Example

Complete the square to find the standard form of the given equation. Then give the center and radius of the circle.

\[ x^2 + y^2 - 4x - 2y - 139 = 0 \]

**ANSWER:**
Rearranging and completing the square, we have

\[
\begin{align*}
x^2 + y^2 - 4x - 2y - 139 &= 0 \\
x^2 - 4x + y^2 - 2y &= 139 \\
x^2 - 4x + 4 + y^2 - 2y + 1 &= 139 + 4 + 1 \\
(x - 2)^2 + (y - 1)^2 &= 144
\end{align*}
\]

This is the standard form of the equation. From this, we see that \( h = 2 \), \( k = 1 \), and \( r^2 = 144 \), so \( r = 12 \). The center is \((2, 1)\) and the radius is 12.