1. (a) (5 pts) On the axes provided, sketch a graph of \( y = 2^x \). (Be sure to give some scale to each axis, for example by identifying coordinates of some points on the graph.)

(b) (5 pts) If \( f(x) = 2^x \) and \( g(x) = \sqrt{x - 1} \), give the formula for, and the domain of, \((g \circ f)(x)\).

2. (5 pts) Find the derivative of \( F(r) = r^3 + e^r \).
3. Compute the limits:

(a) \( \lim_{x \to -4} \frac{1}{4} + \frac{1}{x} \)

(b) \( \lim_{x \to \infty} \frac{x + 2}{\sqrt{9x^2 + 1}} \)

4. (10 pts) On the axes provided, sketch a graph of a function with these properties:

\[ \lim_{x \to -1^-} f(x) = 0, \quad \lim_{x \to -1^-} f(x) = -1, \quad f(0) = 0, \quad f(1) = 3, \quad f'(1) = -3. \]
5. \( (10 \text{ pts}) \) Use the definition of the derivative to find \( f'(x) \) if \( f(x) = x^2 + 2 \).

6. \( (10 \text{ pts}) \) Find all the vertical and horizontal asymptotes of the graph

\[
y = \frac{x^3 + 8}{x^2 - x}
\]
7. If a rock is thrown upward on the planet Mars with a velocity of 10 m/s, its height in meters \( t \) seconds later is given by \( y = 10t - 1.86t^2 \).

(a) (5 pts) Compute the average velocity over the interval \([1, 2]\). (There is no need to simplify the number, but give a formula which would be easy to evaluate on a calculator.)

(b) (5 pts) Set up and then compute a limit to calculate the instantaneous velocity at \( t = 1 \).

(c) (5 pts) Compute \( dy/dt \) if \( y = 10t - 1.86t^2 \).
8. (10 pts) Define the statement

\[ \lim_{x \to a} f(x) = L. \]

Give either the complete sentence definition or the “\( \varepsilon, \delta \)” definition.

9. (a) (5 pts) Use the definition of continuity and the properties of limits to show that the function \( f(x) = \cos 5x \) is continuous at \( x = 0 \).

(b) (5 pts) Compute the limit:

\[ \lim_{x \to 0} \left( x^3 + \frac{\cos 5x}{10000} \right) \]
10. (10 pts) Use the given graph of $f(x) = \frac{1}{x}$ to find a number $\delta$ such that

$$\text{if } |x - 2| < \delta \quad \text{then} \quad \left| \frac{1}{x} - 0.5 \right| < 0.2$$

graph in 2.4 # 1

Extra Credit. (3 pts) Show that the equation

$$x^4 + x - 3 = 0$$

has at least two solutions, and state the facts and name the theorems you use.