## EXAMPLE 3 Find the minimum or maximum value

**Tell whether the function $f(x) = -3x^2 - 12x + 10$ has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.**

### Solution

Because $a = -3$ and $-3 < 0$, the parabola opens down and the function has a maximum value. To find the maximum value, find the vertex.

$$x = -\frac{b}{2a} = -\frac{-12}{2(-3)} = -2$$ The $x$-coordinate is $-\frac{b}{2a}$.

$$f(-2) = -3(-2)^2 - 12(-2) + 10 = 22$$ Substitute $-2$ for $x$. Then simplify.

▶ The maximum value of the function is $f(-2) = 22$.

## EXAMPLE 4 Find the minimum value of a function

**SUSPENSION BRIDGES** The suspension cables between the two towers of the Mackinac Bridge in Michigan form a parabola that can be modeled by the graph of $y = 0.000097x^2 - 0.37x + 549$ where $x$ and $y$ are measured in feet. What is the height of the cable above the water at its lowest point?


### Solution

The lowest point of the cable is at the vertex of the parabola. Find the $x$-coordinate of the vertex. Use $a = 0.000097$ and $b = -0.37$.

$$x = -\frac{b}{2a} = -\frac{-0.37}{2(0.000097)} \approx 1910$$ Use a calculator.

Substitute 1910 for $x$ in the equation to find the $y$-coordinate of the vertex.

$$y \approx 0.000097(1910)^2 - 0.37(1910) + 549 \approx 196$$

▶ The cable is about 196 feet above the water at its lowest point.

## ✓ GUIDED PRACTICE for Examples 3 and 4

3. Tell whether the function $f(x) = 6x^2 + 18x + 13$ has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.

4. **SUSPENSION BRIDGES** The cables between the two towers of the Takoma Narrows Bridge form a parabola that can be modeled by the graph of the equation $y = 0.00014x^2 - 0.4x + 507$ where $x$ and $y$ are measured in feet. What is the height of the cable above the water at its lowest point? Round your answer to the nearest foot.