

## The Product and Quotient Rules

w-up: AP Multiple Choice #20, 24, 25(all non-calculator)

### Product Rule

To find the derivative of the PRODUCT of two functions:

$$\frac{dy}{dx} [f(x) \cdot g(x)] = f(x) \cdot g'(x) + f'(x) \cdot g(x)$$

**Note:** not needed for a product when one of the terms is a constant(see properties of derivatives from section 2.2)

EX) Find the derivative of each function

A)  $f(x) = (2x^2 + 1)(3x^3 - 4x + 10)$       B)  $f(x) = x \sin x$

### Quotient Rule

To find the derivative of the Quotient of two functions:

$$\frac{dy}{dx} \left[ \frac{f(x)}{g(x)} \right] = \frac{g(x) \cdot f'(x) - f(x) \cdot g'(x)}{[g(x)]^2}$$

**NOTE: ORDER MATTERS**

EX) Find the derivative of each function

A)  $f(x) = \frac{x-1}{x+2}$       B)  $f(x) = \frac{5x^2}{x+4}$       C)  $f(x) = \frac{\sin x}{\cos x}$

Since the reciprocal functions are all rational functions, all of their derivatives can be found using the quotient rule!

### Derivatives of the "other" trigonometric functions

$$\frac{dy}{dx} \tan x = \sec^2 x$$

$$\frac{dy}{dx} \cot x = -\csc^2 x$$

$$\frac{dy}{dx} \sec x = \sec x \tan x$$

$$\frac{dy}{dx} \csc x = -\csc x \cot x$$

EX) Find the derivative of each function

A)  $f(x) = 3x \cot x$

B)  $f(x) = \sin x \bullet \csc x$

NOTE: You may use basic identities to simplify trigonometric expressions before or after differentiation. But, **BEFORE** is preferred!

### AP QUESTION

Given:  $f(x) = (1, 2), (2, 5)$  and  $g(x) = (0, -3), (1, 5)$

Assuming  $f(x)$  and  $g(x)$  are linear functions, find  $P'(1)$  if  $P(x) = f(x) \bullet g(x)$