

Name: \_\_\_\_\_  
AP Calc AB: Linear Approximations

Date: \_\_\_\_\_  
Ms. Loughran

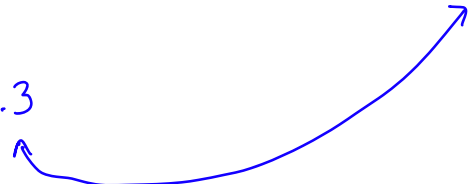
**Do Now**

- Given  $f(x) = x^3$ 
  - Write an equation for the line tangent to the curve at  $x = 1$
  - Using the equation in (a) estimate  $f(1.1)$ .
  - Evaluate  $f(1.1)$  using your calculator.
  - Compare your findings in (b) and (c), what do you notice?

a)  $f'(x) = 3x^2$  very close  
 $f'(1) = 3$   
 $f(1) = 1$   
 $y - 1 = 3(x - 1)$

b)  $y - 1 = 3(1.1 - 1)$   
 $y = 3(1.1 - 1) + 1 = 1.3$

c)  $f(1.1) = (1.1)^3 = 1.331$



**Tangent line approximation:**

To calculate the tangent line at a point  $(a, f(a))$  we first have to find the derivative at  $a$ ,  $f'(a)$ , then use our point slope formula

$$y - f(a) = f'(a)(x - a)$$

The tangent line approximates the graph of  $f(x)$  near  $x = a$ . Basically it is helping us approximate any function which could be very complicated using a linear function which is very easy to work with.

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Consider the curve defined by  $-8x^2 + 5xy + y^3 = -149$ .

- (a) Find  $\frac{dy}{dx}$ .
- (b) Write an equation for the line tangent to the curve at the point  $(4, -1)$ .
- (c) There is a number  $k$  so that the point  $(4.2, k)$  is on the curve. Using the tangent line found in part (b), approximate the value of  $k$ .
- (d) Write an equation that can be solved to find the actual value of  $k$  so that the point  $(4.2, k)$  is on the curve.
- (e) Solve the equation found in part (d) for the value of  $k$ .

$$-16x + 5x \frac{dy}{dx} + 5y + 3y^2 \frac{dy}{dx} = 0$$

$$5x \frac{dy}{dx} + 3y^2 \frac{dy}{dx} = 16x - 5y$$

$$\frac{dy}{dx} = \frac{16x - 5y}{5x + 3y^2}$$

$$b) \left. \frac{dy}{dx} \right|_{(4, -1)} = \frac{16(4) - 5(-1)}{5(4) + 3(-1)^2} = \frac{69}{23} = 3$$
$$y + 1 = 3(x - 4)$$

$$c) k + 1 = 3(4.2 - 4)$$

$$k + 1 = .6$$

$$k = -.4$$

$$d) -8(4.2)^2 + 5(4.2)k + k^3 = -149$$

$$k = -.373$$