Part 1: Computational Skills

1) Find the limit below. (4 points)

$$\lim_{x \to 3} \frac{x^2 - 9}{x - 3}$$

2) Find the limit below. (4 points)

$$\lim_{x \to 3} \frac{x - 3}{2x^2 - 5x - 3}$$

3) Find the limit below. (4 points)

$$\lim_{x \to 3} \frac{2x^2 + x - 4}{x - 3}$$

4) Find the limit below. (4 points)

$$\lim_{x \to 3} \frac{\sqrt{x} - \sqrt{3}}{x - 3}$$

5) The limit below comes out to 1. Show every single step and very clear work on how to get there. (14 points)

$$\lim_{x \to 1} \frac{x^2 - 1}{2x - 2}$$

6) Find the derivative of the function below. (4 points)

$$f(x) = 3x^4 + 7x^2 - 5$$

7) Find the derivative of the function below. (4 points)

$$f(x) = \sin(x)\tan(x)$$

8) Find the derivative of the function below. (4 points)

$$f(x) = \frac{2x^2 + 3x}{6x^7 - 5x^4 + 2}$$

9) Find the derivative of the function below. (4 points)

$$f(x) = \tan^{-1}\left(e^{5x^4}\right)$$

10) Given the function below, $f'(2) = 63$. Show every single step and very clear work on how to get there. (14 points)

$$f(x) = 3(3x^2 - 5x - 1)^3$$

Part 2: Conceptual Understanding

Given the graph of $y = f(x)$ below, find or estimate the following.

11) Find the limit below. (2 points)

$$\lim_{x \to -3^-} f(x)$$

12) Find the derivative below. (2 points)

$$f'(-2)$$

13) Find the limit below. (2 points)

$$\lim_{x \to 3^+} f(x)$$

14) Find the derivative below. (2 points)
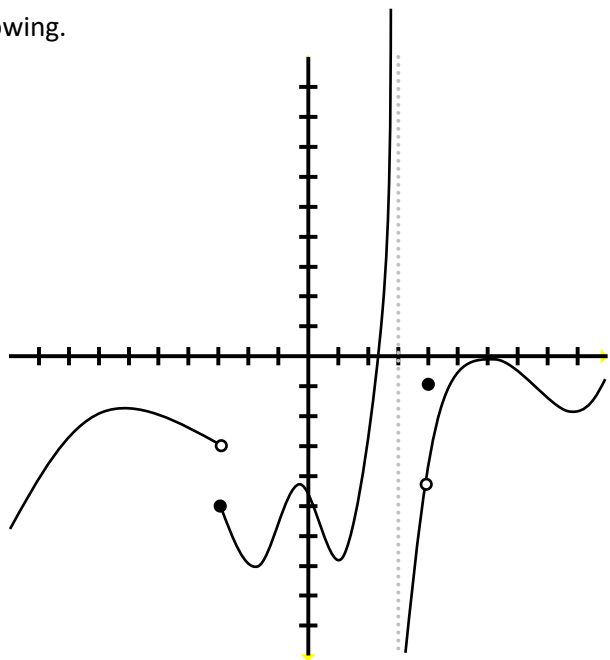
$$f'(5)$$

15) Find the limit below. (2 points)

