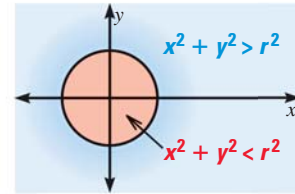


**CIRCLES AND INEQUALITIES** The regions inside and outside the circle  $x^2 + y^2 = r^2$  can be described by inequalities, with  $x^2 + y^2 < r^2$  representing the region inside the circle and  $x^2 + y^2 > r^2$  representing the region outside the circle.



### EXAMPLE 4 Write a circular model

**CELL PHONES** A cellular phone tower services a 10 mile radius. You get a flat tire 4 miles east and 9 miles north of the tower. Are you in the tower's range?

#### Solution

**STEP 1** Write an inequality for the region covered by the tower. From the diagram, this region is all points that satisfy the following inequality:

$$x^2 + y^2 < 10^2$$

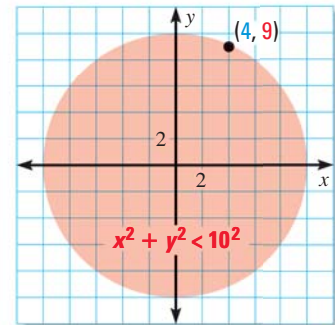
**STEP 2** Substitute the coordinates (4, 9) into the inequality from Step 1.

$$x^2 + y^2 < 10^2 \quad \text{Inequality from Step 1}$$

$$4^2 + 9^2 \stackrel{?}{<} 10^2 \quad \text{Substitute for } x \text{ and } y.$$

$$97 < 100 \quad \checkmark \quad \text{The inequality is true.}$$

► So, you are in the tower's range.



In the diagram above, the origin represents the tower and the positive  $y$ -axis represents north.

### EXAMPLE 5 Apply a circular model

**CELL PHONES** In Example 4, suppose that you fix your tire and then drive south. For how many more miles will you be in range of the tower?

#### Solution

When you leave the tower's range, you will be at a point on the circle  $x^2 + y^2 = 10^2$  whose  $x$ -coordinate is 4 and whose  $y$ -coordinate is negative. Find the point (4,  $y$ ) where  $y < 0$  on the circle  $x^2 + y^2 = 10^2$ .

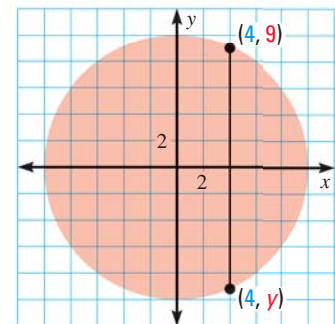
$$x^2 + y^2 = 10^2 \quad \text{Equation of the circle}$$

$$4^2 + y^2 = 10^2 \quad \text{Substitute 4 for } x.$$

$$y = \pm\sqrt{84} \quad \text{Solve for } y.$$

$$y \approx \pm 9.2 \quad \text{Use a calculator.}$$

► Because  $y < 0$ ,  $y \approx -9.2$ . You will be in the tower's range from (4, 9) to (4,  $-9.2$ ), a distance of  $|9 - (-9.2)| = 18.2$  miles.



### GUIDED PRACTICE for Examples 4 and 5

6. **WHAT IF?** In Examples 4 and 5, suppose you drive west after fixing your tire. For how many more miles will you be in range of the tower?