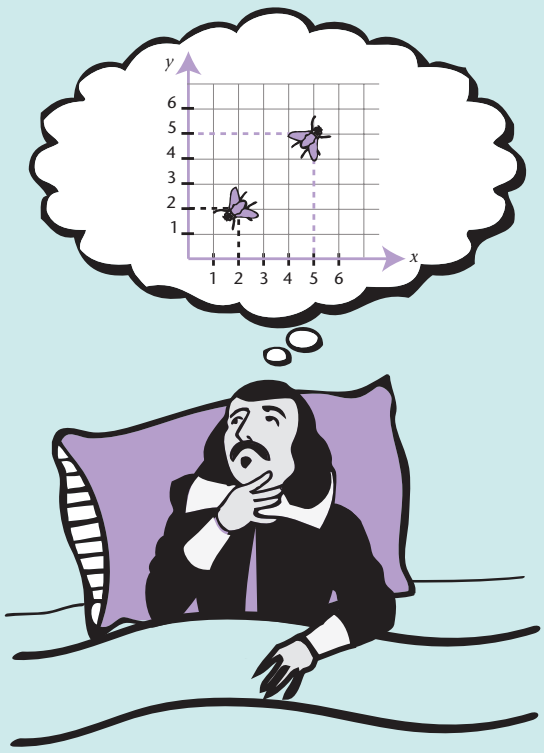
Module 4
Version 03
Sections 1–2

Math 7

Module 4

Cartesian Plane



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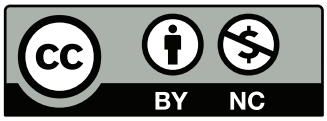

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Course Overview

Welcome to Mathematics 7!

In this course you will continue your exploration of mathematics. You'll have a chance to practise and review the math skills you already have as you learn new concepts and skills. This course will focus on math in the world around you and help you to increase your ability to think mathematically.

Organization of the Course

The Mathematics 7 course is made up of seven modules. These modules are:

Module 1: Numbers and Operations

Module 2: Fractions, Decimals, and Percents

Module 3: Lines and Shapes

Module 4: Cartesian Plane

Module 5: Patterns

Module 6: Equations

Module 7: Statistics and Probability

Organization of the Modules

Each module has either two or three sections. The sections have the following features:

Pretest	This is for students who feel they already know the concepts in the section. It is divided by lesson, so you can get an idea of where you need to focus your attention within the section.
Section Challenge	This is a real-world application of the concepts and skills to be learned in the section. You may want to try the problem at the beginning of the section if you're feeling confident. If you're not sure how to solve the problem right away, don't worry—you'll learn all the skills you need as you complete the lessons. We'll return to the problem at the end of the section.

Each section is divided into lessons. Each lesson is made up of the following parts:

Student Inquiry	Inquiry questions are based on the concepts in each lesson. This activity will help you organize information and reflect on your learning.
Warm-up	This is a brief drill or review to get ready for the lesson.
Explore	This is the main teaching part of the lesson. Here you will explore new concepts and learn new skills.
Practice	These are activities for you to complete to solidify your new skills. Mark these activities using the answer key at the end of the module.

At the end of each module you will find:

Resources	Templates to pull out, cut, colour, or fold in order to complete specific activities. You will be directed to these as needed.
Glossary	This is a list of key terms and their definitions for the module.
Answer Key	This contains all of the solutions to the Pretests, Warm-ups and Practice activities.

Thinking Space

The column on the right hand side of the lesson pages is called the Thinking Space. Use this space to interact with the text using the strategies that are outlined in Module 1. Special icons in the Thinking Space will cue you to use specific strategies (see the table below). Remember, you don't have to wait for the cues—you can use this space whenever you want!

	Just Think It: Questions	Write down questions you have or things you want to come back to.
	Just Think It: Comments	Write down general comments about patterns or things you notice.
	Just Think It: Responses	Record your thoughts and ideas or respond to a question in the text.
	Sketch It Out	Draw a picture to help you understand the concept or problem.
	Word Attack	Identify important words or words that you don't understand.
	Making Connections	Connect what you are learning to things you already know.

More About the Pretest

There is a pretest at the beginning of each section. This pretest has questions for each lesson in the sections. Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in the section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Materials and Resources

There is no textbook required for this course. All of the necessary materials and exercises are found in the modules.

In some cases, you will be referred to templates to pull out, cut, colour, or fold. These templates will always be found near the end of the module, just in front of the answer key.

You will need a calculator for some of the activities and a geometry set for Module 3 and Module 7.

If you have Internet access, you might want to do some exploring online. The Math 7 Course Website will be a good starting point. Go to:

http://www.openschool.bc.ca/courses/math/math7/mod4.html

and find the lesson that you're working on. You'll find relevant links to websites with games, activities, and extra practice. Note: access to the course website is not required to complete the course.

Icons

In addition to the thinking space icons, you will see a few icons used on the left-hand side of the page. These icons are used to signal a change in activity or to bring your attention to important instructions.

Explore Online

Warm-up

Explore

Practice

Answer Key

Use a Calculator

Module 4 Overview

Sharpen your pencil and get out some graph paper – this module will have you plotting, drawing, and transforming up a storm! You'll learn about the Cartesian plane and how coordinates can help us locate objects, or help you find your way when you're lost. You'll also have a chance to draw shapes and see how they can be transformed through sliding, reflecting and rotating. Think of the geometric patterns you've seen in clothing, art and jewelry: many of these can be created through transformations.

You might already know a bit about plotting points and shifting shapes. You'll have plenty of opportunities to review what you already know about these topics and to practise the new skills you learn. So put that calculator away and get ready to explore the Cartesian plane.

Section Overviews

Section 4.1: Introducing the Cartesian Plane

"The Cartesian what? Plane? Like an airplane?"

No airplanes in this section! In this section you'll be introduced to Rene Descartes – the man behind the Cartesian plane. You'll explore the coordinate system of locating and plotting points in the two-dimensional (flat) plane. Once you've mastered plotting points, you'll move on to drawing shapes and pictures on the coordinate grid, and even design your own video game character!

Section 4.2: Transformations

It's time to use the skills you learned in Section 4.1 and go one step further. We're going to investigate the world of transformations.

You've seen your reflection in a mirror, and you've watched the wheels of a bike turn around and around. These are transformations. In this section we're going to transform shapes by sliding, flipping and turning them—all in the Cartesian plane.

How can you tell if a number is divisible by another number? This section is all about divisibility rules. You'll explore patterns in sets of numbers and create some rules for figuring out if a number is divisible by 2, 3, 4, 5, 6, 8, 9, or 10. Learning these rules will help you sharpen your mental math skills and enable you to create and solve number games and puzzles!

Section 4.1: Introducing the Cartesian Plane

Section 1

Contents at a Glance

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Learning Outcomes

By the end of this section you will be better able to:

- identify the features of the Cartesian Plane.
- use ordered pairs to describe the location of points in the Cartesian plane.
- plot points in the Cartesian plane.

Pretest 4.1

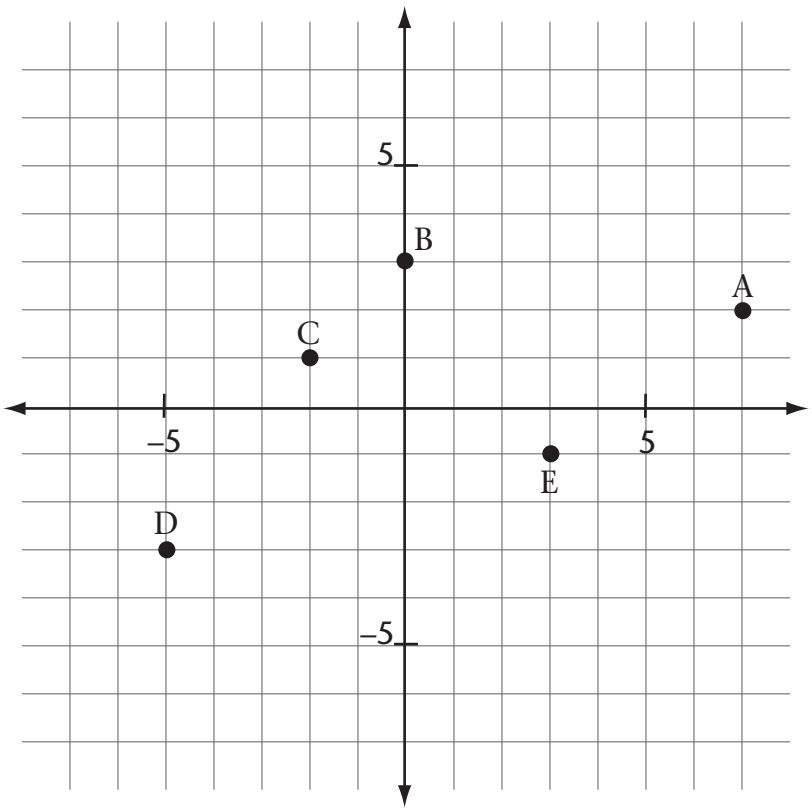
Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in this section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Lesson 4.1A

1. What are the coordinates of each point? (5 marks)



2. Plot each point on the grid provided. (5 marks)

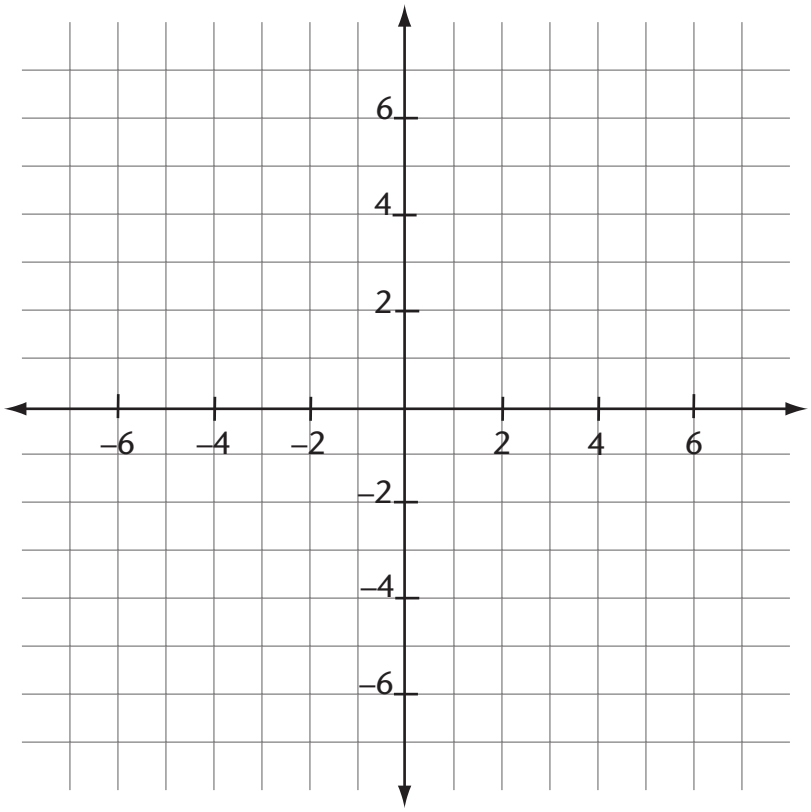
F (4, 3)

G (–2, 2)

H (–4, 3)

I (0, –3)

J (5, –2)



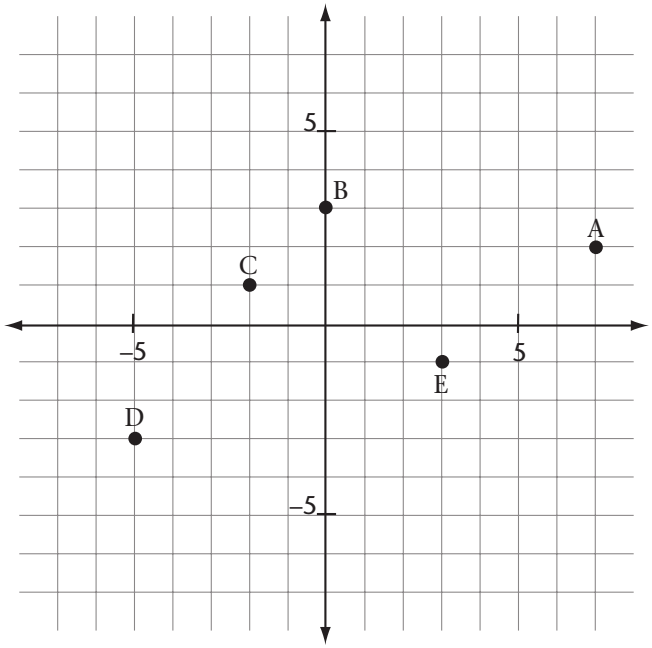
To answer these questions, look at the graph below. Circle the best answer.

3. Point C is in: (1 mark)

a. Quadrant I
b. Quadrant II
c. Quadrant III
d. Quadrant IV

4. Point D is in: (1 mark)

a. Quadrant I
b. Quadrant II
c. Quadrant III
d. Quadrant IV



5. Point B is on the: (1 mark)

a. *x*-axis
b. *y*-axis
c. *x*-coordinate
d. origin

Lesson 4.1B

1. Use the graph below for this question. Complete all parts on the same graph.

   a. Connect these points in the order given: (2 marks)

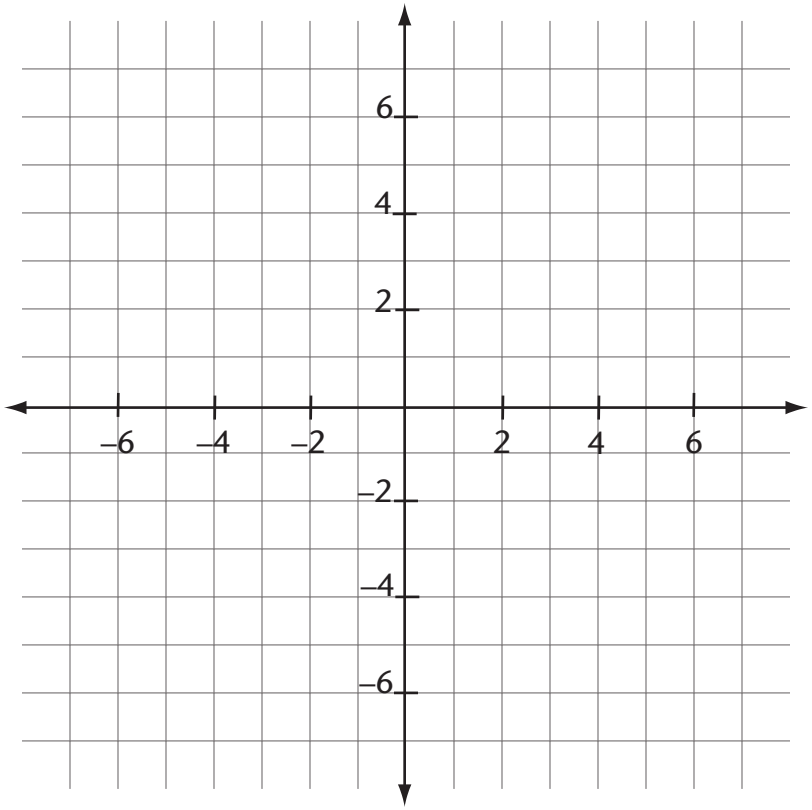
   (–1, 4) (2, 3) (2, –1) (–1, 0)

   Join the last point to the first point.

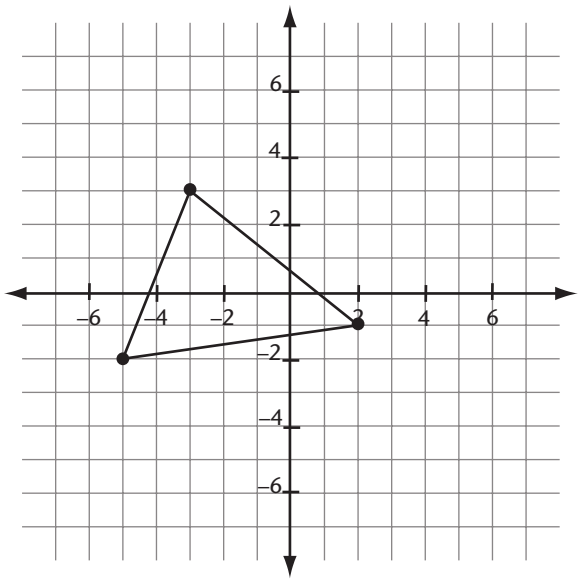
   b. Connect these points in the order given: (2 marks)

   (–1, 4), (3, 4), (3, 0), (2, –1)

   c. Join (3, 4) to (2, 3) (1 mark)



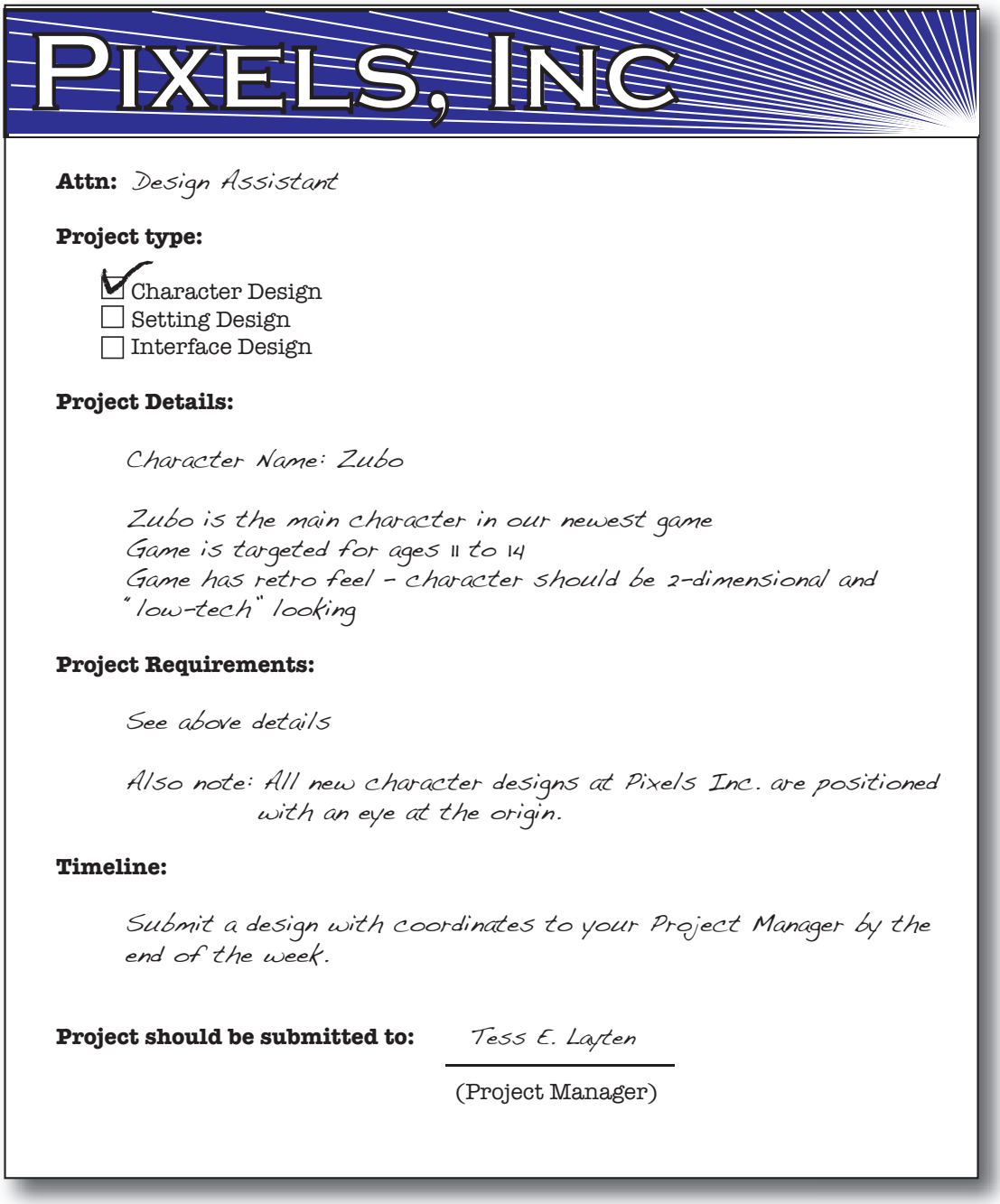
2. Write instructions for drawing this shape. (4 marks: 1 for each point, 1 for instruction)



Turn to the Answer Key at the end of the Module and mark your answers.

Section Challenge

Congratulations! It's the first day of your summer job as design assistant at the video game company Pixels Inc. This note was on your desk.



PIXELS, INC

Attn: Design Assistant

Project type:

- [x] Character Design
- [ ] Setting Design
- [ ] Interface Design

Project Details:

Character Name: Zubo

Zubo is the main character in our newest game
Game is targeted for ages 11 to 14
Game has retro feel – character should be 2-dimensional and "low-tech" looking

Project Requirements:

See above details

Also note: All new character designs at Pixels Inc. are positioned with an eye at the origin.

Timeline:

Submit a design with coordinates to your Project Manager by the end of the week.

Project should be submitted to: Tess E. Layten

(Project Manager)

What's "the origin"? What are "coordinates"? Well, you're in luck. By the end of this section of Math 7, you'll know everything you need to meet your first deadline.

Lesson 4.1A: Points on the Plane

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
What is the Cartesian Plane?		answer
		example
Two number lines make the Cartesian plane. What are their names? Where is the origin?		answer
		example
How do I use an ordered pair to describe the location of a point in the Cartesian plane?		answer
		example
How do I plot a point in the Cartesian plane?		answer
		example

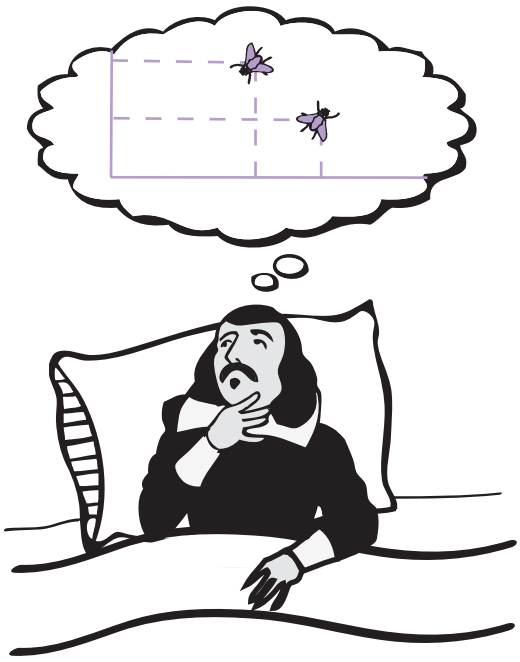
Lesson 4.1A: Points on the Plane

Introduction

What do you do when you're home sick in bed?

Maybe you watch T.V., play videogames, or update your website. René Descartes was home sick in bed in the early 1600s. He watched a fly crawl around on the ceiling.

René noticed that he could describe the fly's position no matter where it was by giving its distance from the corner of the room in two directions.



The design team at Pixels Inc. needs to know exactly where Zubo is displayed on the computer screen.

A pilot needs to know exactly where the airport is, even in a storm.

After an avalanche, the search and rescue team needs to know exactly where to look for the lost hikers.

There are lots of situations where we need to clearly describe the location of an object. Video game designers, aircraft pilots, and search and rescue teams all use René's bug-finding idea to precisely describe information about location.

Thinking Space

Who is René?

Zubo was in the section challenge.

Explore Online

Looking for more practice or just want to play some fun games? If you have internet access, go to the Math 7 website:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Look for *Lesson 4.1A: Points on the Plane* and check out some of the links!

Thinking Space

Warm-up

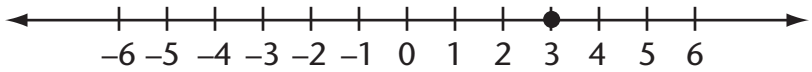
René's bug-finder is like two number lines stuck together. So to get ready for this lesson, let's do some review with number lines.

1. There's already a point on 3. Put a point at each of the following locations.

   a. –2

   b. 5

   c. 0

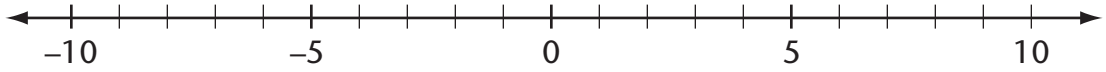


2. Put a point at:

   a. –3

   b. 7

   c. –6

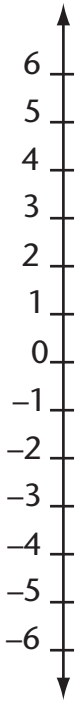


3. Put a point at:

   a. –3

   b. 4

   c. 1

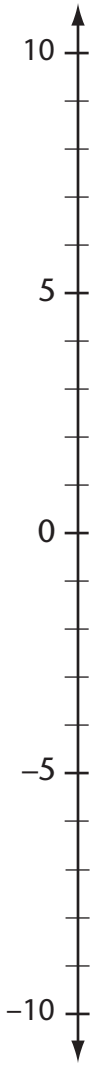


4. Put a point at:

   a. –7

   b. 9

   c. –4



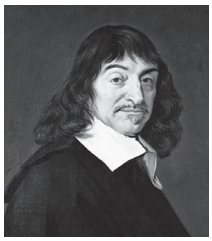
Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Thinking Space

A flat surface is called a plane. We call René's bug-finder the **Cartesian plane**.

Using "X" and "Y" was Descartes idea too!



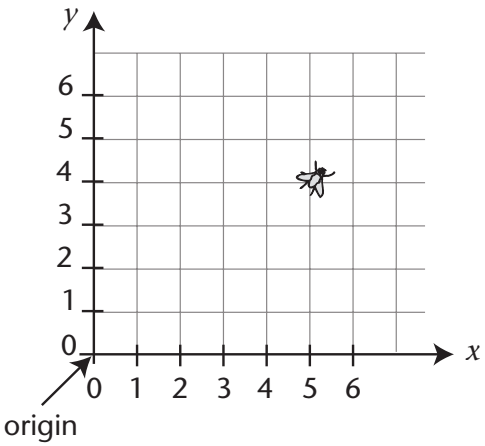
He had lots of ideas about light and lenses,
about weather, about philosophy.
He thought about rainbows and music
and the human heart.

