Name: Key

- There are 12 points possible on this proficiency, one point per problem. **No partial credit will be given.**
- You have one hour 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** $f'(x) =$, $\frac{dy}{dx} =$, or similar.
- **Draw a box around your final answer.**

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

a. $f(x) = x\sin(x)$

$f'(x) = \sin x + x\cos x$

b. $f(x) = \dfrac{1}{4x} + \sqrt{4x} = \frac{1}{4}x^{-1} + 2x^{\frac{1}{2}}$

$f'(x) = -\frac{1}{4}x^{-2} + x^{-\frac{1}{2}}$

c. $f(x) = \dfrac{\sin(x)}{\cos(x)} = \tan x$

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

d. $f(x) = e^{(x^3-4x^2+7)}$

$f'(x) = e^{x^3-4x^2+7}(3x^2-8x)$

e. $f(x) = \dfrac{\cos(x/2)}{2x^4}$

$f'(x) = \dfrac{-\sin\left(\frac{x}{2}\right)\cdot\frac{1}{2}\cdot 2x^4 - \cos\left(\frac{x}{2}\right)\cdot 8x^3}{(2x^4)^2}$

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

$f'(x) = \dfrac{1}{\sec x + \tan x}(\sec x\tan x + \sec^2 x)$

g. $f(x) = \sqrt{x + \ln(3x)}$

$f'(x) = \frac{1}{2}(x + Ln(3x))^{-\frac{1}{2}} \cdot (1 + \frac{1}{3x} \cdot 3)$

h. $f(x) = \frac{x\ln(x)}{\ln 3}$

$f'(x) = \frac{1}{Ln3}(Lnx + x \cdot \frac{1}{x})$

i. $y = \pi\left(\frac{1+x}{2}\right)^4$

$\frac{dy}{dx} = 4\pi\left(\frac{1+x}{2}\right)^3 \cdot \left(\frac{1}{2}\right)$

j. $f(x) = (\cos(x^2+e^2))^5$

$f'(x) = 5(\cos(x^2+e^2))^4 \cdot (-\sin(x^2+e^2)) \cdot 2x$

k. $f(x) = \tan^{-1} x$

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

l. Find $\frac{dy}{dx}$ for $2x+y = y\sin(x)$. You must solve for $\frac{dy}{dx}$.

$2 + \frac{dy}{dx} = \frac{dy}{dx} \cdot \sin x + y\cos x$

$\Rightarrow \frac{dy}{dx} - \sin x \cdot \frac{dy}{dx} = y\cos x - 2$

$\Rightarrow \frac{dy}{dx} = \boxed{\frac{y\cos x - 2}{1 - \sin x}}$