

3.3 Rules For Differentiation

It would be time consuming and tedious if we had to always compute derivatives from the definition of a derivative.

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

$$\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$$

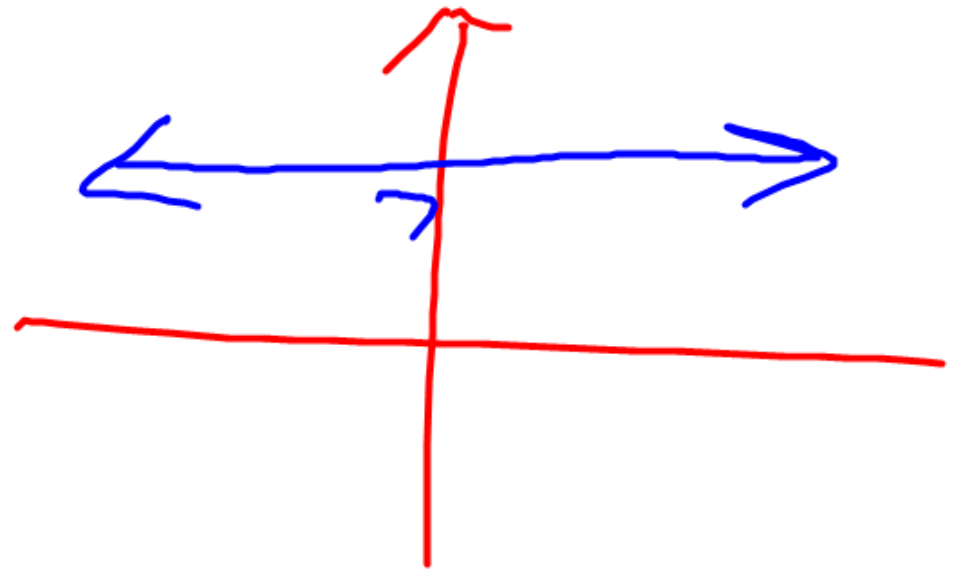
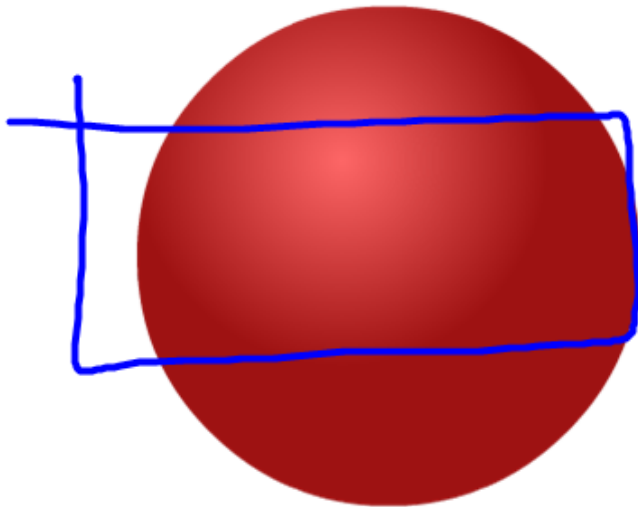
1. Constant Rule

If f is a constant function, $f(x) = c$,
then $f'(x) = 0$.

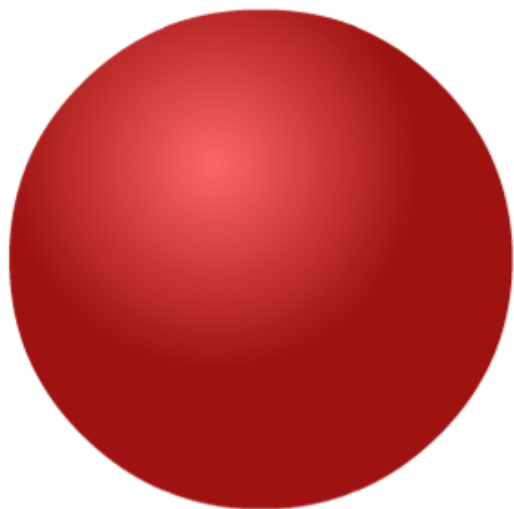
$$\frac{d(c)}{dx} = 0$$

Ex. 1 Differentiate the following:

