Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Tasks

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Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Popcorn Boxes

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 203: POPCORN BOXES

Overview

Students will investigate the different rectangular prisms that can be made from one A4 piece of card and calculate the volumes of these prisms.

Students will need

- two A4 sheets of paper
- rulers
- calculators
- popcorn (or cubes, counters, anything that can be used to fill a container)

Relevant content descriptions from the Western Australian Curriculum

- Calculate volumes of rectangular prisms (ACMMG160)
- Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)

Students can demonstrate

- *fluency* when they
  - calculate accurately with integers
  - calculate areas of shapes and volumes of prisms
- *reasoning* when they
  - apply known geometric facts to draw conclusions about shapes
- *problem solving* when they
  - formulate and solve authentic problems using numbers and measurements

Activity 1

Find a sheet of A4 paper or card.

1. Measure the width of the paper to the nearest centimetre.
   21 cm

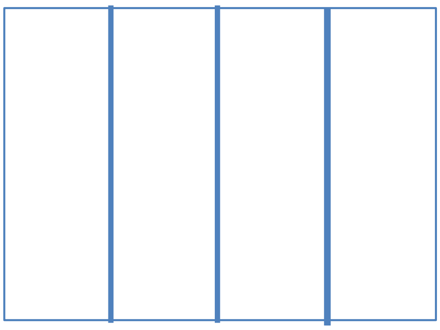
2. Measure the length of the paper to the nearest centimetre.
   30 cm

3. Determine the surface area of the paper in square centimetres.
   $21 \times 30 = 620 \text{ cm}^2$

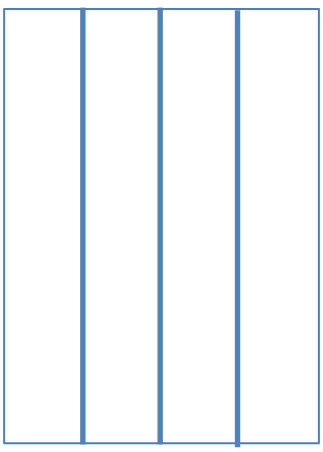
4. Looking at your A4 piece of paper, do you think it will make a good-sized popcorn box? Or will the box be too big or too small?
   Answers will vary

Activity 2

Emily starts making her first popcorn box by taking her A4 sheet of card and folding it in quarters as shown below.



Jack starts making his first popcorn box by taking a sheet of card and folding it as shown;



Emily and Jack both agree that they should make the biggest popcorn box possible, but can't agree on whose container is the bigger.

1. In this case what do you think Emily and Jack mean by the word “bigger”?
Emily is probably referring to the width of her container, while Jack is talking about the height of his container.

Emily thinks her popcorn box is bigger because it is wider than Jack’s.

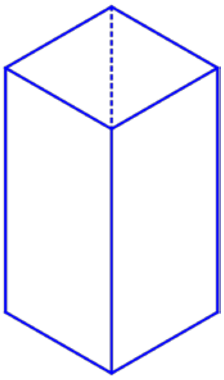
Jack thinks his bigger because it is taller than Emily’s.

Olivia thinks they are both the same because they are made from the same sized piece of paper.

2. Who do you think is correct? Why?
Answers will vary.

3. Use an A4 piece of paper to make a model of Emily’s popcorn box.
Model as appropriate.

4. Draw a 3D view of Emily’s popcorn box.

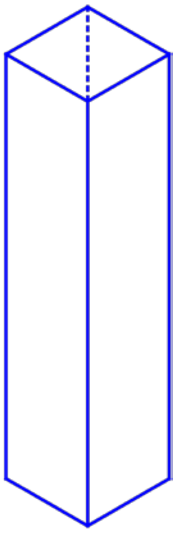


Measure the length, width and height of Emily’s popcorn box.
Length: 7.5 cm
Width: 7.5 cm
Height: 21 cm

6. Determine the volume of Emily’s popcorn box.
$7.5 \times 7.5 \times 21 = 1181.25\ cm^3$

7. Use another A4 piece of paper to make a model of Jack’s popcorn box.

8. Draw a 3D view of Jack’s popcorn box.



9. Measure the length, width and height of Jack's popcorn box.

Length: 5 cm
Width: 5 cm
Height: 30 cm

10. Determine the volume of Jack's popcorn box.
$5 \times 5 \times 30 = 750 \text{ cm}^3$

Activity 3

1. Based on your calculations from activity two, whose popcorn box is bigger, Emily's or Jacks?
   Emily's

2. Place both popcorn box models on the desk in front of you. Make sure they are not too close together. Fill both boxes with popcorn (or cubes, or counters, etc.).

   Now lift the boxes up so that two piles of popcorn are left behind.

   a. Whose popcorn box is bigger?
      Emily's

   b. How can you tell?
      Her container left a bigger pile of popcorn behind.

