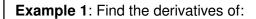
## **Derivative Rules**

## Part 1: The Power Rule



a.) f(x) = 1 (graphically)

b.) g(x) = x (graphically)

c.)  $h(x) = x^2$  (using the definition)

d.)  $i(x) = x^3$  (using the definition)

e.)  $j(x) = x^n$  (following the pattern from above)

Derivative Rule: The power rule

If  $f(x) = x^n$ , where *n* is a real number, then  $f'(x) = n \cdot x^{n-1}$ 

**Example 2**: Find the derivatives of:

- a.)  $f(x) = x^4$
- b.)  $g(x) = x^{-4}$

**Notation**: We use a number of notations to refer to the derivative of y = f(x). They are, but not limited to:

- 1.) f'(x), read "f prime of x" or "the derivative of f with respect to x"
- 2.) f', read, "f prime"

- 3.) y', read, "y prime" 4.)  $\frac{dy}{dx}$ , read, "dy dx" or "dy by dx." 5.)  $\frac{d}{dx} f(x)$  or  $\frac{d}{dx} f$ , read "ddx of f of x" or "ddx of f"

## **Example 3**: Find the derivatives of:

a.) 
$$y = x^{\frac{2}{3}}$$

b.) 
$$\frac{d}{dx} \sqrt{x}$$

c.) If 
$$y = \frac{1}{\sqrt[3]{x}}$$
, find  $\frac{dy}{dx}$ .

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<b>Example 4</b> : Find the equation of the tangent line to $y = x^2$ when $x = 3$
Example 5: Derivatives with constants. Does the power rule still apply?
Find the derivative of $y = \pi x^7$ .

Derivative Rule: The coefficient rule

If  $f(x) = c \cdot u(x)$  where c is a constant and u(x) is a differentiable function of x, then  $f'(x) = c \cdot u'(x)$ .

Example 6: Find:

a.) 
$$\frac{d}{dx} 7 \sqrt[4]{x}$$

b.) 
$$(4 x^5)'$$

c.) If 
$$n = \frac{5}{v^{\frac{2}{3}}}$$
, find  $\frac{dn}{dv}$ 

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Derivative Rule: sums and differences
If $f(x) = u(x) \pm v(x)$ , where $u$ and $v$ are differentiable functions if $x$ , then $f'(x) = u'(x) \pm v'(x)$ .
□ <u>proof</u> .

## Part 2: Applications

**Example 7**: Suppose the revenue from the sale of x items is modeled by  $R(x) = 300 \ x - 0.02 \ x^2$ .

a.) Find  $\overline{MR}$  when x = 40.

b.) Interpret the result from part (a.).

**Example 8**: Suppose the cost from the sale of x items is  $C(x) = 40500 + 190 x + 0.2 x^2$ .

a.) Find the average cost function  $\overline{C}(x) = \frac{C(x)}{x}$ 

b.) Find the instantaneous ROC of the average cost function.

c.) When does the instantaneous ROC of the average cost function (from (b.)) equal zero?

d.) Find  $\overline{MC}(x)$  and  $\overline{C}(x)$  at the zero found in (c.).