Name: ______________________________ ________ / 12

Instructor: **Bueler** | **Jurkowski** | **Maxwell**

- 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.
- Your final answers **must start with** $f'(x) =$, $dy/dx =$, or similar.
- Circle your final answer.

Compute the derivatives of the following functions.

1. $f(x) = \pi x^2 - \dfrac{x - \sqrt{5}}{9}$

$\boxed{f'(x) = 2\pi x - \frac{1}{9}}$

2. $y = x^3 \ln(x)$

$y' = 3x^2 \ln(x) + x^3 \frac{1}{x}$

$= \boxed{x^2 [3 \ln(x) + 1]}$

3. $y = \tan(1 + x^4)$

$\boxed{y' = \sec^2(1+x^4) \cdot 4x^3}$

4. $g(r) = \dfrac{\cos(r)}{1-r^2}$

$$g'(r) = \frac{-\sin(r)(1-r^2) - \cos(r)(-2r)}{(1-r^2)^2}$$

$$= \boxed{\frac{2r\cos(r) - (1-r^2)\sin(r)}{(1-r^2)^2}}$$

5. $h(w) = \arctan(\sin(2w-9))$

$$h'(w) = \boxed{\frac{1}{1+(\sin(2w-9))^2} \cdot \cos(2w-9) \cdot 2}$$

6. $f(t) = \sec(te^t)$

$$f'(t) = \sec(te^t)\tan(te^t) \cdot [1 \cdot e^t + te^t]$$

$$= \boxed{\sec(te^t)\tan(te^t) \cdot [1+t]e^t}$$

7. $f(r) = \ln(1+r^k)$ where k is a fixed constant.

$$\boxed{f'(r) = \frac{1}{1+r^k} \cdot k r^{k-1}}$$

8. $y = (1+x^2)e^{\sin(\pi x)}$

$$\boxed{y' = 2x e^{\sin(\pi x)} + (1+x^2) e^{\sin(\pi x)} \cos(\pi x) \cdot \pi}$$

9. $y = \sqrt{x}\ln(x)\arcsin(x)$

$$y' = \boxed{\frac{1}{2} x^{-1/2} \ln(x) \arcsin(x) + \sqrt{x}\, \frac{1}{x} \arcsin(x) + \sqrt{x} \ln(x) \frac{1}{\sqrt{1-x^2}}}$$

10. $f(x) = \cos(x)\sin(1-2x^3)$

$$\boxed{f'(x) = -\sin(x)\sin(1-2x^3) + \cos(x)\cos(1-2x^3)\cdot(-6x^2)}$$

11. $h(w) = \dfrac{1}{\sin(w)}$

$$h'(w) = \frac{-1}{\sin^2(w)} \cdot \frac{d}{dw}\sin(w)$$

$$\boxed{= -\frac{\cos(w)}{\sin(w)}\,\frac{1}{\sin(w)} = -\cot(w)\csc(w)}$$

12. Compute dy/dx if $\quad x\sin(y) + 3xy^2 = e^x. \quad$ You must solve for dy/dx.

$$\sin(y) + x\cos(y)y' + 3y^2 + 6xyy' = e^x$$

$$[x\cos(y) + 6xy]\,y' = e^x - \sin(y) - 3y^2$$

$$\boxed{y' = \frac{e^x - \sin(y) - 3y^2}{x\cos(y) + 6xy}}$$