Name: ____________________ ________ / 12

- 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 $\boxed{\text{box}}$ around your final answer.**

1. $u(x) = (e^2 + e^x)(7 - x^{-5})$

$u'(x) = (e^2+e^x)(-(-5)x^{-6}) + (7-x^{-5})(e^x)$

$= 5x^{-6}(e^2+e^x) + (7-x^{-5})(e^x)$

alternately

$u(x) = 7e^2 + 7e^x - e^2 \cdot x^{-5} - e^x x^{-5}$

$u'(x) = 0 + 7e^x - e^2(-5x^{-6}) - (e^x(-5x^{-6}) + x^{-5}(e^x))$

2. $f(t) = \dfrac{1}{\sqrt[3]{t}} + \left(\dfrac{2+\pi t}{3}\right)^4 = t^{-1/3} + \left(\frac{2}{3} + \frac{\pi}{3}t\right)^4$

$f'(t) = -\frac{1}{3}e^{-4/3} + 4\left(\frac{2}{3} + \frac{\pi}{3}t\right)^3\left(\frac{\pi}{3}\right)$

3. $g(y) = \dfrac{\tan(y^2)}{1+\sin(y)}$

$g'(y) = \dfrac{(1+\sin(y))(\sec^2(y^2))(2y) - \tan(y^2)(\cos(y))}{(1+\sin(y))^2}$

4. $y = (2x^2+4)\arctan(x)$ (note $\arctan(x) = \tan^{-1}(x)$)

$$y' = (2x^2+4)\left(\frac{1}{1+x^2}\right) + \arctan(x)\,(4x)$$

5. $h(x) = \dfrac{x^5 - ax + b}{x^2}$ (where a and b are constants)

$$= x^3 - ax^{-1} + bx^{-2}$$

$$h'(x) = 3x^2 - a(-x^{-2}) + b(-2x^{-3})$$

$$= 3x^2 + \frac{a}{x^2} - \frac{2b}{x^3}$$

or, $h'(x) = \dfrac{x^2(5x^4-a) - (x^5-ax+b)(2x)}{x^4}$ but don't do this.

6. $G(x) = e^{\cos(x^2)+2}$

$$G'(x) = e^{\cos(x^2)+2}\left(-\sin(x^2)(2x)\right)$$

7. $g(u) = \ln(2) + \ln(u) - \ln(u^2)$ $= \ln(2) + \ln(u) - 2\ln(u)$

$g'(u) = \frac{1}{u} - \frac{1}{u^2}(2u)$

$g'(u) = \frac{1}{u} - \frac{2}{u} = \frac{-1}{u}$

8. $f(\theta) = 2\sin\left(\theta^3 + 2\right)$

$f'(\theta) = 2\cos(\theta^3 + 2)(3\theta^2)$

9. $k(x) = e^{3x}\cos(2x)$

$k'(x) = e^{3x}(-\sin(2x)(2)) + \cos(2x)(e^{3x})(3)$

10. $F(x) = \csc(x) + (\sqrt{2})x$

$F'(x) = -\csc(x)\cot(x) + \sqrt{2}$

11. $g(t) = \dfrac{6}{\cos(t)} = 6\sec(t)$

$g'(t) = 6\sec(t)\tan(t)$

or $g(t) = 6(\cos(t))^{-1}$

$g'(t) = -6\cos(t)^{-2}(-\sin t)$

$= \dfrac{6\sin t}{\cos^2 t}$

or $g'(t) = \dfrac{\cos(t)(0) - 6(-\sin(t))}{(\cos(t))^2}$

$= \dfrac{6\sin t}{\cos^2 t}$

12. Compute $\frac{dy}{dx}$ if $xy - 2y = 2 + e^y$. You $\boxed{\text{must}}$ solve for $\frac{dy}{dx}$.

$x\dfrac{dy}{dx} + y - 2\dfrac{dy}{dx} = e^y\dfrac{dy}{dx}$

$\dfrac{dy}{dx}(x - 2 - e^y) = -y$

$\dfrac{dy}{dx} = \dfrac{-y}{x-2-e^y}$