3. How does this compare to your answer in Activity 2, Question 2? If you have changed your mind, explain why.
   Answers will vary

4. Based on your calculations, does an A4 piece of card make a good-sized popcorn box? Or does the piece of card need to be bigger or smaller than A4?
   Answers will vary

5. How does your answer to the question above compare to your answer in Activity 1, question 4? If you have changed your mind, explain why.
Answers will vary

6. EXTENSION QUESTION – Imagine a container that is as tall as Jack's popcorn box, but has the same volume as Emily's popcorn box. What are the dimensions of the piece of card that you would need to create such a container?
25 cm x 30 cm

Introduction

Three siblings, Emily, Jack and Olivia have decided to hold a movie night for all their friends. They want to serve drinks and popcorn on the night and have decided to make their own popcorn boxes.

Each popcorn box will be made using one A4 sheet of card. The card will be folded into quarters and taped together to create the sides of the box. The base of each box will be made separately later on.

<u>Activity 1</u>

Find a sheet of A4 paper or card.

1. Measure the width of the paper to the nearest centimetre.

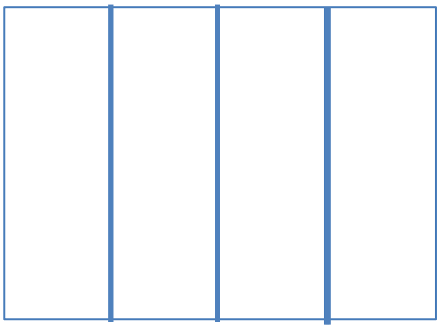
2. Measure the length of the paper to the nearest centimetre.

3. Determine the surface area of the paper in square centimetres.

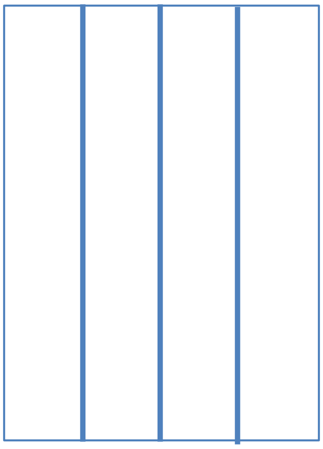
4. Looking at your A4 piece of paper, do you think it will make a good-sized popcorn box? Or will the box be too big or too small?

Activity 2

Emily starts making her first popcorn box by taking her A4 sheet of card and folding it in quarters as shown below.



Jack starts making his first popcorn box by taking a sheet of card and folding it as shown;



Emily and Jack both agree that they should make the biggest popcorn box possible, but can’t agree on whose container is bigger.

1. In this case what do you think Emily and Jack mean by the word “bigger”?

Emily thinks her popcorn box is bigger because it is wider than Jack’s.

Jack thinks his bigger because it is taller than Emily’s.

Olivia thinks they are both the same because they are made from the same sized piece of paper.

2. Who do you think is correct? Why?

3. Use an A4 piece of paper to make a model of Emily’s popcorn box.

4. Draw a 3D view of Emily’s popcorn box.

5. Measure the length, width and height of Emily’s popcorn box.

Length: ____________ cm

Width: ____________ cm

Height: ____________ cm

6. Determine the volume of Emily’s popcorn box.

7. Use another A4 piece of paper to make a model of Jack’s popcorn box.

8. Draw a 3D view of Jack’s popcorn box.

9. Measure the length, width and height of Jack's popcorn box.

Length: ____________cm

Width: ____________cm

Height: ____________ cm

10. Determine the volume of Jack's popcorn box.

<u>Activity 3</u>

1. Based on your calculations from activity two, whose popcorn box is bigger, Emily's or Jacks?

2. Place both popcorn box models on the desk in front of you. Make sure they are not too close together. Fill both boxes with popcorn (or cubes, or counters, etc.).

   Now lift the boxes up so that two piles of popcorn are left behind.

   a. Whose popcorn box is bigger?

   b. How can you tell?

3. How does this compare to your answer in Activity 2, Question 2? If you have changed your mind, explain why.

4. Based on your calculations, does an A4 piece of card make a good-sized popcorn box? Or does the piece of card need to be bigger or smaller than A4?

5. How does your answer to the question above compare to your answer in Activity 1, question 4? If you have changed your mind, explain why.

6. EXTENSION QUESTION – Imagine a container that is as tall as Jack's popcorn box, but has the same volume as Emily's popcorn box. What are the dimensions of the piece of card that you would need to create such a container?

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YEAR 7 MATHEMATICS

Measurement & Geometry Activity

Trying Triangles

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 204: TRYING TRIANGLES

Overview

This task is designed to help students identify the side and angle properties of different types of triangles.

