\_Major Concepts \_

- 1. Derivatives: definition, concept, applications
- 2. Derivative computations: applying rules sum, power, product, quotient, chain
- 3. Derivative of functions: polys, rational, radicals, trig, exponential, logarithmic
- 1. (a) Use the definition of the derivative to compute the derivative of  $f(x) = \frac{1}{x} = x \xrightarrow{2} x \xrightarrow{2} = \frac{1}{x^2}$

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

$$= \lim_{h \to 0} \frac{x - (x+h)}{x + h} = \lim_{h \to 0} \frac{-1}{x + h}$$

$$= \lim_{h \to 0} \frac{-1}{x + h}$$

(b) Use the definition of the derivative to compute the derivative of  $f(x) = 3x^2$ .

$$\lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$$

$$\lim_{h\to 0} \frac{3(x+h)^2 - 3x^2}{h}$$

$$= \lim_{h\to 0} \frac{3(x^2 + 2xh + h^2) - 3x^2}{h}$$

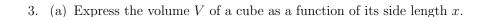
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2. Find the slope of the tangent line to the curve  $y = 3x^2 + 2x + 1$  at x = 5.



(b) Take the derivative of your equation. This is the rate of change of the volume of a cube as a function of x.

(c) Compute V'(1), V'(2), V'(5) and V'(10).

(d) Which has the greater affect on volume, lengthening the side length of a *small* cube by 1 or a large cube by by 1?

4. Compute the derivatives of the following.

(a) 
$$3\sin(4t)$$

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$$3\cos(4t) \cdot du$$

(b) 
$$e^{7t}$$
  $\frac{7t}{3} - \frac{3}{3} = -\frac{2}{3}$ 

(c) 
$$\frac{\sqrt[3]{x} - \ln(x)}{\sqrt{x^2 + 1}}$$
   
 $(x^2 + 1)$    
 $(x^2$ 

$$\sqrt{x^2+1} = \left(x^2+1\right)^2 \xrightarrow{\text{Page 2}}$$

$$\frac{b \times x}{x} + \frac{10}{x} = b + \frac{10}{x}$$

$$= b \times \frac{10}{x}$$
5. Suppose that  $f(x) = \frac{6x + 10}{x}$ . Evaluate  $f'(x)$  and  $f'(3)$ .
$$\frac{b \times x}{x} + \frac{10}{x} = b \times \frac{-10}{x^2}$$

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$$\frac{-10}{x^2}$$

$$f'(3) = \frac{-10}{9}$$

6. Suppose that  $f(x) = 2x^{-4} + 3x^{-2}$ . Evaluate f'(x) and f'(2).

$$-8 \times \frac{32}{-8} - \frac{6.4}{8.4} - \frac{32}{32}$$

$$-8(2)^{-5} - 6(3)^{-3}$$

$$= -1$$

7. Suppose that  $f(x) = \tan \frac{1}{x} + 3\cos(x^{-2})$ . Evaluate f'(x).

$$\frac{1}{\sec^{2}\left(\frac{1}{x}\right) \cdot \frac{-1}{x^{2}} - 3\sin\left(x^{-2}\right)\left(-2x^{-3}\right)}{-\sec^{2}\left(\frac{1}{x}\right)} + \frac{b\sin\left(\frac{1}{x^{2}}\right)}{x^{3}}$$

8. Suppose that  $f(x) = \sqrt{x} \sin(x)$ . Evaluate f'(x) and  $f'(\pi)$ .

$$\left(\frac{1}{2}x^{\frac{1}{2}}\right) \sin(x) + \sqrt{x} \cos(x)$$

$$\approx \left(\frac{1}{2}x^{\frac{1}{2}}\right) \sin(x) + \sqrt{\pi} \cdot \cos(\pi) = -\sqrt{\pi}$$

9. Suppose that  $f(x) = \frac{6x + \cos x}{x + \sin x}$ . Evaluate f'(x) and f'(3).

$$f(x) = \frac{(x + \sin x)(b - \sin x) - (bx + \cos x)(1 + \cos x)}{(x + \sin x)^2}$$

(a) Find the slope of the tangent line to f(x) at x = 2.

$$M = f'(2) = 3.$$
 (rounding)

- (b) Find the instantaneous rate of change of f(x) at x = 2.
- (c) Find the equation of the tangent line to f(x) at x = 2.  $y y_1 = m(x x_1)$   $(x_1 y_1) = (2_1 y_1)$   $y y_2 = 3(x y_2)$

10. A bungee jumper's height in feet above the river is given by 
$$f(t) = 876e^{-.17}\cos(-.05x)$$
 where  $t$  is the number of seconds after jumping. Compute the velocity of the jumper at the following times:  $t = 1, t = 19, t = 60$ .