Name: _____

**Directions:** Show all work. No credit for answers without work.

1. [**4 parts, 3 points each**] The temperature $T$ in degrees Fahrenheit of a frozen pizza placed in a hot oven is given by $T = f(t)$, where $t$ is the time in minutes since the pizza was put in the oven.

   (a) What is the sign of $f'(t)$? Briefly explain your answer.

   (b) What are the units of $f'(t)$?

   (c) What is the sign of $f''(t)$? Briefly explain your answer.

   (d) What are the units of $f''(t)$?

2. [**8 points**] Sketch a graph of a continuous function $f$ with the following properties:

   - When $x < 1$, $f'(x) < 0$; $f'(1) = 0$; and when $x > 1$, $f'(x) > 0$.
   - When $x < 3$, $f''(x) > 0$; $f''(3) = 0$; and when $x > 3$, $f''(x) < 0$.

3. [**10 parts, 2 points each**] Differentiate the following functions.

(a) $f(x) = 4$

(b) $f(x) = 3x^2 - 4x + 1$

(c) $f(x) = \frac{3}{x^4}$

(d) $f(x) = e^{-x}$

(e) $f(x) = 7^x$

(f) $f(x) = 3\sqrt{x}$

(g) $f(x) = \ln\left(\sqrt{3} + e^2\right)$

(h) $f(x) = e^{\sqrt{2}\cdot x}$

(i) $f(x) = x^{\ln(4)}$

(j) $f(x) = 2\ln(x)$

4. [**4 parts, 5 points each**] Differentiate the following functions.

   (a) $f(x) = (x^5 + 2x^3 + 2)(x^4 + 1)$

   (b) $f(x) = (e^x + \ln(x))^8$

   (c) $f(x) = \dfrac{x^4 + x}{x^2 + 1}$

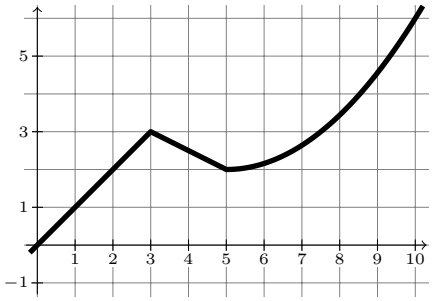
   (d) $f(x) = \sqrt{e^{(x^2)} + 1}$

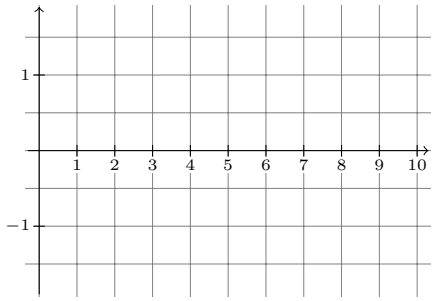
5. Let $g(x) = \ln(x^3 + 1)$.

   (a) [**5 points**] Find $g'(x)$.

   (b) [**5 points**] Find the equation of the tangent line to $g(x)$ at $x = 2$.

6. [**10 points**] The graph of $f(x)$ appears below. Sketch $f'(x)$ in the space provided.



7. Let $f(x) = (2x+1)^3(3x+1)$.

   (a) [**6 points**] Find $f'(x)$.

   (b) [**7 points**] Find the critical points of $f$.

   (c) [**7 points**] Use the First Derivative Test to classify each critical point as a local minimum, a local maximum, or neither.