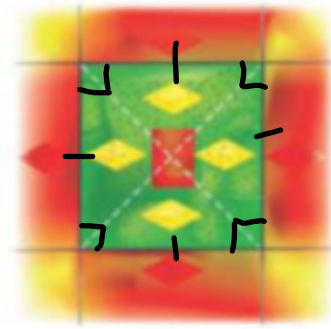
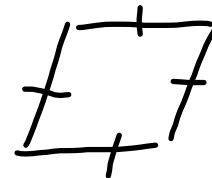


3. **QUILTING** Kathy is designing a quilt with blocks like the one shown.
- If she marks the diagonals of each yellow piece and determines that each pair of diagonals is perpendicular, can she conclude that each yellow piece is a rhombus? Explain.
  - If all four angles of the green piece have the same measure and the bottom and left sides have the same measure, can she conclude that the green piece is a square? Explain.



**Sachin has a shape he knows to be a parallelogram and all four sides are congruent. Which information does he need to know to determine whether it is also a square?**

- The diagonal bisects a pair of opposite angles.
- The diagonals bisect each other.
- The diagonals are perpendicular.
- The diagonals are congruent.



**D. The diagonals are congruent.**

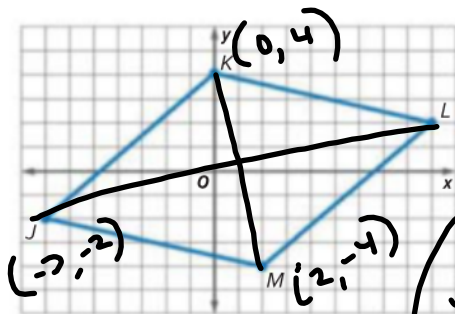
**Example 4** Classify Quadrilaterals Using Coordinate Geometry

**COORDINATE GEOMETRY** Determine whether  $\square JKLM$  with vertices  $J(-7, -2)$ ,  $K(0, 4)$ ,  $L(9, 2)$ , and  $M(2, -4)$  is a *rhombus*, a *rectangle*, or a *square*. List all that apply. Explain.

**Understand** Plot and connect the vertices on a coordinate plane.

It appears from the graph that the parallelogram has four congruent sides, but no right angles. So, it appears that the figure is a rhombus, but not a square or a rectangle.

**Plan** If the diagonals of the parallelogram are congruent, then it is a rectangle. If they are perpendicular, then it is a rhombus. If they are both congruent and perpendicular, the parallelogram is a rectangle, a rhombus, and a square.



$$km = \frac{4 - -2}{0 - -7} = \frac{6}{7}$$

$$jl = \frac{-2 - 2}{-7 - 9} = \frac{-4}{-16} = \frac{1}{4}$$

$\frac{6}{7} \neq \frac{1}{4}$

**Solve Step 1** Use the Distance Formula to compare the diagonal lengths.

$$KM = \sqrt{(0 - -7)^2 + (4 - -2)^2} = \sqrt{49 + 36} = \sqrt{85}$$

$$JL = \sqrt{(-7 - 9)^2 + (-2 - 2)^2} = \sqrt{256 + 16} = \sqrt{272}$$

Rhombus

**Step 2** Use the Slope Formula to determine whether the diagonals are perpendicular.

### Guided Practice

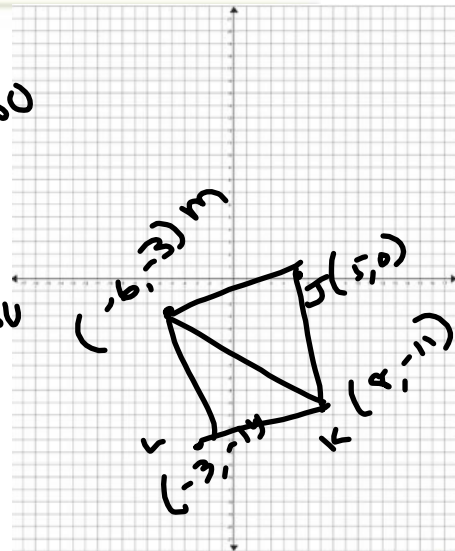
4. Given  $J(5, 0)$ ,  $K(8, -11)$ ,  $L(-3, -14)$ ,  $M(-6, -3)$ , determine whether parallelogram  $JKLM$  is a rhombus, a rectangle, or a square. List all that apply. Explain.

