1. Find the domain of each of the following functions, and list in interval notation. **Use a number line to convert from inequalities to intervals, if necessary.**

\[ f(x) = \frac{5 + 2\sqrt{x + 4}}{x^2 - 1} \]

In this function we have two restrictions; the radicand of the square root in the numerator \((x + 4)\) must be non-negative, and the denominator of the fraction \((x^2 - 1)\) cannot be equal to zero.

\[ x + 4 \geq 0 \quad \text{AND} \quad x^2 - 1 \neq 0 \]

\[ x \geq -4 \quad \text{AND} \quad (x - 1)(x + 1) \neq 0 \]

\[ x \geq -4 \quad \text{AND} \quad x - 1 \neq 0 \quad \text{AND} \quad x + 1 \neq 0 \]

\[ x \geq -4 \quad \text{AND} \quad x \neq 1 \quad \text{AND} \quad x \neq -1 \]

The inequality \(x \geq -4\) indicates that only inputs that are greater than or equal to \(-4\) are allowed for the function \(f(x)\). However two inputs which are greater than or equal to \(-4\) are not allowed; \(1\) and \(-1\). So we must exclude those two inputs from the set of real numbers that are greater than or equal to \(-4\).
Taking our number and translating that to interval notation, we have the following:

$$\left[-4, -1\right) \cup (-1, 1) \cup (1, \infty)$$
2. Given \( k(x) = \frac{1}{x\sqrt{1+x}} \), find the domain of the function.

\[
\frac{1}{x\sqrt{1+x}}
\]

\( x\sqrt{1+x} \neq 0 \) AND \( 1 + x \geq 0 \)

\( x \neq 0 \) AND \( \sqrt{1+x} \neq 0 \) AND \( x \geq -1 \)

\( x \neq 0 \) AND \( 1 + x \neq 0 \) AND \( x \geq -1 \)

\( x \neq 0 \) AND \( x \neq -1 \) AND \( x \geq -1 \)

The second inequality \( (x \neq -1) \) tells us that we cannot have an input of \(-1\), while the third inequality \( (x \geq -1) \) tells us that we must inputs that are greater than or equal to \(-1\). However since \( x \neq -1 \), we must change the third inequality to \( x \) is strictly greater than negative one \( (x > -1) \) since \( x \) cannot equal \(-1\).

\( x \neq 0 \) AND \( x \neq -1 \) AND \( x \geq -1 \)

\( x \neq 0 \) AND \( x > -1 \)
Taking our number and translating that to interval notation, we have the following:

$\left( -1, 0 \right) \cup \left( 0, \infty \right)$