Calc BC Section 3.2 Notes

Warm Up 1. Find the derivative of $y = x^3 + x$ using the definition of the derivative.

2. Find the numical derivative of $f(x) = 4x - x^2$ at $x = 1$ use $h = .001$ and use the symmetric difference quotient

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Rules for Differentiation

→ Derivative of a constant. If c is a constant

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

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

Ex: $\frac{d}{dx}(x^3) = 3x^2$

$\frac{d}{dx}(x^5) = 5x^2$

→ Constant multiple $\quad \frac{d}{dx}(cu) = c\frac{du}{dx}$

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Ex

$$\frac{d}{dx}\left(5x^3\right) = 5\left(\frac{d}{dx}x^3\right) =$$

$$= 5\left(3x^2\right) = 15x^2$$

$$\frac{d}{dx}\left(8x^4\right) = 32x^3$$

Ex If $f'(x) = 13x$ · Find $\frac{d}{dx}\left(2f(x)\right)$

$$\frac{d}{dx}\left(2f(x)\right) = 2f'(x) = 2(13x) = \boxed{26x}$$

Sum and Difference

$$\frac{d}{dx}\left[f(x) \pm g(x)\right] = f'(x) \pm g'(x$$

Ex

$$\frac{d}{dx}\left[5x^3 + 2x^2 - 3x\right] =$$

$$\boxed{15x^2 + 4x - 3}$$

Finding a horizontal tangent

Ex: Find the x-value of the horizontal tangents for

$$f(x) = 4x^3 + 6x^2$$

Product Rule (1st)(d of 2nd) + (2nd)(d of 1

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$$

Ex: Find the derivative of

$$F(x) = (x^3 + 3x)(x^2 + 1)$$

Quotient Rule

$$\frac{d}{dx}\left[\frac{u}{v}\right] = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

Higher Order Derivatives

Ex: Find the derivative

$$\frac{d}{dx}\left[\frac{x^3}{x^2+3x}\right] = \frac{(x^2+3x)(3x^2)-x^3(2x+3)}{(x^2+3x)^2}$$

$$= \frac{3x^4+9x^3-2x^4-3x^3}{(x^2+3x)}$$

$$= \boxed{\frac{x^4+6x^3}{x^2+3x}}$$

Ex: Find the derivative of $y = 3x^2+2x$

graph the derivative you found and use the calculator to find the graph of the derivative

Higher order derivatives

1st	$\frac{dy}{dx}$	$f'(x)$, y'
2nd	$\frac{d^2y}{dx^2}$	$f''(x)$, y''
3rd	$\frac{d^3y}{dx^3}$	$f'''(x)$, y'''