Name: _____

1. Find the derivative of each function.

a) $y = 3x^2 \, e^x$

b) $y = \sin x - \cos x$

c) $y = \dfrac{\sin x}{4x^2}$

d) $y = 12 \sin x + 4e^x$

e) $y = 2 \sin x \, e^x + x^2$

2. Find the derivative of each function in the chart below using the product rule. What pattern do you notice?

function	derivative	function	derivative
$y = e^x$		$y = (e^x)^2$	
$y = \sin x$		$y = \sin^2 x$	
$y = \ln x$		$y = (\ln x)^2$	
$y = \cos x$		$y = \cos^2 x$	
$y = e^x$		$y = (e^x)^3$	
$y = \sin x$		$y = \sin^3 x$	
$y = \ln x$		$y = (\ln x)^3$	
$y = \cos x$		$y = \cos^3 x$	
$y = e^x$		$y = (e^x)^4$	
$y = \sin x$		$y = \sin^4 x$	
$y = \ln x$		$y = (\ln x)^4$	
$y = \cos x$		$y = \cos^4 x$	

What pattern do you notice?

This rule is called the **chain rule.** Let's use some simplifiable functions to show it works.

3. Find the derivative of each function by **simplifying (i)** and then **using the chain rule (ii)**.

a) $(x + 3)^2$
   i. Simplify and take the derivative

   ii. Use the chain rule

b) $(5x)^3$
   i. Simplify and take the derivative

   ii. Use the chain rule

c) $(3x^4)^3$
   i. Simplify and take the derivative

   ii. Use the chain rule

d) $(2x + 4)^2$
   i. Simplify and take the derivative

   ii. Use the chain rule

e) $\dfrac{1}{8x^4}$
   i. Simplify and take the derivative

   ii. Use the chain rule

f) $\sqrt{16x^4}$
   i. Simplify and take the derivative

   ii. Use the chain rule