1. Use the sign of $f$, $f'$, and $f''$ to sketch a graph of $f(x) = x^4 - 2x^3$. Label all relative maximums and minimums and inflection points.

2. The graph of the derivative $f'$ of a function $f$ is shown.

   a) On what intervals is $f$ increasing?

   b) On what intervals is $f$ concave up?
3.a) The Mean Value Theorem states that for the function $f$ graphed on the right there is a number $c$ in the interval $[a, b] = [-2, 2]$ where $f'(c) = \frac{f(b) - f(a)}{b - a}$. Based on the graph, which of the following numbers is the best estimate for $c$?

a) -2 b) -1 c) 0 d) 1 e) 2

3.b) Use the Mean Value Theorem to prove the following theorem. If $f' > 0$ on and interval $(a, b)$, then $f$ is increasing on $(a, b)$.

4. A particle moves horizontally along a line with acceleration $a(t) = e^t - \sin(t) + t$. Find its velocity $v(t)$ and position $s(t)$ if $v(0) = 3$ and $s(0) = 4$. 
5.  (a) Find \( \lim_{x \to 0} \frac{x - \sin(x)}{x + \cos(x)} \).

(b) Find \( \lim_{x \to 0} \frac{e^x - 1}{x^3} \).

(c) Find \( \lim_{x \to 0^+} x \ln(x) \).

6. A farmer wants to enclose a rectangular area of 15,000 square feet, and then divide it into 2 pens with fencing parallel to one of the sides. What dimensions will minimize the cost of the fence?
7. Consider the function \( f \) graphed on the right consisting of a semi-circle and a line segment.

(a) Find the exact value for \( \int_0^4 f(x)dx \).

(b) Approximate \( \int_0^4 f(x)dx \) using \( R_4 \) (using right endpts and 4 subintervals) and show the rectangles you are using on the graph above.

8. Evaluate the following:

(a) \( \int_{-1}^{2} (6x^2 + 6x + 6) \, dx \)

(b) \( \int (e^{3x} + \sec(x) \tan(x)) \, dx \)