$$a) f(x) = 7$$



$$b) y = \pi$$



$$c) \frac{d}{dx} (-4.5)$$

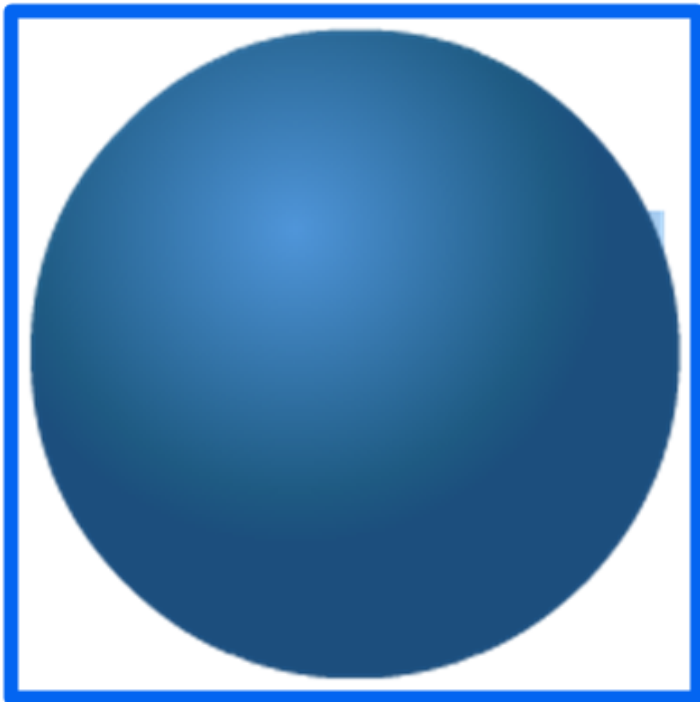
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2. Power Rule

If $f(x) = x^n$, where n is a positive integer, then $f'(x) = nx^{n-1}$.

Ex.2 Find the derivative of the following:

$$a) f(x) = x^7$$



$$b) y = x^{100}$$



$$c) \frac{d}{du} (u^9)$$



Ex.3 Find the **equation** of the **tangent line** to the curve $y = x^6$ at the point $(-2, 64)$.

$$m = y' = 6x^5$$

$$y'(-2) = 6(-2)^5$$
$$= 6(-32)$$

$$y'(-2) = -192$$

$$y - y_1 = m(x - x_1)$$

$$y - 64 = -192(x + 2)$$

$$y - 64 = -192x - 384$$

$$y = -192x - 320$$

3. General Power Rule

If n is any real number, then

$$\frac{d(x^n)}{dx} = nx^{n-1}$$

Ex.4 Differentiate

$$a) f(x) = \frac{1}{x^3}$$

$$\begin{aligned} a) f(x) &= x^{-3} \\ f'(x) &= -3x^{-4} \\ &= \frac{-3}{x^4} \end{aligned}$$

$$b) y = \sqrt{x}$$

$$\begin{aligned} y &= x^{1/2} \\ y' &= \frac{1}{2} x^{-1/2} \\ &= \frac{1}{2x^{1/2}} \\ &= \frac{1}{2\sqrt{x}} \end{aligned}$$

4. Constant Multiple Rule

If $g(x) = cf(x)$, then
 $g'(x) = cf'(x)$.

