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

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

b. $g(\theta) = e^\theta \tan(\theta)$

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

c. $h(x) = \csc(x^2)$ $= (\sin(x^2))^{-1}$

or

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

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

d. $y = (x^{0.2}+3)^{-2/5}$

$$y' = \left(\frac{-2}{5}\right)\left(x^{0.2}+3\right)^{-7/5}\left(0.2x^{-0.8}\right)$$

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

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

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

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

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

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

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

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

$$y' = 2xe^{x^2} + 9\sec(9x)\tan(9x)$$

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

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

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

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

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

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

$$= \sqrt{2}Ke^{-Kx}\sin(1+e^{-Kx})$$

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

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

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

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