If you want to learn more about Descartes, start your search at the Math 7 website at http://www.openschool.bc.ca/courses/math/math7/mod4.html

The corner of the room is the **origin**. That just means the place where we start. All of our descriptions of distances will be measured from this spot.

The horizontal direction is called ***x***. The horizontal number line is called the ***x*-axis**.

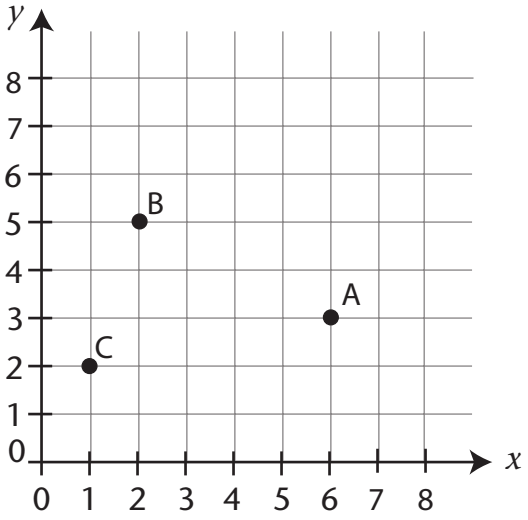
The vertical direction is called ***y***. The vertical number line is called the ***y*-axis**.



The fly is called a **point**.

To describe the location of the fly, we ALWAYS give the distance in the ***x*** direction first. This fly is located 5 units to the right of the origin and 4 units above the origin. The fly is at (5,4).

It's your turn to try. Describe the location of points A, B, and C. Remember to describe the distance in the ***x*** direction first.

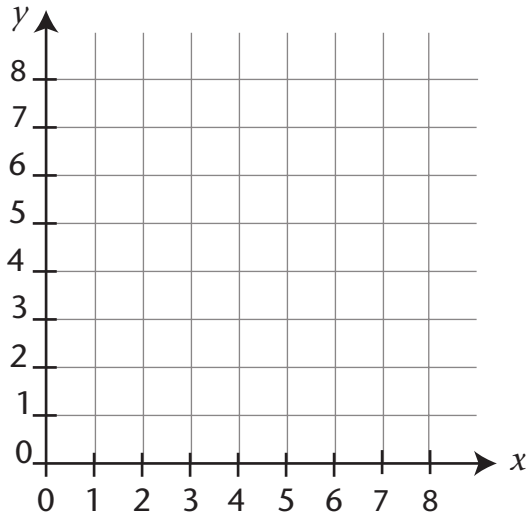


A (6 , 3)

B (,)

C (,)

Put points D, E, and F on the graph provided.



D (4,1)

E (7, 3)

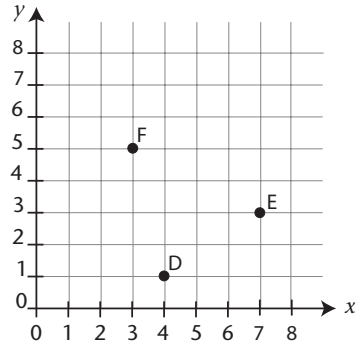
F (3, 5)

Do your answers match these ones? Once you've figured out the correct answers, try the practice exercise.

A (6, 3)

B (2, 5)

C (1, 2)



Thinking Space

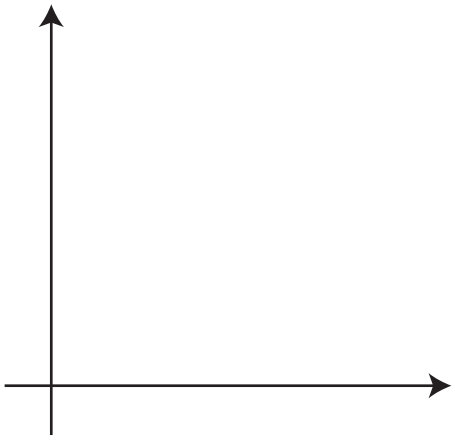
Point A is 6 units to the right and 3 units up.

Practice 1

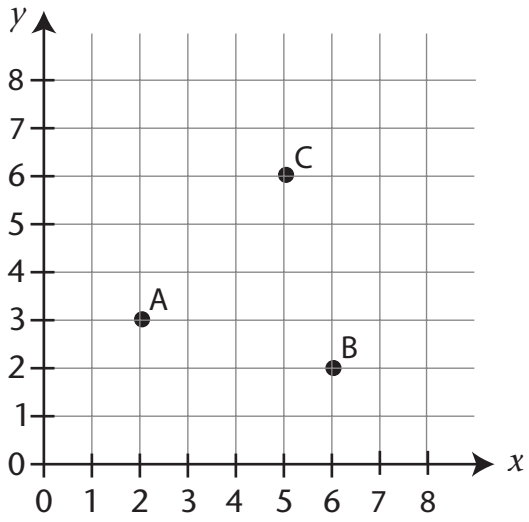
1. Colour the origin red.

   Colour the ***x***-axis blue.

   Colour the ***y***-axis green.



2. Describe the location of each point.

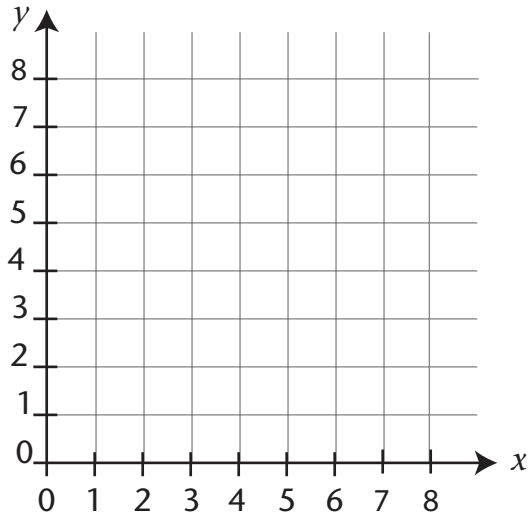


A (,)

B (,)

C (,)

3. Place each point on the graph provided.



D (1, 7)

E (2, 2)

F (5, 3)

Turn to the Answer Key at the end of the Module and mark your answers.

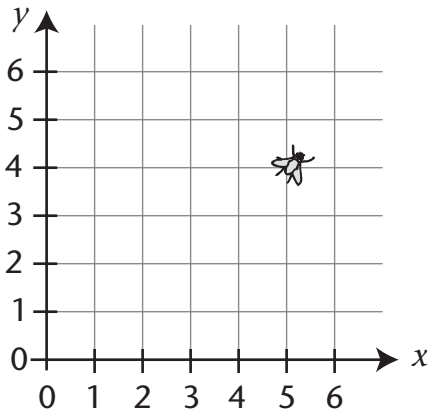
Explore

Thinking Space

There are just a few more new words that we need to talk about. They are all related to how we describe the location of a point.

Let's look at the location of the fly again.

The fly is at (5,4).



You know that the first number describes the distance in the *x* direction. This number is called the ***x*-coordinate**. The ***x***-coordinate of the location of the fly is **5**.

The second number describes the distance in the *y* direction. This number is called the ***y*-coordinate**. The *y*-coordinate of the location of the fly is **4**.

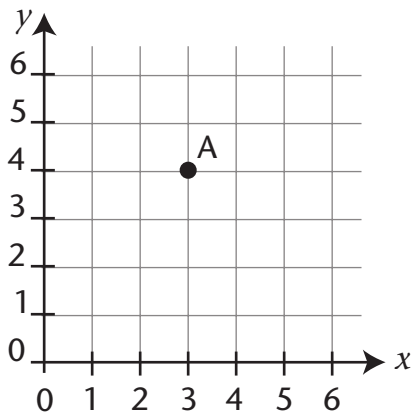
When we write the two coordinates together, they are ALWAYS in round brackets. The two numbers are separated by a comma. The **coordinates** of the location of the fly are **(5,4)**.

Sometimes we call coordinates a **coordinate pair** or an **ordered pair**. The Cartesian plane is just one example of a **coordinate system**.

Explore Online

For information about other kinds of coordinate systems, go to the Math 7 Web site at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Practice 2



1. What is the *x*-coordinate of point A?

2. What is the *y*-coordinate of point A?

3. What are the coordinates of point A?

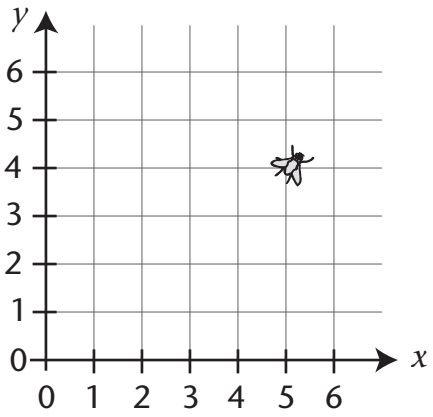
4. The Cartesian plane is an example of a _____ system.

Turn to the Answer Key at the end of the Module and mark your answers.

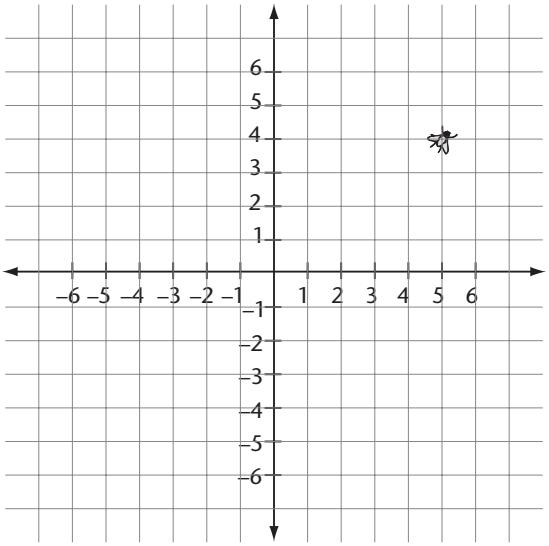
Explore

Thinking Space

Until now, we have been using only half of a number line for each axis: *x* and *y*.



It's time to stretch out. Let's use a complete number line for each axis.

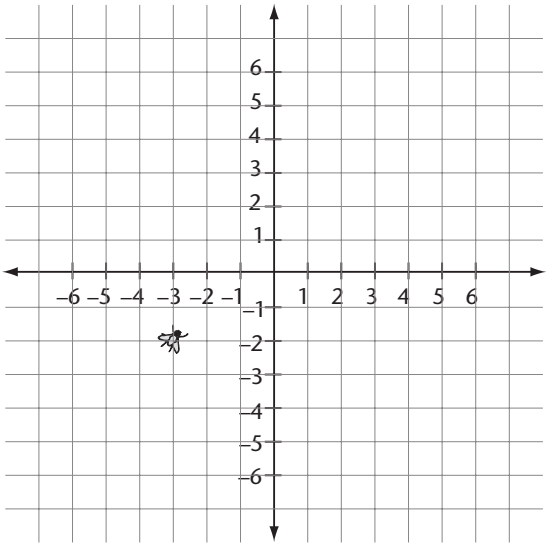


Now our fly isn't stuck walking around on René's bedroom ceiling anymore. It can go as far as it likes in any direction.

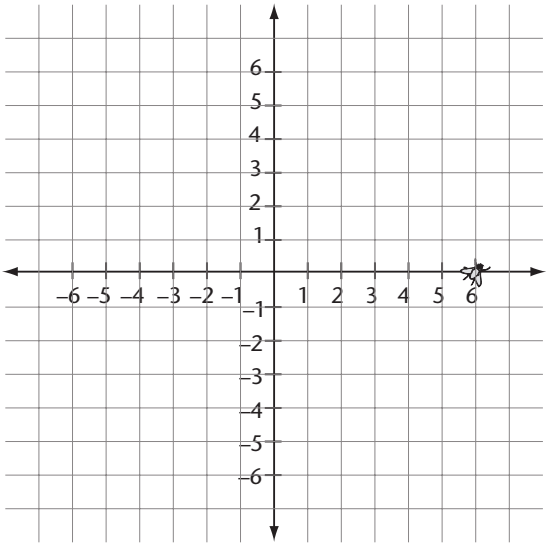
The *positive* numbers on the *x*-axis describe distances to the *right* of the origin, just like you have already seen. If the *x*-coordinate is 2, we know that the point is 2 units to the right of the origin. When we want to describe distances to the *left* of the origin, we use the *negative* numbers on the *x*-axis. If the *x*-coordinate is –2, we know that the point is 2 units to the left of the origin.

The *y*-axis works in a similar way. The *positive* numbers on the *y*-axis describe distances *above* the origin. If the *y*-coordinate is 5, we know that the point is 5 units above the origin. When we want to describe distances *below* the origin, we use the *negative* numbers on the *y*-axis. If the *y*-coordinate is –5 we know that the point is 5 units below the origin.

Thinking Space



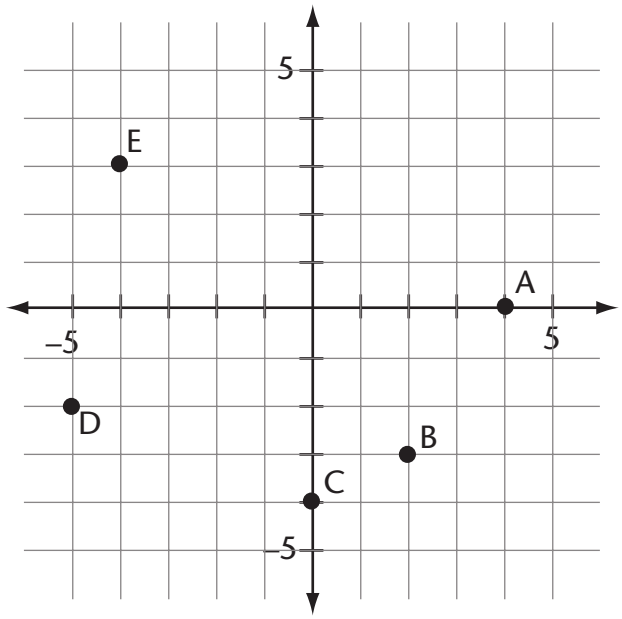
The fly moved. Can you describe its new location? It is 3 units to the LEFT of the origin. The *x*-coordinate is now –3. It is 2 units BELOW the origin. The *y*-coordinate is –2. The fly is at coordinates (–3,–2).



When the fly has landed on an axis, we still have to describe its position. This fly is 6 units to the right of the origin. The *x*-coordinate is 6. However, the fly is neither above nor below the origin. The *y*-coordinate is 0. The fly is at coordinates (6, 0).

Thinking Space

It's your turn again. Give the coordinates of each point.



A (,)

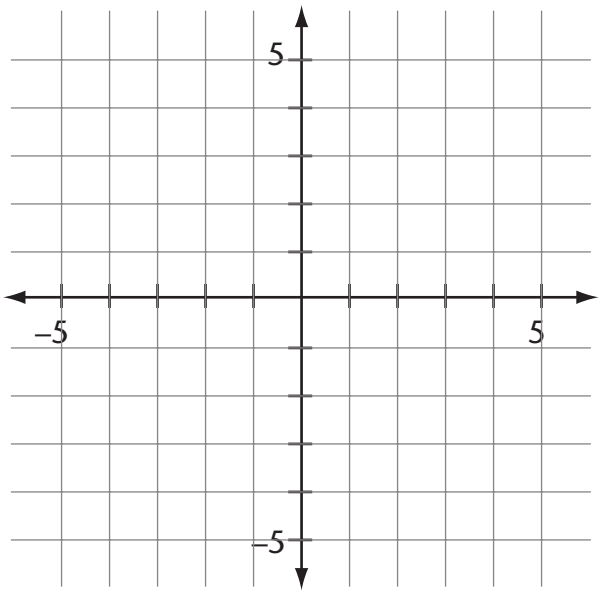
B (,)

C (,)

D (,)

E (,)

Position each of these points on the Cartesian plane.



F (3, –1)

G (0, 3)

H (–3 ,2)

I (0, 0)

J (–5, –4)

Remember: The point (0, 0) is called the origin.

Make sure you understand each of these answers before you move on the practice exercise.

Thinking Space

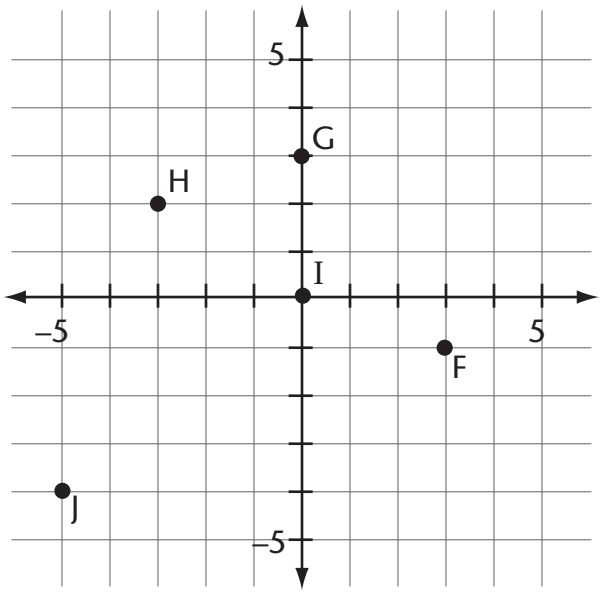
A(4, 0)

B(2, –3)

C(0, –4)

D(–5, 0)

E(–4, 3)

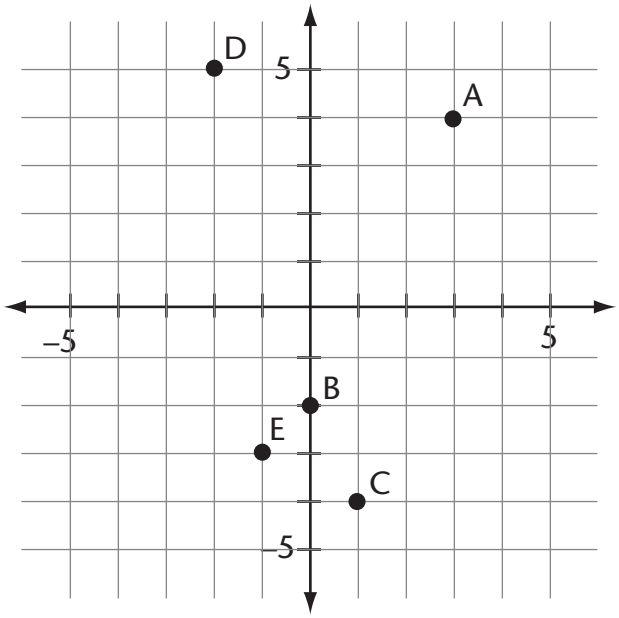


Explore Online

For more practice plotting points, go to the Math 7 Web site at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Practice 3

1. Give the coordinates of each point.



A (,)

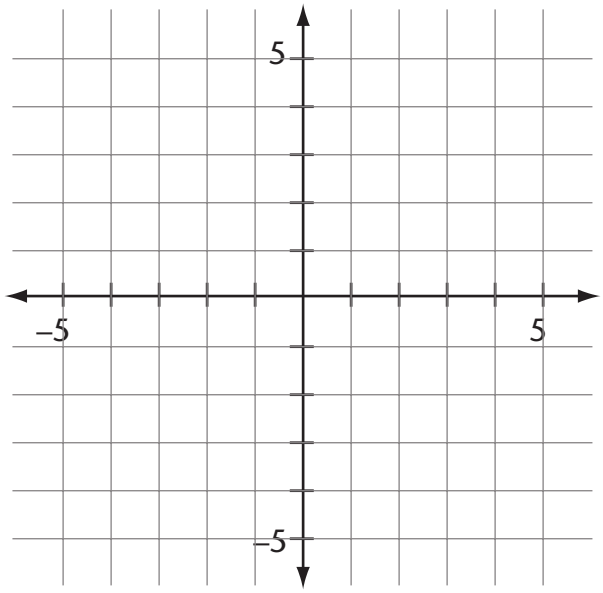
B (,)

C (,)

D (,)

E (,)

2. Plot each point on the Cartesian plane.



F (–3, 1)

G (–1, 4)

H (–2 , –4)

I (0, –2)

J (2, 1)

Turn to the Answer Key at the end of the Module and mark your answers.

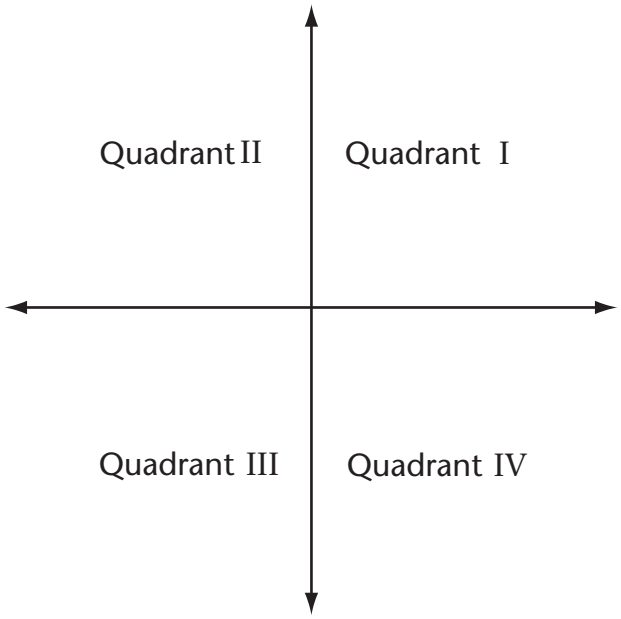
Explore

A quad is a dirt-bike with four wheels. Quadruplets are four babies born at the same time. A building divided into four apartments is a quadruplex.

Have you ever heard of a quadrille? It is a dance for couples. How many? You guessed it—four.

The quadriceps muscle in your thigh is actually four different muscles that work together to extend your knee.

We have one more new word to learn. The *x*-axis and the *y*-axis split the Cartesian plane into four sections. Each section is called a **quadrant**.



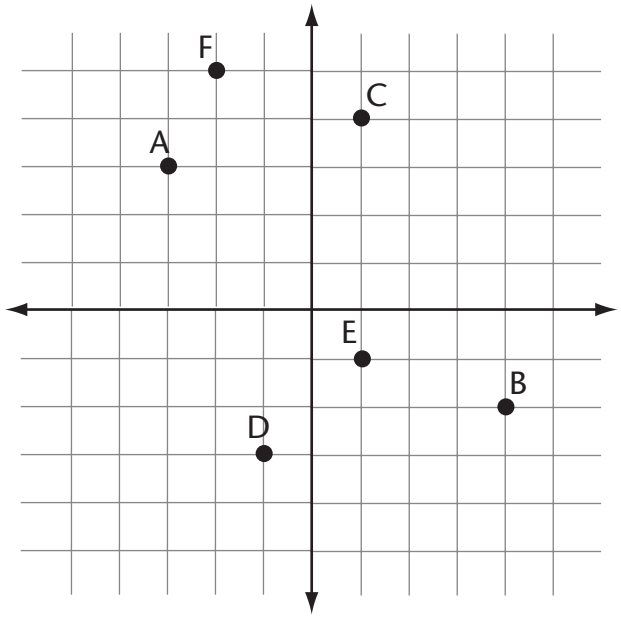
Notice that the quadrants are numbered with Roman numerals: I, II, III, IV. Fancy!

Thinking Space

What do you notice about all of these things?

Practice 4

1. Give the quadrant number of each point. The first one has been done for you.



Point	Quadrant
A	II
B	_____
C	_____
D	_____
E	_____
F	_____

2. What are the coordinates of the points in Quadrant IV?

3. Fill in each blank with "positive" or "negative."

   The *x*-coordinate of all the points in Quadrant IV is _____

   The *y*-coordinate of all the points in Quadrant IV is _____

Turn to the Answer Key at the end of the Module and mark your answers.

Explore Online

Did you know that plotting points is a sport? Orienteering competitors need to move quickly over rough terrain.They have to find specific locations using a map and compass.

For more information, go to the Math 7 Web site:
http://www.openschool.bc.ca/courses/math/math7/mod2.html

Lesson 4.1B: Plotting Points, Drawing Pictures

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
How do I draw shapes and designs on a Cartesian plane?		answer
		example
What is a vertex? What are vertices?		answer
		example
Can I identify coordinates of the vertices of a shape on the Cartesian plane?		answer
		example

Lesson 4.1B: Plotting Points, Drawing Pictures

Thinking Space

Introduction

You learned a lot about plotting points in the last lesson.

You know what "coordinates" are, and you know what the "origin" is. You even know the coordinates of the origin!

In this lesson you will practise plotting points by drawing shapes on the Cartesian plane.

Explore Online

Looking for more practice or just want to play some fun games? If you have internet access, go to the Math 7 website at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Look for *Lesson 4.1B: Plotting Points, Drawing Pictures* and check out some of the links!

