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
$$f(x) = \frac{x}{x+2}$$
using the definition of the derivative.

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

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

using the definition of the derivative.

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

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

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

   (b) $f(x) = \dfrac{6x^4 - 5x}{x + 1}$

(c) $f(x) = xe^x \cot(x)$

(d) $f(x) = \left(\dfrac{x^4+1}{x^2+1}\right)^5$

(e) $f(x) = \sin(x)\cos(1 - x^2)$

6. (*10 Points*) Find a parabola with equation $y = ax^2 + bx + c$ that has slope 4 at $x = 1$, slope -8 at $x = -1$, and passes through the point $(2, 15)$.

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

$$f(x) = e^x \cos(x)$$

8. (*10 Points*) At what point on the curve $y = \sqrt{1 + 2x}$ is the tangent line perpendicular to the line $6x + 2y = 1$?