1. (9 pts) True/False. If False, a reason or counterexample must be given for full credit.

T F If \( f'(x) > 0 \) on the interval \((a, b)\) then \( f \) is increasing on \((a, b)\).

T F If the graph of \( f \) is concave down on the interval \((a, b)\) then \( f' \) is increasing on \((a, b)\).

T F Critical numbers of \( f \) occur where the graph of \( f' \) crosses the y-axis.

2. Read this question carefully! The graph shown is the graph of the derivative of a function \( f \).

(a) (4pts) The critical numbers for \( f \) in the interval \([0, 6, 3]\) are:

(b) (4pts) Intervals on which \( f \) is increasing are:

(c) (4 pts) Intervals on which the graph of \( f \) is concave down are:

(d) (4pts) Sketch a graph of \( f \) on the axes above.

3. (6 pts) True/False. If False, a reason or counterexample must be given for full credit.

T F If \( c \) is a critical number of \( f \) then \( f \) has a relative maximum or a relative minimum at \( x = c \).

T F The graph of \( y = f(x) \) can have at most one horizontal asymptote.

4. (5 pts) Sketch the graph of a function \( f \) having the following characteristics. \( f(0) = f(2) = 0, f'(1) = 0, f'(x) < 0 \) if \( x < 1, f'(x) > 0 \) if \( x > 1, f''(x) > 0 \).

5. (5 pts) Find all asymptotes of \( f(x) = \frac{x^2 - 6x + 12}{x - 4} \) and give reasons for your answers.
6. (6 pts) True/False. If False, a reason or counterexample must be given for full credit.

T F The Mean Value Theorem is a special case of Rolle’s Theorem.
T F If "the rate of growth of the national deficit is decreasing", then the deficit itself is decreasing.

7. (20 pts) A farmer has 200 feet of fencing with which to enclose two adjacent hog pens next to a barn, one rectangular and the other semicircular, as shown. What dimensions should be used so the enclosed area is a maximum? (The Norman fencing problem!)

8. (12 pts) Suppose $C(p)$ represents the cost in dollars of removing $p$ per cent of the air pollutants in the stack emissions at the UMR coal-fired power plant. If $C(60) = 120,000$ and $C'(60) = 5000$, approximate the cost to remove 65 percent of the pollutants.

9. (9 pts) The year is 1964. A commuter drives from Cuba to Rolla, 20 miles, in 15 minutes. The police radar in Cuba records the speed as 60 mph, and the radar in Rolla records the speed as 50 mph. What theorem can be used to prove that the commuter exceeded the speed limit of 70 mph? Give the proof.

10. The derivative of $f(x) = \frac{\cos x - 3x \sin x}{3x^{2/3}}$ is $f'(x) = \frac{-2 \cos x + 9x^2 \cos x + 6x \sin x}{9x^{5/3}}$. This means that $f'(x) = 0$ whenever $2 \cos x + 9x^2 \cos x + 6x \sin x = 0$.

   (a) (6 pts) Use Newton’s Method 3 times, starting with $x_0 = 2$, to approximate one of the critical numbers of $f$ by finding a zero of $2 \cos x + 9x^2 \cos x + 6x \sin x$. Give 4 decimal places in your answers.
   
   $x_1 = \underline{\phantom{0000}}$ $x_2 = \underline{\phantom{0000}}$ $x_3 = \underline{\phantom{0000}}$

   (b) (6 pts) Use your calculator to plot the graph of $f(x) = \frac{\cos x - 3x \sin x}{3x^{2/3}}$ for $0 \leq x \leq 6$, $-2 \leq y \leq 2$, sketch the plot, and clearly identify the point on the graph which corresponds to the value you got in part (a).