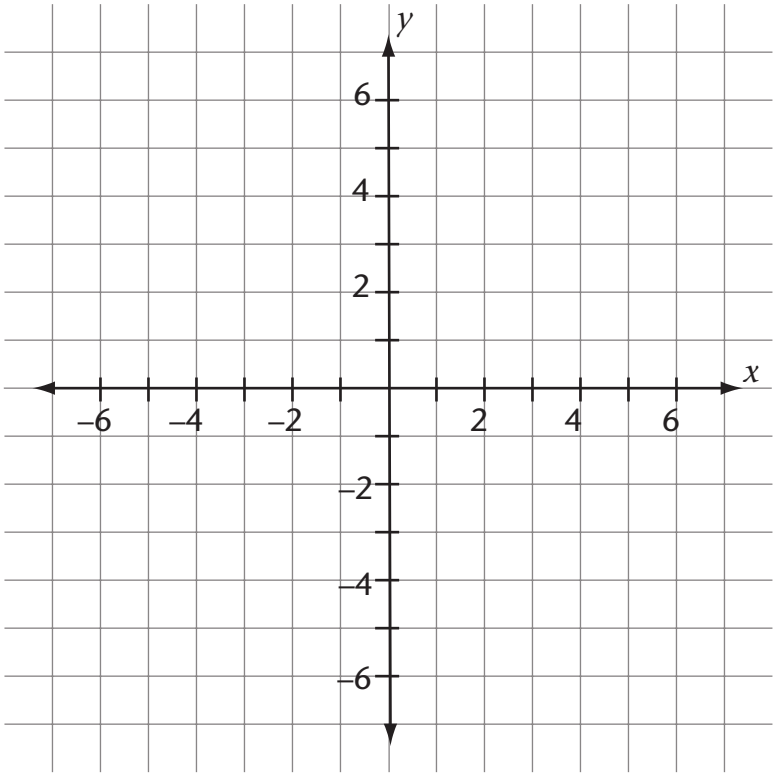
Warm-up

We'll be plotting lots of points in this lesson, so we'll start with a quick review.

Remember, the first number is the *x*-coordinate. It describes the position of the point left or right along the *x*-axis.

The second number is the *y*-coordinate. It describes the position of the point up or down along the *y*-axis.

Plot A(5, 4), B(–3, 0) and C(–1, –5).



Turn to the Answer Key at the end of the Module and mark your answers.

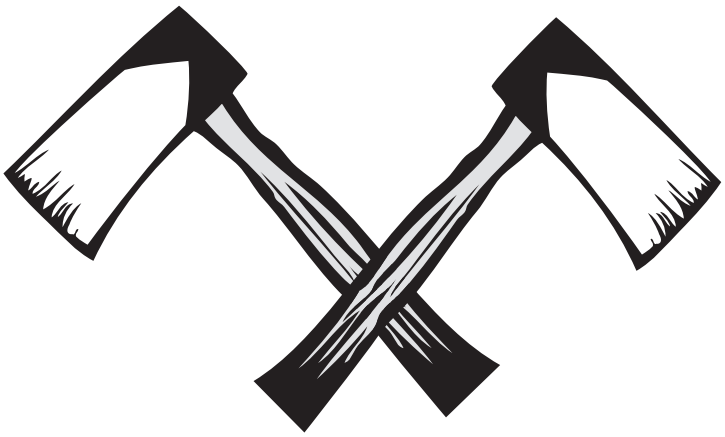
Explore

Thinking Space

To do this activity, you'll need:

- some graph paper (you'll find this at the end of the Module)
- a ruler,
- a pencil.

Draw axes on your graph paper.



No! Not those axes! **Axes** (pronounced ax-ees, with a long "ee" sound) is plural for axis. "Draw axes" means draw an *x*-axis and a *y*-axis.

Write "x" at the right side of the *x*-axis. Write "y" at the top of the *y*-axis.

Number each axis by twos.

Look at the axes provided for your work in the warm-up activity. This is what yours should look like.

Plot these points:

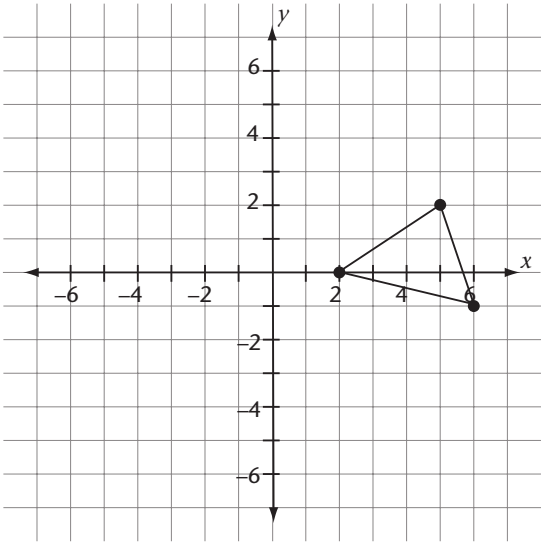
(5, 2)

(6, –1)

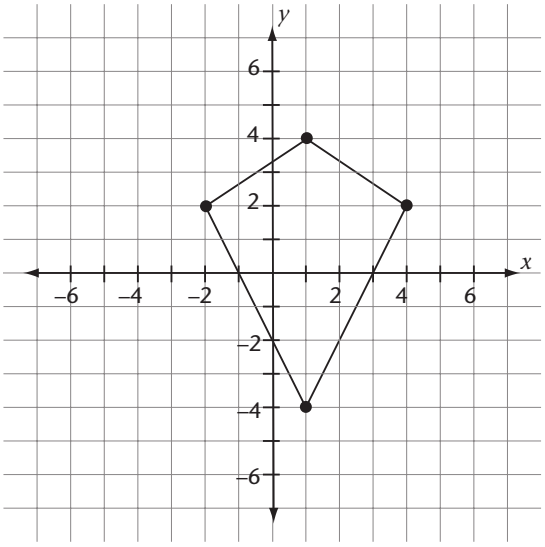
(2, 0)

Join the points in the order they are given. Then join the last point to the first point.

Does your graph look like this? Each point is a **vertex** of the triangle. The triangle has three **vertices**.



Look at the shape below. Let's make a set of instructions for drawing it.



First record the coordinates of the vertices.

The vertices of the shape are:

(1, 4)

(4, 2)

(1, –4)

(–2, 2)

Then give instructions for connecting the points.

Join the points in the order given. Join the last point to the first point.

Thinking Space

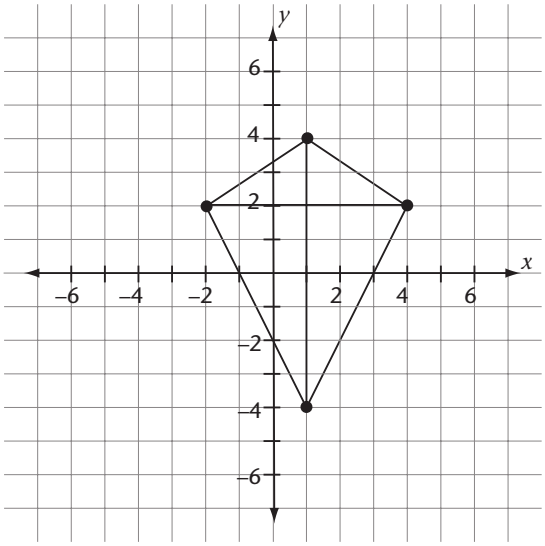
Thinking Space

Now check these instructions by making your own copy of the kite shape. Get a piece of graph paper from the end of the Module and draw axes on it. Follow the instructions we just wrote.

Maybe we could make this kite shape more interesting if we added some more lines.

Join (1, 4) to (1, –4).

Join (–2, 2) to (4, 2)



Let's finish this kite with a string and some bows. These are the instructions for the first bow. You draw it on your copy.

Connect these points in order:

(3, –5)

(3, –7)

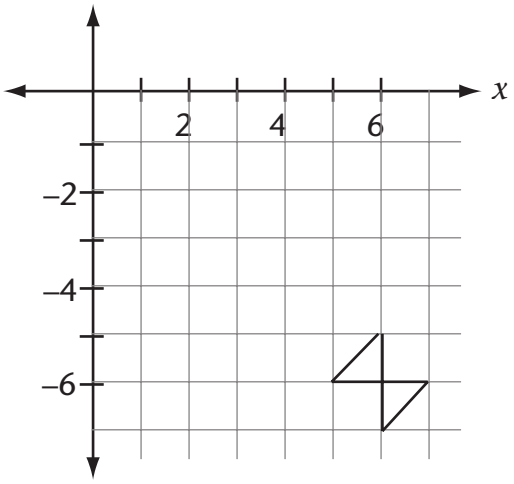
(2, –6)

(4, –6).

Join the last point to the first point.

The second bow looks like this. In the space below, write the instructions for drawing it.

Thinking Space



First record the coordinates of the vertices.

Then give instructions for connecting them.

Your instructions should look something like this:

> These are the vertices: (6, –5), (6, –7), (7, –6), (5, –6).
>
> Connect these points in order. Join the last point to the first point.

Did you choose to start your instructions with a different point? That's OK. Did you go around the shape in a different direction? That's OK, too.

For example, maybe you started with (7, –6). If you went around the shape in the same direction, your list would be:

> (7, –6), (5, –6), (6, –5), (6, –7)

If you went around the shape in the other direction, your list would be:

> (7, –6), (6, –7), (6, –5), (5, –6)

Try it out!

Test your instructions for the second bow on your copy.

Now all that's left is the string.

Connect these points in order with a squiggly line:

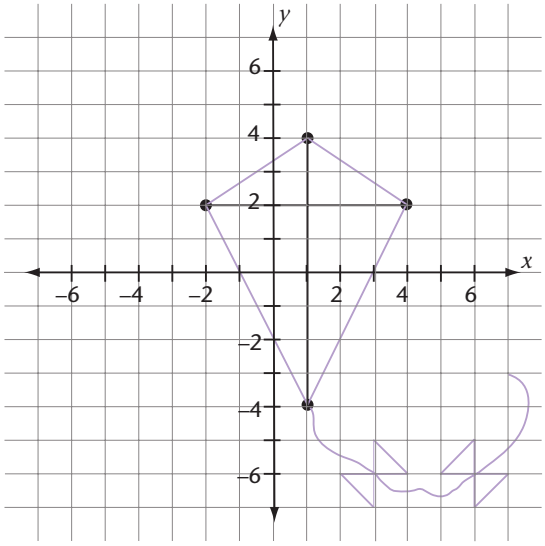
(1, –4)

(3, –6)

(6, –6)

(7, –3)

Wow! That looks great!

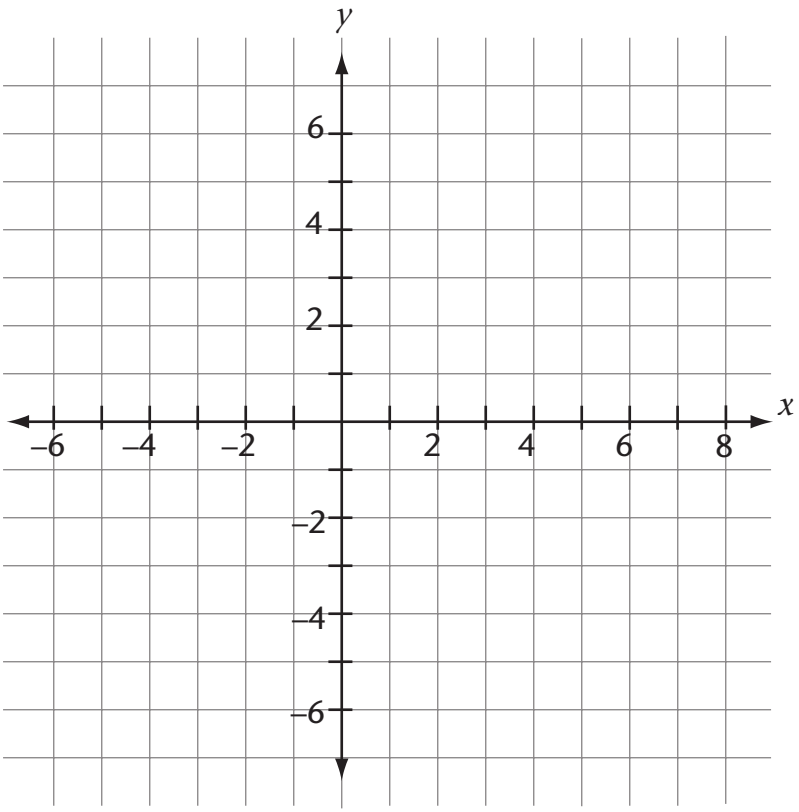


Practice 1

1. On the graph provided, plot and connect these points in order:

   (5, 5), (5, 2), (8, 0), (5, –1), (5, –4), (2, –1), (–2, –2), (0, 1), (–1, 5), (2, 3)

   Then, join the last point to the first point.



2. On the graph provided, follow the instructions to create a picture.

   Join (–7, 2) to (–7, –3).

   Join (–4, 2) to (–7, 0) to (–4, –3).

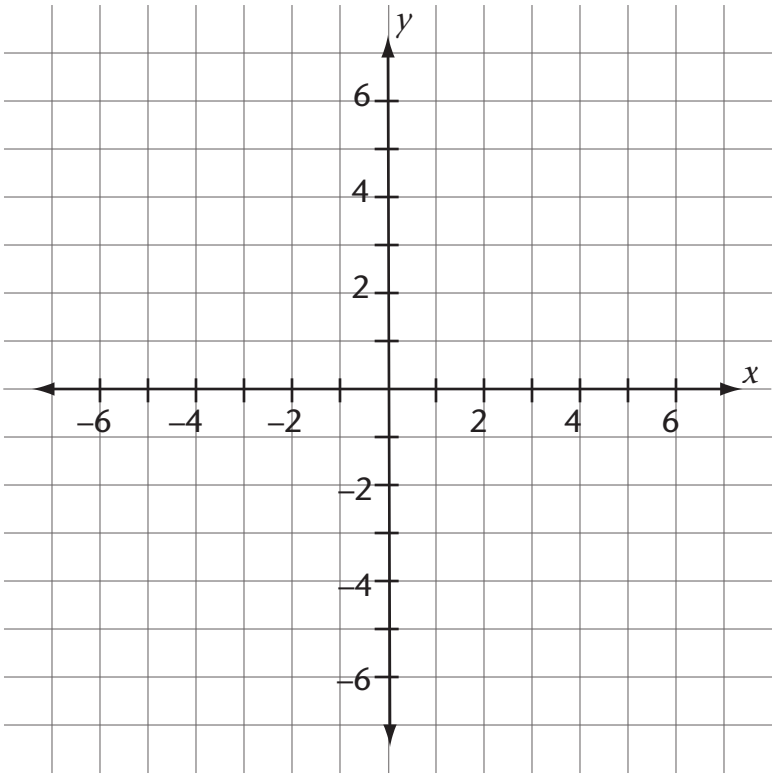
   Join (–3, 2) to (–3, –3).

   Join (–1, 2) to (3, 2).

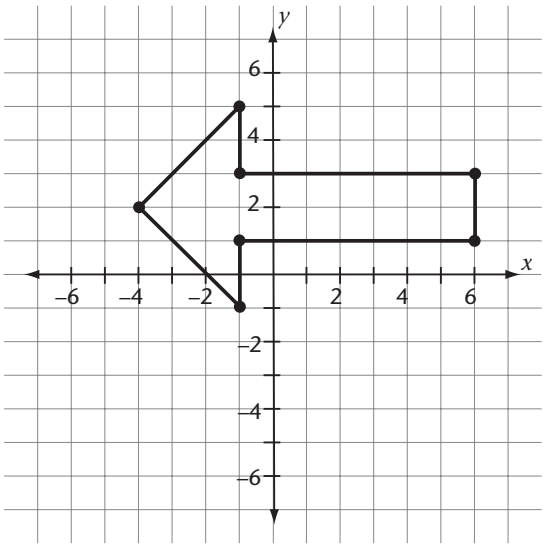
   Join (1, 2) to (1, –3).

   Join (7, 2) to (4, 2) to (4, –3) to (7, –3).

   Join (4, 0) to (6, 0).



3. Write instructions for drawing the shape below.



Turn to the Answer Key at the end of the Module and mark your answers.

Section Summary

By now, you are probably getting very good at using René's bug-finder, the Cartesian plane.

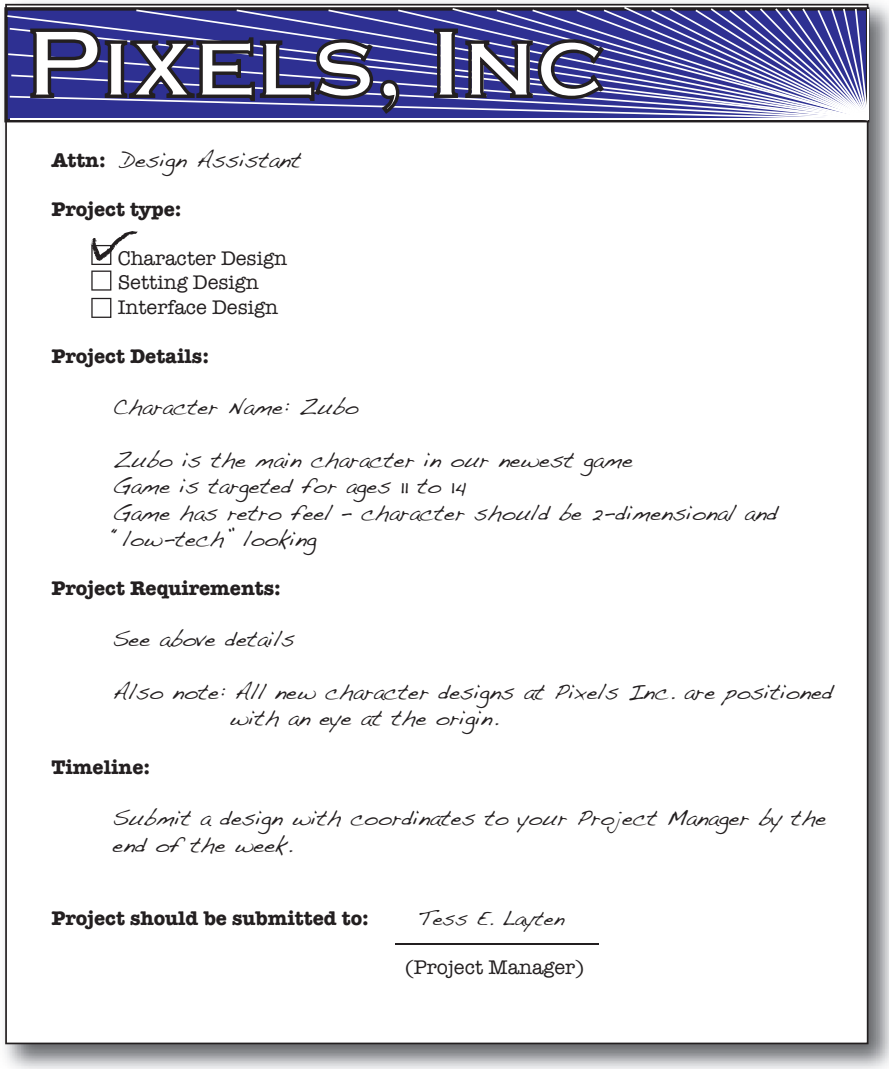
You've plotted lots of points, and you've connected them to create shapes. In the next section, we'll start moving those shapes around.

You've also learned a lot of new words. Look over this list and make sure you didn't miss any:

- axes
- Cartesian plane
- coordinate pair
- coordinates
- ordered pair
- origin
- point
- quadrant
- vertex
- vertices
- *x*-axis
- *x*-coordinate
- *y*-axis
- *y*-coordinate

Section Challenge

There's one more thing to do before we move on. You have a deadline approaching!



PIXELS, INC

Attn: *Design Assistant*

Project type:

- [x] Character Design
- [ ] Setting Design
- [ ] Interface Design

Project Details:

Character Name: Zubo

Zubo is the main character in our newest game
Game is targeted for ages 11 to 14
Game has retro feel - character should be 2-dimensional and "low-tech" looking

Project Requirements:

See above details

Also note: All new character designs at Pixels Inc. are positioned with an eye at the origin.

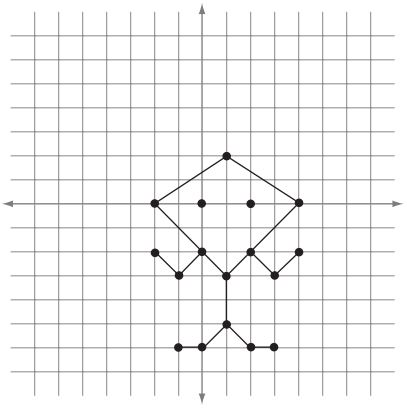
Timeline:

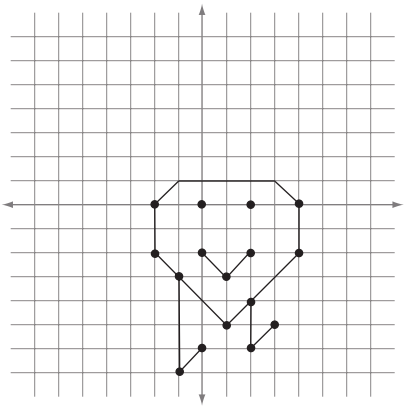
Submit a design with coordinates to your Project Manager by the end of the week.

Project should be submitted to: *Tess E. Layten*

(Project Manager)

It's time to create "Zubo." You may use one of these designs, or create one of your own.





1. Draw Zubo on a sheet of the graph paper in the Templates at the end of module. Include the *x*-axis and *y*-axis.

   Remember: All new character designs at Pixels Inc. are positioned with an eye at the origin.

2. Write the instructions for drawing Zubo.

Section 4.2: Transformations

Section 2

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Learning Outcomes

By the end of this section you will be better able to:

- give instructions to transform points in the Cartesian plane.
- give instructions to transform a shape in the Cartesian plane.
- perform more than one transformation on the same shape.

Pretest 4.2

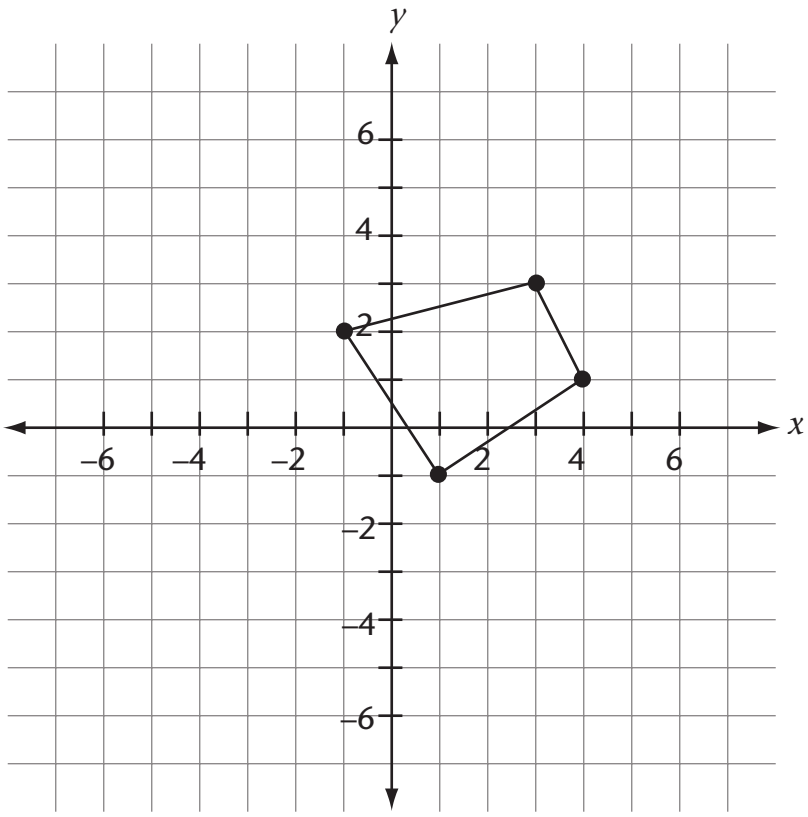
Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in this section. Mark your answers using the key found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

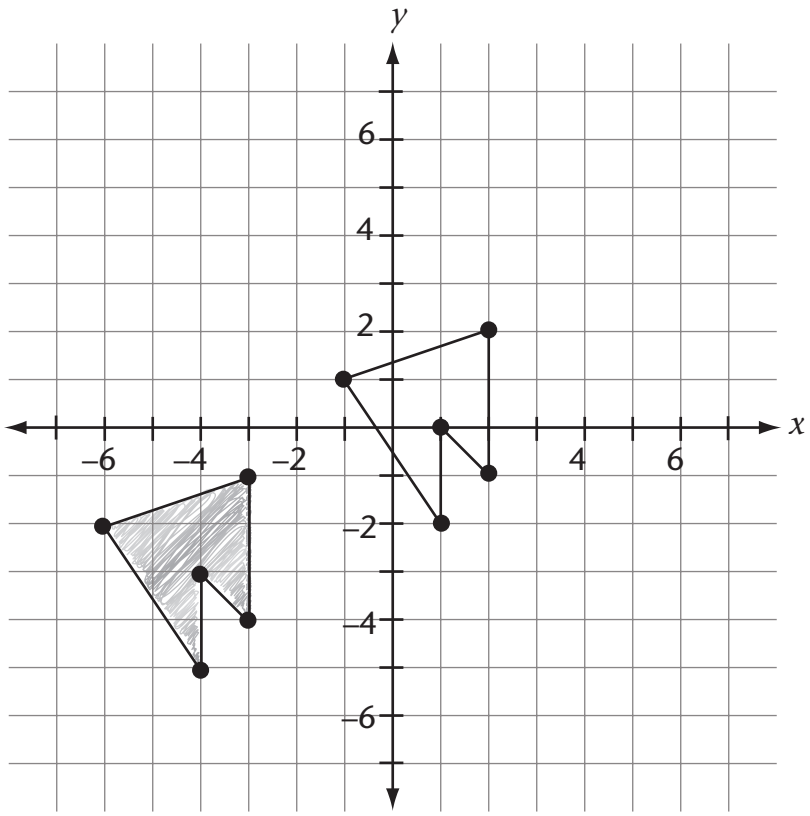
If you get all the answers correct for one or more lessons but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Lesson 4.2A

