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. $f(x) = \pi x^{1/8} + 7e^x + \sqrt{5}$

$$\boxed{f'(x) = \frac{\pi}{8} x^{-7/8} + 7e^x}$$

b. $f(t) = \frac{t^3 - t^{\frac{3}{2}} + 1}{\sqrt{t}}$

$$f(t) = t^{5/2} - t + t^{-1/2}$$

$$\boxed{f'(t) = \frac{5}{2} t^{3/2} - 1 - \frac{1}{2} t^{-\frac{3}{2}}}$$

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

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

d. $f(x) = \dfrac{\sin(x)}{1+e^{-3x}}$

$$\boxed{f'(x) = \frac{\cos(x)\left(1+e^{-3x}\right) + 3\sin(x)e^{-3x}}{\left(1+e^{-3x}\right)^2}}$$

e. $f(x) = \dfrac{1}{\sin(x)}$

$$f'(x) = \boxed{\frac{-\cos(x)}{\sin^2(x)}} = \boxed{-\cot(x)\csc(x)}$$

either is acceptable

f. $f(t) = t\ln(at)$

$$f'(t) = \ln(at) + t\,\frac{1}{at}\cdot a$$

$$= \boxed{\ln(at) + 1}$$

g. $f(x) = \tan(x)x^{\frac{1}{2}}e^{3x}$

$$\boxed{f'(x) = \sec^2(x)\,x^{1/2}e^{3x} + \tan(x)\,\frac{1}{2}x^{-1/2}e^{3x} + 3\tan(x)\,x^{1/2}e^{3x}}$$

h. $f(z) = \arctan(\sqrt{z})$

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

$$= \boxed{\frac{1}{2(1+z)\sqrt{z}}}$$

i. $f(t) = \sec(\ln(1+t^2))$

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

j. $f(x) = \sin^5(x^2 + x)$

$$\boxed{f'(x) = 5\sin^4(x^2+x)\cdot\cos(x^2+x)\cdot(2x+1)}$$

k. $f(x) = \frac{1}{9x} + \left(\pi\frac{x+2}{2}\right)^3$

$$\boxed{f'(x) = \frac{-1}{9x^2} + 3\left(\pi\frac{(x+2)}{2}\right)^2\cdot\frac{\pi}{2}}$$

l. Compute dy/dx if $e^y\sin(x) = 1 - xy$. You must solve for dy/dx.

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

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

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