TRANSLATIONS OF RADICAL FUNCTIONS The procedure for graphing functions of the form $y = a\sqrt{x - h} + k$ and $y = a\sqrt[3]{x - h} + k$ is described below.

KEY CONCEPT   *For Your Notebook*

Graphs of Radical Functions

To graph $y = a\sqrt{x - h} + k$ or $y = a\sqrt[3]{x - h} + k$, follow these steps:

STEP 1   **Sketch** the graph of $y = a\sqrt{x}$ or $y = a\sqrt[3]{x}$.

**STEP 2**   **Translate** the graph horizontally h units and vertically k units.

EXAMPLE 4   **Graph a translated square root function**

Graph $y = -2\sqrt{x - 3} + 2$. Then state the domain and range.

Solution

STEP 1   **Sketch** the graph of $y = -2\sqrt{x}$ (shown in blue). Notice that it begins at the origin and passes through the point $(1, -2)$.

STEP 2   **Translate** the graph. For $y = -2\sqrt{x - 3} + 2$, $h = 3$ and $k = 2$. So, shift the graph of $y = -2\sqrt{x}$ right 3 units and up 2 units. The resulting graph starts at $(3, 2)$ and passes through $(4, 0)$.
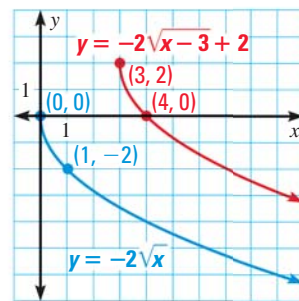
From the graph, you can see that the domain of the function is $x \geq 3$ and the range of the function is $y \leq 2$.

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EXAMPLE 5   **Graph a translated cube root function**

Graph $y = 3\sqrt[3]{x + 4} - 1$. Then state the domain and range.

Solution

STEP 1   **Sketch** the graph of $y = 3\sqrt[3]{x}$ (shown in blue). Notice that it passes through the origin and the points $(-1, -3)$ and $(1, 3)$.

STEP 2   **Translate** the graph. Note that for $y = 3\sqrt[3]{x + 4} - 1$, $h = -4$ and $k = -1$. So, shift the graph of $y = 3\sqrt[3]{x}$ left 4 units and down 1 unit. The resulting graph passes through the points $(-5, -4)$, $(-4, -1)$, and $(-3, 2)$.
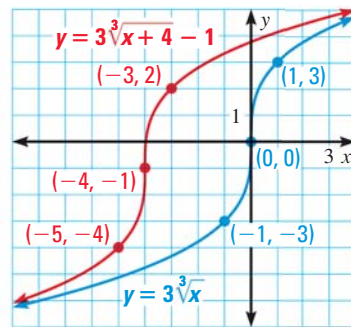
From the graph, you can see that the domain and range of the function are both all real numbers.

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