7.1 Comparing Positions on a Grid

You will need
- grid paper

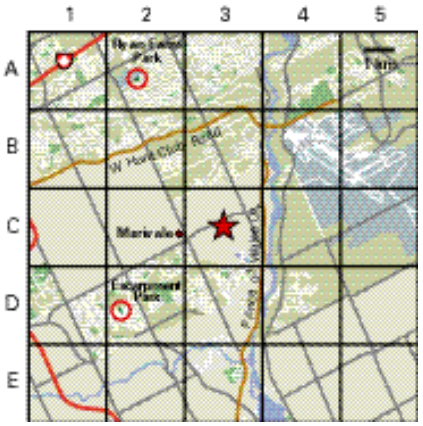
GOAL
Locate positions on a Cartesian grid with integer coordinates.

Learn about the Math

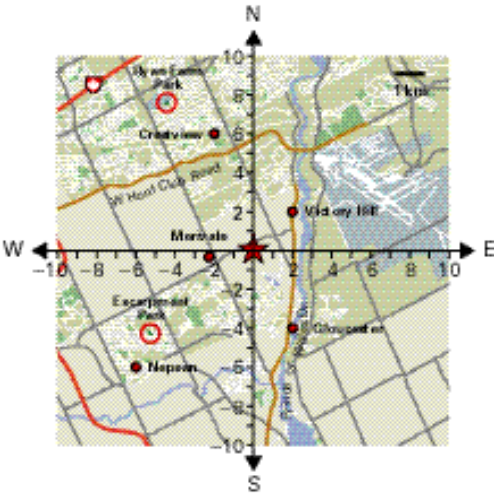
Katya and Susan use a map of their neighbourhood to plan a bicycle route. The girls want their route to start at Katya's house and end at Escarpment Park. They decide to mark Katya's house with a red star.

Katya draws a grid of squares on her copy of the map to help her find different locations. Susan uses a **Cartesian coordinate system**. She draws two axes that cross at Katya's house.

Cartesian coordinate system
a method (named after mathematician René Descartes) for describing a location by identifying the distance from a horizontal number line (the *x*-axis) and a vertical number line (the *y*-axis); the axes intersect at 0; the location is represented by an ordered pair of coordinates, (*x*, *y*)



Katya's Map



Susan's Map

? Whose method is easier for identifying locations on the map, Katya's or Susan's?

A. Using Susan's map, identify the location that is represented by each set of coordinates below.

a) (+2, +2) **b)** (−6, −6) **c)** (−2, +6) **d)** (+2, −4)

B. Name the coordinates of each location using the grid system on Katya's map and Susan's map.

a) Katya's house **b)** Escarpment Park **c)** Ryan Farm Park

C. Susan says that CD Express has the coordinates $(+3, -4)$ on her map and Pizza Shack has the coordinates $(-4, -2)$.

a) Which location is farther west? How do you know?

b) Which location is farther south? How do you know?

D. Susan rides her bicycle from her school, at $(-5, +4)$, to her grandmother's house, at $(-3, +6)$.

a) Does she ride east or west? **b)** Does she ride north or south?

Reflecting

1. You are given the coordinates of two points on a Cartesian coordinate system. How can you tell which point is farther north? Explain.

2. You are given the coordinates of two different points. How can you tell which point is farther west? Explain.

3. Which coordinate grid is easier for identifying locations, Katya's or Susan's? Explain your thinking.

Communication Tip

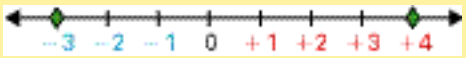
- The plus sign (+) in a set of coordinates or an ordered pair is not usually included before positive integers. $(+3, -4)$ can be written as $(3, -4)$.
- The point where the axes intersect is $(0, 0)$. This is called the origin and can be represented by O.

Work with the Math

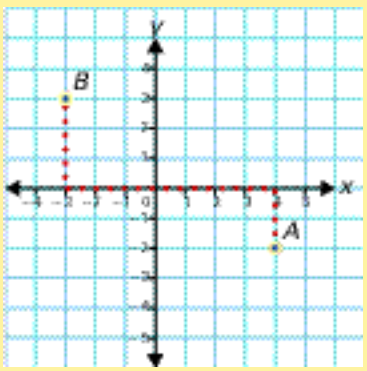
Example: Describing locations of points

Point A has coordinates $(4, -2)$ on a Cartesian coordinate system. Where is $B(-3, 3)$ in relation to A?

James's Solution



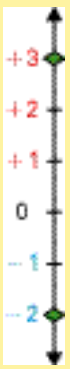
I compared the first coordinates of the two ordered pairs, 4 and –3, on a horizontal number line. Since $-3 < 4$, B is to the left of A.



I compared the second coordinates of the ordered pairs, -2 and 3, on a vertical number line.

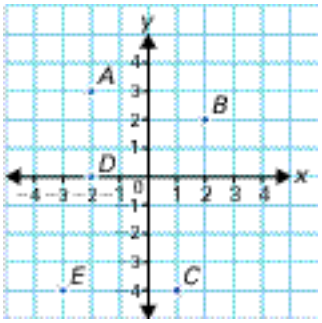
Since $3 > -2$, B is above A.

I drew the horizontal number line to intersect the vertical number line, so they become the axes of a Cartesian coordinate system. When I plotted the points, $B(-3, 3)$ is to the left and above $A(4, -2)$.