$$\lim_{x \to 4} f(x)$$

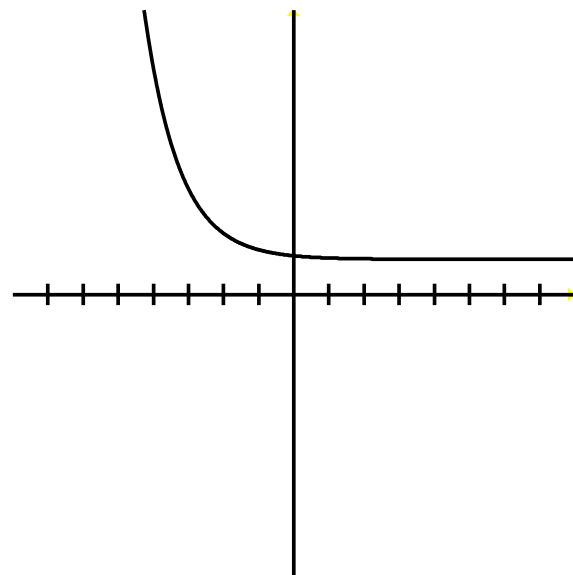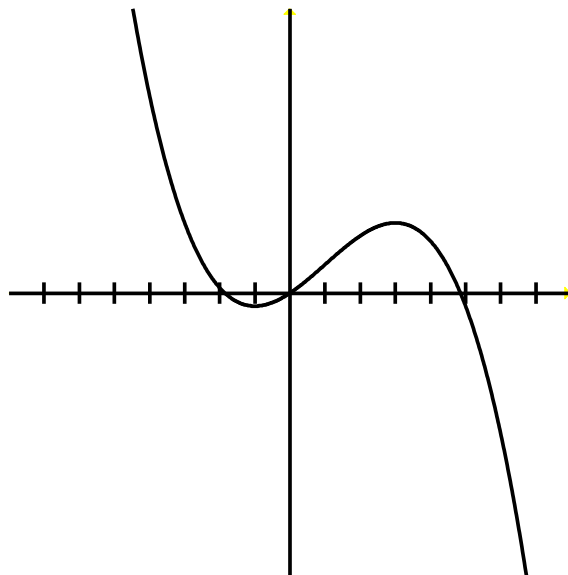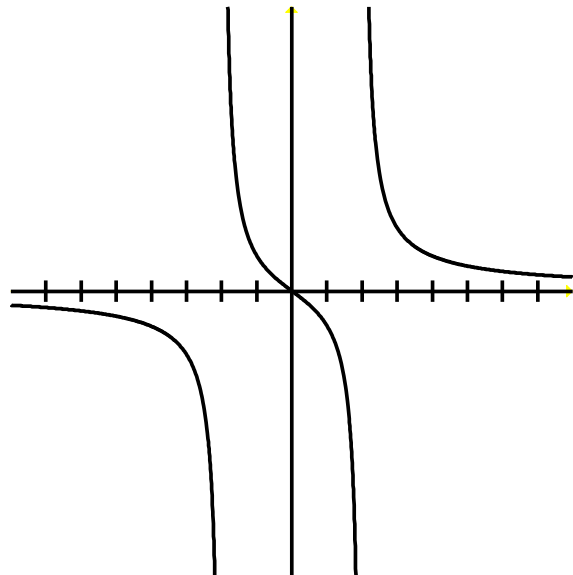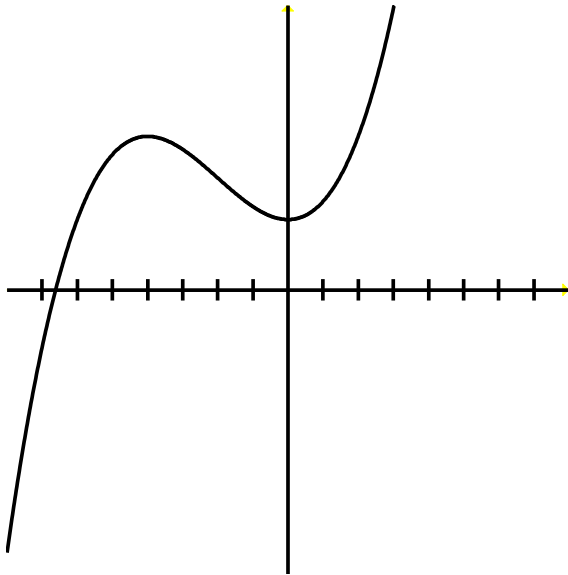16) Find the derivative below. (2 points)

$$f'(3)$$

17) What is the average rate of change of $f(x)$ between $x = 0$ and $x = 1$? (2 points)

18) What is the instantaneous rate of change of $f(x)$ at $x = -1$? (2 points)

19) For each graph given below, graph the derivative. (3 points each)

Part 3: Applications

20) A spherical rubber bladder is being filled with water. Water is pumped I at a rate of 2 cubic feet per minute. How is the radius changing with respect to time when the radius is equal to 2 feet? (8 points)

21) Velocity is defined as the change in position over time. If the relative position of a rodent running away from a cat is given by $p(t) = 3t^2 + 2t$ where p is measured in feet and t is measured in seconds. What is the velocity of the rodent after 2 seconds? (4 points)