$$mK \sqrt{\frac{(-6-8)^2 + (-3-11)^2}{196 + 64}} = \sqrt{260}$$

$$LJ \sqrt{\frac{(-3-5)^2 + (-14-0)^2}{64 + 196}} = \sqrt{260}$$

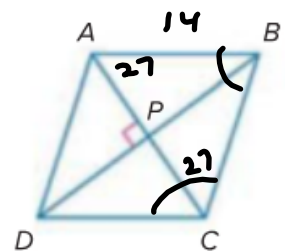
$$mK = -\frac{8}{14} \quad LJ = \frac{+14}{+8} = \frac{1}{1}$$

Square



**ALGEBRA** Quadrilateral  $ABCD$  is a rhombus. Find each value or measure.

7. If  $AB = 14$ , find  $BC$ .  $= 14$
8. If  $m\angle BCD = 54$ , find  $m\angle BAC$ .  $= 27$
9. If  $AP = 3x - 1$  and  $PC = x + 9$ , find  $AC$ .
10. If  $DB = 2x - 4$  and  $PB = 2x - 9$ , find  $PD$ .
11. If  $m\angle ABC = 2x - 7$  and  $m\angle BCD = 2x + 3$ , find  $m\angle DAB$ .
12. If  $m\angle DPC = 3x - 15$ , find  $x$ .



$$\begin{aligned} 9) \quad 3x - 1 &= x + 9 \\ 2x &= 10 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} 5 + 9 &= 14 \\ \frac{14}{2} &= 7 \end{aligned}$$

$$\begin{aligned} 10) \quad 2x - 4 &= 2(2x - 9) \\ 2x - 4 &= 4x - 18 \\ 14 &= 2x \\ 7 &= x \end{aligned}$$

$$PD = 2(7) - 9 = 5$$

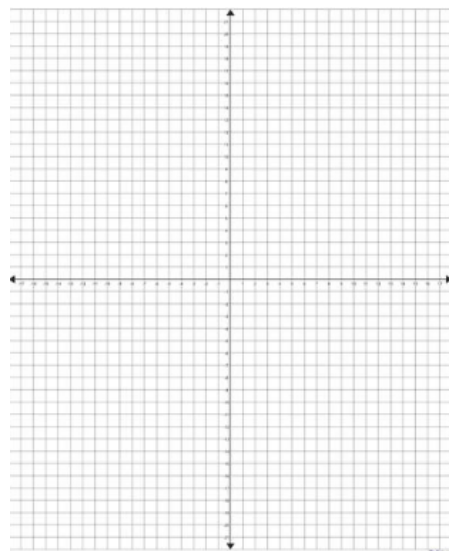
$$\begin{aligned} 11) \quad 2x - 7 + 2x + 3 &= 180 \\ 4x - 4 &= 180 \\ 4x &= 184 \\ x &= 46 \end{aligned}$$

$$\begin{aligned} \angle DAB &= 2(46) + 3 \\ &= 95 \end{aligned}$$

$$\begin{aligned} 12) \quad 3x - 15 &= 90 \\ 3x &= 105 \\ x &= 35 \end{aligned}$$

**COORDINATE GEOMETRY** Given each set of vertices, determine whether  $\square JKLM$  is a *rhombus*, a *rectangle*, or a *square*. List all that apply. Explain.

19.  $J(-4, -1)$ ,  $K(1, -1)$ ,  $L(4, 3)$ ,  $M(-1, 3)$



$ABCD$  is a rhombus. If  $PB = 12$ ,  $AB = 15$ , and  $m\angle ABD = 24$ , find each measure.

23.  $AP$

25.  $m\angle BDA$

24.  $CP$

26.  $m\angle ACB$

