1. (17pts) Differentiate and simplify where appropriate:

$$\frac{d}{dx}\left(4x^3 - \frac{3}{x^6} + \sqrt[3]{x^{13}} + 4^5\right) =$$

$$\frac{d}{dx}\left((\sqrt{x} + 7)(3\sqrt[4]{x} - x^2)\right) =$$

$$\frac{d}{dy}\left(4e^y + 3e^4\right) =$$

2. (10pts) Use the Intermediate Value Theorem to show that the equation $\cos x = x - 1$ has at least one solution. Write a nice sentence that shows how you are using the IVT.

3. (22pts) Find the following limits algebraically.
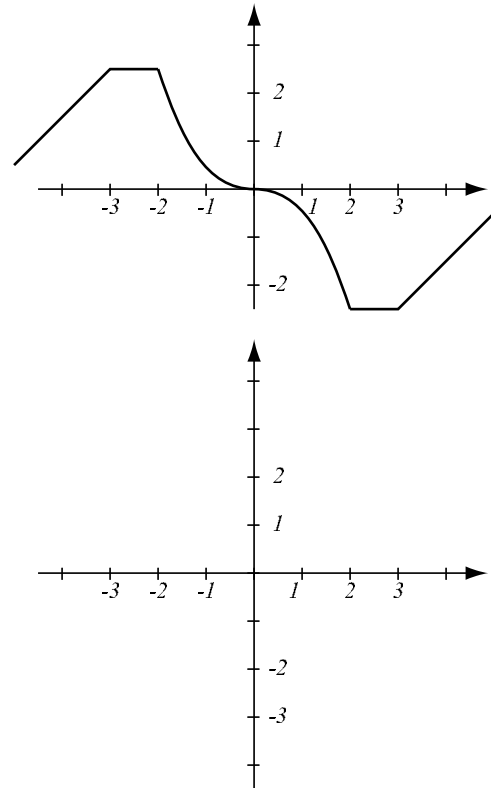
$$\lim_{x \to -4} \frac{x^2 - 3x - 28}{x^2 - 16} =$$

$$\lim_{x \to 1} \frac{\sqrt{x+3} - 2}{x - 1} =$$

$$\lim_{x \to 0} \frac{\sin(7x)}{\sin(5x)} =$$

4. (10pts) Find $\lim_{x \to 0} x^2 \left(\sin \frac{1}{x} + \cos \frac{1}{x} \right)$. Use the theorem that rhymes with what you pay at the bursar's office, other than tuition.

5. (15pts) The graph of the function $f(x)$ is shown at right.

a) Find the points where $f'(a)$ does not exist.
b) Use the graph of $f(x)$ to draw an accurate graph of $f'(x)$.
c) Is $f(x)$ odd or even? How about $f'(x)$?

6. (16pts) Let $f(x) = \dfrac{1}{x^2}$.

a) Use the limit definition of the derivative to find the derivative of the function.
b) Check your answer by taking the derivative of f using rules.
c) Write the equation of the tangent line to the curve $y = f(x)$ at point $(2, \frac{1}{4})$.

7. (10pts) Consider the limit below. It represents a derivative $f'(a)$.

a) Find f and a.

b) Use the infomation above to find the limit.

$$\lim_{h \to 0} \frac{\sqrt[3]{8 + h} - 2}{h}$$

Bonus. (10pts) Use the limit definition of the derivative to find the derivative of the function
$$f(x) = \frac{x^2}{x + 3}.$$