Name: Solutions **Instructor (circle):** **Maxwell** **Jurkowski** **Sus**

- 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 60 minutes to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- You must show sufficient work to justify your final expression; a correct answer for a non-trivial computation with no supporting work will be marked as incorrect.
- 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. $f(x) = e^2 x^{1/2} + 2e^x + \sqrt{9}$

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

b. $r(x) = (x^4 - x^2)\sin(x)$

$$r'(x) = (4x^3 - 2x)\sin(x) - (x^4 - x^2)\cos x$$

c. $h(x) = \sin(kx^2 - 5)$ where k is a constant.

$$h'(x) = \cos(kx^2 - 5) \cdot (2kx)$$

d. $g(x) = \frac{2}{x} + \frac{x^3}{\sqrt{5}}$

$$g'(x) = -\frac{2}{x^2} + \frac{3x^2}{\sqrt{5}}$$

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

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

f. $y = \frac{\cos(2x)}{x^5 + \pi}$

$$y' = \frac{-\sin(2x) \cdot 2 \cdot (x^5 + \pi) - 5x^4 \cdot \cos(2x)}{(x^5 + \pi)^2}$$

g. $w(x) = \ln(\cos(x^3) - 4x^7)$

$$w'(x) = \frac{1}{\cos(x^3) - 4x^7} \cdot \left(-\sin(x^3) \cdot 3x^2 - 28x^6\right)$$

h. $f(x) = \arctan(\sqrt{1+x})$

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

i. $h(x) = x^4 \tan(x) \sin(x)$

$$h'(x) = \left(4x^3 \tan(x) + x^4 \sec^2(x)\right)\sin(x) +$$
$$+ x^4 \tan(x) \cdot \cos(x)$$

j. $r(x) = \sin(\ln(1+x^2))$

$$r'(x) = \cos(\ln(1+x^2)) \cdot \frac{1}{1+x^2} \cdot 2x$$

k. $g(x) = \sec(xe^x)$

$$g'(x) = \sec(xe^x) \cdot \tan(x \cdot e^x) \cdot (e^x + xe^x)$$

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

$$\frac{d}{dx}(e^y \cos(x)) = \frac{d}{dx}(xy+1)$$

$$e^y \cdot y' \cos(x) + e^y(-\sin x) = y + xy'$$

$$y'(e^y \cos(x) - x) = y + e^y \sin(x)$$

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