A Checking

4. Name the coordinates for each point.



5. Plot the following points on a Cartesian coordinate system:

(2, 3), (−1, 4), (−3, −5), (4, −6), (0, 0)

6. Plot each set of points on a separate Cartesian coordinate system. Connect the points in order, and connect the last point to the first point. Write the name of the polygon you formed. Explain how you know the name.

a) $A(0, 5)$, $B(4, 5)$, $C(4, 0)$

b) $D(-3, 1)$, $E(-3, -3)$, $F(-1, -4)$, $G(-1, 3)$

7. Use each inequality to complete the ordered pairs and make the statement true.

a) Since $-5 < 6$, (, 4) is to the left of (, 4).

b) Since $-2 > -8$, (10,) is above (10,).

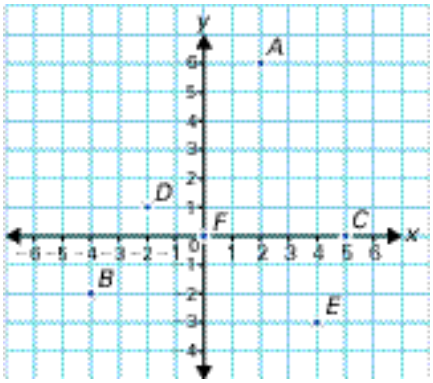
8. Copy and complete each statement by filling in the boxes. (Replace ? with a number from the first ordered pair.)

a) (5, −3) is to the right of (, 2) because ? > .

b) (2, −6) is below (2,) because ? < .

B Practising

9. Name the coordinates for each point.



10. Plot each set of points on a separate Cartesian coordinate system. Connect the points in order, and connect the last point to the first. Write the name of the polygon you formed. Explain how you know the name.

a) $R(-5, 2)$, $S(0, 0)$, $T(0, -4)$

b) $K(0, 3)$, $L(-5, 0)$, $M(0, -3)$, $N(5, 0)$

c) $U(-2, 3)$, $V(4, 3)$, $W(3, -1)$, $X(-3, -1)$

d) $A(-3, 4)$, $B(4, 5)$, $C(1, -2)$, $D(-2, -5)$, $E(-6, 0)$

11. Name three points for each description.

a) to the left of (−17, −12)

b) to the right of (−17, −12)

c) above (−17, −12)

d) below (−17, −12)

12. Copy and complete each statement. Write "above" or "below" in the green box. Write the correct numbers from the vertical axis in the grey boxes.

a) (4, −5) is ■ (−4, −3) because < .

b) (−10, −1) is ■ (−4, −3) because > .

13. Copy and complete each statement. Write "left" or "right" in the green box. Write the correct numbers from the horizontal axis in the grey boxes.

a) $(4, -3)$ is to the ■ of $(-5, -2)$ because ■ $>$ ■.

b) $(-10, -1)$ is to the ■ of $(-5, -2)$ because ■ $<$ ■.

14. Copy and complete each statement. Write $>$ or $<$ in the grey boxes. Write "above" or "below" in the green box. Write "right" or "left" in the blue box.

a) Since -15 ■ -42 and 31 ■ -16, $(-15, 31)$ is ■ and to the ■ of $(-42, -16)$.

b) Since 8 ■ -5, -10 ■ -18, $(8, -10)$ is ■ and to the ■ of $(-5, -18)$.

15. Use the points $(-21, 38)$, $(-38, 25)$, $(-25, -38)$, and $(-38, -25)$.

a) Which point is farthest left?

b) Which point is farthest right?

c) Which point is highest up?

d) Which point is lowest down?

16. a) List five points where the y-coordinate is the opposite integer of the x-coordinate.

b) Plot your points on a Cartesian coordinate system.

c) What pattern do these points form?

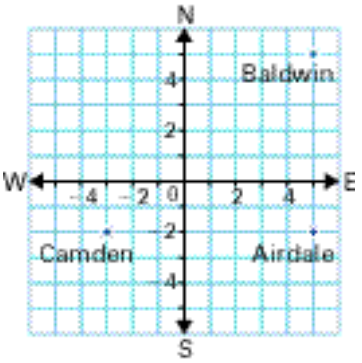
d) As the first coordinate increases, does the point move up, down, to the right, or to the left?

17. (a, b) is below and to the left of (c, d).

a) Is a greater or less than c?

b) Is b greater or less than d?

18. Each unit on this map represents 5 km.



a) Find the distance between Baldwin and Airdale.

b) Find the distance between Camden and Airdale.

c) Can you accurately find the distance between Baldwin and Camden? Explain.

19. A right triangle has these two vertices: $A(-2, 2)$ and $Z(-8, -3)$. What are the coordinates of the other vertex? Draw two possible answers.

20. Draw a parallelogram that has $(-5, -3)$ as its top right corner. State the possible coordinates of the other corners. Explain how you determined these coordinates.

C Extending

21. Suppose that $c < d$ and $f > g$.

a) Describe the positions of (c, f) and (d, g) in relation to each other.

b) Describe the positions of (c, d) and (f, g) in relation to each other.

22. The diagonals of a rectangle intersect at $(0, 0)$. The rectangle is 6 units long and 4 units wide. Find the coordinates of the four corners of the rectangle.

23. On a Cartesian coordinate system, draw two different triangles that each have an area of 30 square units.