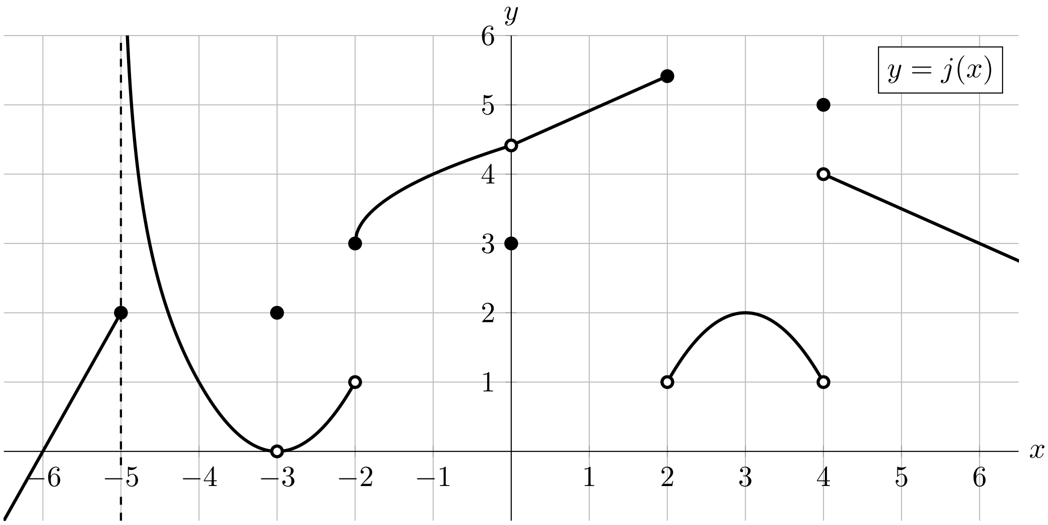
1. [11 points] Below is a portion of the graph of the function $j(x)$. Note that $j(x)$ has a vertical asymptote at $x = -5$, and is linear on the intervals $(-6, -5)$, $(0, 2)$, and $(4, 6)$.



a. [1 point] At which of the following values of x is the function $j(x)$ continuous? Circle all correct answers.

$x = -3$ $\quad$ $x = -2$ $\quad$ $\boxed{x = 3}$ $\quad$ $x = 4$ $\quad$ NONE OF THESE

b. [6 points] Find the **exact** numerical value of each expression below, if possible. For any values that do not exist, including if they are limits that diverge to $\pm\infty$, write DNE.

i. $\lim_{x\to 3} j(x) =$ 2

ii. $\lim_{x\to -3} j(x) =$ 0

iii. $\lim_{x\to 4} j(x) =$ **DNE**

iv. $\lim_{x\to 0} \dfrac{j(5+x) - j(5)}{x} =$ $-1/2$

v. $\lim_{x\to 2^+} j(x) =$ 1

vi. $\lim_{x\to -5^+} \dfrac{1}{j(x)} =$ 0

c. [2 points] Consider the function $k(x) = 2 \cdot j\left(\frac{1}{2}(x-9)\right) + 1$. Which of the following must be a vertical asymptote of $k(x)$? Circle the one correct answer.

$x = -9$ $\quad$ $x = -5$ $\quad$ $x = -3$ $\quad$ $\boxed{x = -1}$ $\quad$ $x = 1$

d. [2 points] Given that $j'(-4) = -2$, find an equation of the line tangent to the graph of $j(x)$ at the point $(-4, 1)$.

Solution: An equation of the line tangent to the graph of $j(x)$ at $x = -4$ is given by

$$y - j(-4) = j'(-4)(x + 4).$$

Subbing in $j(-4) = 1$ and $j'(-4) = -2$, we get the equation $y - 1 = -2(x + 4)$.

Answer: $y = 1 - 2(x + 4)$, **or** $y = -2x - 7$