EXAMPLE 4 Find the minimum or maximum value

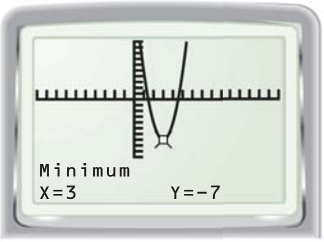
Tell whether the function $y = 3x^2 - 18x + 20$ has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.

Solution

Because $a > 0$, the function has a minimum value. To find it, calculate the coordinates of the vertex.

$$x = -\frac{b}{2a} = -\frac{(-18)}{2(3)} = 3$$

$$y = 3(3)^2 - 18(3) + 20 = -7$$



▸ The minimum value is $y = -7$. You can check the answer on a graphing calculator.

TAKS EXAMPLE 5 TAKS REASONING: Multi-Step Problem

GO-CARTS A go-cart track has about 380 racers per week and charges each racer \$35 to race. The owner estimates that there will be 20 more racers per week for every \$1 reduction in the price per racer. How can the owner of the go-cart track maximize weekly revenue?

Solution

STEP 1 **Define** the variables. Let x represent the price reduction and $R(x)$ represent the weekly revenue.

STEP 2 **Write** a verbal model. Then write and simplify a quadratic function.

Revenue (dollars)	=	Price (dollars/racer)	•	Attendance (racers)
$R(x)$	=	$(35 - x)$	•	$(380 + 20x)$

$$R(x) = 13{,}300 + 700x - 380x - 20x^2$$

$$R(x) = -20x^2 + 320x + 13{,}300$$

INTERPRET FUNCTIONS
Notice that $a = -20 < 0$, so the revenue function has a maximum value.

STEP 3 **Find** the coordinates $(x, R(x))$ of the vertex.

$$x = -\frac{b}{2a} = -\frac{320}{2(-20)} = 8 \qquad \text{Find } x\text{-coordinate.}$$

$$R(8) = -20(8)^2 + 320(8) + 13{,}300 = 14{,}580 \qquad \text{Evaluate } R(8).$$

▸ The vertex is (8, 14,580), which means the owner should reduce the price per racer by \$8 to increase the weekly revenue to \$14,580.

✓ GUIDED PRACTICE for Examples 4 and 5

7. Find the minimum value of $y = 4x^2 + 16x - 3$.

8. **WHAT IF?** In Example 5, suppose each \$1 reduction in the price per racer brings in 40 more racers per week. How can weekly revenue be maximized?