Students will need

- Scissors
- Rulers
- access to the internet (Activity 2 and 3 only)
- Protractors
- Triangle Strips worksheet
- Triangular Triples Game

Relevant content descriptions from the Western Australian Curriculum

- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)
- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)

Students can demonstrate

- *fluency* when they
  - can name triangles based on their side or angle properties
- *understanding* when they
  - categorise triangles based on their sides and properties
  - can show that a triangles angles total 180°
- *reasoning* when they
  - can create triangles that fit a given side and angle property
- *problem solving* when they
  - sort triangles based on both side and angle properties

Activity 1 (Teacher-led Activity)

1. Give each student a copy of the “TRIANGLE STRIPS” worksheet. Students should cut out all the strips and use them to create as many different triangles as possible.

   Ask students to draw an accurate sketch of each triangle that they create on a separate piece of plain paper.

2. Once students start to run out of new ideas, have them compare their answers with those of the student next to them.

3. Have a class discussion about the activity. Some questions to include:

   a. Did students use any system or method to create their triangles?
   b. Were there any strips that couldn’t be put together to make triangles?
   c. If the students had to repeat the process with a different set of strips, how could they be sure they had made all the possible triangles?

4. Tell students that you would like them to work in pairs to organise all the triangles that they have created into different groups. It is up to each pair to decide how to group the triangles, but they need to be able to explain the groupings to the rest of the class.

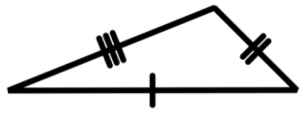
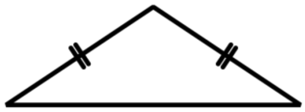
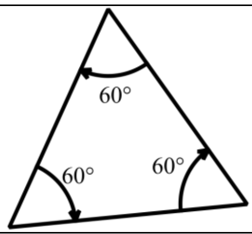
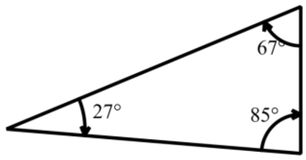
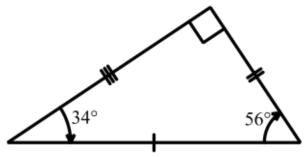
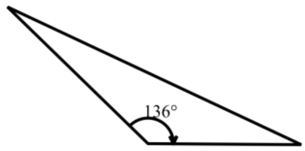
5. Have a class discussion about the different groupings each pair has made. Have the class agree on the grouping that they like best.

6. On the same sheet of paper where they recorded their triangles, have students write a description of the grouping agreed upon in Question 5. This should be done in their own words.

Activity 2

1. Using the Internet, or any other resources in the room, complete the definitions for the following terms.

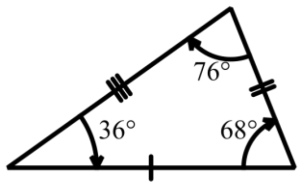
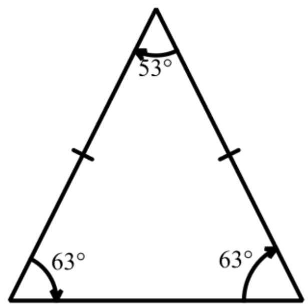
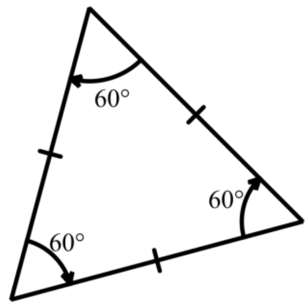
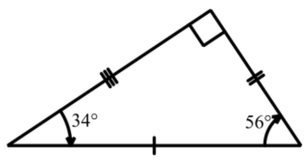
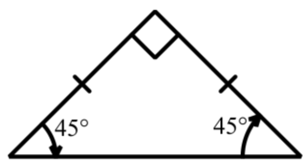
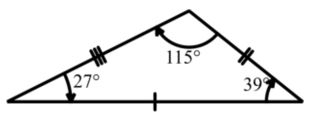
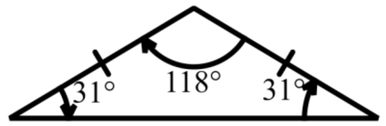
Once you have written down the definition of each type, draw a picture to illustrate the concept.

Word/Phrase	Definition	Illustration/Example
Scalene triangle	All sides are different lengths	
Isosceles triangle	Two sides are the same length and the third side is different	
Equilateral triangle	All sides are the same length All angles are the same size	
Acute-angled triangle	All angles are less than 90 degrees	
Right-angled triangle	One angle is 90 degrees; the other angles are both less than 90 degrees	
Obtuse-angled triangle	One angle is greater than 90 degrees, the others are both less than 90 degrees	

2. Have a look at the groups of triangles you created earlier. Re-write the description of each category using the terms above wherever possible.

