**Name:** ______________________________

- 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.** $f(\theta) = \sin(3\theta^5 + 2\theta + 1)$

$f'(\theta) = \cos(3\theta^5 + 2\theta + 1)(15\theta^4 + 2)$

**b.** $p(x) = \dfrac{3}{\sqrt{2x}} + \left(\dfrac{x+8}{3}\right)^2 = \dfrac{3}{\sqrt{2}} x^{-1/2} + \left(\dfrac{x}{3} + \dfrac{8}{3}\right)^2$

$p'(x) = \dfrac{3}{\sqrt{2}}\left(\dfrac{-1}{2}\right) x^{-3/2} + 2\left(\dfrac{x}{3} + \dfrac{8}{3}\right)\left(\dfrac{1}{3}\right)$

**c.** $h(x) = \cot(x)$

$h'(x) = -\csc^2(x)$

**d.** $f(x) = \arcsin(x^{-2})$

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

**e.** $f(t) = \sqrt{t \ + \cos^3(t)}$ $= \left(t + (\cos(t))^3\right)^{1/2}$

$$f'(t) = \frac{1}{2}\left(t + (\cos(t))^3\right)^{-1/2}\left(1 + 3(\cos(t))^2(-\sin(t))\right)$$

$$= \frac{1 - 3\sin(t)\cos^2(t)}{2\sqrt{t^3 + \cos^3(t)}}$$

**f.** $f(x) = x^{5/3}\sec(x)$

$$f'(x) = \frac{5}{3}x^{2/3}\sec(x) + x^{5/3}\sec(x)\tan(x)$$

**g.** $f(x) = \dfrac{x}{x+\tan(x)}$

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

**h.** $g(x) = (\sin(\ln(x)))^6$

$$g'(x) = 6(\sin(\ln(x)))^5(\cos(\ln(x)))\left(\frac{1}{x}\right)$$

**i.** $f(x) = e^{5x}(2-x)$

$$f(x) = 5e^{5x}(2-x) + e^{5x}(-1)$$

**j.** $k(x) = \dfrac{x^2\ln(x)+5}{x}$ $= x\ln(x) + 5x^{-1}$

$$k'(x) = 1\cdot\ln(x) + x\cdot\frac{1}{x} - 5x^{-2} = \ln(x) + 1 - \frac{5}{x^2}$$

**k.** $f(x) = x^p + \ln(ax+3)$ (Assume $p$ and $a$ are fixed positive constants.)

$$f'(x) = px^{p-1} + \frac{a}{ax+3}$$

**l.** Find $\dfrac{dy}{dx}$ for $\quad x + y + \pi = ye^x$

$$1 + \frac{dy}{dx} = 1\cdot\frac{dy}{dx}\cdot e^x + ye^x$$

$$(1 - e^x)\frac{dy}{dx} = ye^x - 1$$

$$\frac{dy}{dx} = \frac{ye^x - 1}{1 - e^x}$$