Name: _____

- Write all of your responses on these exam pages. If you need more space for your answers please use the backs of the exam pages.
- Make sure that you show all of your work, answers without supporting work will receive no credit.
- **No calculation devices are to be used on this exam.**

1. (*15 Points*) Find $f'(x)$ for

$$f(x) = \frac{1}{1+\sqrt{x}}$$

using the definition of the derivative.

2. (*15 Points*) Find $f'(x)$ for

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

using the definition of the derivative.

3. (*10 Points*) Using the definition of the derivative, prove that $\dfrac{d}{dx}\left(\cos(x)\right) = -\sin(x)$. You may use the facts that $\lim\limits_{x\to 0}\dfrac{\sin(x)}{x} = 1$ and $\lim\limits_{x\to 0}\dfrac{\cos(x)-1}{x} = 0$.

4. (*10 Points*) Using the definition of the derivative prove the quotient rule in general, $\dfrac{d}{dx}\left(\dfrac{f(x)}{g(x)}\right) = \dfrac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$.

5. (*25 Points*) Using the derivative rules, find the derivatives of each of the following functions. You do not need to simplify your results.

   (a) $f(x) = e^x(x + x\sqrt{x})$

   (b) $f(x) = \dfrac{x}{1+\sqrt{x}}$

(c) $f(x) = x\cos(x)\sin(x)$

(d) $f(x) = \sin\left(\dfrac{e^x}{1+e^x}\right)$

(e) $f(x) = (1-4x)^2\sqrt{x^2+1}$

6. (*10 Points*) Find a parabola with equation $y = ax^2 + bx + c$ that has slope 7 at $x = 1$, slope -17 at $x = -2$, and passes through the point $(1, 8)$.

7. (*10 Points*) Find all values of x where the following function has a horizontal tangent?

$$f(x) = x + 2\sin(x)$$

8. (*10 Points*) At what point on the curve $y = \sqrt{4 + 3x}$ is the tangent line perpendicular to the line $8x + 3y = 7$?