Calculateds are allowed. Answer the questions in the spaces provided. If you run out of room for an answer, continue on the back of the last page. **For full credit you must show your work. Answers read off the calculator will not be accepted.**

Name: ____________________________________________________________

1. Compute the following limits.
   (a) (5 points) \( \lim_{x \to 0} \frac{5x^2 - 6x}{e^x - 1} \)

   (b) (5 points) \( \lim_{x \to \infty} e^{-x}(3x - 4) \)

   (c) (5 points) \( \lim_{x \to 1^+} x^{\frac{1}{x-1}} \) (Hint: use the logarithmic approach.)

2. (5 points) True or False. A function \( f(x) \) can only have one absolute (global) maximum and one absolute (global) minimum on a closed interval \([a, b]\). Explain.
3. (6 points) Find the extreme values of \( f(x) = \frac{1}{5}x^5 - 100x \) on \([-20, 15]\).

4. (6 points) Determine the inflection points of \( g(x) = x^7 - \frac{42}{5}x^5 \), the intervals on which the function is concave up and the intervals on which the function is concave down.

5. (6 points) Find the critical points of \( y = 13x - e^{7x} \) then use the first derivative test to determine the local maximum(s) and local minimum(s) of the function.
6. (6 points) Find the critical points of \( y = x^{5/2} - 10x^2 \) and then use the second derivative test to determine the local maximum(s) and local minimum(s) of the function.

7. (5 points) What is the relationship between \( \frac{dV}{dt} \) and \( \frac{dr}{dt} \) if \( V = \frac{4}{3} \pi r^3 \)?

8. (8 points) A cylindrical water tank is being filled at a rate of \( 9 \text{ ft}^3/\text{min} \). It’s circular base has radius \( 5 \text{ ft} \). How fast does the water level rise?

9. (8 points) A UFO flies directly over a calculus classroom at a height of \( 8 \text{ km} \) at a speed of \( 500 \text{ km/hr} \). Assuming it maintains constant speed and altitude, what is the rate of change in the distance from the classroom to the UFO 20 minutes later?
10. (5 points) Can a function with the real numbers as its domain, in other words its domain is $(-\infty, \infty)$, that takes on only negative values have a positive derivative? If it is possible, write “YES” and sketch an example of such a graph. If it is not possible, write “NO.”

11. (12 points) Sketch a graph of a function, $f$, which satisfies the following requirements:
   (a) $f'' > 0$ in the interval $(-3, 5)$ and $f'' < 0$ in the intervals $(-\infty, -3)$ and $(5, \infty)$
   (b) $f' = 0$ at $x = 0$
   (c) $f' < 0$ in the interval $(-5, 0)$

12. (6 points) Find a point $c$ satisfying the Mean Value Theorem (MVT) for the function $f(x) = x^2 - 8$ and the interval $[-1, 2]$. 
13. (12 points) Using the graph below of \( f' \), the derivative of some function \( f \), answer the following questions.

(a) What are the critical points of \( f \)?

(b) For what value(s) of \( x \), if any, does \( f \) have a minimum (either local or absolute)?

(c) On what interval(s) is \( f \) increasing?

(d) On approximately what interval(s) is \( f \) concave down?