1. Translate this shape 2 units to the left and 3 units down. (2 marks)

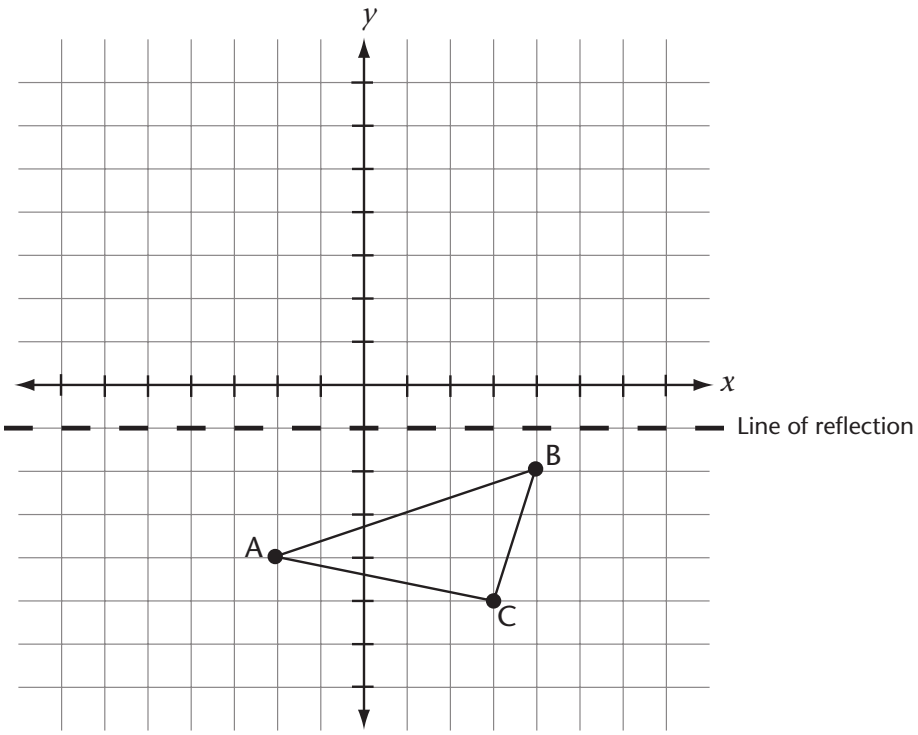


2. Describe the translation that moves the shaded figure to the white figure. (2 marks)

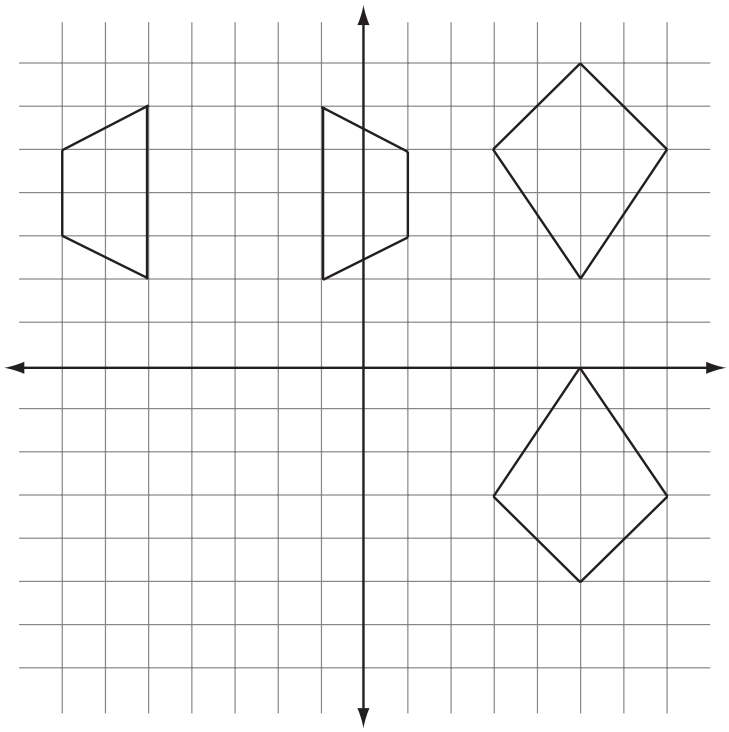


Lesson 4.2B

1. Reflect triangle ABC in the line given. What are the coordinates of the vertices of the image? (3 marks)



2. Draw the line of reflection between each pair of shapes. (2 marks)

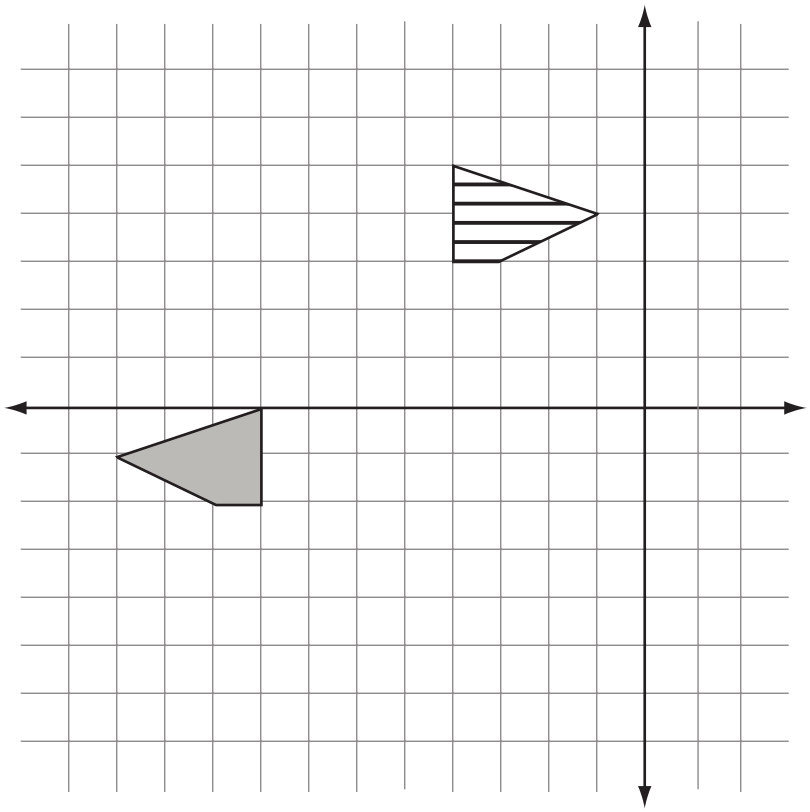


3. Which transformation moves the shaded shape to the striped shape? (2 marks)

   a. Reflect in the horizontal line through (0, –3), then translate 4 units right.

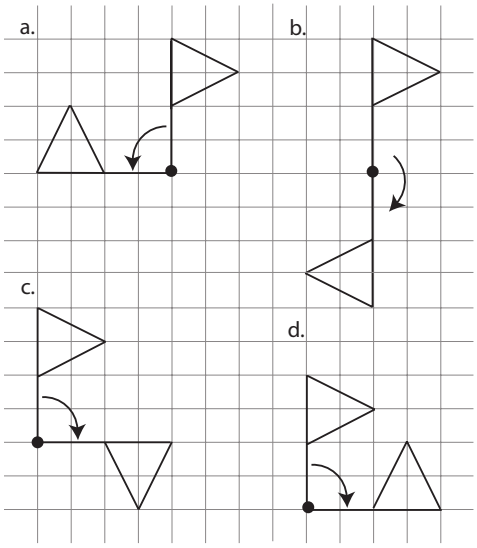
   b. Translate 4 units right and 4 units up.

   c. Reflect in the vertical line through (–6, 0) then translate 5 units up.

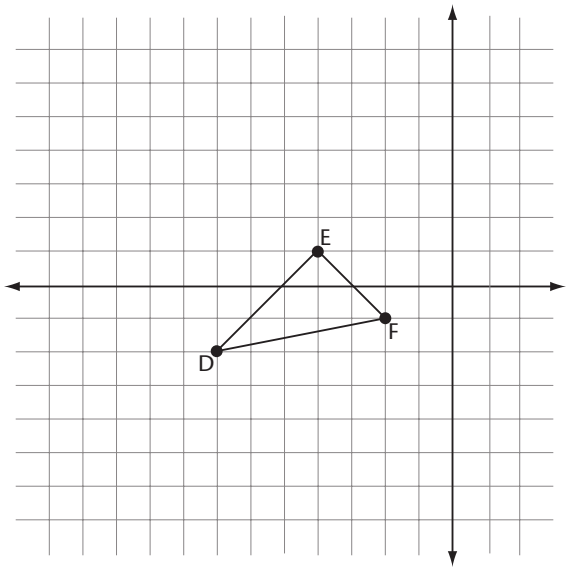


Lesson 4.2C

1. Choose the diagram that shows a rotation of 90° counter-clockwise. (1 mark)



2. Copy triangle DEF onto graph paper. Rotate 180° about the point (–1, 2). What are the coordinates of the vertices of triangle D'E'F'? (3 marks)



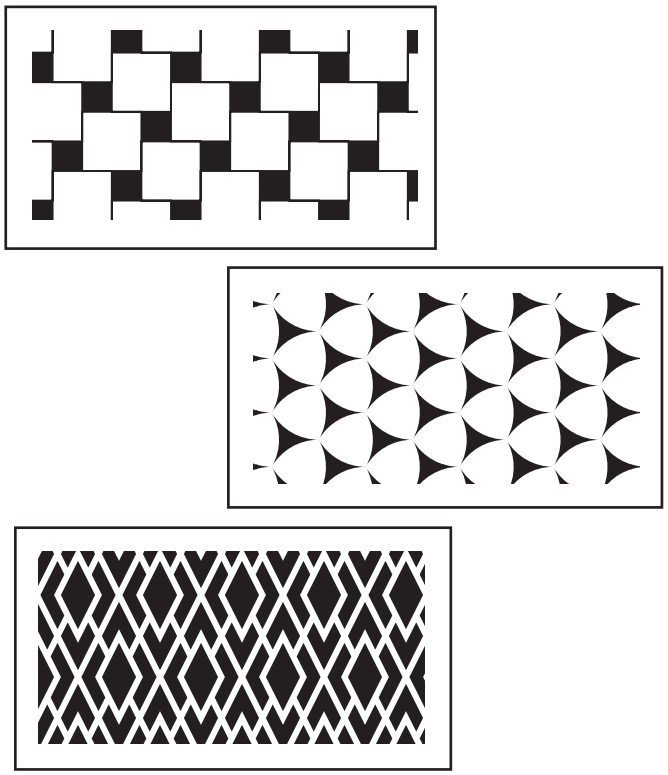
Turn to the Answer Key at the end of the Module and mark your answers

Section Challenge

Look how this egg *transforms* into a baby bird and then to an adult bird:

Transformation just means *change*. There are many ways to transform shapes on the Cartesian plane, and in this section you learn about three of them: shifts (also called translations), reflections, and rotations.

Can you spot the shifts, reflections, and rotations in these designs?



Speaking of change, you've got a new job. Now you're working with a stained glass window designer. She is famous for turning the suggestions of her clients into beautiful designs.

Her newest clients want a window designed that shows their affection for the number three. The designer has decided to use triplets of triangles for this three-loving family.

She knows that the Cartesian plane will help her draft this design. You're the in-house Cartesian plane expert, so she has come to you for help.

You'll be using your knowledge of transformations to help design a beautiful window. Let's get started!

Lesson 4.2A: Sliding Points, Shifting Shapes

Student Inquiry

This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
What is a translation?		answer
		example
How do I move from one point to another point?		answer
		example
Can I follow translation instructions to move a shape to a new location on the plane?		answer
		example
Can I give translation instructions to describe how a shape moves on the plane?		answer
		example

Lesson 4.2A: Sliding Points, Shifting Shapes

Introduction

The Cartesian plane has helped us describe precisely where we are. Now we want to describe where we are going, and we want to know what our position will be when we get there.

The Global Positioning System (GPS) uses a coordinate system that is a lot like the Cartesian plane. The airline pilot uses this coordinate system to precisely describe the location of the plane. But where will the plane be after flying north 50 km and then west 35 km?

Learning about translations can help us figure that out.

Translations are used in art and design too. M. C. Escher used translations in these designs, called tessellations.

M.C. Escher's Symmetry Drawing E104 © 2008 The M.C. Escher Company-Holland. All rights reserved. www.mcescher.com

M.C. Escher's Symmetry Drawing E126 © 2008 The M.C. Escher Company-Holland. All rights reserved. www.mcescher.com

Explore Online

If you have internet access, go to the Math 7 website at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Look for *Lesson 4.2A: Sliding Points, Shifting Shapes* and check out some of the links to learn more about:

- GPS
- M.C. Escher
- translations

Warm-up

When we first started working with the Cartesian plane, we noticed that it's like two number lines stuck together. Moving around on the Cartesian plane will be a lot like moving around on the number line.

This sounds like a good time to get some practice adding and subtracting integers.

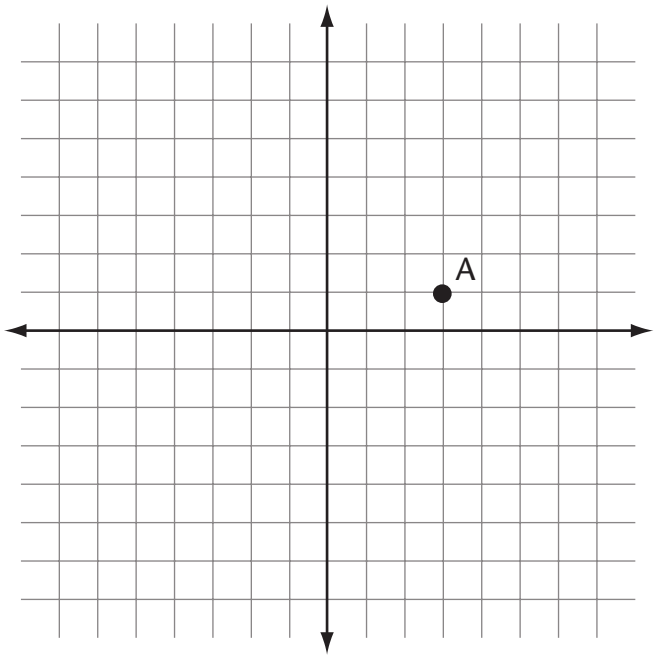
1. $2 + 3 =$
2. $-1 + 4 =$
3. $2 - 5 =$
4. $-3 + 7 =$
5. $1 - 5 =$
6. $-2 - 8 =$
7. $-4 + 2 =$
8. $7 - 2 =$
9. $8 + 4 =$
10. $-5 - 2 =$
11. $-8 + 6 =$
12. $-7 + 7 =$
13. $-6 + 3 =$
14. $-5 + 7 =$
15. $-8 - 3 =$
16. $-9 + 4 =$
17. $-6 - 6 =$
18. $3 - 5 =$
19. $7 + 4 =$
20. $5 - 9 =$

Turn to the Answer Key at the end of the Module and mark your answers.

Explore

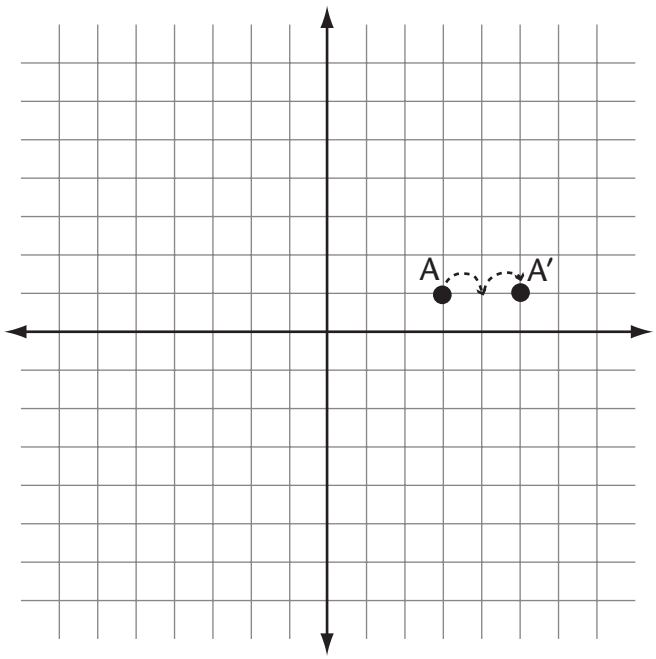
Shapes on the Cartesian plane are made of points connected by lines.

We will learn a lot about moving shapes on the plane if we start by moving points.



Look at point A. Its coordinates are (3, 1).

Now move point A to the right by 2.



Thinking Space

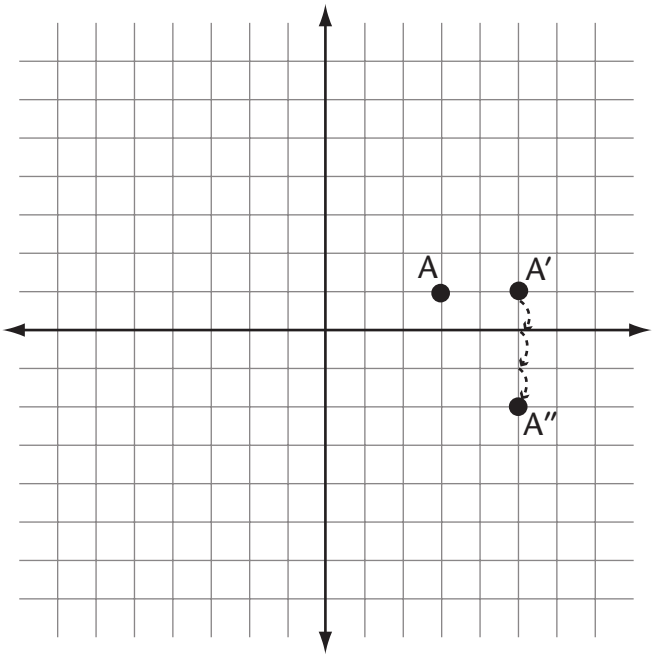
I remember doing that in the last lesson.

Thinking Space

The new point is called the **image** of A. Call the new point A′ (read "A prime"). This label reminds us that the new point is the image of A. What are the coordinates of A′?

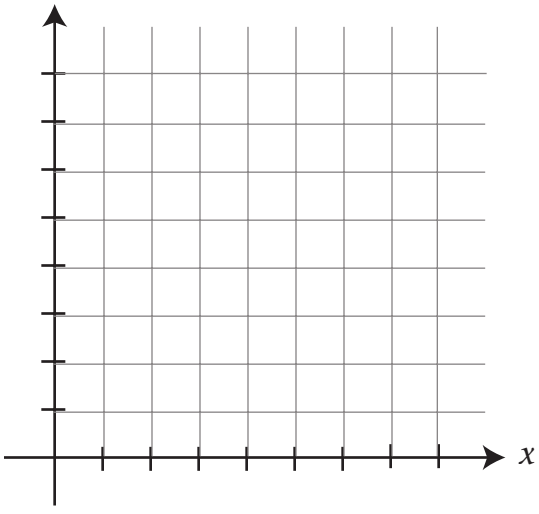
The coordinates of A′ are (5, 1). We moved two units to the *right*. The *x*-coordinate *increased* by 2. The *y*-coordinate did not change.

Let's move again. Move point A′ down by 3. Call the new point A″ (read "A double prime"). This reminds us that the point is the image of A′. What are the coordinates of A″?



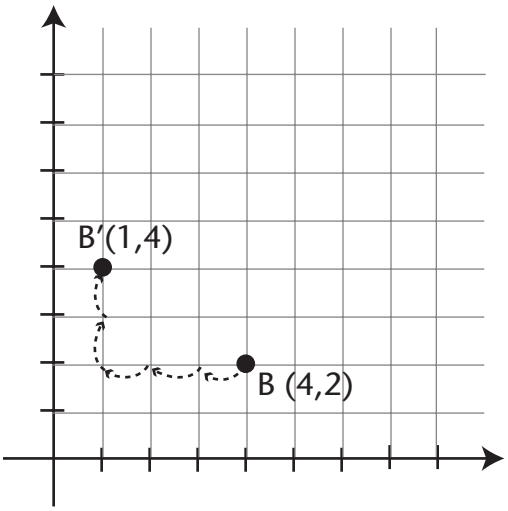
The coordinates of A″ are (5, –2). We moved 3 units *down*. The *x*-coordinate did not change. The *y*-coordinate *decreased* by 3.

Now it's your turn to try one. Plot the point B(4, 2) on the graph provided here.



Move the point left 3, then up 2. Label the image as B′. What are the coordinates of B′?

Can you also figure out the coordinates of B′ without using the graph?



The coordinates of B were (4, 2).

The point moved *left* 3. That's in the direction of the *x*-axis. The *x*-coordinate will *decrease* by 3. To find the new *x*-coordinate, we will *subtract* 3.

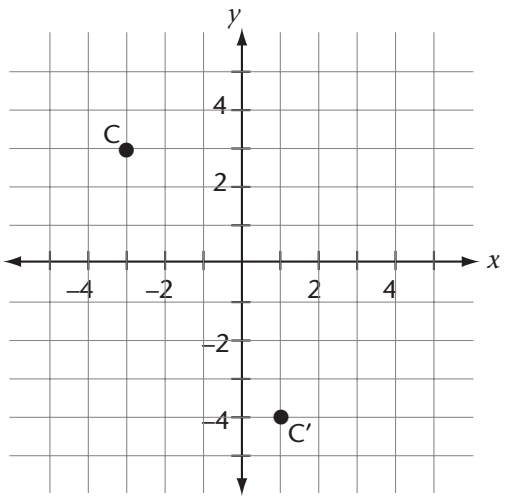
The point moved *up* 2. That's in the direction of the *y*-axis. The *y*-coordinate will *increase* by 2. To find the new *y*-coordinate, we will *add* 2.

The coordinates of the image are: (4 – 3, 2 + 2) = (1, 4)

If you got a different answer, keep trying until you understand how these movements affect B.

You've been **translating** points on the plane. To translate a point means to change its position by shifting it left or right, up or down.

Look at this graph.



Can you figure out what translation moved point C to C′?

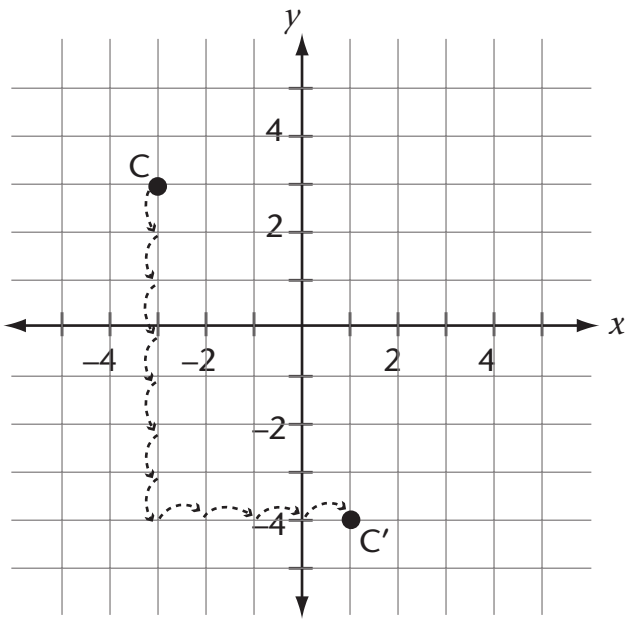
In other words, describe the movement from C to C′.

Thinking Space

It seems like down, left, decrease, & subtract usually go together ...

... and up, right, increase, & add go together.

Thinking Space



The translation that moved point C to C′ was:

7 units down and 4 units right

You could also give the instructions in a different order.

The translation that moved point C to C′ was:

4 units right and 7 units down

Now try these practice exercises.

Practice 1

1. Work out the coordinates of the images *without* graphing. Then, use a graph to check your work.

   a. A(–3, –2) is moved right 1 and down 2.

   The image is called _____.

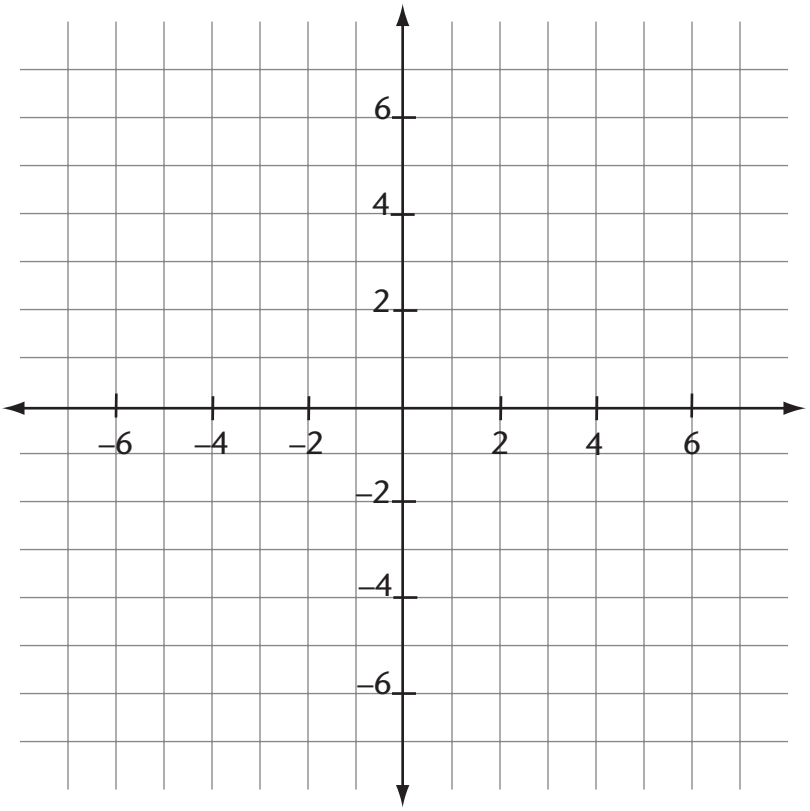
   Its coordinates are _____.

   b. B(2, –1) is moved left 4 and up 5.

   The coordinates of B′ are _____.

   c. C(–1, 2) is moved right 6 and down 2.

   The coordinates of C′ are _____.

