Name_____ Date_____ Period_____

Worksheet 4.4—Product & Quotient Rules

Show all work. No calculator unless otherwise stated.

1. State the Product Rule: $\dfrac{d}{dx}[f(x)g(x)]=$

2. State the Quotient Rule: $\dfrac{d}{dx}\left[\dfrac{f(x)}{g(x)}\right]=$

3. Find the derivative of each. Show all steps, including rewriting and **simplifying** (except part (e)).

(a) $f(x)=(6x+5)(x^3-3)$

(b) $h(t)=2t\sin t+t^2\cos t$

(c) $f(x)=2x^2\cot x$

(d) $f(x)=\dfrac{x+\tan x}{\sin x+1}$

(e) $f(x)=\left(\dfrac{x^2-x-3}{x^2+1}\right)(x^2+x+1)$

(f) $f(x)=\tan x\sin x$

(g) $f(x)=\dfrac{x}{x^2+1}$

(h) $f(x)=\dfrac{\cos x}{x^2}$

(i) $h(x)=\csc^2 x$

7. Find the equation of the tangent lines to the graph of $y = \dfrac{x+1}{x-1}$ that are parallel to the line $2y + x = 6$.

8. If $f(x) = \dfrac{3x}{x+2}$ and $g(x) = \dfrac{5x+4}{x+2}$, verify that $f'(x) = g'(x)$, and explain the relationship between f and g.

9. The radius of a right circular cylinder is given by $\sqrt{t+2}$ and its height is $\dfrac{\sqrt{t}}{2}$, where t is time in seconds and the dimensions are in inches. (Note: $V = \pi r^2 h$)

   (a) Find an equation for the volume, $V(t)$, of the right circular cylinder as a function of time.

   (b) Find the rate of change of volume with respect to time.

10. Determine whether there exist any values of x in the interval $[0, 2\pi)$ such that the rate of change of $f(x) = \sec x$ and the rate of change of $g(x) = \csc x$ are equal.

11. Sketch the graph of a differentiable function f such that $f(2) = 0$, $f' < 0$ for $x < 2$, and $f' > 0$ for $x > 2$

12. If $g(2) = 3$, $g'(2) = -2$, $h(2) = -1$, and $h'(2) = 4$, find $f'(2)$ for

(a) $f(x) = 2g(x) + h(x)$ (b) $f(x) = 4 - h(x)$ (c) $f(x) = \dfrac{g(x)}{h(x)}$ (d) $f(x) = 2g(x)h(x)$