Name: Key

- There are 12 points possible on this proficiency, one point per problem. **No partial credit will be given.**
- You have 1 hour to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions.
- Correct parenthesization is required.
- 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. $g(x) = e^x \sin(x) + \csc(x)$

   $g'(x) = e^x \sin(x) + e^x \cos(x) - \csc(x)\cot(x)$

   b. $f(x) = \ln\left((x^2 - 4x + 30)^5\right) = 5\ln(x^2 - 4x + 30)$

   $f'(x) = \dfrac{5(2x-4)}{x^2 - 4x + 30}$

   c. $h(\theta) = \sec\left(\dfrac{\theta}{9}\right)$

   $h'(\theta) = \sec\left(\frac{\theta}{9}\right)\tan\left(\frac{\theta}{9}\right) \cdot \frac{1}{9}$

d. $k(x) = x^2 \arcsin(x)$

$k'(x) = 2x \arcsin(x) + \dfrac{x^2}{\sqrt{1-x^2}}$

e. $f(x) = \sqrt{3x} - \sqrt{3} + \dfrac{1}{\sqrt{3x}}$

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

f. $r(x) = \dfrac{e^{3x}+1}{\cos(\pi x)}$

$r'(x) = \dfrac{3e^{3x}\cos(\pi x) - (e^{3x}+1)(-\sin(\pi x)\cdot\pi)}{(\cos^2(\pi x))}$

g. $y = \tan^2(x) + 1$

$\frac{dy}{dx} = 2\tan(x)\sec^2(x)$

h. $y = \dfrac{5x^{-0.2}}{x^4 + 20}$

$\frac{dy}{dx} = \dfrac{-x^{-1.2}(x^4+20) - 5x^{-0.2}(4x^3)}{(x^4+20)^2}$

i. $f(x) = \cot\left(\dfrac{2-x^2}{3x}\right)$

$f'(x) = -\csc^2\left(\frac{2-x^2}{3x}\right) \cdot \dfrac{(-2x)(3x) - (2-x^2)\cdot 3}{(3x)^2}$

j. $f(x) = \left(x^{-2} + \ln(x)\right)^a$ where a is a fixed constant

$$f'(x) = a\left(x^{-2} + \ln(x)\right)^{a-1} \cdot \left(-2x^{-3} + \frac{1}{x}\right)$$

k. $y = 2^x + 2x^5$

$$\frac{dy}{dx} = 2^x \ln(2) + 10x^4$$

l. Find $\dfrac{dy}{dx}$ for $\sin(y) + 5x = 10 + xy^2$

$$\frac{d}{dx}\left[\sin(y) + 5x\right] = \frac{d}{dx}\left[10 + xy^2\right]$$

$$\cos(y)\frac{dy}{dx} + 5 = y^2 + 2xy\frac{dy}{dx}$$

$$\cos(y)\frac{dy}{dx} - 2xy\frac{dy}{dx} = y^2 - 5$$

$$\frac{dy}{dx} = \frac{y^2 - 5}{\cos(y) - 2xy}$$