## SECTION 3.4 THE CHAIN RULE

1. For each function H(x) below, write it as a (nontrivial) composition of functions in the form f(g(x)).

(b)  $H(x) = e^{2-2x}$ (a)  $H(x) = \tan(2 - x^4)$  $f(x) = e^{x}$ g(x) = 2 - 2xf(x) = tanx $g(x) = 2 - x^4$ 

2. Complete the Chain Rule (using both types of notation)

• If 
$$F(x) = f(g(x))$$
,  
then  $F'(x) = \left[ f'(g(x)) \right] \left[ g'(x) \right]$   
then  $\frac{dy}{dx} = \frac{dy}{dx} \cdot \frac{du}{dx}$ 

3. Find the derivative of the function. You do not need to simplify your answer.

(a) 
$$y = \sqrt[3]{4 - 2x} = (4 - 2x)^{3}$$
  $f = x^{3}$   $g = 4 - 2x$   
 $y' = \frac{1}{3}(4 - 2x)^{-2/3}(-2) = -\frac{2}{3}(4 - 2x)^{3}$ 

(b) 
$$f(x) = 0.04 \sin(3x + e^x)$$
  
 $f'(x) = (0.04) (\cos(3x + e^x)) (3 + e^x)$ 

(c)  $x(t) = \frac{e^{-\pi t/10}}{100}$  (**Don't** use the quotient rule here!)  $X(t) = \frac{1}{100} e^{(\frac{\pi}{2})t^2}$  $\chi'(t) = \frac{1}{100} \left( \frac{-\pi t^2}{e^{\pi t^2}} \right) \left( \frac{-\pi t^2}{102} \right) = \frac{-\pi}{500} e^{\pi t^2}$ 

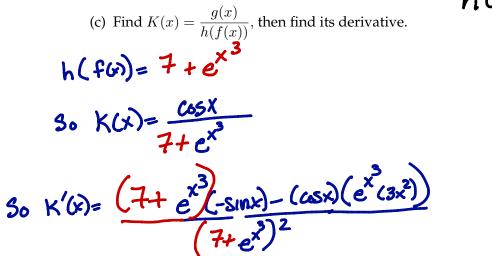
(d)  $g(x) = \frac{50\sqrt{2}}{x + \tan x}$  (**Don't** use the quotient rule here!)  $g(x) = 50\sqrt{2}(x+\tan x)$  $q'(x) = (50Vz)(-1)(x+tanx)(1+sec^2x)$ 

4. Suppose that  $f(x) = x^3$ ,  $g(x) = \cos(x)$  and  $h(x) = 7 + e^x$ . (a) Find F(x) = f(x) (g(h(x))), then find its derivative.  $F(x) = x^3 \cos(7 + e^x)$   $F'(x) = 3x^2 \cos(7 + e^x) + x^3 (-\sin(7 + e^x)) (e^x)$   $= 3x^2 \cos(7 + e^x) - x^3 e^x \sin(7 + e^x)$ 

(b) Find G(x) = f(g(x)h(x)), then find its derivative.  $g(x)h(x) = (cosx)(7+e^{x}) = 7cosx + e^{x}cosx$   $G(x) = (7cosx + e^{x}cosx)^{3}$   $G'(x) = 3(7cosx + e^{x}cosx)^{2}(-7sinx + e^{x}cosx - e^{x}sinx)$  $= 3(e^{x}cosx - (7+e^{x})sinx)(7cosx + e^{x}cosx)^{2}$ 

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 $h(x) = 7 + \rho^{X}$ 



(d) Find G(x) = f(g(h(x))), then find its derivative.

 $G(x) = (cos(7+e^{x}))^{3}$  $G'(x) = 3(\cos(7+e^{x}))^{2}(-\sin(7+e^{x}))(e^{x})$ =  $-3e^{x}\sin(7+e^{x})[\cos(7+e^{x})]^{2}$