1. (16pts) Use the graph of the function to answer the following. Justify your answer if a limit does not exist.

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

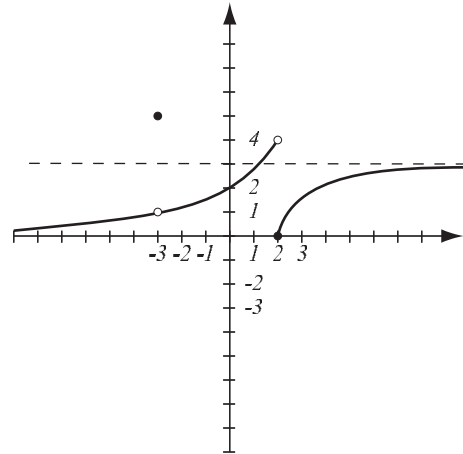$\lim_{x \to 2^+} f(x) =$

$\lim_{x \to 2^-} f(x) =$

$\lim_{x \to 2} f(x) =$

$\lim_{x \to \infty} f(x) =$

$\lim_{x \to -\infty} f(x) =$

List points where f is not continuous and justify why it is not continuous at those points.

2. (4pts) Briefly explain why the function $f(x) = \dfrac{x+3}{3x-2}$ is continuous on its domain.

3. (10pts) Find $\lim_{x \to 0} x^4 \left(\left(7 + \cos\left(\frac{1}{x^3}\right)\right)\right)$. Use the theorem that rhymes with what a doctor may cure.

Find the following limits algebraically. Do not use the calculator.

4. (5pts) $\displaystyle\lim_{x\to 7}\frac{x-7}{x^2-2x-35} =$

5. (7pts) $\displaystyle\lim_{x\to 16}\frac{\sqrt{x}-4}{x-16} =$

6. (7pts) $\displaystyle\lim_{x\to 0}\frac{\sin(3x)}{5x} =$

7. (7pts) $\displaystyle\lim_{x\to\infty}\frac{4x^3-3x^2-7x+2}{7x^3-x^2+5x} =$

8. (6pts) $\displaystyle\lim_{x\to 5^+}\frac{4-2x}{x-5} =$

9. (10pts) Use the Intermediate Value Theorem to show that the equation $x^3 + 2x = 4\sqrt{x} + 2$ has at least one solution.

10. (10pts) Consider the limit $\lim\limits_{x \to 0} \dfrac{5^x - 1}{x}$. Use your calculator to estimate this limit with accuracy 4 decimal points. Write a table of values that will justify your answer.

x	$\dfrac{5^x - 1}{x}$	x	$\dfrac{5^x - 1}{x}$

11. (4pts) Consider the limit below, representing a derivative $f'(a)$: find f and a.

$$\lim_{h \to 0} \frac{(3 + h)^4 - 81}{h}$$

12. (14pts) The amount of water (in gallons) in a 100-gallon tank that is draining at the bottom is given by $V(t) = t^2 - 20t + 100$, where t is in minutes, $0 \le t \le 10$.

a) What is the average rate of draining from $t = 2$ to $t = 5$? What are the units?

b) What is the instantaneous rate of draining when $t = 2$? What are the units?

Bonus. (10pts) Consider the limit $\displaystyle \lim_{x \to \sqrt{3}} \frac{x^2 - 3}{x - \sqrt{3}}$.

a) Use your calculator to estimate this limit with accuracy 4 decimal points. Write a table of values that will justify your answer.

b) Find the limit algebraically.

x	$\dfrac{x^2 - 3}{x - \sqrt{3}}$