Name: ____________________________________

- There are 12 points possible on this proficiency, one point per problem. **No partial credit will be given.**
- You have 1 hour to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- Correct parenthesization is required.
- Your final answers **must start with** $f'(x) =$, $dy/dx =$, or similar.
- **Circle or box your final answer.**

1. [12 points] Compute the derivatives of the following functions.

a. $g(\theta) = e^{\theta}\tan(\theta)$

$$g'(\theta) = e^{\theta}\cdot\tan(\theta) + e^{\theta}\sec^2\theta$$

b. $h(x) = \csc(x^3)$ $= (\sin(x^3))^{-1}$

or

$$h'(x) = -\csc(x^3)\cot(x^3)(3x^2)$$

$$h'(x) = (-1)(\sin(x^3))^{-2}(\cos(x^3))(3x^2)$$

c. $f(x) = \dfrac{5x}{3} + \dfrac{5}{3x^2} - \dfrac{\pi^2}{3}$ $= \dfrac{5}{3}x + \dfrac{5}{3}x^{-2} - \pi^2/3$

$$f'(x) = \frac{5}{3} - \frac{10}{3}x^{-3}$$

d. $f(x) = x\arctan(x)$

$$f'(x) = 1 \cdot \arctan(x) + x\left(\frac{1}{1+x^2}\right)$$

$$= \arctan(x) + \frac{x}{1+x^2}$$

e. $y = (x^{0.3}+3)^{-1/5}$

$$y' = -\frac{1}{5}(x^{0.3}+3)^{-6/5}(0.3x^{-0.7})$$

f. $f(t) = \sqrt{t^2+\sin^2(t)}$ $= \left(t^2 + (\sin t)^2\right)^{1/2}$

$$f'(t) = \frac{1}{2}\left(t^2 + (\sin(t))^2\right)^{-1/2}\left(2t + 2\sin(t)\cos(t)\right)$$

g. $g(x) = \dfrac{x^2+2}{6} + \ln(8+\cos(x))$

$$g'(x) = \frac{2}{6}x + \frac{1}{8+\cos(x)}\left(-\sin(x)\right)$$

h. $f(x) = \dfrac{\sin(\pi/x)}{x^3+x}$ $= \dfrac{\sin(\pi x^{-1})}{x^3+x}$

$$f'(x) = \frac{(x^3+x)(\cos(\pi x^{-1})(-\pi x^{-2}) - (3x^2+1)(\sin(\frac{\pi}{x}))}{(x^3+x)^2}$$

i. $y = \ln(9) + e^{x^2} + \sec(5x)$

$$y' = 2xe^{x^2} + 5\sec(5x)\tan(5x)$$

j. $f(x) = \sqrt{2}\cos(1+e^{-Nx})$ (Assume N is a fixed positive constant.)

$$f'(x) = -\sqrt{2}\sin(1+e^{-Nx})\left(e^{-Nx}(-N)\right)$$

$$= \sqrt{2}\,N e^{-Nx}\sin(1+e^{-Nx})$$

k. $j(x) = \dfrac{x\ln(x) - \sqrt{x}}{x} = \ln(x) - x^{-1/2}$

$$j'(x) = \frac{1}{x} + \frac{1}{2}x^{-3/2}$$

l. Find $\dfrac{dy}{dx}$ for $\quad 1 + xe^y = x^3 + y^2$

$$1\cdot e^y + xe^y\frac{dy}{dx} = 3x^2 + 2y\frac{dy}{dx}$$

$$(xe^y - 2y)\left(\frac{dy}{dx}\right) = 3x^2 - e^y$$

$$\frac{dy}{dx} = \frac{3x^2 - e^y}{xe^y - 2y}$$