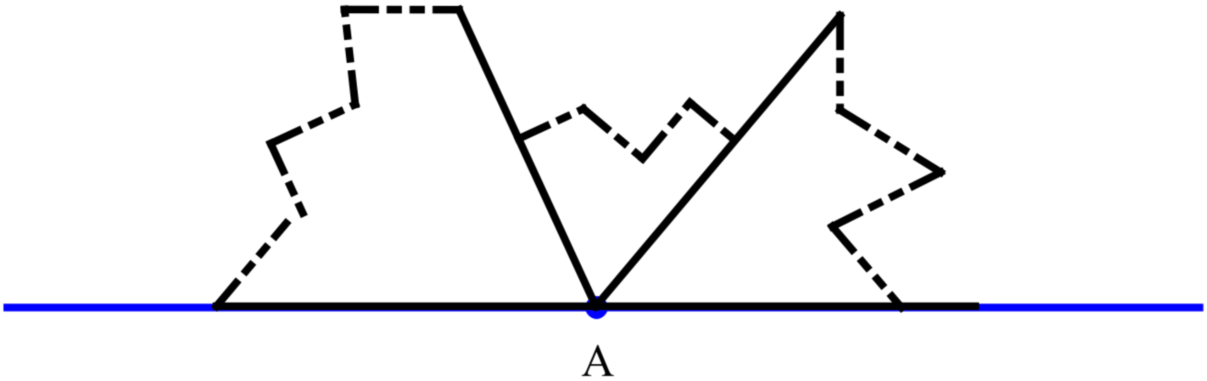
Activity 3

1. Below is a two-way table. The different angle properties of triangles are listed down the side and the different side properties of triangles are listed across the top. Draw a triangle in each box that meets the given criteria. If it can't be done, explain why not.

	Scalene	Isosceles	Equilateral
Acute-angled			
Right-angled			Can't be done. If all sides are equal, then all angles need to be equal; i.e., exactly 60 degrees.
Obtuse-angled			Can't be done. If all sides are equal, then all angles need to be equal; i.e., exactly 60 degrees.

Activity 4

1. Using a protractor, measure the angle of a straight line at point A.



2. On a separate piece of plain paper, draw a large triangle of any sort.

3. Cut out your triangle.

4. Tear a corner off your triangle. Place this corner along the line above, making sure the tip of the corner is at point A.

5. Tear another corner off your triangle. Place this corner next to the first corner, again with the tip of the corner at point A.

6. Repeat the process with the last corner.

7. What do you notice?

The three corners (vertices) make a straight angle or straight line when you put them all together.

8. Compare your answer with others in your class. Did they get the same result?

9. Based on this experiment, what can we say about the angles in any triangle?

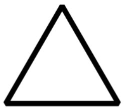
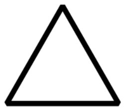
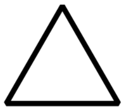
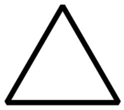
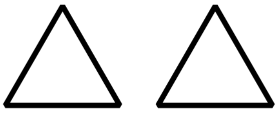
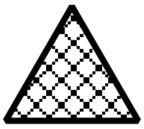
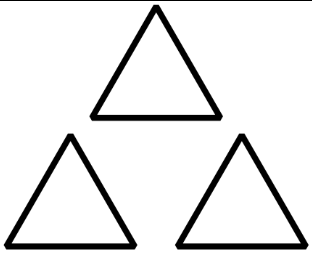
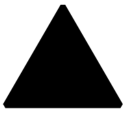
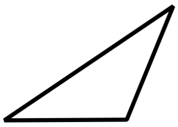
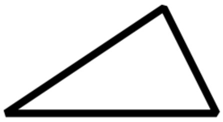
The three angles in any triangle sum to 180 degrees.

Activity 5

Play a game of Triangle Triples: A game for 2 - 4 players. See details that follow.

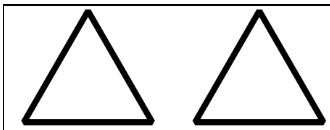
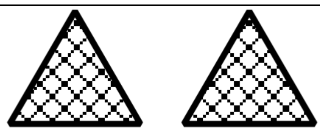
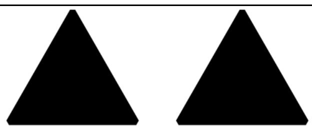
Triangle Triples - Rules

Aim: To identify as many triples as possible. Each card has four characteristics, as outlined below.

