Name: ______________________________

- There are 12 points possible on this proficiency, one point per problem. **No partial credit will be given.**
- A passing score is 10/12.
- You have one hour to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- 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. $f(x) = \dfrac{1}{2x} + \sqrt{2x}$ $= \frac{1}{2} x^{-1} + \sqrt{2}\, x^{1/2}$

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

b. $f(x) = a^{\sin(x)}$ where a is a constant, $a > 1$

$f'(x) = (\ln a) a^{\sin(x)} (\cos(x))$

c. $f(x) = \sqrt{x + \ln(2x)}$ $= (x + \ln(2x))^{1/2}$

$f'(x) = \frac{1}{2}(x + \ln(2x))^{-1/2}\left(1 + \frac{2}{2x}\right)$

d. $f(x) = 1 - x^2 + \sin(1.7x)$

$$f'(x) = -2x + 1.7\cos(1.7x)$$

e. $y = \sin^{-1}(\sqrt{x})$

$$y' = \frac{1}{\sqrt{1-x}}$$

f. $f(x) = \sec\left(\dfrac{x}{x+1}\right)$

$$f'(x) = \sec\left(\frac{x}{x+1}\right)\tan\left(\frac{x}{x+1}\right)\left[\frac{(x+1)(1) - x(1)}{(x+1)^2}\right]$$

g. $f(x) = \sqrt{1+x^3} = (1+x^3)^{1/2}$

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

h. $f(x) = \frac{e^x}{x^3} = x^{-3}e^x$

$f'(x) = -3x^{-4}e^x + x^{-3}e^x$

OR quotient rule

$f'(x) = \frac{x^3e^x - e^x(3x^2)}{x^6} = \frac{e^x(x^3-3x^2)}{x^6}$

i. $f(x) = \left(\ln(x^2+e^2)\right)^5$

$f'(x) = 5\left(\ln(x^2+e^2)\right)^4\left(\frac{1}{x^2+e^2}\right)(2x)$

$= \frac{10x\left(\ln(x^2+e^2)\right)^4}{x^2+e^2}$

j. $f(x) = \dfrac{x\ln(x)}{2}$

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

k. $f(x) = e^{\pi x+1} + \sqrt{3}\tan(\pi x)$

$$f'(x) = \pi e^{\pi x+1} + \sqrt{3}\,\pi \sec^2(\pi x)$$

l. Find $\dfrac{dy}{dx}$ for $2x + y = \cos(xy)$. You must solve for $\dfrac{dy}{dx}$.

$$2 + \frac{dy}{dx} = -\sin(xy)\left(1\cdot y + x\cdot\frac{dy}{dx}\right)$$

$$\frac{dy}{dx}\left(1 + x\sin(xy)\right) = -y\sin(xy) - 2$$

$$\frac{dy}{dx} = \frac{-y\sin(xy) - 2}{1 + x\sin(xy)}$$