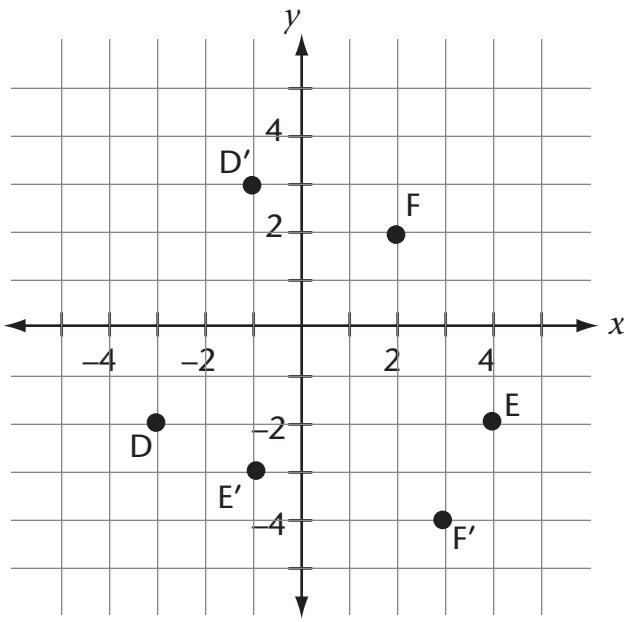


2. Describe these transformations:

   a. D to D′

   b. E to E′

   c. F to F′



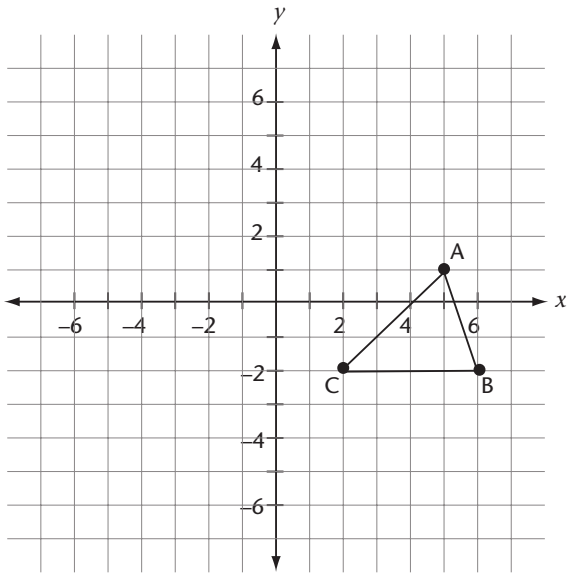
Turn to the Answer Key at the end of the Module and mark your answers.

Explore

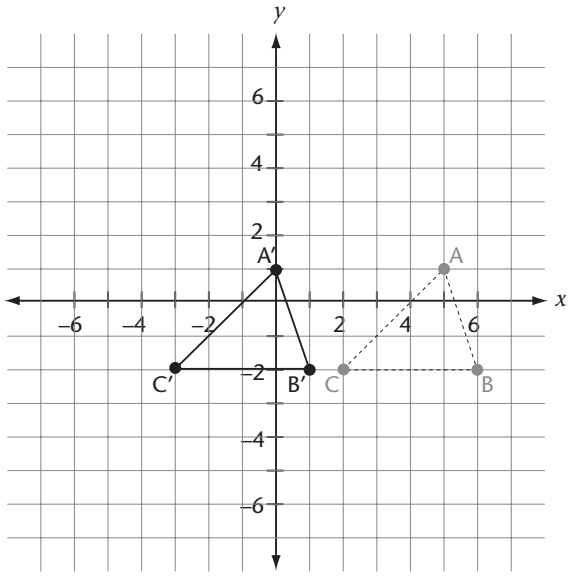
Thinking Space

Now you're ready to move some shapes. You'll need some graph paper for this part. You'll find this at the end of the module.

Copy this triangle onto your own graph paper. Remember to label the vertices.



Now, on the same graph, shift each vertex 5 units to the left. Label the vertices. Draw the image.



Did you notice?

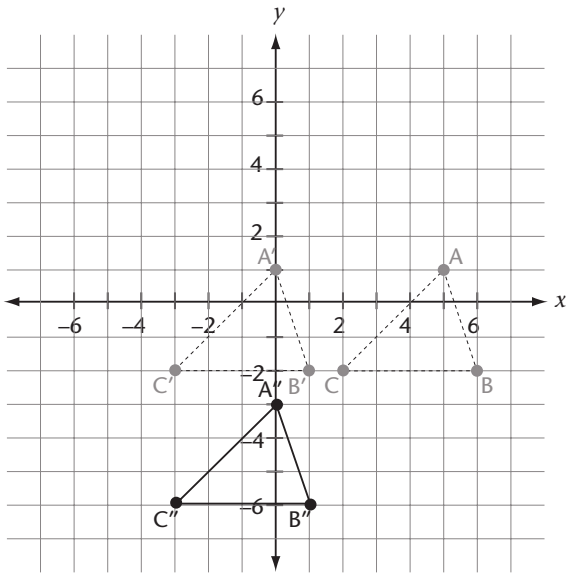
Shifting each vertex

is *exactly* the same thing as

shifting the whole shape.

Thinking Space

Let's do one more translation on that graph. Move the triangle 4 units down.



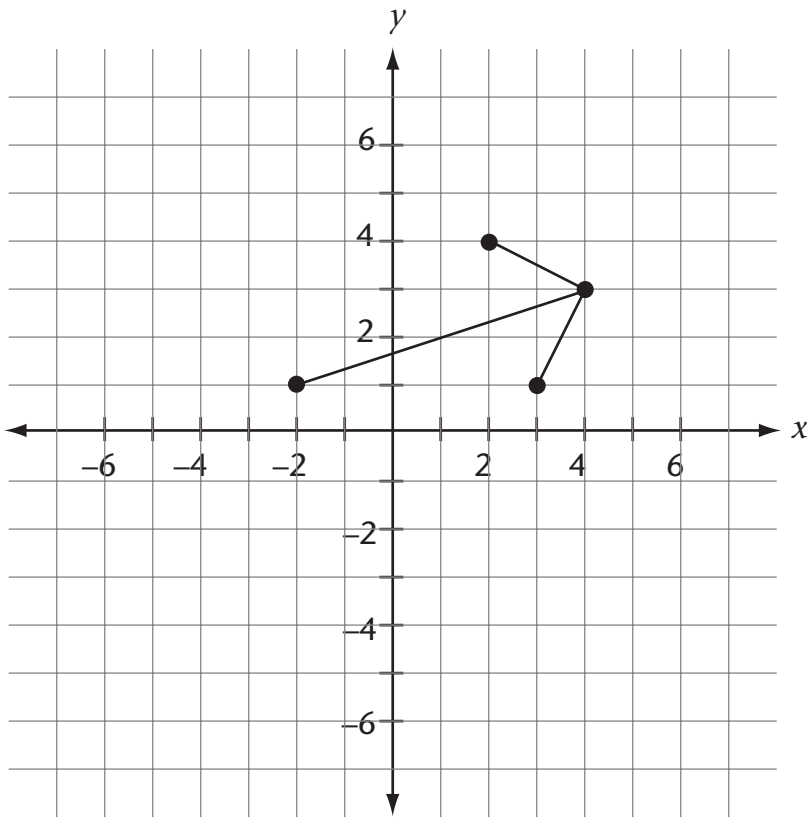
Now, describe the translation from ΔABC to ΔA″B″C″.

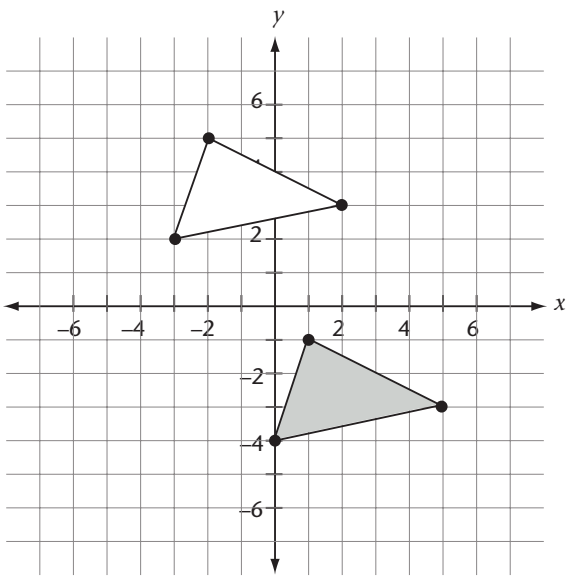
5 units to the left and 4 units down

That's all there is to it! You're translating shapes on the Cartesian plane.

Practice 2

1. Translate the shape on the graph by moving it 3 units to the right and 2 units down. Draw the image.





2. Describe the translation from the white triangle to the shaded triangle.

_____

_____

_____

3. Describe the translation from the shaded triangle to the white triangle.

_____

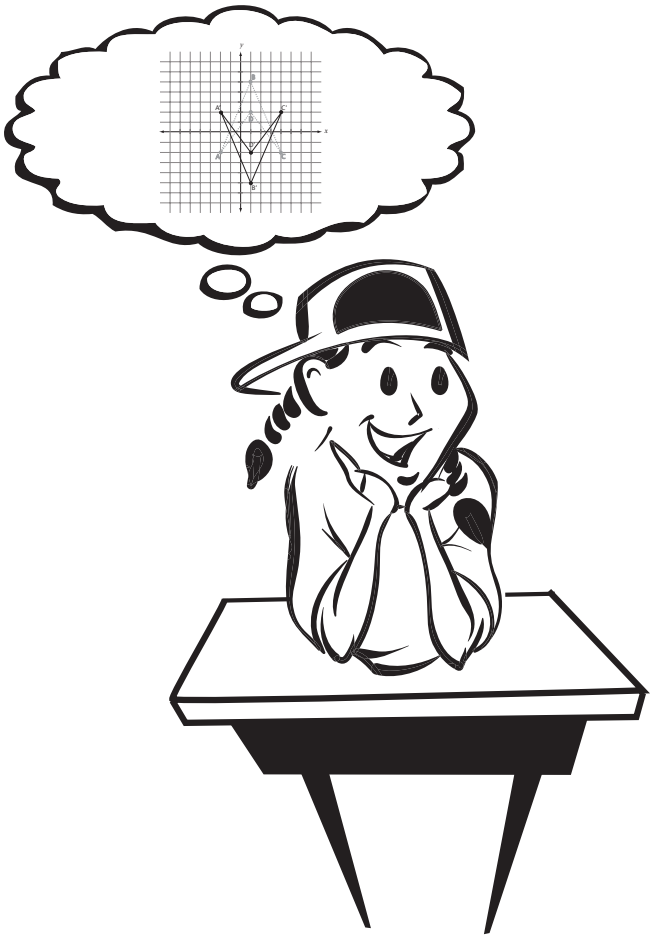
_____

_____

Turn to the Answer Key at the end of the Module and mark your answers.

Lesson 4.2B: Mirror, Mirror—Reflections on the Cartesian Plane

Student Inquiry



This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

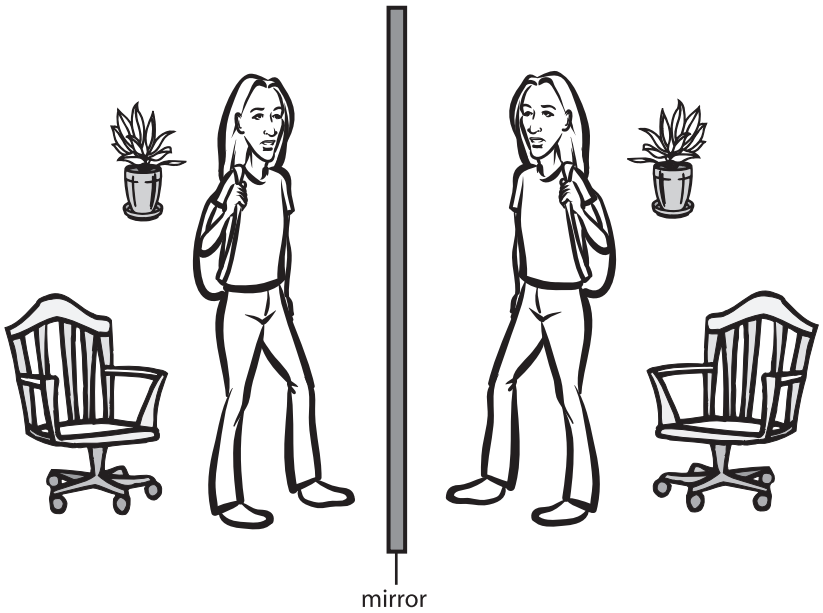
Student Inquiries	BEFORE THE LESSON	AFTER THE LESSON
	What I already know about this question:	What I thought at the end: My final answer, and examples:
What is a reflection?		answer
		example
Can I follow reflection instructions to move a shape to a new location on the plane?		answer
		example
Can I give reflection instructions to describe how a shape moved on the plane?		answer
		example
Is it possible to perform a translation and a reflection on the same shape? How?		answer
		example

Lesson 4.2B: Mirror, Mirror—Reflections on the Cartesian Plane

Thinking Space

Introduction

The next type of transformation we're going to work with is the reflection. You already know how reflections work—you see your own in the mirror everyday! Look at Mary. She's standing in front of a big mirror in a room with a potted plant and a chair.



Notice that things that are far away from the mirror in the original picture are far away from the mirror in the image. Things that are close to the mirror in the original picture are close to the mirror in the image.

In this lesson we'll explore reflections using the Cartesian Plane.

Image—I learned that word in Lesson 4.2A.

Explore Online

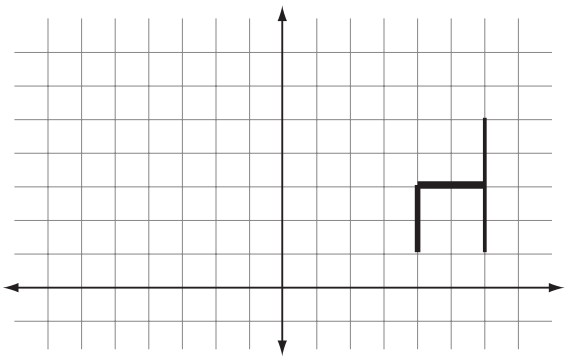
Looking for more practice or just want to play some fun games? If you have internet access, go to the Math 7 website at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Look for *Lesson 4.2B: Mirror, Mirror—Reflections on the Cartesian Plane* and check out some of the links.

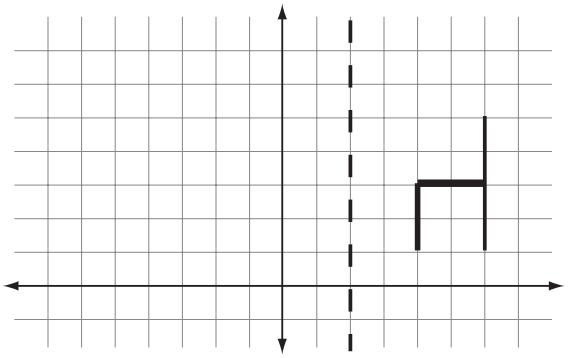
Explore

Get a pencil and some graph paper from the end of the module.

Let's look at that chair again, but this time on the Cartesian plane. Make a copy of this diagram on your paper.

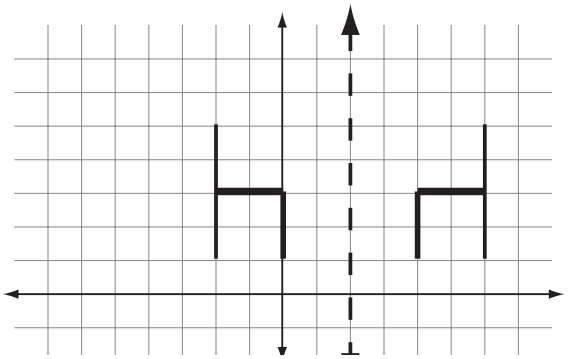


Now draw a vertical line through the point (2, 0). This will be our mirror.



You know what comes next. Draw the reflection of the chair.

The front of the chair is 2 units away from the mirror. So in the image, the front will be two units away from the mirror. The back of the chair is 4 units away from the mirror. The image of the back of the chair will also be 4 units away from the mirror.

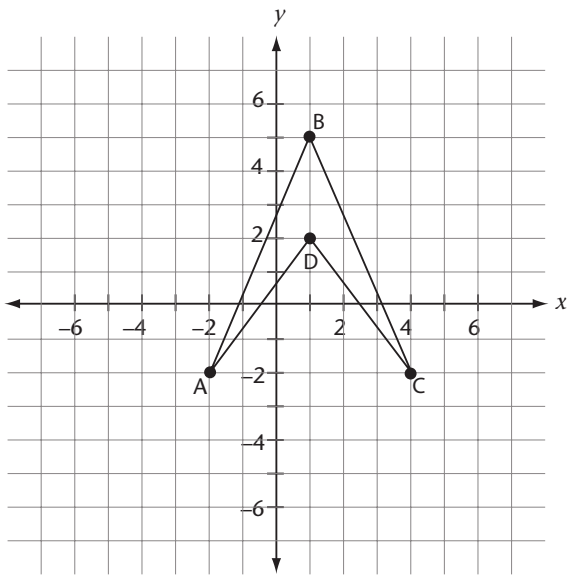


Thinking Space

How did the *x*-coordinates change in this reflection?

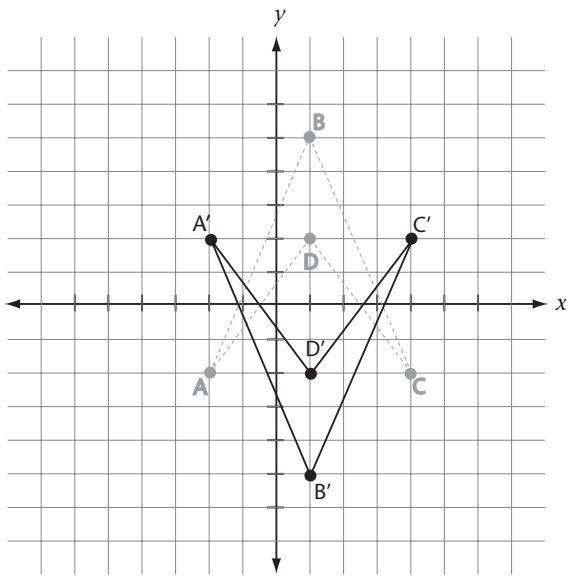
How did the *y*-coordinates change?

We'll do one more together, then it's time for you to practise on your own. Copy the shape ABCD onto your graph paper.



This time the reflection line will be the *x*-axis. Draw the image of the shape. Label the image A'B'C'D'.

In this example, there are points on both sides of the reflection line. That's OK. Just reflect each point in the reflection line and connect them to form the image.



Thinking Space

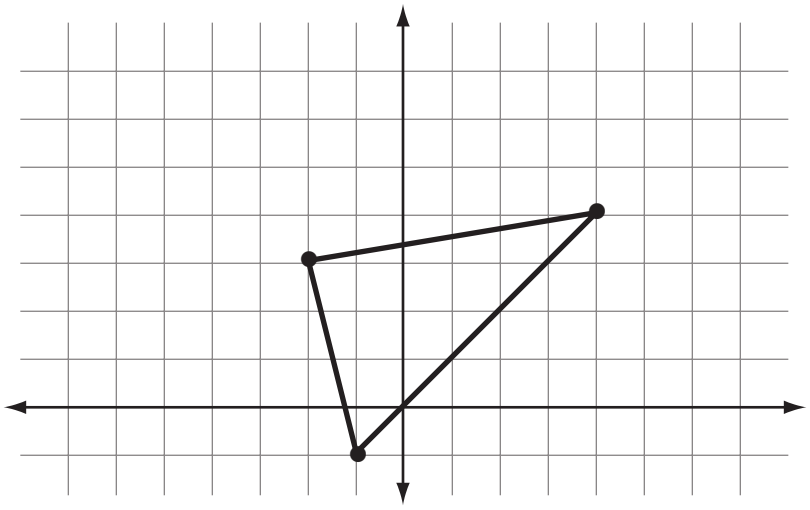
The reflection line is like the mirror.

How did the *x*-coordinates change in this reflection?

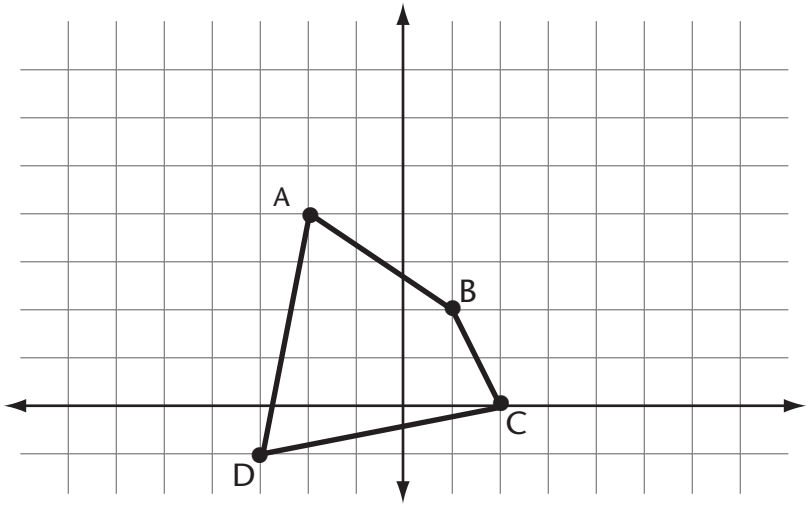
How did the *y*-coordinates change?

Practice 1

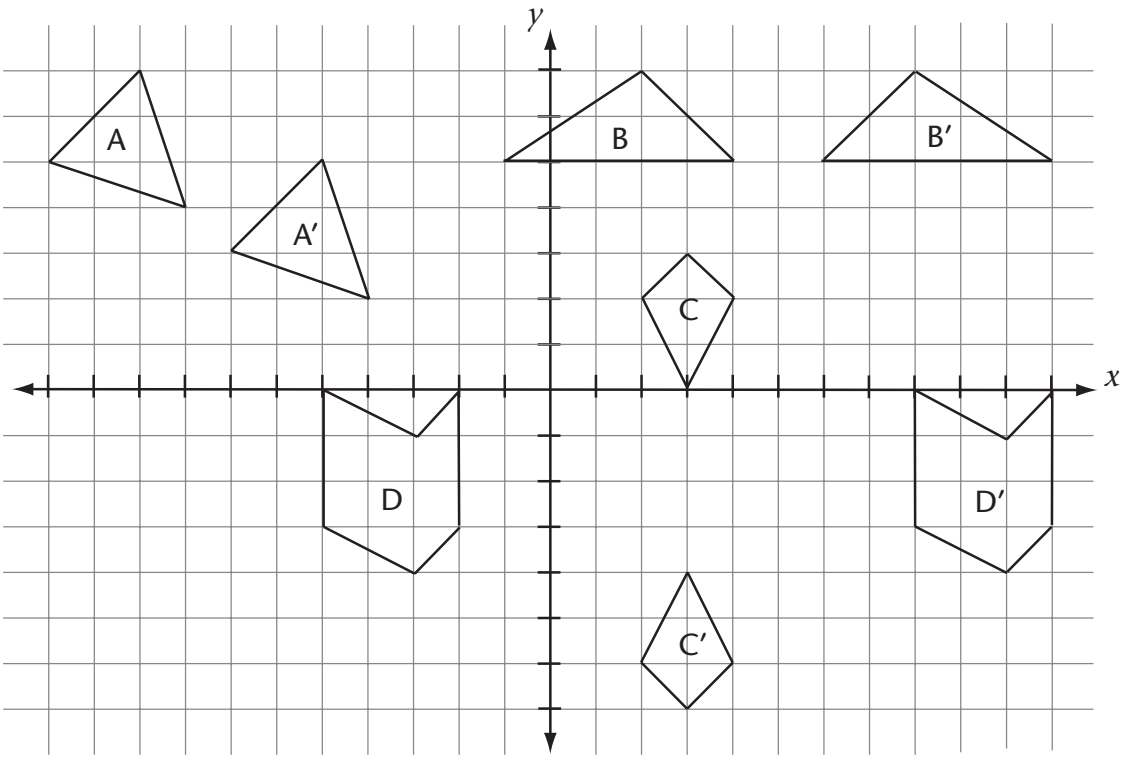
1. Copy this shape onto graph paper. Draw a horizontal reflection line through the point (0, –3). Draw the reflection.



2. Copy the shape ABCD onto graph paper. Reflect the shape in the *y*-axis and label the image A'B'C'D'.



3. Look at these pairs of shapes. Which are translations and which are reflections? For each translation, describe the translation. For each reflection, draw the reflection line.

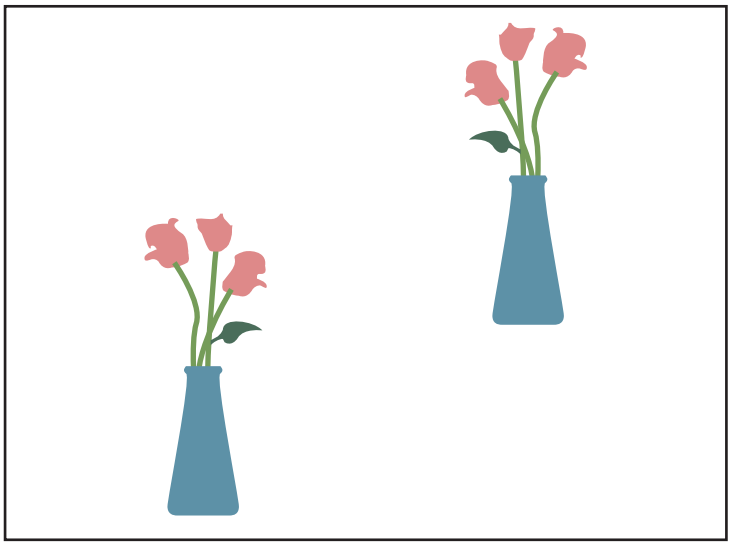


Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Thinking Space

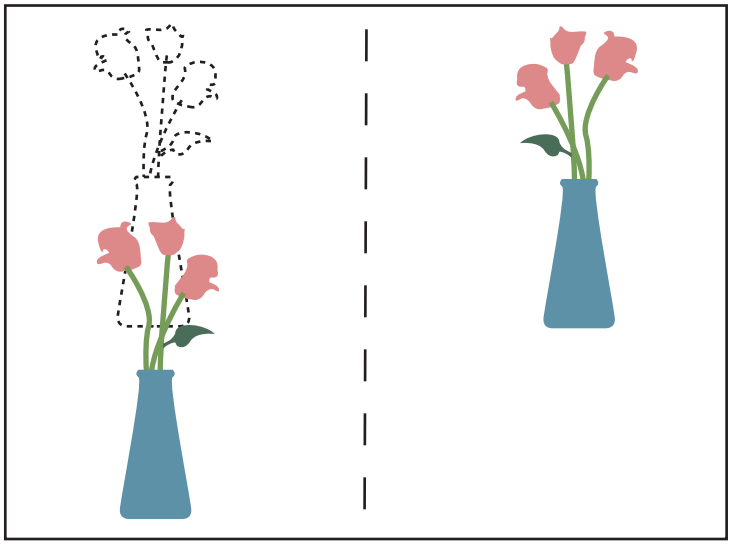
Look at these two plants. Is this an example of a reflection or a translation?



