Section 5.1

1. Given the graph of $f'(x)$ find intervals if increase/decrease, local extrema, intervals of concavity and inflection points. Given that $f(x)$ is continuous and $f(0) = 0$, sketch a possible graph of $f(x)$

![Graph of f', the derivative of f](image)

2. Sketch a graph satisfying:
   a.) Domain: All real numbers
   b.) $f(-1) = -2, f(0) = 0, f(2) = 3$
   c.) $f'(x) < 0$ for $x < -1$ and $x > 2$
   d.) $f'(x) > 0$ if $-1 < x < 2$
   e.) $f''(x) > 0$ if $x < 0$ and $f''(x) < 0$ if $x > 0$

Section 5.2

3. For the following functions, identify all critical values.
   a.) $f(x) = 4x^3 - 9x^2 - 12x + 3$
   b.) $f(x) = x^2e^{2x}$
   c.) $f(x) = |x^2 - 2x|$
   d.) $f(x) = (x^2 - x)^{1/3}$
   e.) $f(x) = \frac{x + 1}{x - 2}$

4. Find the absolute and local extrema for the following functions by graphing.
   a.) $f(x) = 1 - x^2, -1 < x \leq 2$
   b.) $f(x) = \begin{cases} x^2 & \text{if } -1 \leq x < 0 \\ 2 - x^2 & \text{if } 0 \leq x \leq 1 \end{cases}$

5. Find the absolute extrema for:
   a.) $f(x) = x^3 - 12x + 1$ over the interval $[-1, 5]$
   b.) $f(x) = x \ln x$ over the interval $[1, 3]$

6. Sketch a graph of a function satisfying the following conditions:
   a.) $x = 2$ is a critical number, but $f(x)$ has no local extrema.
   b.) $f(x)$ is a continuous function with a local maximum at $x = 2$, but $f(x)$ is not differentiable at $x = 2$.

Section 5.3

7. State the Mean Value Theorem. Verify $f(x) = x^2$ satisfies the Mean Value Theorem on the interval $[-1, 2]$. Find all $c$ that satisfies the conclusion of the Mean Value Theorem.

8. Find the intervals where the given function is increasing or decreasing and identify all local extrema:
   a.) $f(x) = 3x^4 + 4x^3 - 12x^2 + 8$
   b.) $y = \tan^{-1}(x^2)$
   c.) $f(x) = \frac{x}{(x - 1)^2}$
   d.) $f(x) = x \sin x + \cos x$ on $[0, 2\pi]$

9. Determine the intervals where the given function is concave up or concave down and identify all inflection points for $f(x) = x^5 + 5x^4$

10. Given $f(-3) = 4, f'(-3) = 0, f''(-3) = 7, f(2) = -5, f'(2) = 0, \text{ and } f''(2) = -6$, identify any local extrema of $f$. 