**Name:** _____

- There are 12 points possible on this proficiency, one point per problem. **No partial credit will be given.**
- You have 60 minutes to complete this proficiency.
- No aids (book, calculator, etc.) are permitted.
- You do **not** need to simplify your expressions, but you must show sufficient work to justify your final expression.
- 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.** $f(x) = \dfrac{\sqrt{x}}{2} + \dfrac{2}{\sqrt{x}} - \dfrac{\sqrt{2}}{3}$ $= 2x^{1/2} + 2x^{-1/2} - \frac{\sqrt{2}}{3}$

$f'(x) = x^{-1/2} - x^{-3/2}$

$= \dfrac{1}{\sqrt{x}} - \dfrac{1}{x\sqrt{x}}$

**b.** $g(x) = \sin(x)\cos(x)$

$g'(x) = \cos^2(x) - \sin^2(x)$

**c.** $h(x) = \dfrac{\sec(x)}{x}$

$h'(x) = \dfrac{\sec(x)\tan(x)\cdot x - \sec(x)}{x^2}$

$= \dfrac{\sec(x)(x\tan x - 1)}{x^2}$

**d.** $f(t) = \sin^{-1}\left(t^2\right)$

$$f'(x) = \frac{1}{\sqrt{1-t^4}} \cdot 2t$$

**e.** $f(x) = 3(5^x + 5^2)^3$

$$f'(x) = 9(5^x + 5^2)^2 \cdot \ln(5)\, 5^x$$

**f.** $f(\theta) = \ln\left(\theta^3 + \tan(3\theta)\right)$

$$f'(\theta) = \frac{1}{\theta^3 + \tan(3\theta)} \cdot \left(3\theta^2 + \sec^2(3\theta)\cdot 3\right)$$

$$= 3\,\frac{\theta^2 + \sec^2(3\theta)}{\theta^3 + \tan(3\theta)}$$

**g.** $y = \left(x^{0.3} + x\right)^{-4/3}$

$$y' = -\frac{4}{3}\left(x^{0.3} + x\right)^{-7/3} \cdot \left(0.3x^{-0.7} + 1\right)$$

**h.** $f(x) = \csc(\pi/x)$

$$f'(x) = -\csc(\pi/x)\cot(\pi/x) \cdot \left(-\frac{\pi}{x^2}\right)$$

$$= \frac{\pi \csc(\pi/x)\cot(\pi/x)}{x^2}$$

**i.** $y = e^{-x} + x^4 e^{4x}$

$$y' = -e^{-x} + 4x^3 e^{4x} + x^4 \cdot 4e^{4x}$$

**j.** $f(x) = \ln\left(\dfrac{\sin^2(x)}{1-2x}\right)$

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

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

**k.** $g(x) = \dfrac{\cos(2)}{\sqrt[3]{\cos(x)}}$ $= \cos(2)\cdot[\cos(x)]^{-1/3}$

$$g'(x) = -\frac{\cos(2)}{3}\cdot[\cos(x)]^{-4/3}\cdot(-\sin(x))$$

$$= \frac{\cos(2)\sin(x)}{3(\cos(x))^{4/3}}$$

**l.** Find $\dfrac{dy}{dx}$ for $5(x^2+y^2) = ye^x$. You must solve for $\dfrac{dy}{dx}$.

$$10x + 10y\,y' = y'e^x + ye^x$$

$$10x - ye^x = y'e^x - 10y\,y'$$

$$y' = \frac{dy}{dx} = \frac{10x - ye^x}{e^x - 10y}$$