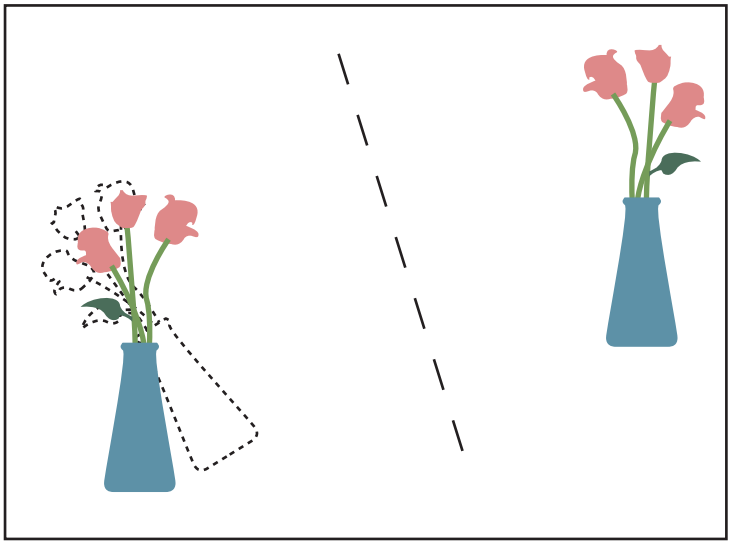
It can't be a translation, because the leaf has changed sides.

So, it must be a reflection. Let's figure out where the reflection line goes.

This reflection line almost works, but the image is too high.



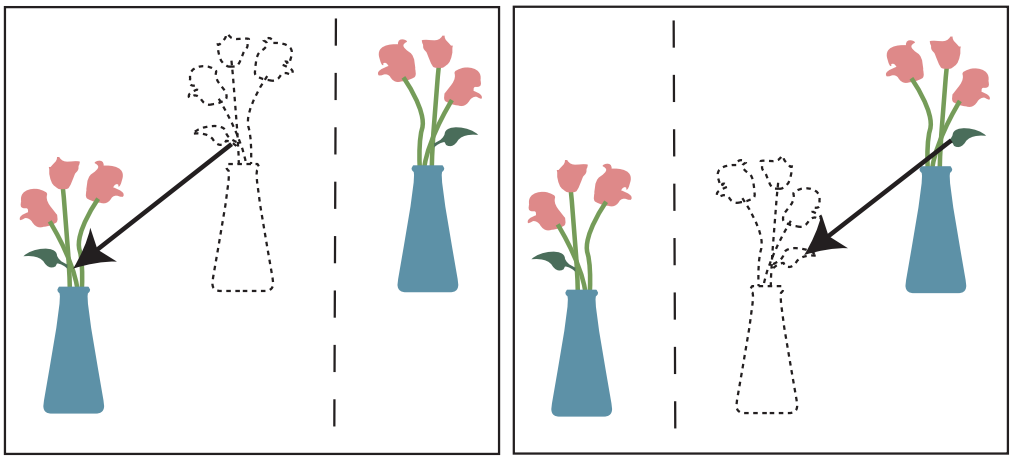
This reflection line puts the image on the right spot, but the image is twisted.



What's going on?

This image is the result of a reflection and a translation. Can you figure out the steps?

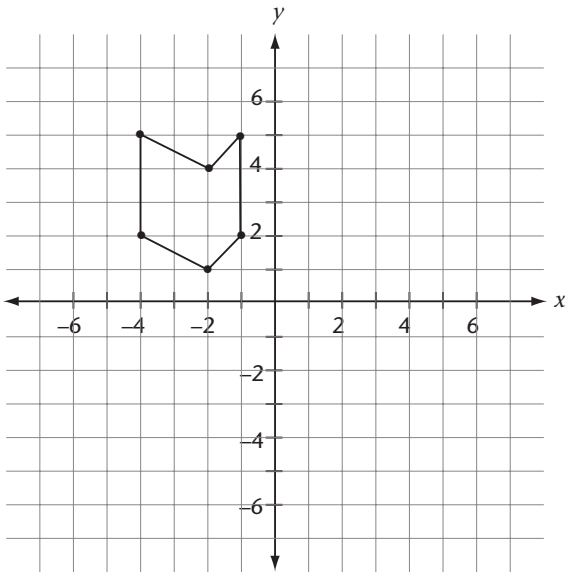
Does your solution look like one of these? Don't worry if it doesn't. There are lots of ways to do it.



Thinking Space

There are actually infinitely many ways to do this!

Copy this shape onto your graph paper.

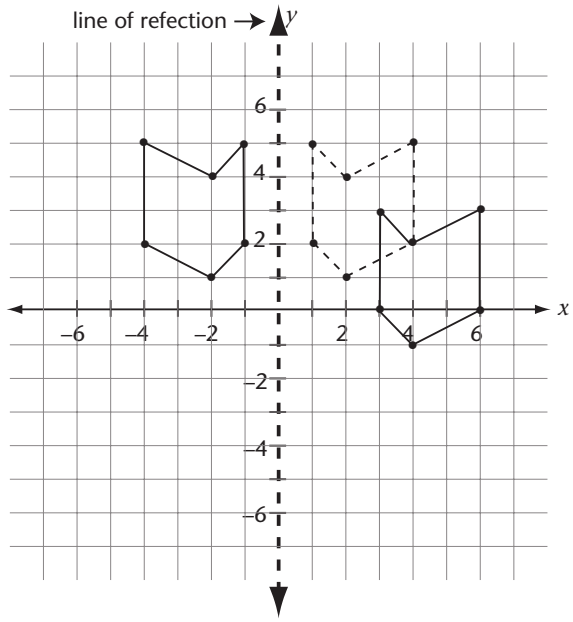


Reflect the shape in the *y*-axis.

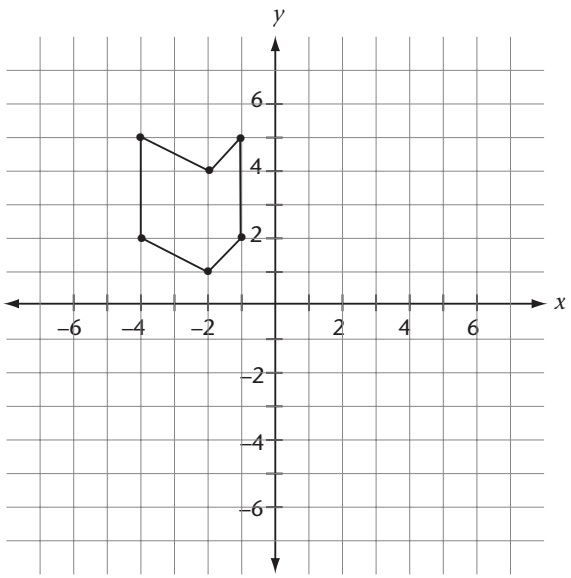
Then translate the shape 2 units right and 2 units down.

Thinking Space

This is the result of those two transformations. The image of the first step is shown with a dashed line.

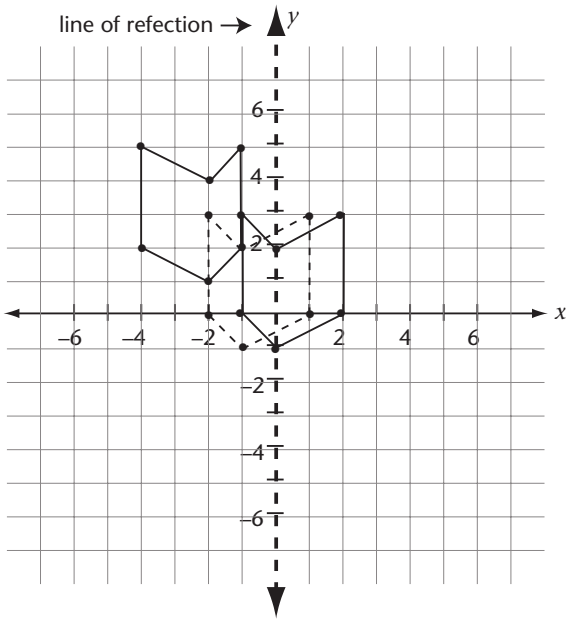


Copy that same shape onto your graph paper again.



Translate the shape 2 units right and 2 units down.

Then reflect the shape in the *y*-axis.



This image is in a different place! When we changed the order of the transformations, we got a different result.

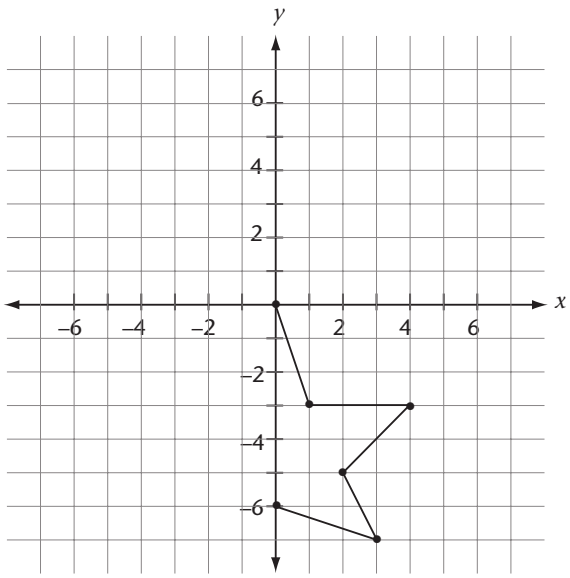
Thinking Space

?

Is this true for all pairs of transformations? What about two different reflections? two different translations?

Practice 2

1. Copy this shape onto graph paper.



   Reflect the shape in the *y*-axis.

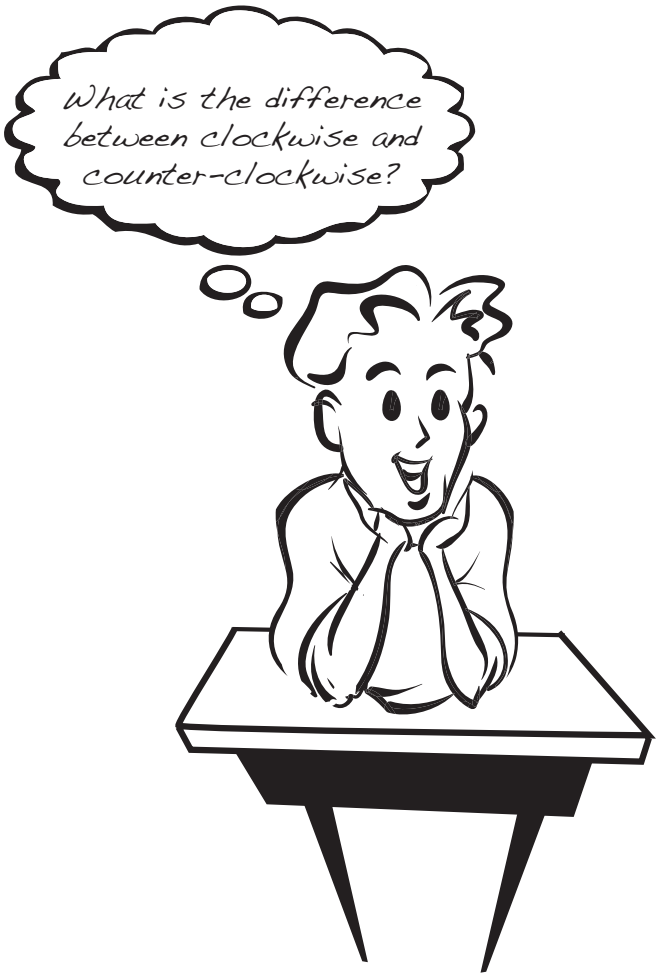
   The original shape and its image have made a new shape.

2. Translate the new shape up 6 units.

Turn to the Answer Key at the end of the Module and mark your answers.

Lesson 4.2C: Rotations on the Cartesian Plane

Student Inquiry



This activity will help you get ready for, learn, and review the information in the upcoming lesson.

When you turn this page over, you will find a chart containing the inquiry outcomes for this lesson. You may be able to answer some of these questions already! Start by writing down your thoughts before the lesson.

When you finish the lesson, answer each question and give an example.

Student Inquiries	BEFORE THE LESSON What I already know about this question:	AFTER THE LESSON What I thought at the end: My final answer, and examples:
What is the difference between clockwise and counter-clockwise?		answer
		example
What is a turn of 90°? 180°? 270°?		answer
		example
What is a *centre of rotation*? Can I follow rotation instructions to move a shape to a new location on the plane?		answer
		example
Can I perform translations, reflections, and rotations on the same shape?		answer
		example

Lesson 4.2C: Rotations on the Cartesian Plane

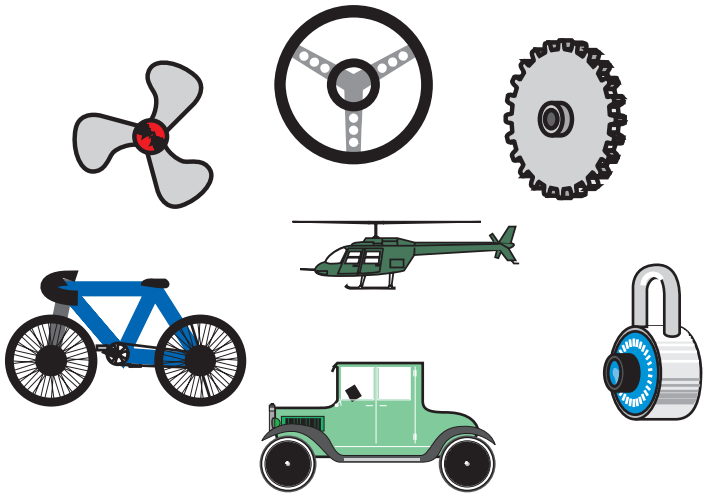
Thinking Space

Introduction

You've learned about two kinds of transformations already: translations and reflections. There's only one more to do—rotations.

Think about some things that rotate:

- the wheels of a bike or a car
- a CD being played
- a merry-go-round
- the blades of a fan
- the bit of a drill
- a steering wheel
- the propeller on a helicopter
- a combination lock
- gears



Think about how the action of rotation is different than translation or reflection.

Explore Online

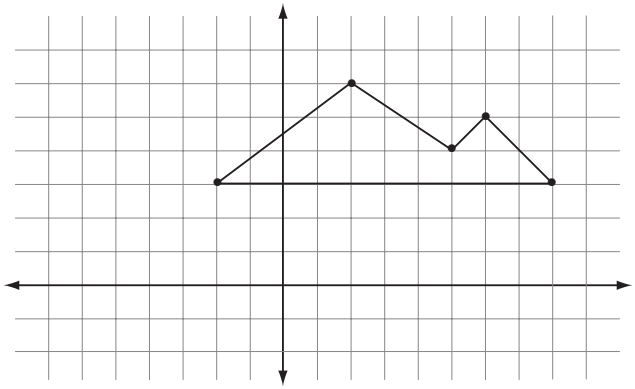
Looking for more practice or just want to play some fun games? If you have internet access, go to the Math 7 website at:
http://www.openschool.bc.ca/courses/math/math7/mod4.html

Look for *Lesson 4.2C: Rotations on the Cartesian Plane* and check out some of the links.

Warm-up

Let's do a quick review of translations and reflections.

These questions will use this shape.



1. Copy the shape onto your graph paper.

   a. Translate the shape 3 units left and 4 units down.

   b. Reflect the image from part (a) in the *y*-axis.

2. Make another copy of the shape. Draw a horizontal line of reflection through the point (0, 2). Draw the image of the reflection.

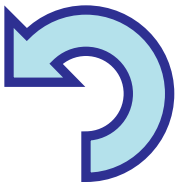
Turn to the Answer Key at the end of the Module and mark your answers.

Explore

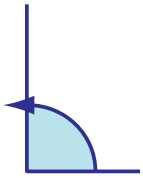
Thinking Space

Before we get started doing rotations, we need to agree on the meaning of some terms.

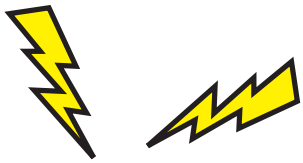
Clockwise means to rotate in the direction of the hands of a clock. This arrow is rotating in a clockwise direction. In other words, if you are rotating something clockwise, you are spinning the object so the top of it moves to the right.



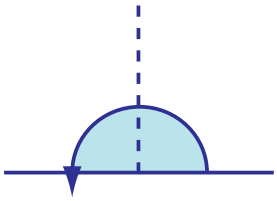
Counter-clockwise means to rotate in the other direction. This arrow is rotating in a counter-clockwise direction. The top of an object that is rotating counter-clockwise moves to the left.



This is a 90° angle.



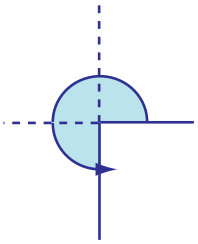
Rotate 90° means make a ¼ turn. This thunderbolt has been rotated 90° clockwise.



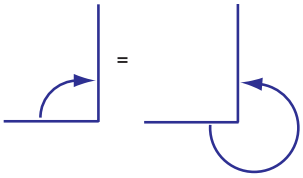
This is a 180° angle.

When you jump your bike or your skateboard, turn in the air, and land facing in the other direction, you've "done a 180." Rotate 180° means make a ½ turn. This cloud has been rotated 180°.

Thinking Space



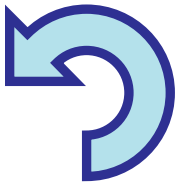
A 270° angle represents a ¾ turn.



Look at the thunderbolts again. Do you see that a rotation of 90° clockwise is the same as a rotation of 270° counter-clockwise?

Practice 1

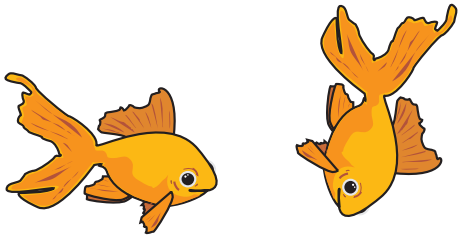
1. The direction of this arrow is:



   a. clockwise

   b. counter-clockwise

2. The goldfish has been rotated:

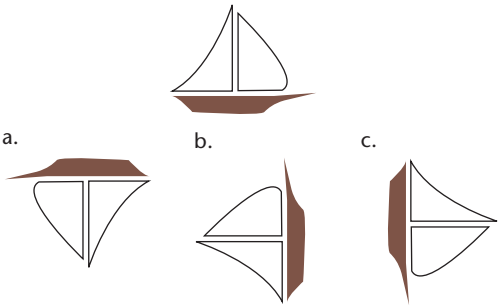


   a. 90° counter-clockwise

   b. 180° clockwise

   c. 270° counter-clockwise

3. Which boat has been rotated 180°?

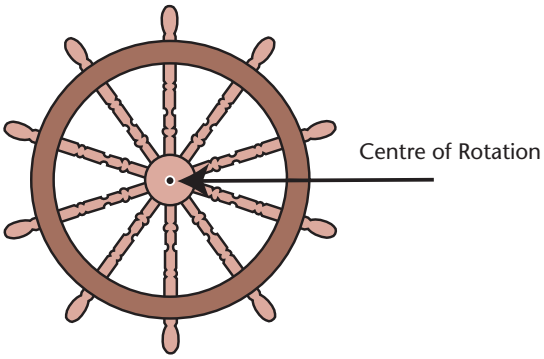


Turn to the Answer Key at the end of the Module and mark your answers.

Explore

Thinking Space

When a wheel rotates, there is one place that doesn't change position. This is the **centre of rotation**.

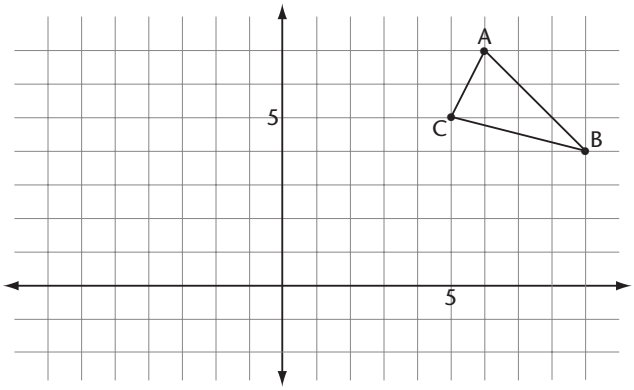


Every other part of the wheel spins around the centre of rotation.

When we do rotations on the Cartesian plane, we need to know three things:

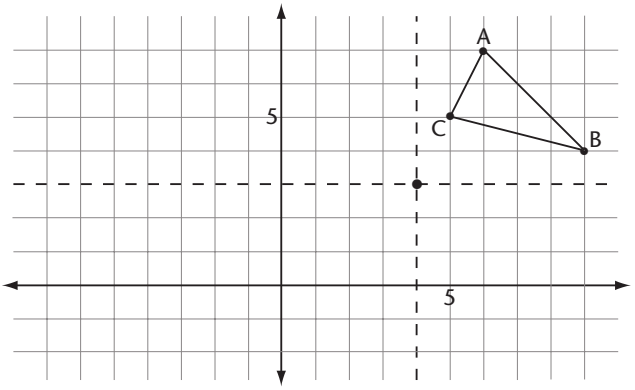
- the amount of rotation: 90°, 180°, or 270°
- the direction of rotation: clockwise or counter-clockwise
- the centre of rotation

Let's rotate the triangle ABC 90° clockwise around the point (4, 3).



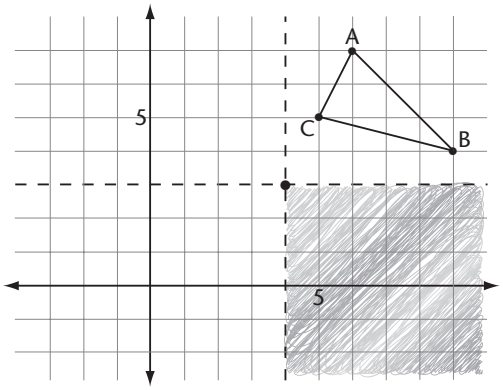
Copy triangle ABC onto your graph paper.

Plot the centre of rotation (4, 3). Draw a dashed vertical line through the centre of rotation. Draw a dashed horizontal line through the centre of rotation.

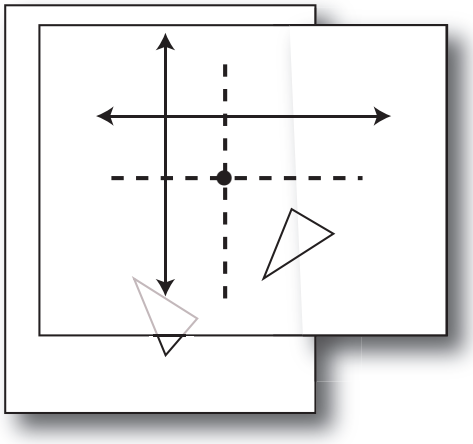


These dashed lines will help us figure out where the image of this transformation belongs.

A rotation of 90° clockwise will put our triangle in the shaded region.

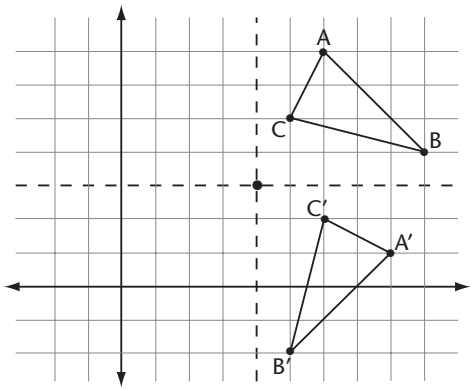


Copy triangle ABC onto another sheet of graph paper and position it underneath your first graph.

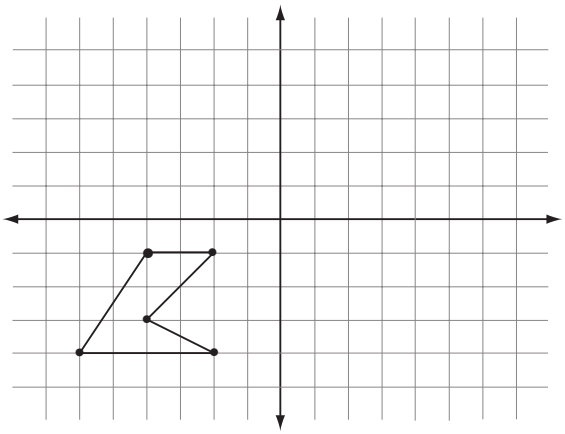


This will help you find the position of the image.

Draw the image and label it A'B'C'.

