

## The Connection Between Asymptotes and Limits

**Part I:** For each question, describe what the given information tells you about the graph of  $y = f(x)$ . Then, decide whether the given information allows you to identify a horizontal or vertical asymptote for the graph of  $y = f(x)$ . If there is sufficient information, state the equations of any asymptotes.

**Example:**  $\lim_{x \rightarrow 2} f(x) = \infty$

- Explain what this tells you about the graph of  $y = f(x)$

As  $x$  gets closer to 2, both from the left and from the right, the  $y$ -coordinates are unbounded, getting larger and larger in the positive direction.

- Vertical asymptote(s)?  No  Yes, equation(s):  $x = 2$
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

1.  $\lim_{x \rightarrow 3^-} f(x) = +\infty$ ,  $\lim_{x \rightarrow 3^+} f(x) = -\infty$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

2.  $\lim_{x \rightarrow +\infty} f(x) = 2$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

3.  $\lim_{x \rightarrow -1^-} f(x) = 4$ ,  $\lim_{x \rightarrow -1^+} f(x) = -\infty$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_



4.  $\lim_{x \rightarrow +\infty} f(x) = 2, \lim_{x \rightarrow -\infty} f(x) = 4$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

5.  $\lim_{x \rightarrow 4^-} f(x) = 2, \lim_{x \rightarrow 4^+} f(x) = 3$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

6.  $\lim_{x \rightarrow 1} f(x) = +\infty, f(1) = 4$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_

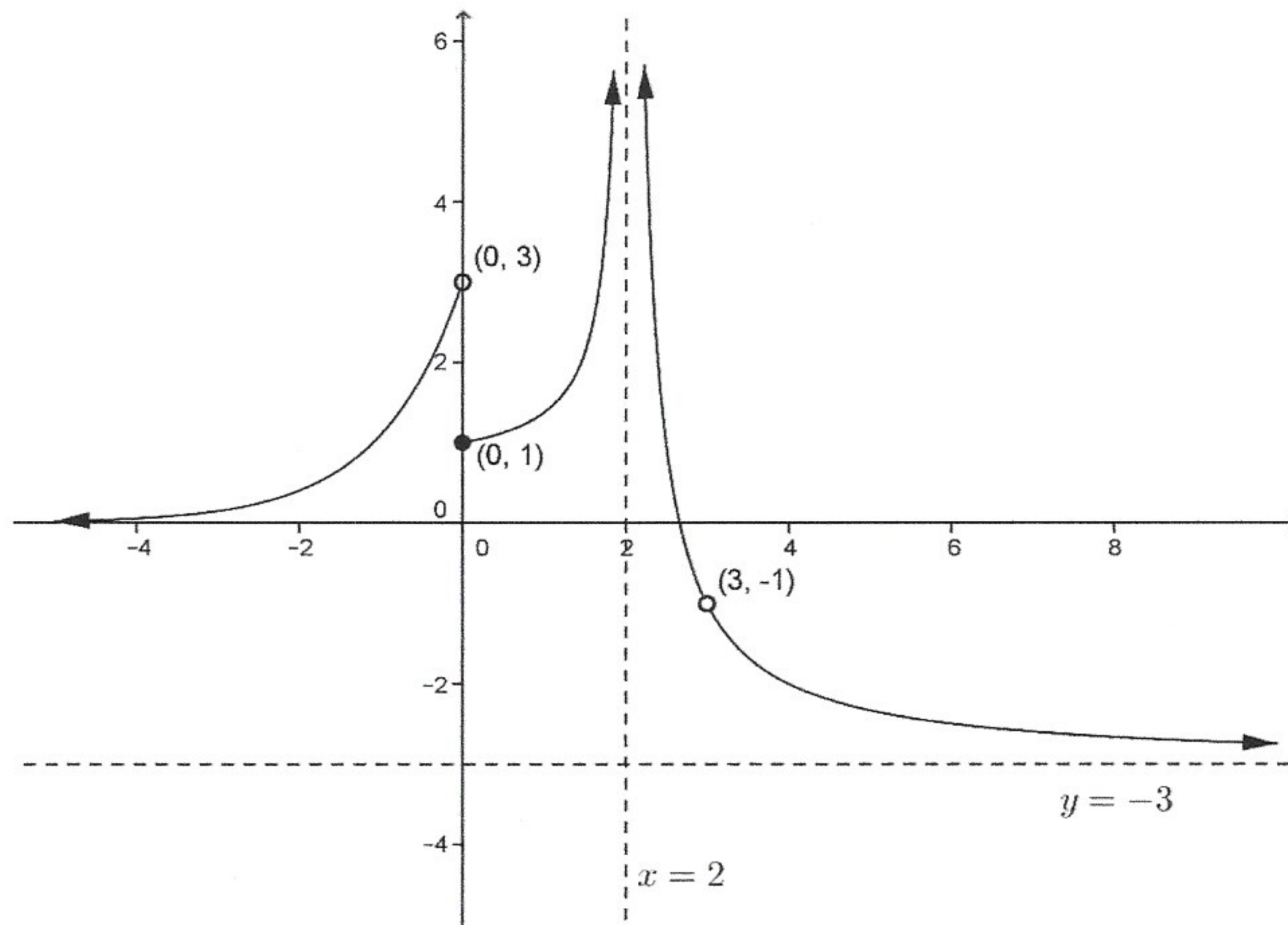
7.  $\lim_{x \rightarrow 2^+} f(x) = -\infty, \lim_{x \rightarrow 3^-} f(x) = +\infty, \lim_{x \rightarrow +\infty} f(x) = +\infty, \lim_{x \rightarrow -\infty} f(x) = -\infty$

- Explain what this tells you about the graph of  $y = f(x)$

- Vertical asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_
- Horizontal asymptote(s)?  No  Yes, equation(s): \_\_\_\_\_



**Part II:** This part of the activity concentrates on writing correct notation for limit statements as well as making the connection between limits and graphical behavior. Shown below is the graph of a function  $f(x)$ . There are eleven limit statements, including one-sided and two-sided limits, based on the labeled points and lines on this graph. Write at least ten of these limit statements.



- |          |           |
|----------|-----------|
| 1. _____ | 6. _____  |
| 2. _____ | 7. _____  |
| 3. _____ | 8. _____  |
| 4. _____ | 9. _____  |
| 5. _____ | 10. _____ |
|          | 11. _____ |