

Name: _____

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Circle one: Rhodes (F01) | Bueler (F02)

25 points possible. No aids (book, calculator, etc.) are permitted. You need not simplify, but show all work and use proper notation for full credit.

1. **[8 points]** Sketch an appropriately labeled graph of a function that satisfies all of the given conditions.

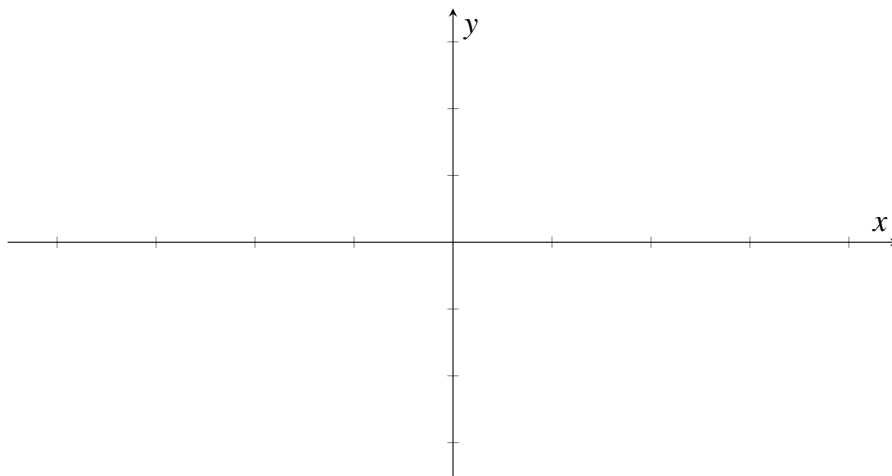
1. $f(0) = 2$

2. $f'(1) = 0$

3. $f'(x) > 0$ for $x < 1$; $f'(x) < 0$ for $x > 1$

4. $f''(x) > 0$ for $x < -2$; $f''(x) < 0$ for $x > -2$

5. $\lim_{x \rightarrow -\infty} f(x) = -3$; $\lim_{x \rightarrow \infty} f(x) = -\infty$



2. **[4 points]** Compute the following limits.

a. $\lim_{x \rightarrow \infty} \frac{\sqrt{x}}{e^{2x}}$

b. $\lim_{x \rightarrow 0} \frac{x^2}{e^x - 2}$

3. [13 points] Consider the function $f(x) = \ln(x^2 + 9)$. We have computed for you

$$f'(x) = \frac{2x}{x^2 + 9}, \quad f''(x) = \frac{-2x^2 + 18}{(x^2 + 9)^2}.$$

- a. Find the domain of $f(x)$.
- b. Find intercepts.
- c. Find the critical point(s).
- d. Determine the intervals where $f(x)$ is increasing and decreasing.
- e. Find the intervals where $f(x)$ is concave up and concave down.
- f. Using the above information, sketch the graph of $f(x)$, making sure to label x -coordinates of all important points. [Hint: $\ln 9 \approx 2$]

