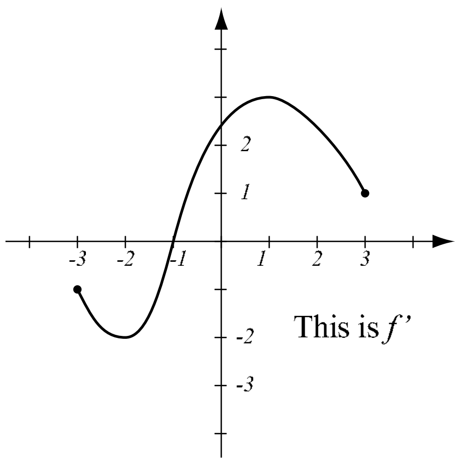
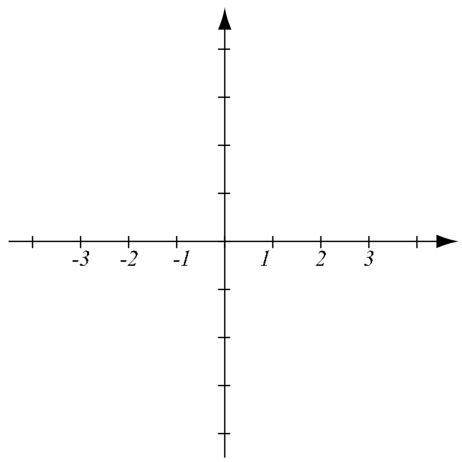
1. (19pts) Let the domain of f be $[-3, 3]$. The graph of its derivative f' is drawn below. Use the graph to answer:
a) What are the intervals of increase and decrease of f? Where does f have a local minimum or maximum?
b) What are the intervals of concavity of f? Where does f have inflection points?
c) Use the information gathered in a) and b) to draw one possible graph of f at right.





2. (10pts) A rubber ball is being inflated. Using linear approximation, estimate by how much volume changes if radius changes from $r = 6$in to $r = 6.5$in. (The volume of a ball of radius r is $V = \frac{4\pi}{3}r^3$.)

3. (13pts) Verify the Mean Value Theorem for the function $f(x) = \sqrt{x}$ on the interval $[1, 4]$.

4. (21pts) Let $f(x) = \dfrac{x+3}{x^2+7}$.

a) Find the cricital points and the intervals of increase and decrease of f. Determine where f has a local maximum or minimum.

b) Using information found in a), draw a rough sketch of f.

c) _____ Initial here if you are glad you were not asked to find the second derivative of f. (But if you really want to, see the bonus).

5. (16pts) Let $f(\theta) = \sin^2\theta - \cos\theta$. Find the absolute minimum and maximum values of f on the interval $[0, \pi]$.

6. (21pts) Let $f(x) = e^{-x}(2x + 3)$.
a) Find the intervals of concavity and points of inflection for f.
b) Find the critical points and use a) to determine which are local minima or maxima.

The better of these two bonus problems will count toward your grade.

Bonus. (8pts) After two hours of driving, Frank was 70 miles away from his starting point. After three hours he was 120 miles from the starting point. There are three values that you can be sure his speedometer displayed during his drive. What are they? Justify your answer with a theorem. (Don't say one of the values is zero, because he might not have been at a standstill when we started observing.)

Bonus. (10pts) Find the intervals of concavity for the function in problem 4.