2.2 Basic Differentiation Rules

*AKA "Short Cut Rules"

THEOREM 2.2 The Constant Rule

The derivative of a constant function is 0. That is, if c is a real number, then

$$\frac{d}{dx}[c] =$$

ex: Differentiate.

$$y = 234897\pi$$

THEOREM 2.3 The Power Rule

If n is a rational number, then the function $f(x) = x^n$ is differentiable and

$$\frac{d}{dx}[x^n] =$$

ex: Differentiate.

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

b) $f(x) = x^{20}$

ex: Differentiate.

c) $g(x) = \frac{1}{x}$

d) $h(x) = \sqrt{x}$

e) $y = \frac{1}{\sqrt{x}}$

THEOREM 2.4 The Constant Multiple Rule

If f is a differentiable function and c is a real number, then cf is also differentiable and

$$\frac{d}{dx}[cf(x)] =$$

ex: Differentiate.

a) $y = 30x^7$

b) $g(x) = \dfrac{4}{\sqrt[3]{x}}$

ex: Differentiate.

c) $g(x) = \pi$

d) $m(x) = 4x$

THEOREM 2.5 The Sum and Difference Rules

The sum (or difference) of two differentiable functions f and g is itself differentiable. Moreover, the derivative of $f + g$ (or $f - g$) is the sum (or difference) of the derivatives of f and g.

$$\frac{d}{dx}[f(x) + g(x)] =$$

$$\frac{d}{dx}[f(x) - g(x)] =$$

ex: Differentiate.

a) $y = 3x^4 - 2x + \pi$

ex: Differentiate.

b) $f(x) = \pi^2 + \frac{1}{\pi} + \sqrt{\pi}$

c) $s(x) =$

THEOREM 2.6 Derivatives of Sine and Cosine Functions

$$\frac{d}{dx}[\sin x] = \qquad \frac{d}{dx}[\cos x] =$$

ex: Differentiate.

a) $y = 4\cos x - 2\sin x + 3$

THEOREM 2.7 Derivative of the Natural Exponential Function

$$\frac{d}{dx}[e^x] =$$

ex: Differentiate.

a) $y = 3e^x$

ex: Differentiate.

b) $y = x^2 - e^x$

c) $f(x) = \cos x + 5e^x$

ex: Differentiate.

d) $y = x\left(x^2 + 5\right)$

ex: Differentiate.

d) $f(x) = \dfrac{x^2 + 5}{x}$

ex: Find the slope at the given point.

a) $f(x) = -5x^4 - 2x^3 + 3\pi, \quad x = -1$

ex: Find the slope at the given point.

b) $g(x) = -e^x, \quad x = 0$

ex: Write an equation of the tangent line at the given point.

a) $y = \cos x, \quad x = \dfrac{3\pi}{4}$

ex: Write an equation of the tangent line at the given point.

b) $f(x) = 3 - \frac{3}{5x}, \quad x = \frac{3}{5}$

ex: Find all points, if any, at which f(x) has a horizontal tangent line.

a) $f(x) = \sin x, \quad [0, 2\pi)$

ex: Find all points, if any, at which f(x) has a horizontal tangent line.

b) $y = e^x - 2$

ex: Find an equation of a line that is tangent to $f(x) = 5x^2 + 3$ and parallel to $5x - y = 4$.

ex: Find the value of k such that the line $y = x + 4$ is tangent to $f(x) = k\sqrt{x}$.