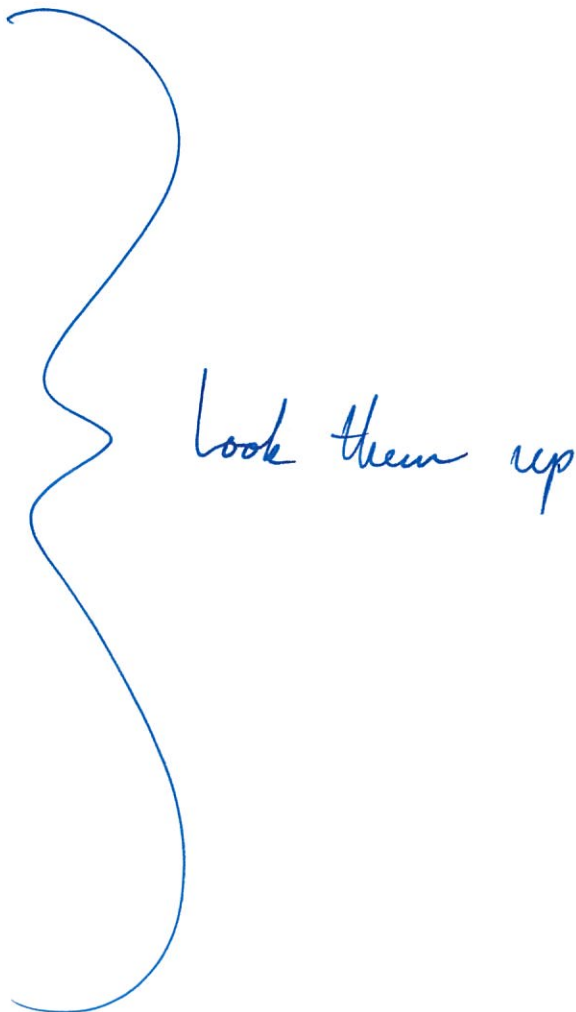
b *The constant multiple rule*

c *The sum rule*

d *The product rule*

e *The power rule*

f *The quotient rule*



*look them up*

**Problem 2** Prove the constant multiple rule.

The constant multiple rule states that,  
if  $g(x) = c f(x)$ , then  $g'(x) = c f'(x)$

By definition of the derivative:

$$g'(x) = \lim_{h \rightarrow 0} \frac{g(x+h) - g(x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{c f(x+h) - c f(x)}{h}$$

$$= c \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$= c f'(x)$$

**Problem 3** Find the derivative of the following function, remembering to show all of your work:

$$f(x) = \left(\frac{1}{x} + 4x^5\right)(x^5 + \sqrt{x})$$

$$\begin{aligned} f'(x) &= \frac{d}{dx} \left( \left(\frac{1}{x} + 4x^5\right)(x^5 + \sqrt{x}) \right) \\ &= \left( \frac{d}{dx} \left(\frac{1}{x} + 4x^5\right) \right) (x^5 + \sqrt{x}) + \left(\frac{1}{x} + 4x^5\right) \left( \frac{d}{dx} (x^5 + \sqrt{x}) \right) \\ &= \left( -\frac{1}{x^2} + 20x^4 \right) (x^5 + \sqrt{x}) + \left( \frac{1}{x} + 4x^5 \right) \left( 5x^4 + \frac{1}{2}x^{-1/2} \right) \end{aligned}$$

**Problem 4** Find the derivative of the following function, remembering to show all of your work:

$$f(x) = \frac{3x^2 + 80x}{e^x + 2x}$$

$$f'(x) = \frac{d}{dx} \left( \frac{3x^2 + 80x}{e^x + 2x} \right)$$

$$= \frac{(e^x + 2x) \frac{d}{dx} (3x^2 + 80x) - (3x^2 + 80x) \frac{d}{dx} (e^x + 2x)}{(e^x + 2x)^2}$$

$$= \frac{(e^x + 2x)(6x + 80) - (3x^2 + 80x)(e^x + 2)}{(e^x + 2x)^2}$$