All work on this lab should be the collective effort of all group members. Technology allowed on this lab includes: Desmos (`https://www.desmos.com/calculator`) and an approved TI calculator. This lab has 7 questions for a total of 50 points.

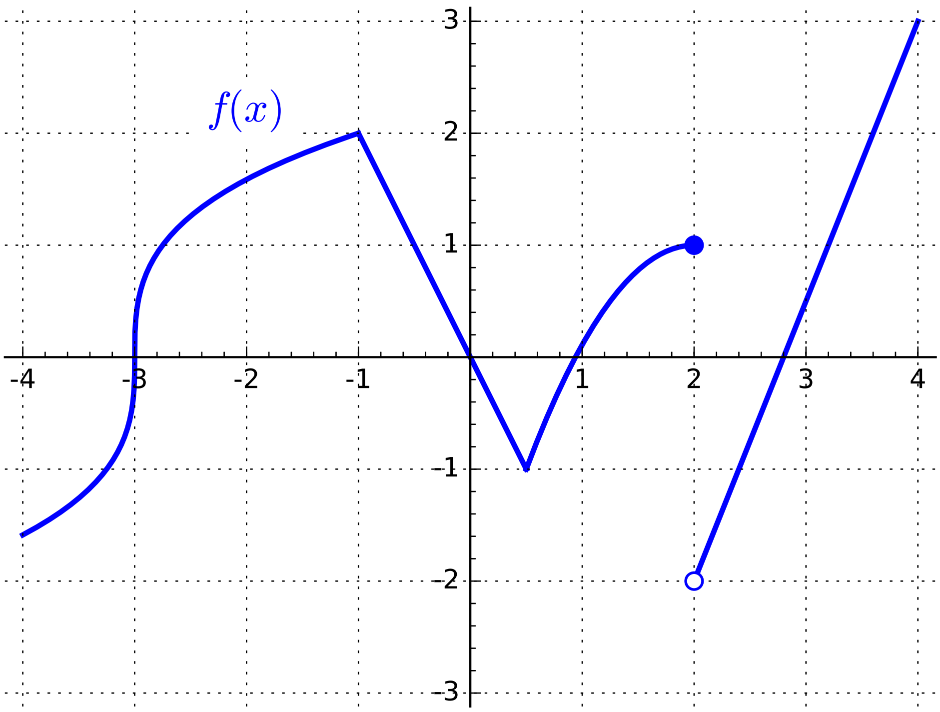
1. (6 points) Determine whether the function $\ln(x^2 - 4x + 3)$ satisfies the hypotheses of the Mean Value Theorem on the interval $[4, 7]$. If it does, use derivatives and algebra to find the exact values of all $c \in (4, 7)$ that satisfy the conclusions of the Mean Value Theorem.

2. (5 points) Explain why the following function does not satisfy the hypotheses of the Mean Value Theorem on its domain.

$$f(x) = \begin{cases} \frac{\sin x}{x}, & -\pi \leq x < 0 \\ 0, & x = 0 \end{cases}$$

3. (5 points) A driver of an 18-wheel truck is traveling on a road with two toll stations. She pays for the toll at the first station, then two hours and 161 miles later arrives at the second toll. When she pays for the second toll she is given a ticket for speeding by the on-site state trooper. How did the police officer know she was speeding?

4. (8 points) Use the graph of $f(x)$ below to create the sign chart of f' and f''.

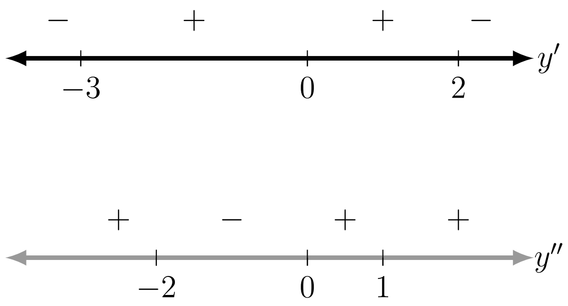


Sign Charts of f

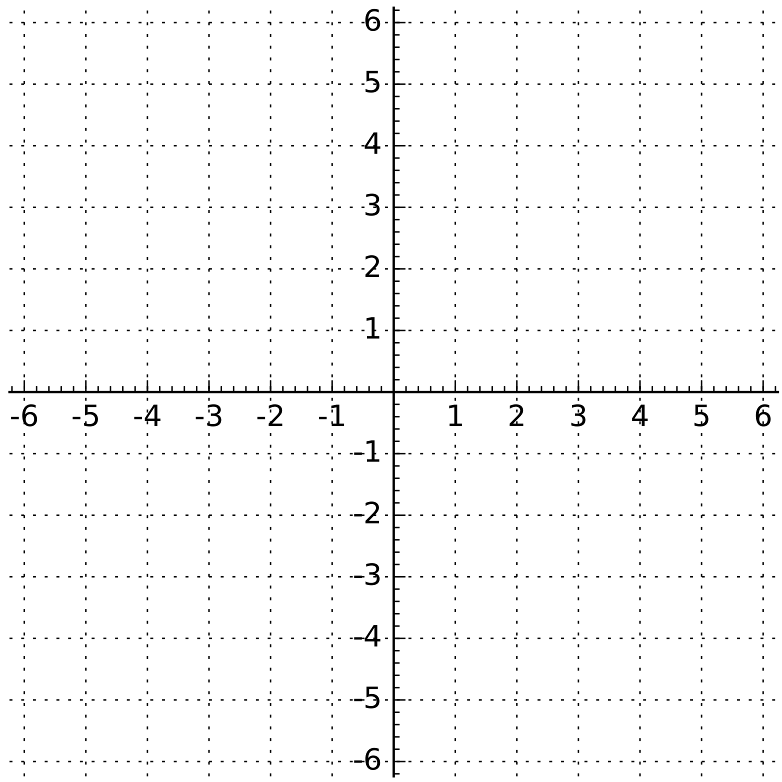
5. (8 points) Let $g(x) = xe^x$. Create the sign charts for g' and g'' and use them to identify the local extrema.

Sign Charts of g

6. (6 points) Below is the sign charts of a twice-differentiable function $y = f(x)$. Using the sign charts and the fact that $f(x)$ passes through the points $(-3, -2)$, $(-2, 0)$, $(0, 1)$, $(1, 2)$, and $(2, 3)$ sketch a graph.



Sign Charts of y



7. (12 points) Consider the function $h(x)$ defined below. Determine all of the following characteristics of the function. Use ***exact*** values. NO DECIMAL ANSWERS!

$$h(x) = \frac{\sqrt{x+1}\,(x-4)^2}{x^2+1}$$

1. Critical points/values.
2. Increasing interval(s)
3. Decreasing interval(s)
4. Inflection points
5. Interval(s) where $h(x)$ is concave up
6. Interval(s) where $h(x)$ is concave down