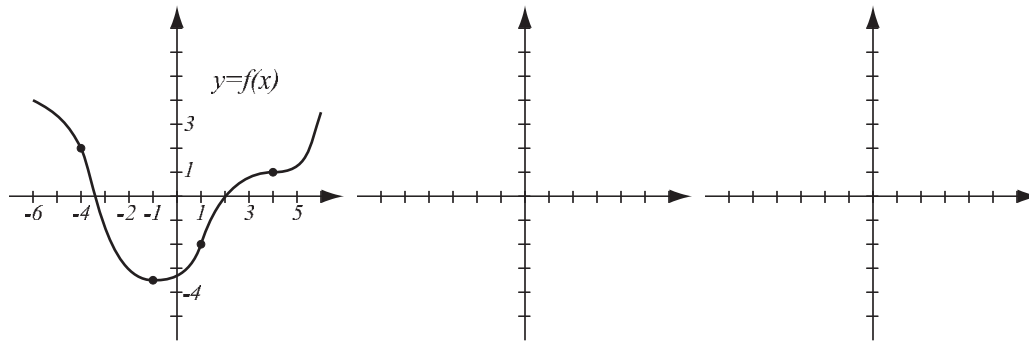


1. (30pts) Let $f(x) = \frac{x^2}{x^2 + 9}$. Draw an accurate graph of f by following the guidelines.
- Find the intervals of increase and decrease, and local extremes.
 - Find the intervals of concavity and points of inflection.
 - Find $\lim_{x \rightarrow \infty} f(x)$ and $\lim_{x \rightarrow -\infty} f(x)$.
 - Use information from a)–c) to sketch the graph.

2. (16pts) Let $f(x) = x^2e^x$. Find the absolute minimum and maximum values of f on the interval $[-4, 1]$.

3. (14pts) The graph of f is given. Use it to draw the graphs of f' and f'' in the coordinate systems provided. Pay attention to increasingness, decreasingness and concavity of f . The relevant special points have been highlighted.

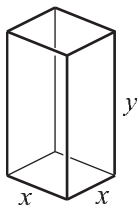


4. (18pts) Consider $f(x) = \sin^2 x - \cos x$ on the interval $[0, 2\pi]$.

a) Verify that the function satisfies the assumptions of the Mean Value Theorem.

b) Find all numbers c that satisfy the conclusion of the Mean Value Theorem.

5. (22pts) A box with a square base uses 50 square inches of material (that is its surface area, including top and bottom). Find the dimensions x, y of the box that give the maximal possible volume of the box.



Bonus. (10pts) Let $f(x) = \frac{5}{9}x^{\frac{9}{5}} - \frac{15}{4}x^{\frac{4}{5}}$. Note domain is all real numbers.

- a) Find the intervals of increase and decrease, and local extremes.
- b) Find the intervals of concavity and points of inflection.
- c) Use information from a) and b) to sketch the graph.