Name: SOLUTIONS ________ / 12

- There are 12 points possible on this proficiency: **One point per problem. No partial credit.**
- A passing score is 10/12.
- 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 **must start with** $f'(x) =$, $dy/dx =$, or similar.
- Circle your final answer.

Compute the derivatives of the following functions.

1. $f(x) = \dfrac{x - \ln 2}{3} - \sqrt[5]{x}$

$f'(x) = \frac{1}{3} - \frac{1}{5} x^{-4/5}$

2. $g(x) = \dfrac{\sin(x)}{\cos(x)}$ $= \tan(x)$

$g'(x) = \sec^2(x)$

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

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

4. $f(x) = x^k + e^{kx}$, where k is a fixed constant

$$f'(x) = kx^{k-1} + ke^{kx}$$

5. $h(z) = e^{-z/4}\sin(z)$

$$h'(z) = -\frac{1}{4}e^{-z/4}\sin(z) + e^{-z/4}\cos(z)$$

6. $y = \arccos\left(2x + \sqrt{7}\right)$

$$y' = -\frac{1}{\sqrt{1-(2x+\sqrt{7})^2}}(2)$$

7. $y = \dfrac{\sec(x)}{1+\ln(x)}$

$$\frac{dy}{dx} = \frac{\sec(x)\tan(x)(1+\ln x) - \sec(x)\left(\frac{1}{x}\right)}{(1+\ln(x))^2}$$

8. $h(x) = \dfrac{\pi}{x^2} + (x+1)^3$ $= \pi x^{-2} + (x+1)^3$

$$h'(x) = -2\pi x^{-3} + 3(x+1)^2$$

9. $y = e^x \tan(x)\ln(x)$

$$\frac{dy}{dx} = e^x \tan(x)\ln(x) + e^x \sec^2(x)\ln(x) + e^x \tan(x)\cdot\frac{1}{x}$$

10. $y = \sin^3\left(x - \sqrt{x^2+1}\right)$

$$y' = 3\sin^2\left(x - \sqrt{x^2+1}\right)\cos\left(x - \sqrt{x^2+1}\right)\left(1 - \tfrac{1}{2}(x^2+1)^{-1/2}\cdot 2x\right)$$

11. $g(x) = \dfrac{\cos(3x)}{x^2+x}$

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

12. Compute dy/dt if $y\cos(y) = e^y + t^2$. You must solve for dy/dt.

$$y'\cos(y) + y(-\sin y)\,y' = e^y y' + 2t$$

$$y'\left(\cos(y) - y\sin(y) - e^y\right) = 2t$$

$$\frac{dy}{dt} = \frac{2t}{\cos(y) - y\sin(y) - e^y}$$