Name: Solutions ______ / 12

- There are 12 points possible on this proficiency: one point per problem with no partial credit.
- You have 30 minutes to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- Your final answers should start with $f'(x) =$, $dy/dx =$ or something similar.
- Circle your final answer.

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

a. $f(x) = \dfrac{\cos(x)}{\sin(x)} = \cot x$

$f'(x) = -\csc^2 x$

b. $f(x) = e^{x-1} + 4\pi + \dfrac{6^{2/3}}{x^{2/3}} = e^{x-1} + 4\pi + 6^{2/3} x^{-2/3}$

$f'(x) = e^{x-1} + 6^{2/3}\left(-\frac{2}{3}x^{-5/3}\right)$

c. $f(x) = (x - x^7)\cos(x)$

$f'(x) = (1-7x^6)(\cos x) + (x - x^7)(-\sin x)$

d. $f(t) = \dfrac{t\sqrt{t} - 8\sqrt{t} + 1}{\sqrt{t}} = t - 8 + t^{-1/2}$

$$f'(t) = 1 - \frac{1}{2} t^{-3/2}$$

e. $f(x) = \dfrac{\tan(x)}{1 + e^{-12x}}$

$$f'(x) = \frac{(1 + e^{-12x})(\sec^2 x) - \tan x\,(-12 e^{-12x})}{(1 + e^{-12x})^2}$$

f. $f(x) = 3^x \cos(3x)$

$$f'(x) = (\ln 3) 3^x \cos(3x) + 3^x(-\sin(3x))3$$

$$= 3^x \left[(\ln 3)(\cos(3x)) - 3\sin(3x)\right]$$

g. $f(x) = \frac{1}{2x} + \left(\frac{\pi(x+1)}{5}\right)^3 = \frac{1}{2}x^{-1} + \left(\frac{\pi}{5}(x+1)\right)^3$

$$f'(x) = -\frac{1}{2}x^{-2} + 3\left(\frac{\pi}{5}(x+1)\right)^2\left(\frac{\pi}{5}\right)$$

h. $f(t) = t^q \ln(ct+1)$

$$f'(t) = \left(qt^{q-1}\right)\left(\ln(ct+1)\right) + t^q \cdot \left(\frac{c}{ct+1}\right)$$

i. $f(x) = \sin\left(\frac{e^x}{x}\right) = \sin\left(x^{-1}e^x\right)$

$$f'(x) = \cos\left(x^{-1}e^x\right)\left[-x^{-2}e^x + x^{-1}e^x\right]$$

j. $f(t) = \ln(x + \sec^2(x))$

$$f'(t) = \frac{1 + 2\sec x \sec x \tan x}{x + \sec^2 x}$$

k. $f(z) = \arcsin\left(\frac{2}{z}\right) = \arcsin(2z^{-1})$

$$f'(z) = \frac{1}{\sqrt{1-(2z^{-1})^2}} \cdot \left(-2z^{-2}\right)$$

l. Compute dy/dx if $e^y + \sin x = \ln(5) - xy$. You must solve for dy/dx.

$$e^y \frac{dy}{dx} + \cos x = -y - x\frac{dy}{dx}$$

$$\frac{dy}{dx}\left(e^y + x\right) = -y - \cos x$$

$$\frac{dy}{dx} = \frac{-(y + \cos x)}{e^y + x}$$