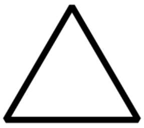
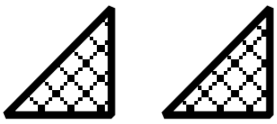
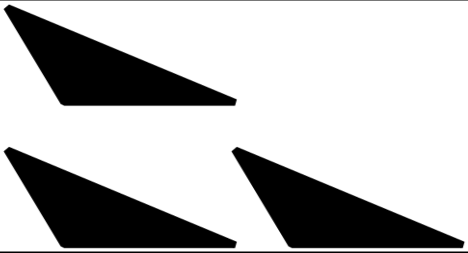
Number	Shading	Angle Properties	Side Properties
 one	 clear	 acute	 equilateral
 two	 shaded	 right	 isosceles
 three	 shaded	 Obtuse	 Scalene

A “Triangle Triple” consists of 3 cards in which each of the characteristics, when looked at separately, are either exactly the same or entirely different. See the examples below.

Examples

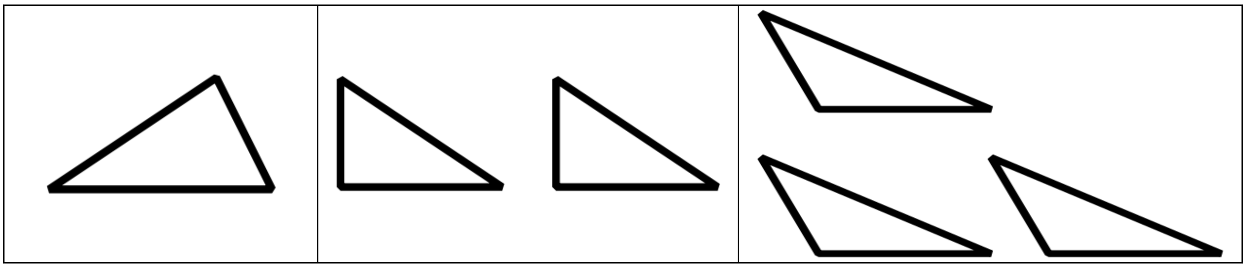
		

This is a Triangle Triple. All three cards have the same shapes, the same angle properties and the same side properties, and they all have different shading.

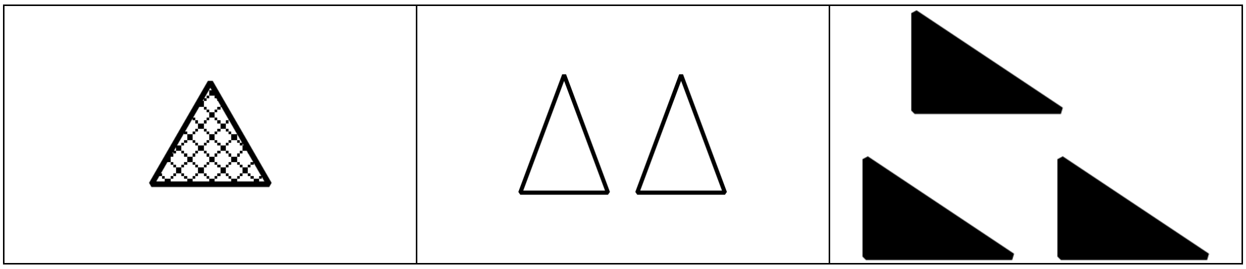
		

This is a Triangle Triple. All three cards have different shapes, different shading, different angle properties, and different side properties.

Examples (Continued)



This is a Triangle Triple. They all have the same shading and the same side properties (scalene) and they all have different numbers of shapes and different angle properties.



This is <u>NOT</u> a Triangle Triple. They all have a different number of shapes, they are all shaded differently and they all have different side properties. However, two cards have the same angle property (acute-angled), but one does not. Therefore this is not a Triangle Triple.

The Play

One player is nominated as the dealer. The dealer shuffles the cards and deals 6 cards to each player and places 6 more cards face up in the centre of play. The remaining cards become the stock-pile.

Each player tries to make a “Triangle Triple” using any combination of cards in their hand and cards on the table. When a player thinks they have a Triangle Triple, they yell “Triangle Triple” and then they show the other players the relevant cards.

