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

- There are 12 points possible on this proficiency, one point per problem. **No partial credit.**
- 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.**

All students must affirm the following statements by initialing in the blanks provided. Students using their own paper must write out the statements in full.

____________ I will not seek or accept help from anyone.

____________ I will not use a calculator, books, notes, the internet or other aids.

____________ I understand that a correct answer without sufficient supporting work will be marked as incorrect.

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

a. $f(x) = e^2\sqrt{x} + \frac{x^9}{\pi} - \sqrt[3]{5}$

$$f'(x) = \frac{e^2}{2\sqrt{x}} + \frac{9x^8}{\pi}$$

b. $g(x) = \tan(x)\cos(x)$

$$g'(x) = \sec^2(x)\cos(x) - \tan(x)\sin(x)$$

c. $h(t) = \frac{t^4}{t^3 - 2}$

$$h'(t) = \frac{4t^3(t^3-2) - t^4 \cdot 3t^2}{(t^3-2)^2}$$

d. $g(x) = e^{\sin(\alpha x)}$ where α is a constant.

$$g'(x) = e^{\sin(\alpha x)} \cdot \cos(\alpha x) \cdot \alpha$$

e. $f(x) = \dfrac{e^x \cos(x)}{1+x}$

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

f. $y = x^3 \sin(e^x)$

$$y' = 3x^2 \sin(e^x) + x^3 \cos(e^x) \cdot e^x$$

g. $k(x) = \sin(x)\ln(x)\cos(7x - \pi)$

$$k'(x) = \left(\cos(x)\ln(x) + \sin(x)\,\frac{1}{x}\right)\cos(7x-\pi) +$$
$$+ \sin(x)\ln(x)\left(-7\sin(7x-\pi)\right)$$

h. $f(x) = \sec\left(\dfrac{1}{1+x}\right)$

$$f'(x) = \sec\left(\frac{1}{1+x}\right)\tan\left(\frac{1}{1+x}\right)\left(-\frac{1}{(1+x)^2}\right)$$

i. $y = \sin(\sqrt{1-x^2})$

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

j. $s(\theta) = \tan(\theta^2 \ln(\theta))$

$$s'(\theta) = \sec^2(\theta^2 \ln(\theta)) \cdot \left(2\theta \ln(\theta) + \theta^2 \cdot \frac{1}{\theta}\right)$$

k. $w(r) = \ln(\arctan(r))$

$$w'(r) = \frac{1}{\arctan(r)} \cdot \frac{1}{1+r^2}$$

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

$$\frac{d}{dx}(\sin(y)x) = \frac{d}{dx}(x^3y)$$

$$\cos(y) \cdot y' \cdot x + \sin(y) = 3x^2 \cdot y + x^3 y'$$

$$y'(\cos(y) \cdot x - x^3) = 3x^2 \cdot y - \sin(y)$$

$$y' = \frac{3x^2y - \sin(y)}{x\cos(y) - x^3}$$