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. $f(x) = \sqrt{19}\,x^{1/3} - 2e^x + \pi$

$$\boxed{f'(x) = \sqrt{19}\,\frac{1}{3}x^{-2/3} - 2e^x}$$

b. $f(t) = \dfrac{t^{\frac{5}{2}} + t^2 - t}{\sqrt{t}}$

$$f(t) = t^2 + t^{3/2} - t^{1/2}$$

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

c. $f(x) = (x - x^2)\sin(x)$

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

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

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

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. $f(t) = t^2 \ln(at)$

$$f'(t) = 2t\ln(at) + t^2 \frac{1}{at}\cdot a$$

$$= \boxed{2t\ln(at) + t}$$

g. $f(x) = \sec(x)x^{\frac{1}{3}}e^{4x}$

$$\boxed{f'(x) = \sec(x)\tan(x)\, x^{1/3} e^{4x} + \sec(x)\,\frac{1}{3}x^{-\frac{2}{3}} e^{4x} + \sec(x)\, x^{1/3} \cdot 4e^{4x}}$$

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

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

$$= \boxed{\frac{1}{2\sqrt{1-z}\,\sqrt{z}}}$$

i. $f(t) = \tan(\ln(t^3 - 1))$

$$\boxed{f'(t) = \sec^2(\ln(t^3-1)) \cdot \frac{1}{t^3-1} \cdot 3t^2}$$

j. $f(x) = \cos^4(x^2 - x)$

$$\boxed{f'(x) = -4\cos^3(x^2-x)\cdot\sin(x^2-x)\cdot(2x-1)}$$

k. $f(x) = \frac{1}{9x^2} + \left(\pi\frac{x-3}{5}\right)^3$

$$\boxed{f'(x) = \frac{-2}{9x^3} + 3\left(\pi\frac{x-3}{5}\right)^2 \cdot \frac{\pi}{5}}$$

l. Compute dy/dx if $e^y\cos(x) = x^2y - 3$. You must solve for dy/dx.

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

$$\frac{dy}{dx}\left[e^y\cos(x) - x^2\right] = 2xy + e^y\sin(x)$$

$$\boxed{\frac{dy}{dx} = \frac{2xy + e^y\sin(x)}{e^y\cos(x) - x^2}}$$