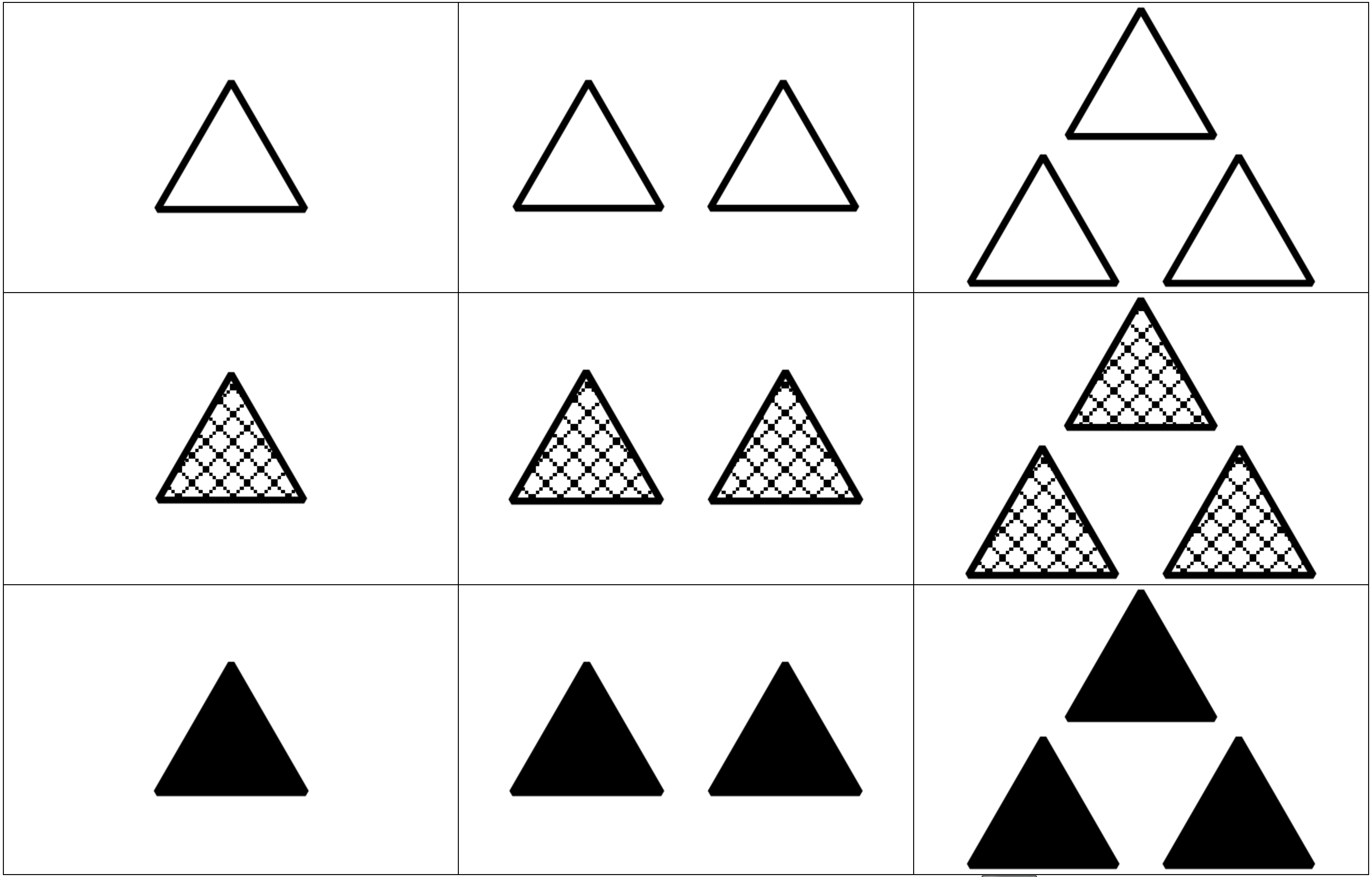
If their Triangle Triple is accepted, those cards are turned upside down and are out of play. (The player who got the Triangle Triple will use these at the end of the game to work out their score). The player who got the Triangle Triple will replace any cards that they used from their hand with cards from the stockpile. The dealer will replace any cards used from the centre with cards from the stockpile.