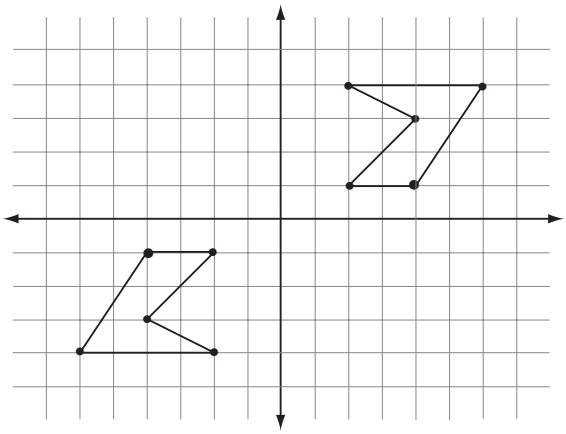


Let's do one more example. Copy this shape onto your graph paper.



Rotate it 180° counter-clockwise about the origin.

Notice that 180° counter-clockwise is the same as 180° clockwise.



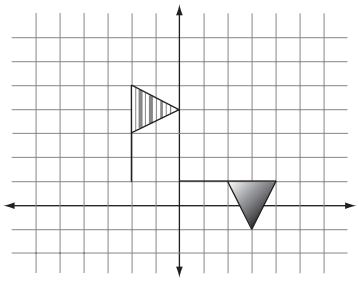
Thinking Space

The origin is the point (0,0).

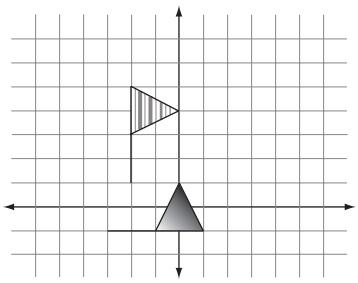
Practice 2

1. The striped flag is the original and the shaded flag is the image. Which diagram represents a rotation of 90° clockwise followed by a translation of 2 units to the right?

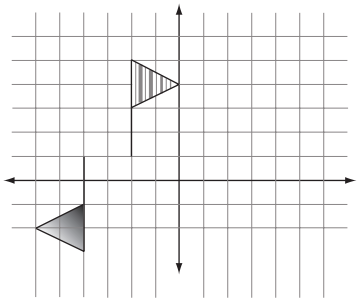
a.



b.



c.



2. Triangle DEF has coordinates D(–5, 1), E(1, 2), and F(0, –2). Find the coordinates of the image after rotating 270° clockwise about E.

Turn to the Answer Key at the end of the Module and mark your answers.

Section Summary

We did a lot of drawing in this section, and you learned about three kinds of transformations:

1. translations
2. reflections
3. rotations

Look over the terms we defined in this section and make sure you didn't miss any. Try writing a definition for each term. Maybe some of the terms are easier to explain with a picture. How does your definition compare with the definition in the glossary?

- centre of rotation
- clockwise
- counter-clockwise
- image
- line of reflection
- reflection
- rotate 180°
- rotate 270°
- rotate 90°
- rotation
- transformation
- translation

Section Challenge

Remember your new job? You're working with a stained glass window designer. She is famous for turning the suggestions of her clients into beautiful designs.

Her newest clients want a window designed that shows their affection for the number three. The designer has decided to use triplets of triangles for this three-loving family.

She knows that the Cartesian plane will help her draft this design. You're the in-house Cartesian plane expert, so she has come to you for help.

You'll be using your knowledge of transformations to help design a beautiful window. The stained glass designer that you work for has had some ideas about your window project. Follow the instructions to create a design for a stained glass window.

Use the graph paper provided on the next pages for this. A ruler might be useful, but it's not necessary.

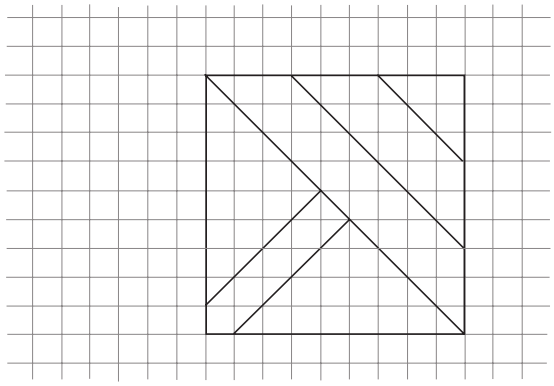
1. a. Join these points in order: (–3, 12), (–12, 12), (–12, 3), (–3, 3). Join the first point to the last point.

   This is a square in Quadrant II.

   b. Reflect this square in the *x*-axis.

   Now you also have a square in Quadrant III.

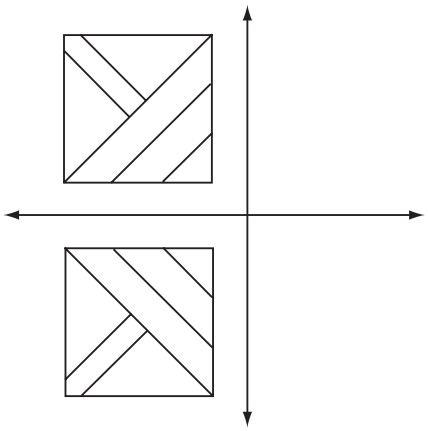
   c. Copy this design in the Quadrant III square.



   d. On a separate sheet of graph paper, rotate the design 90° clockwise.

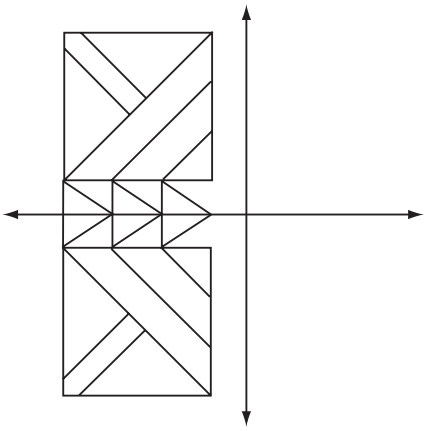
   Copy the rotated image into the Quadrant II square.

   So far, your design should look something like this.



2. a. Draw a triangle with vertices (–3, 0), (–6, 3), (–6, –3).
   b. Translate the triangle 3 units left.
   c. Translate the image from part (b) 3 units left.

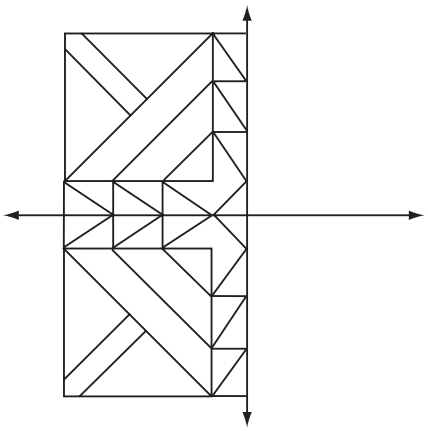
   Now your design looks like this.



3. a. Connect (0, 12) to (–3, 12) to (0, 9).
   b. Translate this line 3 units down.
   c. Translate the image from part (b) 3 units down.
   d. Draw a line from (–3, 0) to (0, 3).

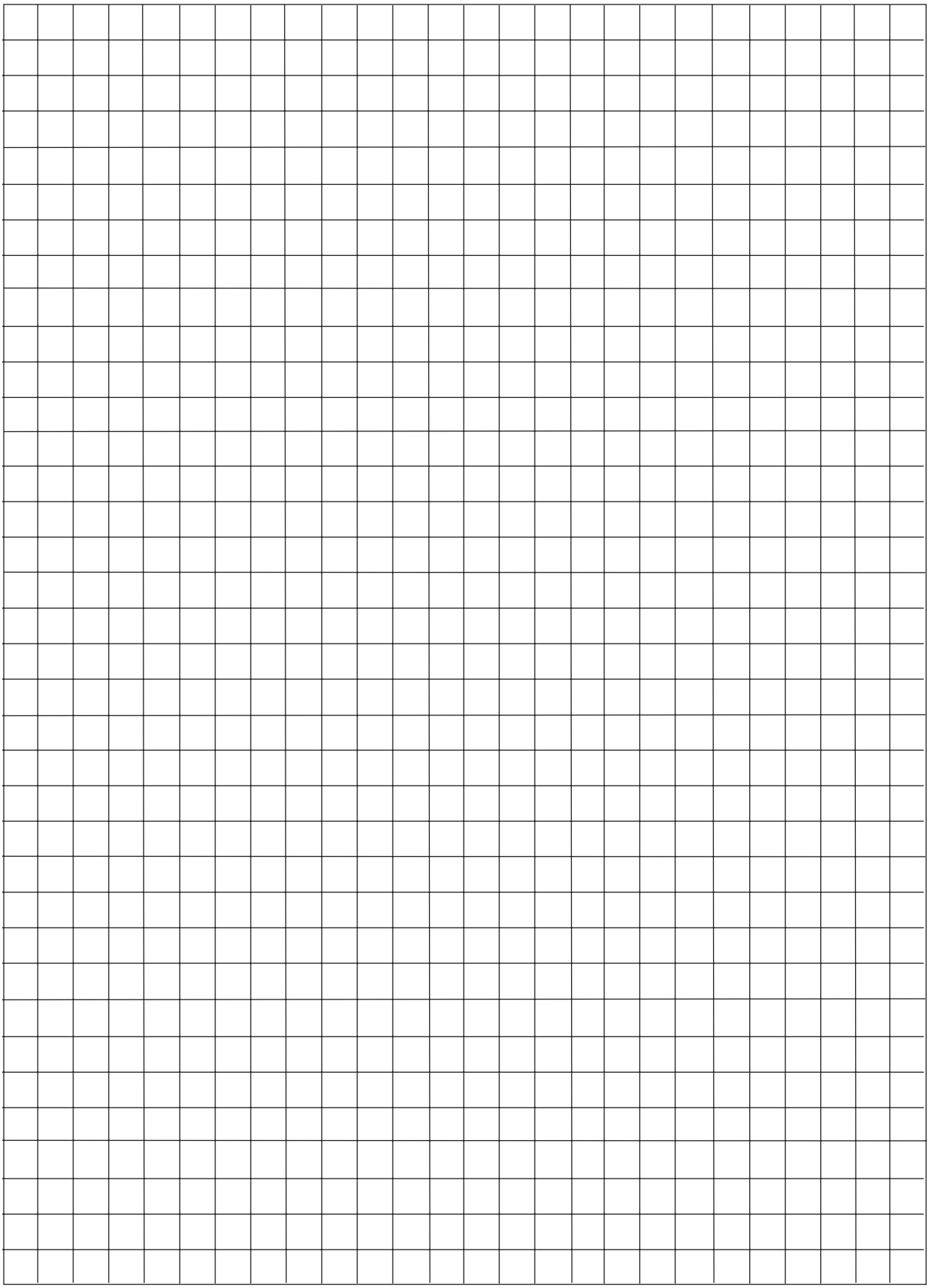
4. Quadrant III is almost a perfect reflection of Quadrant II, but some lines are missing. Fill in those missing lines.

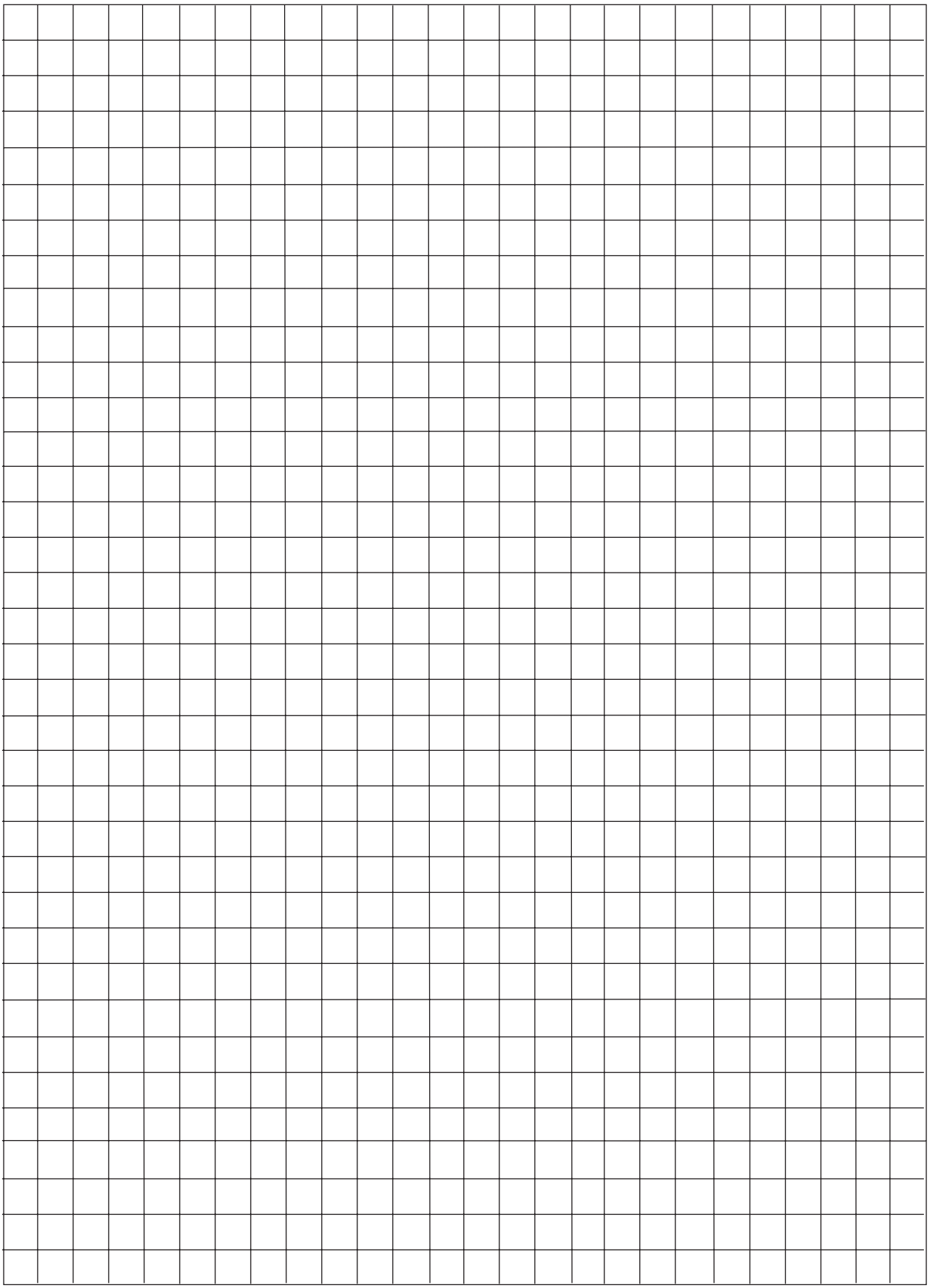
   Now your design should look like this.

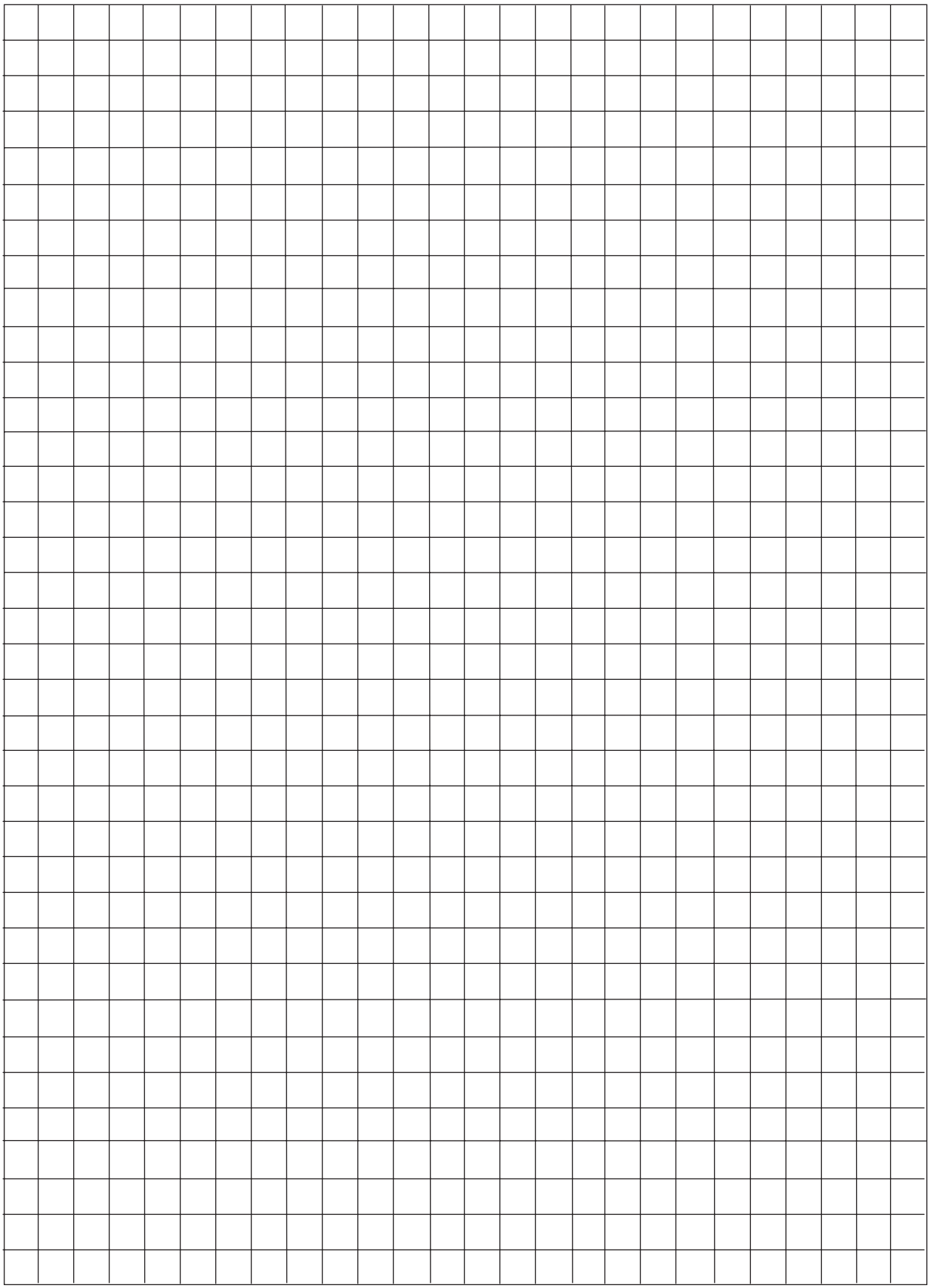


5. Almost done! Reflect the entire design in the *y*-axis.

   Whew! Being a designer is a lot of work! Add some colour to the design if you want to.







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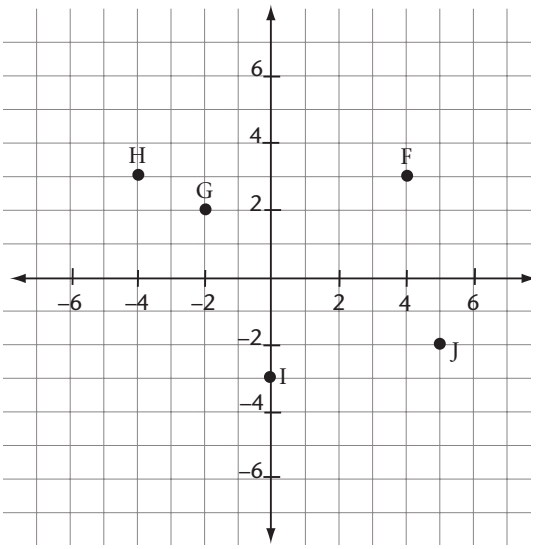
Answer to Pretest 4.1

Lesson 4.1A

1. A (7, 2)
   B (0, 3)
   C (–2, 1)
   D (–5, –3)
   E (3, –1)

2.



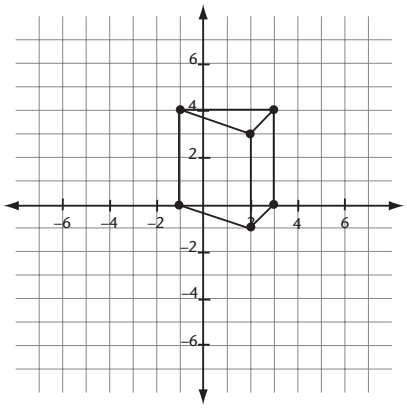
3. b. Quadrant II

4. c. Quadrant III

5. b. *y*-axis

Lesson 4.1B

1.



2. You may start with any point, but your list must be in the same order as one of these lists.

   Join these points in the order given:

   (–3, 3) (2, –1) (–5, –2)

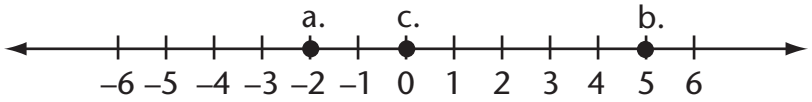
   OR

   (–3, 3) (–5, –2) (2, –1)

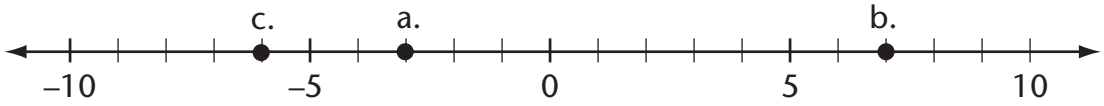
   Connect the first point to the last point.

Answer to Lesson 4.1A Warm-up

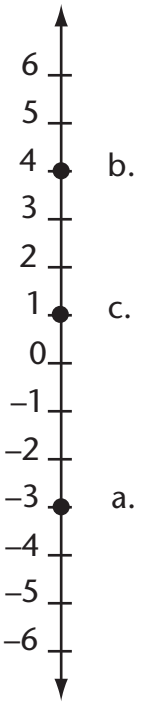
1.



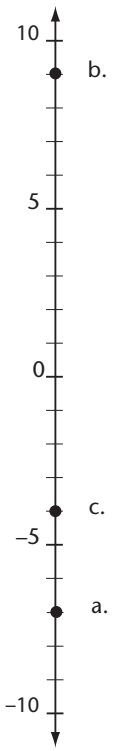
2.



3.

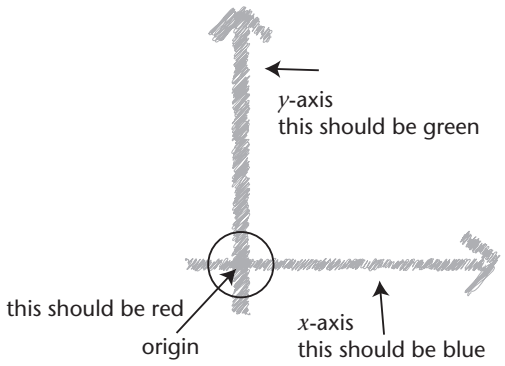


4.



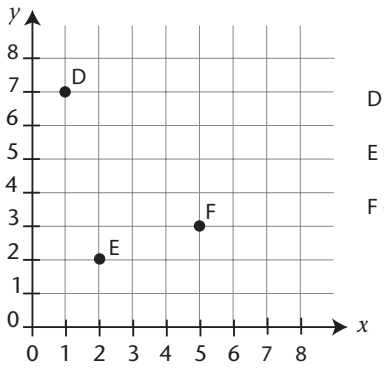
Answer to Lesson 4.1A Practice 1

1.



2. A(2, 3)
   B(6, 2)
   C(5, 6)

3.



D (1, 7)

E (2, 2)

F (5, 3)

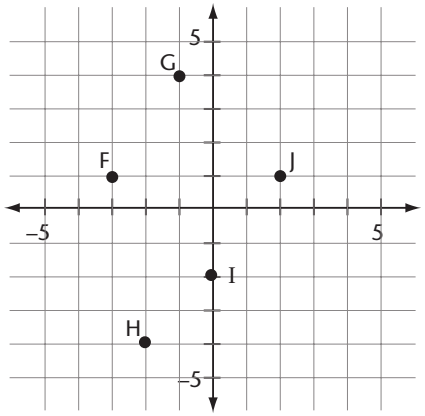
Answer to Lesson 4.1A Practice 2

1. 3
2. 4
3. (3, 4)
4. coordinate

Answer to Lesson 4.1A Practice 3

1. A(3, 4)
   B (0, –2)
   C (1, –4)
   D (–2, 5)
   E (–1, –3)

2.



F (–3, 1)

G (–1, 4)

H (–2 , –4)

I (0, –2)

J (2, 1)

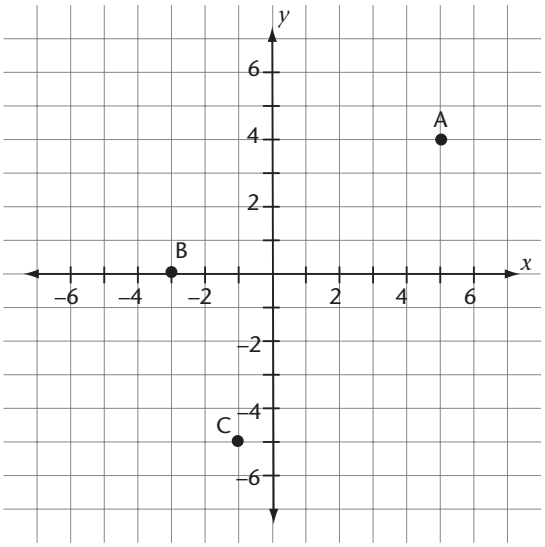
Answer to Lesson 4.1A Practice 4

1. A - Quadrant II
   B - Quadrant IV
   C - Quadrant I
   D - Quadrant III
   E - Quadrant IV
   F - Quadrant II

2. E (1, –1) and B (4, –2)

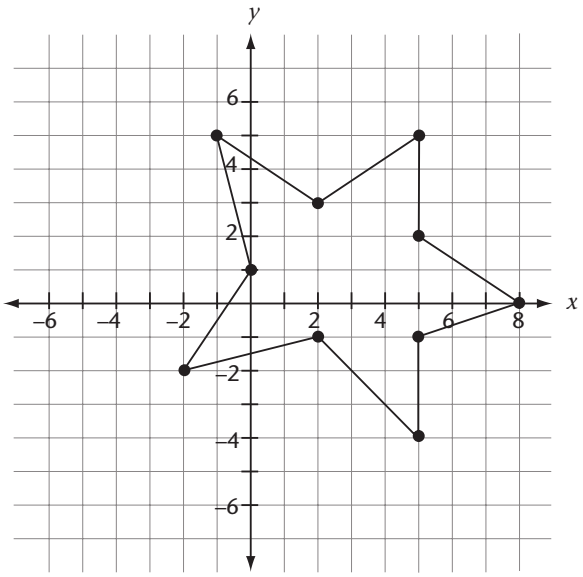
3. The *x*-coordinate of all the points in Quadrant IV is positive.
   The *y*-coordinate of all the points in Quadrant IV is negative.

