Name: ______________________________

- 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 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 or box your final answer.**

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

a. $f(x) = \dfrac{\cos x}{x^3}$ $= x^{-3}\cos(x)$

$f'(x) = -3x^{-4}\cos(x) + x^{-3}(-\sin(x))$

$= \boxed{-(3x^{-4}\cos(x) + x^{-3}\sin(x))}$

b. $f(x) = e^{(4-x^5)}$

$f'(x) = -5x^4 e^{4-x^5}$

• **c.** $f(x) = (\sin(4x) + e^x)^{6/5}$

$f'(x) = \frac{6}{5}(\sin(4x)+e^x)^{\frac{1}{5}}(4\cdot\cos(4x)+e^x)$

d. $f(x) = \ln(\sec x + \tan x)$

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

e. $f(x) = \frac{x^3}{2} + \frac{7}{\sqrt{x}} + \sqrt{30}$ $= \frac{1}{2} x^3 + 7 x^{-1/2} + \sqrt{30}$

$$\boxed{f'(x) = \frac{3}{2} x^2 - \frac{7}{2} x^{-3/2}}$$

f. $f(x) = \log_b(x \cos x)$ (where $b > 1$)

$$= \log_b x + \log_b(\cos(x))$$

$$f'(x) = \frac{1}{x \ln b} + \frac{-\sin(x)}{(\ln b)\cos(x)}$$

g. $f(x) = \dfrac{1+x^4}{x\tan(\pi/3)}$ $= \dfrac{1}{\tan(\pi/3)} \cdot x^{-1}(1+x^4) = \dfrac{1}{\tan(\pi/3)}\left(x^{-1}+x^{3}\right)$

$$\boxed{f'(x) = \frac{1}{\tan(\pi/3)}\left(-x^{-2}+3x^{2}\right)}$$

h. $y = \pi\left(\dfrac{x+8}{5}\right)^2$ $= \pi\left(\frac{1}{5}x+\frac{8}{5}\right)^2$

$$\boxed{\begin{aligned}\frac{dy}{dx} &= 2\pi\left(\frac{1}{5}x+\frac{8}{5}\right)\left(\frac{1}{5}\right)\\ &= \frac{2\pi}{25}(x+8)\end{aligned}}$$

i. $f(x) = \arctan(\sqrt{x})$

$$f'(x) = \frac{1}{1+(\sqrt{x})^2}\cdot\left(\frac{1}{2}x^{-1/2}\right)$$

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

j. $f(x) = x^2 \ln(6 + \frac{x}{6}) = x^2 \ln\left(6 + \frac{1}{6}x\right)$

$$f'(x) = 2x \ln\left(6 + \frac{1}{6}x\right) + x^2 \cdot \left(\frac{\frac{1}{6}}{6 + \frac{1}{6}x}\right)$$

$$= \boxed{2x \ln\left(6 + \frac{1}{6}x\right) + \frac{x^2}{36 + x}}$$

k. $f(x) = x^{0.7} + e^2 + e^{-x}$

$$f'(x) = 0.7x^{-0.3} + 0 - e^{-x}$$

$$= \boxed{0.7x^{-0.3} - e^{-x}}$$

l. Find $\frac{dy}{dx}$ for $x^2 + y^2 = 25 + 2xy^3$. You must solve for $\frac{dy}{dx}$.

$$2x + 2y\frac{dy}{dx} = 0 + 2 \cdot y^3 + 2x \cdot 3y^2 \frac{dy}{dx}$$

$$\left(2y - 6xy^2\right)\frac{dy}{dx} = 2y^3 - 2x$$

$$\boxed{\frac{dy}{dx} = \frac{2y^3 - 2x}{2y - 6xy^2}}$$