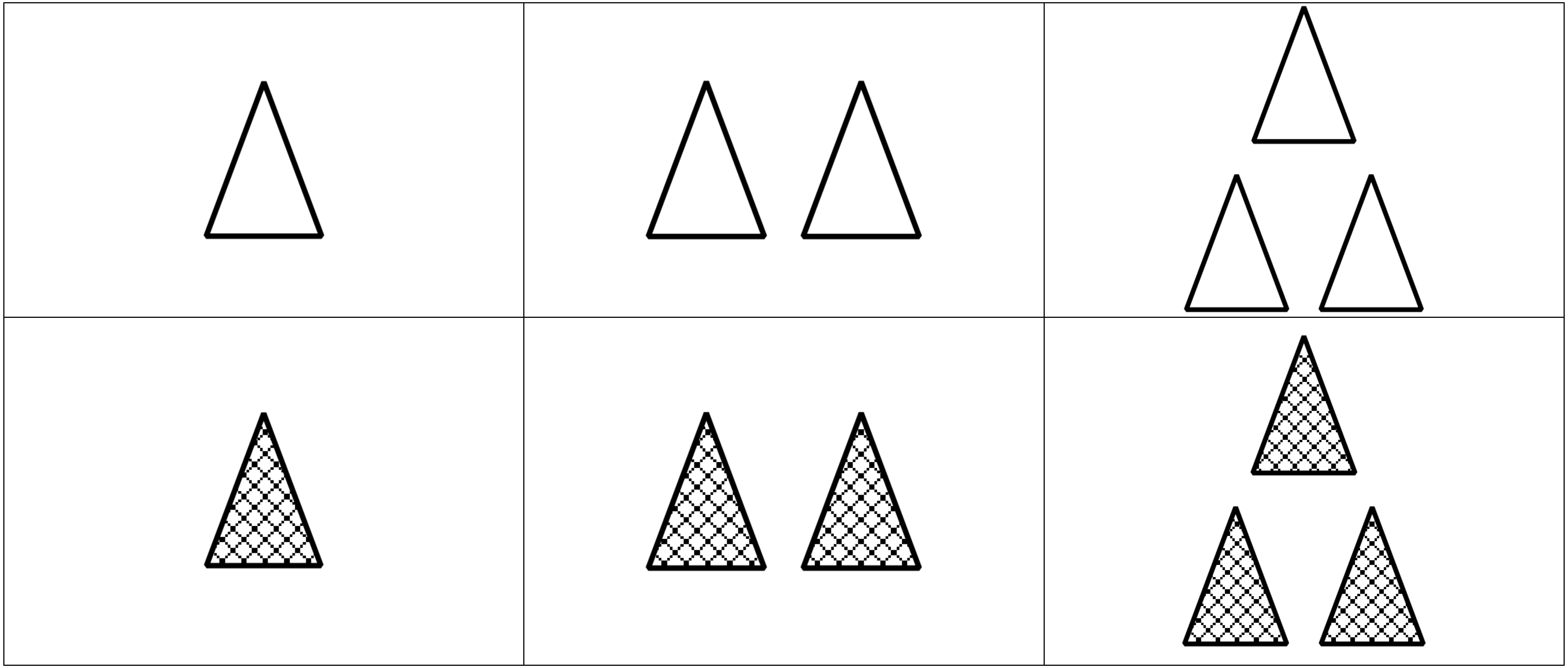
If their Triangle Triple is not accepted, all those cards remain face up on the table and the player does not collect any more cards.

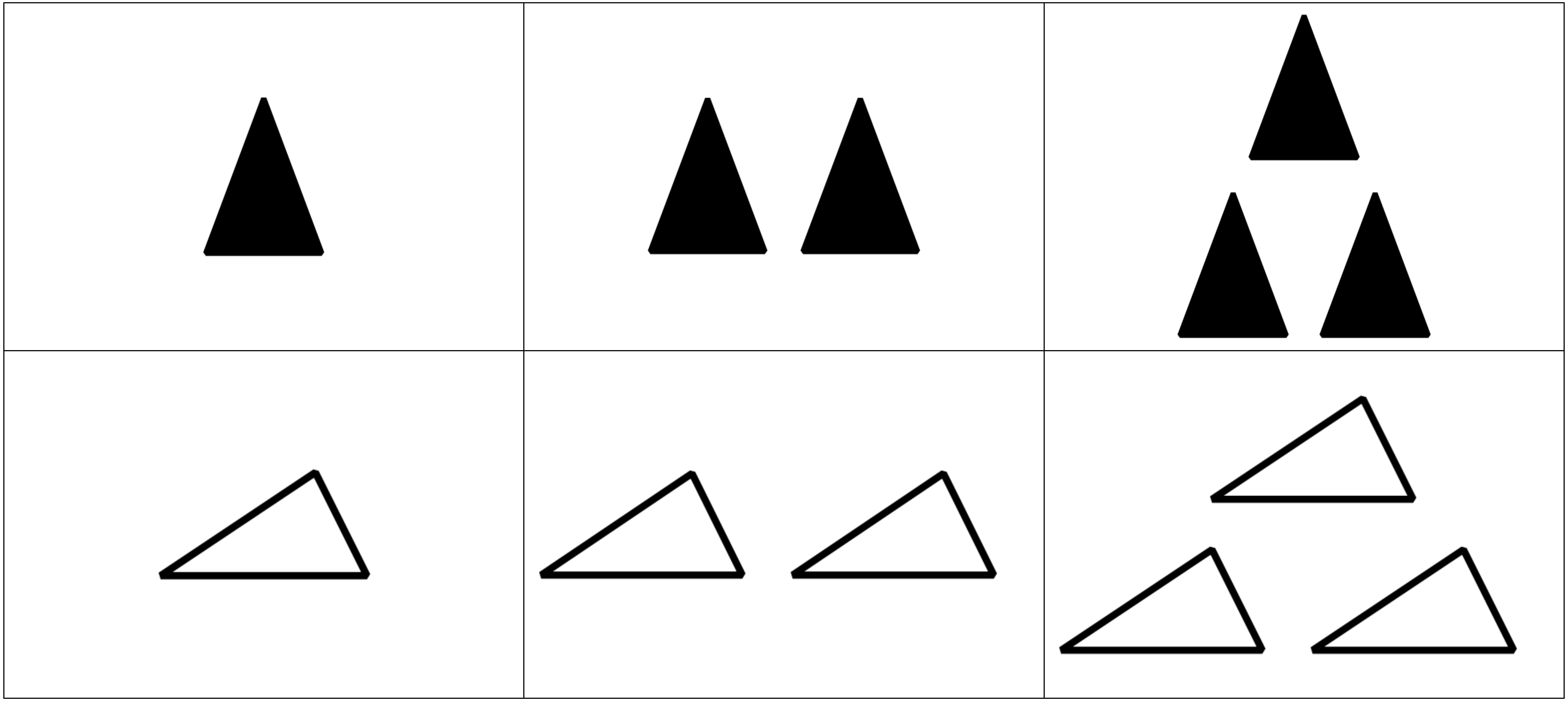
If no-one can make a move, then the dealer can elect to turn over 3 more cards from the stockpile.