Ex.5 Differentiate

$$a) f(x) = 8x^3$$

$$f' = 24x^2$$

$$b) y = 6x^{\frac{8}{3}}$$



$$y' = \frac{48}{3} x^{\frac{5}{3}}$$
$$= 16 x^{\frac{5}{3}}$$

<http://www.mathtv.com/>

Ex.6 At what **points** on the hyperbola $xy = 12$ is the tangent line parallel to the line **$3x + y = 0$** .

$$y = \frac{12}{x}$$

$$y = 12x^{-1}$$

$$y' = -12x^{-2}$$

$$y' = \frac{-12}{x^2}$$

$$\begin{aligned} \hookrightarrow y &= -3x \\ m &= -3 \end{aligned}$$

$$-3 = \frac{-12}{x^2}$$

$$-3x^2 = -12$$

$$x^2 = 4$$

$$x = \pm 2$$

Find y coordinate

$$y = \frac{12}{x}$$

$$y = \frac{12}{2}$$

$$y = 6$$

$$(2, 6)$$

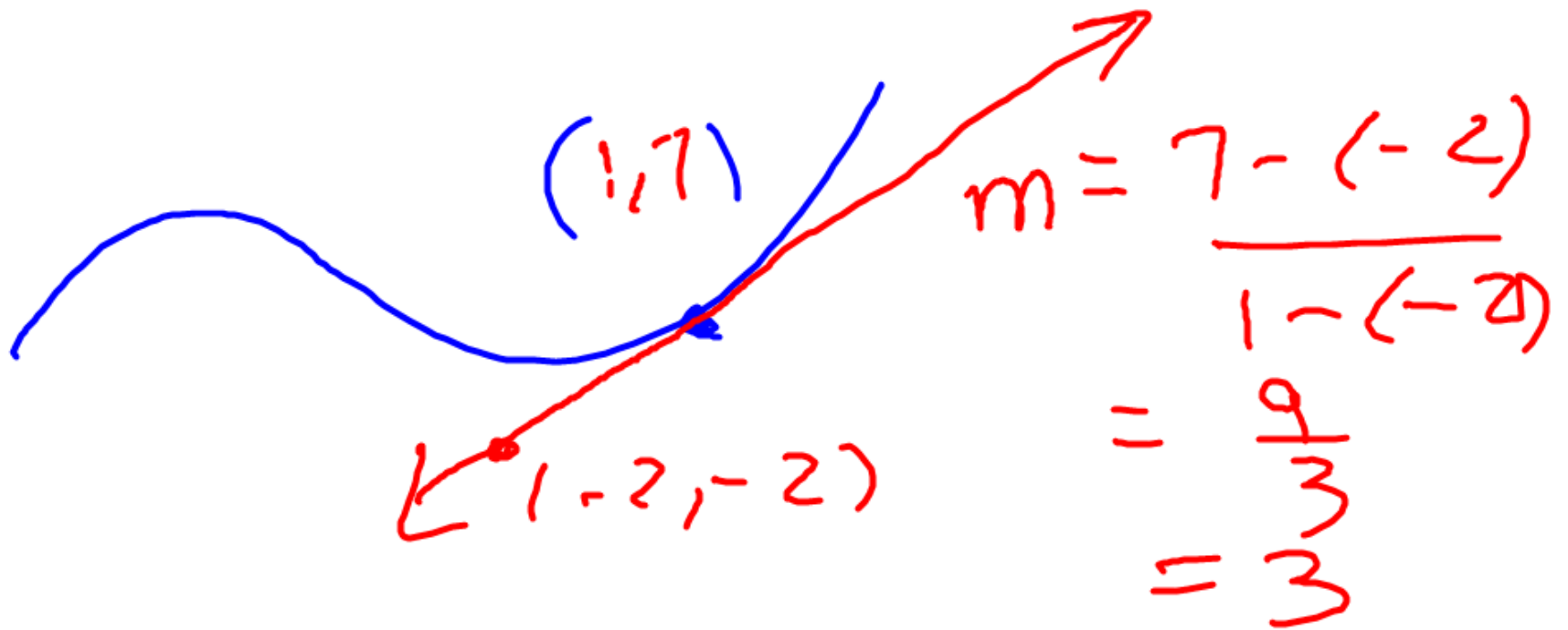
$$y = \frac{12}{-2}$$

$$y = -6$$

$$(-2, -6)$$

16. If the line tangent to the graph of the function f at the point $(1, 7)$ passes through the point $(-2, -2)$, then $f'(1)$ is

- (A) -5 (B) 1 (C) 3 (D) 7 (E) undefined



Assignment
Handout
#s 1,2,3,4,7,8