Answer to Lesson 4.1B Warm-up

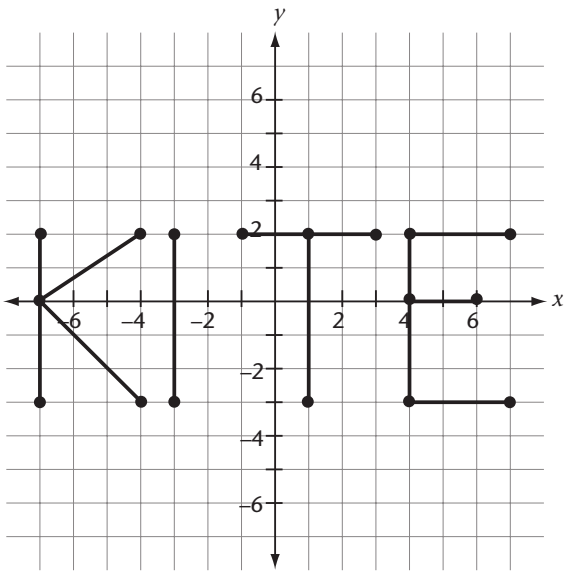


Answer to Lesson 4.1B Practice 1

1.



2.



3. Remember: You may start with any point, but your list must be in the same order as one of these lists.

   Connect these point in order:

   (–4, 2), (–1, 5), (–1, 3), (6, 3), (6, 1), (–1, 1), (–1,–1)

   OR

   (-4, 2), (–1,–1), (–1, 1), (6, 1), (6, 3), (–1, 3), (–1, 5)

   Join the last point to the first point.

Answer to Section Challenge 4.1

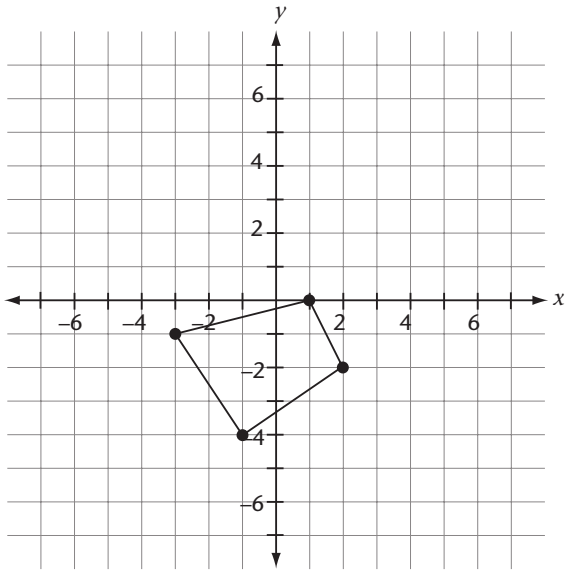
1. Answers will vary. A drawing of the student's Zubo character. One of Zubo's eyes should be at the origin.

2. Answers will vary. Instructions for drawing Zubo. Coordinates for all vertices should be listed with instructions for which lines are to be drawn.

Answer to Pretest 4.2

Lesson 4.2A

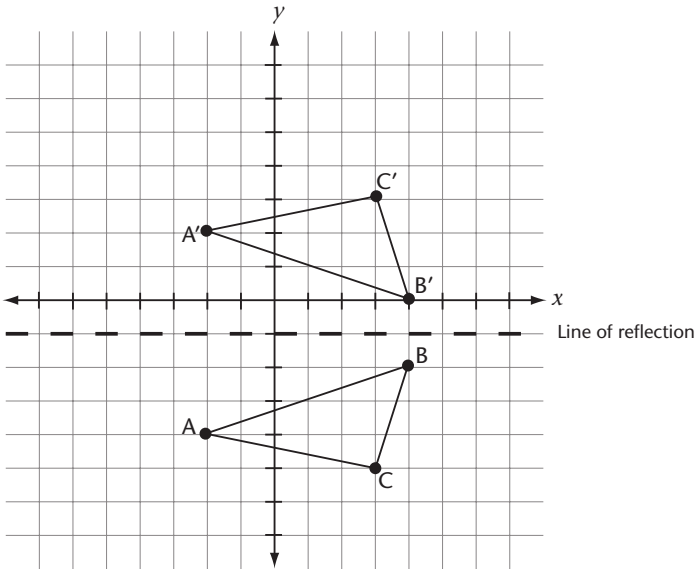
1.



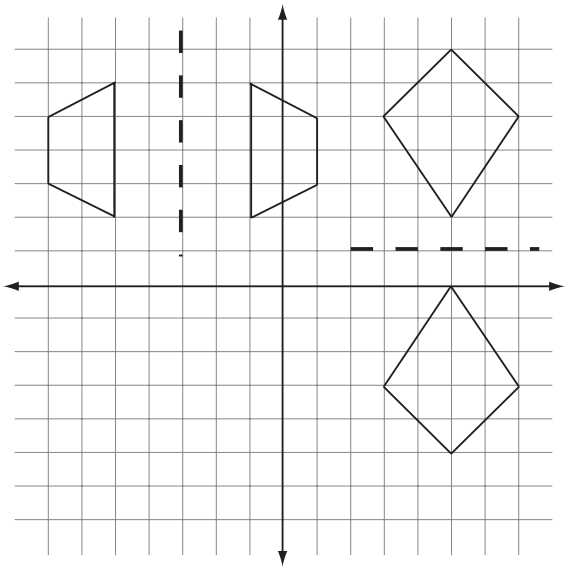
2. 5 units to the right and 3 units up

Lesson 4.2B

1. The coordinates are A′(–2, 2), B′(4, 0), and C′(3, 3).



2.

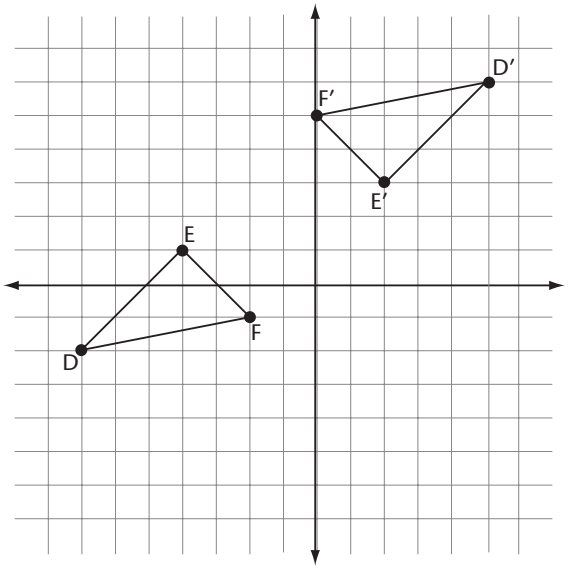


3. c

Lesson 4.2C

1. a

2.



D'(5, 6)
E'(2, 3)
F'(0, 5)

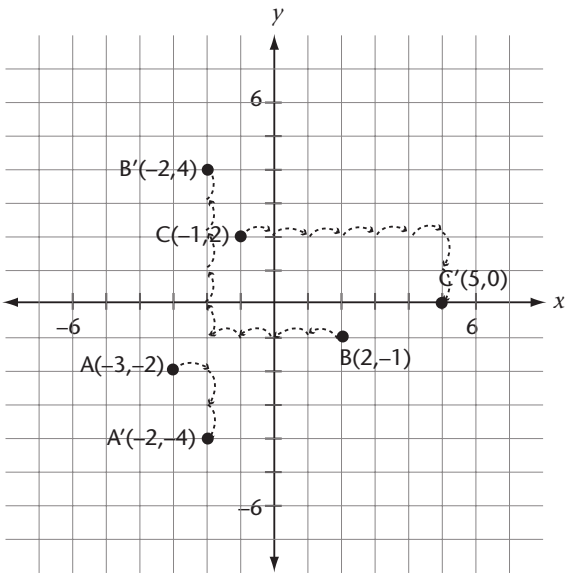
Answer to Lesson 4.2A Warm-up

1. 5
2. 3
3. –3
4. 4
5. –4
6. –10
7. –2
8. 5
9. 12
10. –7
11. –2
12. 0
13. –3
14. 2
15. –11
16. –5
17. –12
18. –2
19. 11
20. –4

Answer to Lesson 4.2A Practice 1

1. a. The image is called A′.
The image is 1 unit to the right of A.
Add 1 to the *x*-coordinate.

The image is 2 units below A.
Subtract 2 from the *y*-coordinate.
Its coordinates are
(–3 + 1, –2 – 2) = (–2, –4)



b. The image is 4 units to the left of B.
Subtract 4 from the *x*-coordinate.

The image is 5 units above B.
Add 5 to the *y*-coordinate.
(2 – 4, –1 + 5)
The coordinates of B′ are (–2, 4)

c. The image is 6 units to the right of C.
Add 6 to the *x*-coordinate.

The image is 2 units below C.
Subtract 2 from the *y*-coordinate.
(–1 + 6, 2 – 2)
The coordinates of C′ are (5, 0).

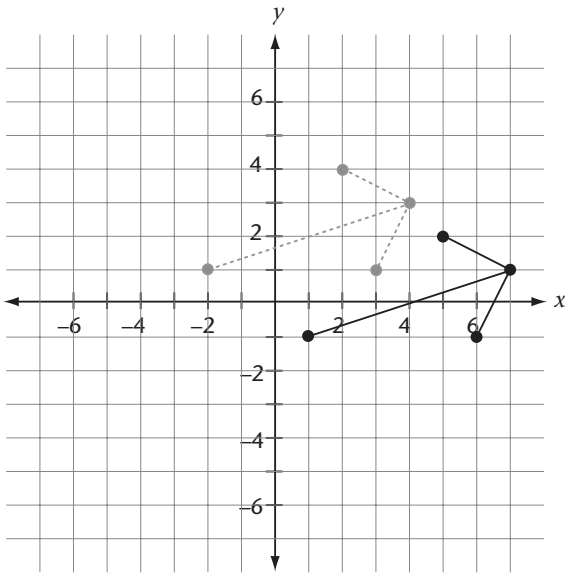
2. a. right 2 and up 5

b. left 5 and down 1

c. right 1 and down 6

Answer to Lesson 4.2A Practice 2

1.

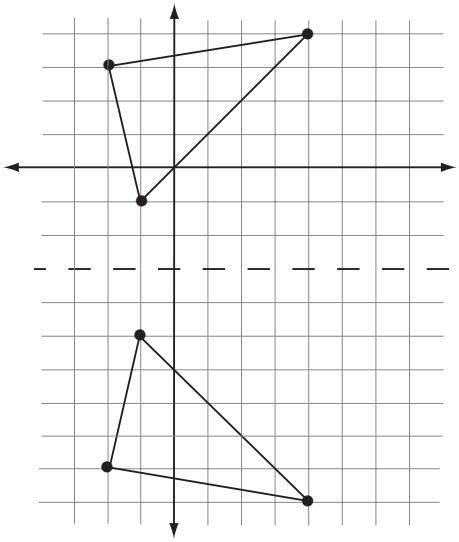


2. 3 units to the right and 6 units down

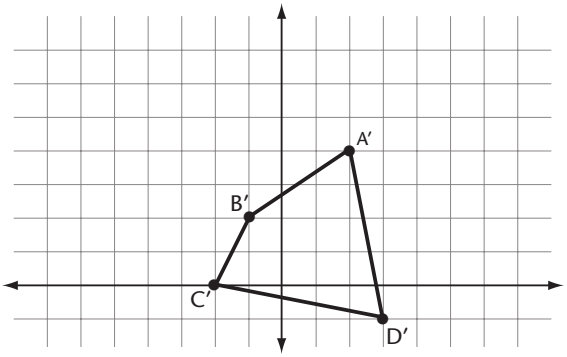
3. 3 units to the left and 6 units up

Answer to Lesson 4.2B Practice 1

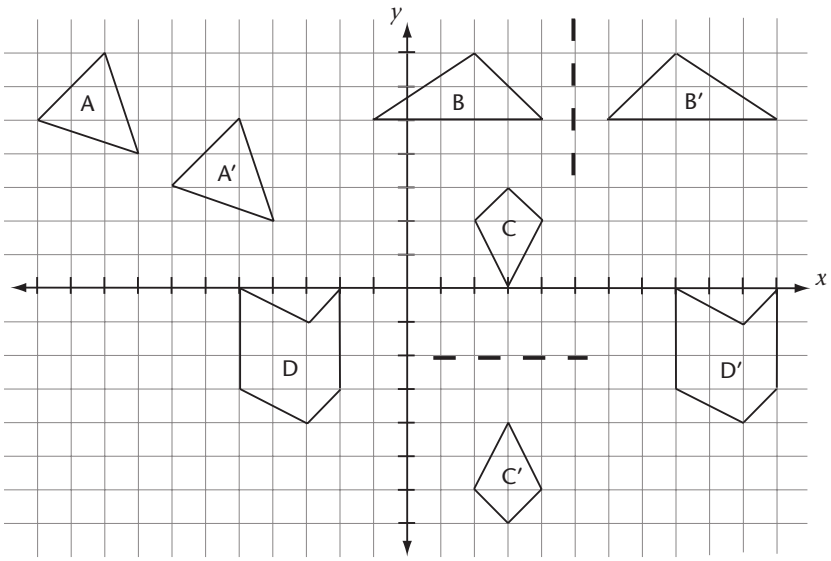
1.



2.



3.



A to A′ is a translation—4 right and 2 down

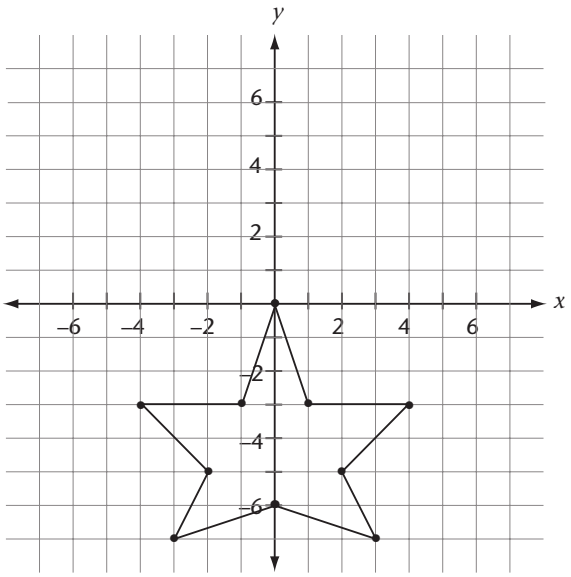
B to B′ is a reflection

C to C′ is a reflection

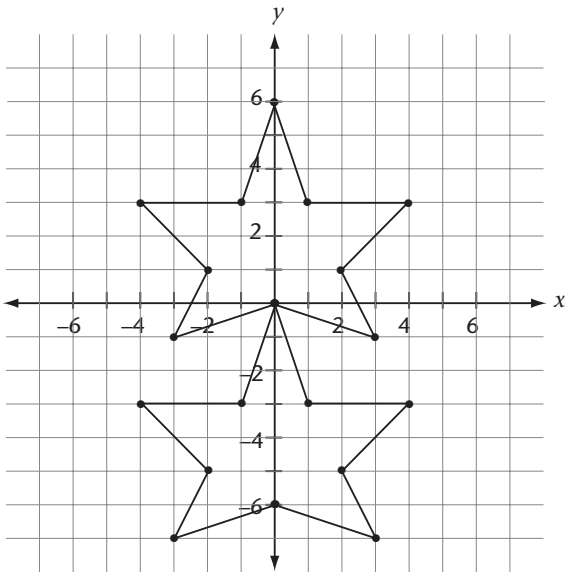
D to D′ is a translation—13 left

Answer to Lesson 4.2B Practice 2

1. After the reflection…

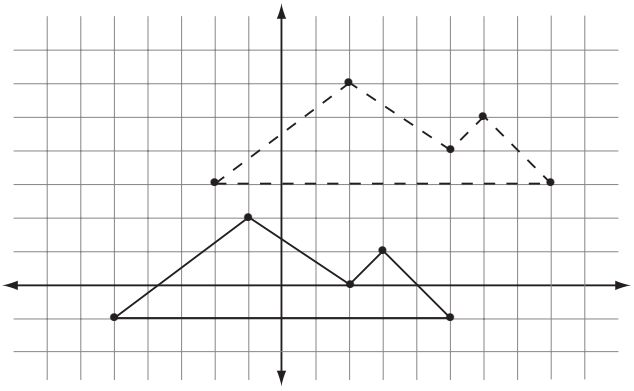


2. and then after the translation.

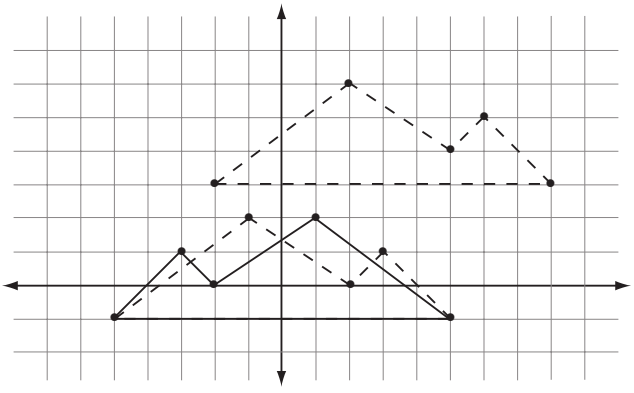


Answer to Lesson 4.2C Warm-up

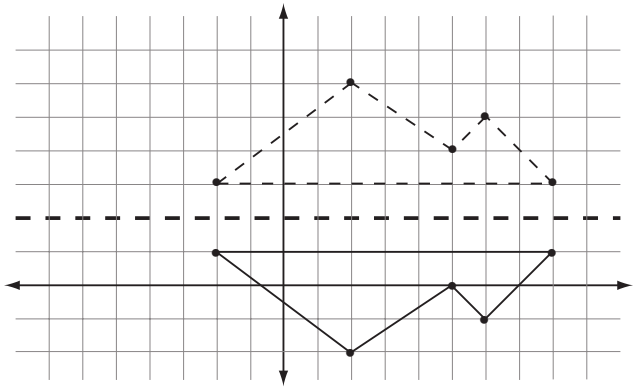
1. a.



b.



2.

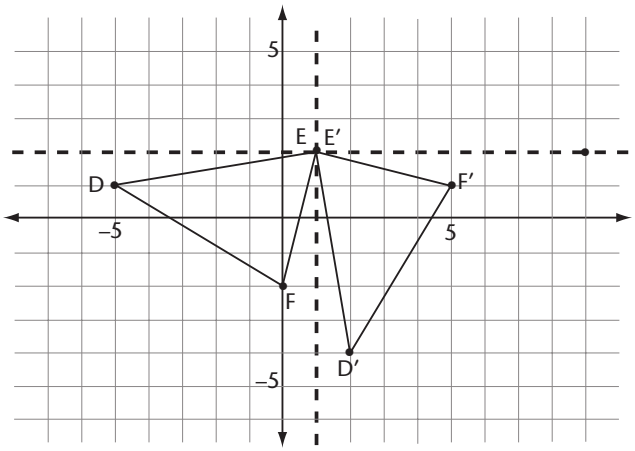


Answer to Lesson 4.2C Practice 1

1. b
2. c
3. a

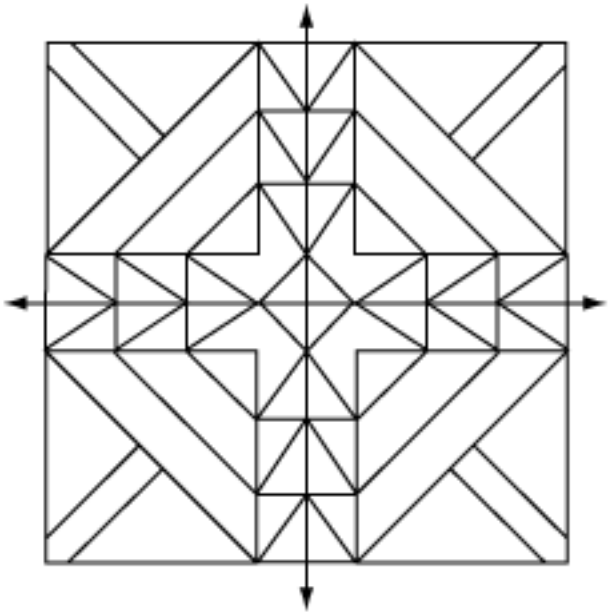
Answer to Lesson 4.2C Practice 2

1. a
2. The coordinate of the image are D′(2, –4), E′(1, 2), and F′(5, 1).



Answer to Section Challenge 4.2

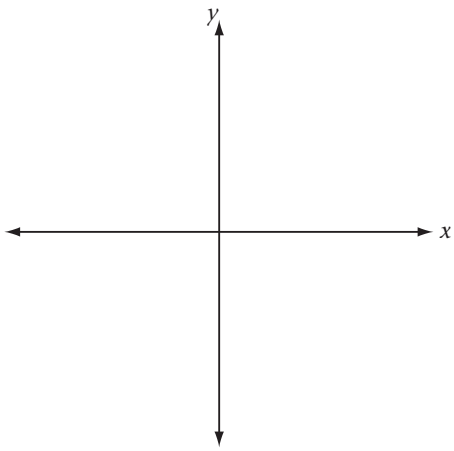
The completed design should like something like this.



Module 4 Glossary

Axes

The plural of axis. "Draw axes" means draw an *x*-axis and a *y*-axis.

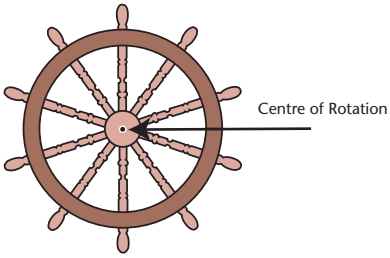


Cartesian plane

A tool for precisely describing the position of a point on a flat surface

Centre of rotation

The point that doesn't change position when an object rotates



Clockwise

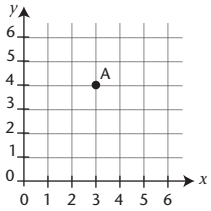
Rotating in the direction of the hands of a clock

When an object is rotating clockwise, the top of it is moving to the right.

Coordinate pair

See entry for "coordinates."

Coordinates



The description of the location of a point

The coordinates of this point are (3, 4).

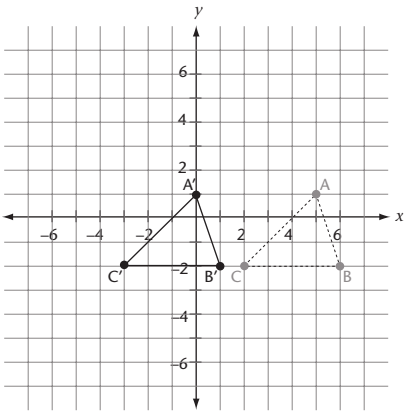
Counter-clockwise

Rotating in the opposite direction of the hands of a clock

When an object is rotating counter-clockwise, the top of it is moving to the left.

Image

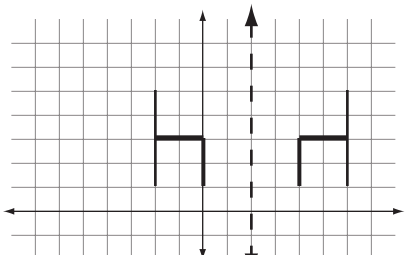
The result of a transformation



Triangle A′B′C′ is the image of triangle ABC.

Line of reflection

The mirror in a reflection transformation



Ordered pair

See entry for "coordinates."

Origin

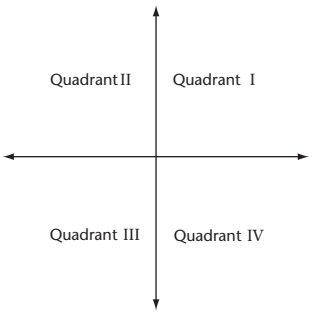
The place where the *x*-axis and the *y*-axis cross. The coordinates of the origin are (0,0).

Point

A location on the Cartesian plane

Quadrant

One of the four regions of the Cartesian plane



Reflection

Transforming an object by using a mirror; see also, "line of reflection."

Rotate 180°

A half-turn

Rotate 270°

A three quarters-turn

Rotate 90°

A quarter-turn

Rotation

Transforming an object by spinning it about a point; see also "centre of rotation."

Transformation

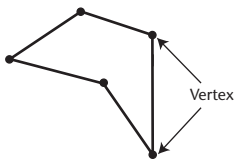
Change. In this module, we changed the position of objects in the Cartesian plane by rotating, reflecting, and translating. These are three examples of transformations on the Cartesian plane.

Translation

Transforming an object by sliding it

Vertex

A corner of a shape



Vertices

More than one vertex

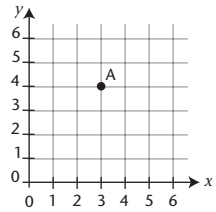
x-axis

The horizontal number line on the Cartesian plane

x-coordinate

The *x*-coordinate describes distances left and right of the origin

The *x*-coordinate of the point is 3.



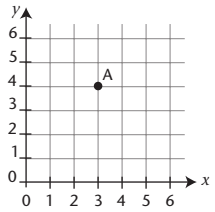
y-axis

The vertical number line on the Cartesian plane

y-coordinate

The second coordinate of a coordinate pair. The *y*-coordinate describes distances above and below the origin.

The *y*-coordinate of the point is 4.



Module 4 Templates