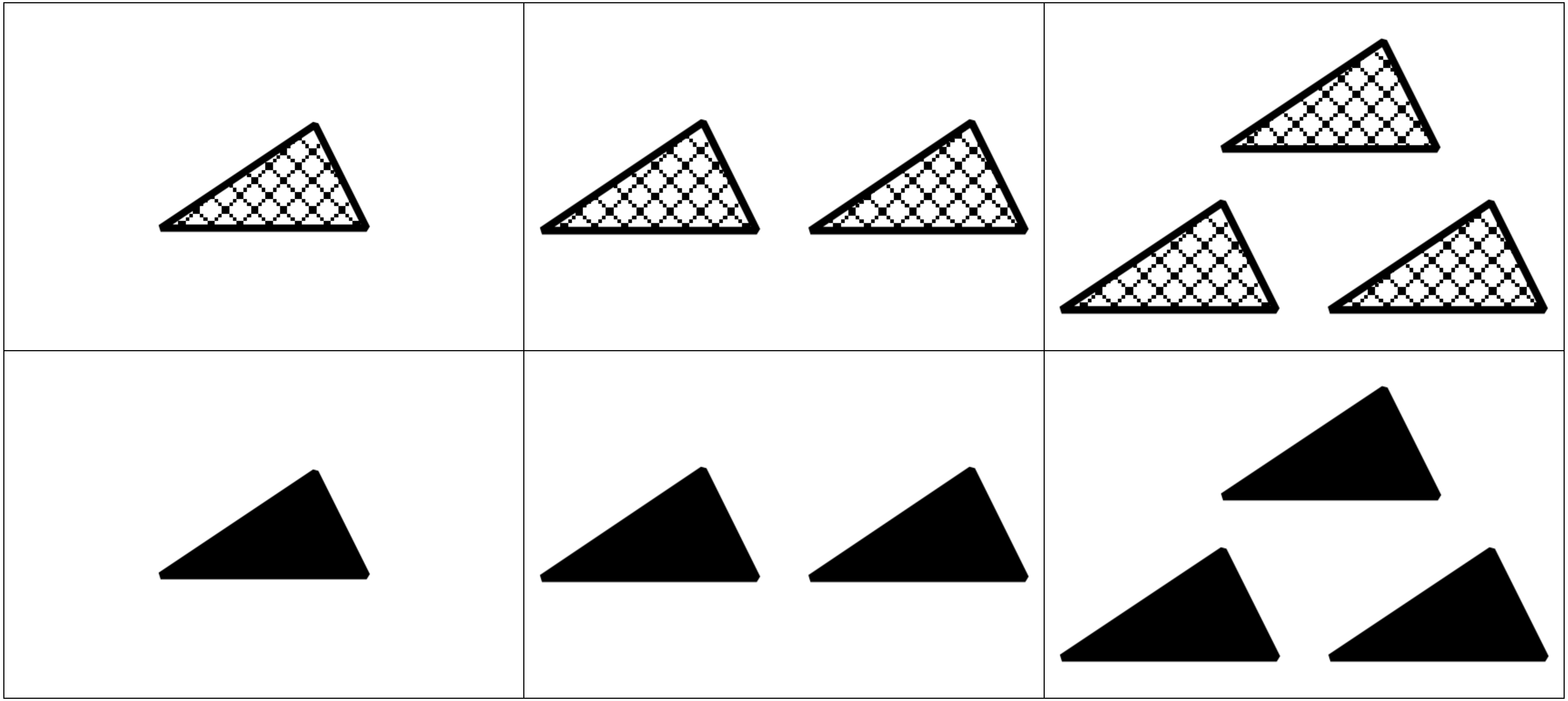
Play is over when there are no more moves to make.

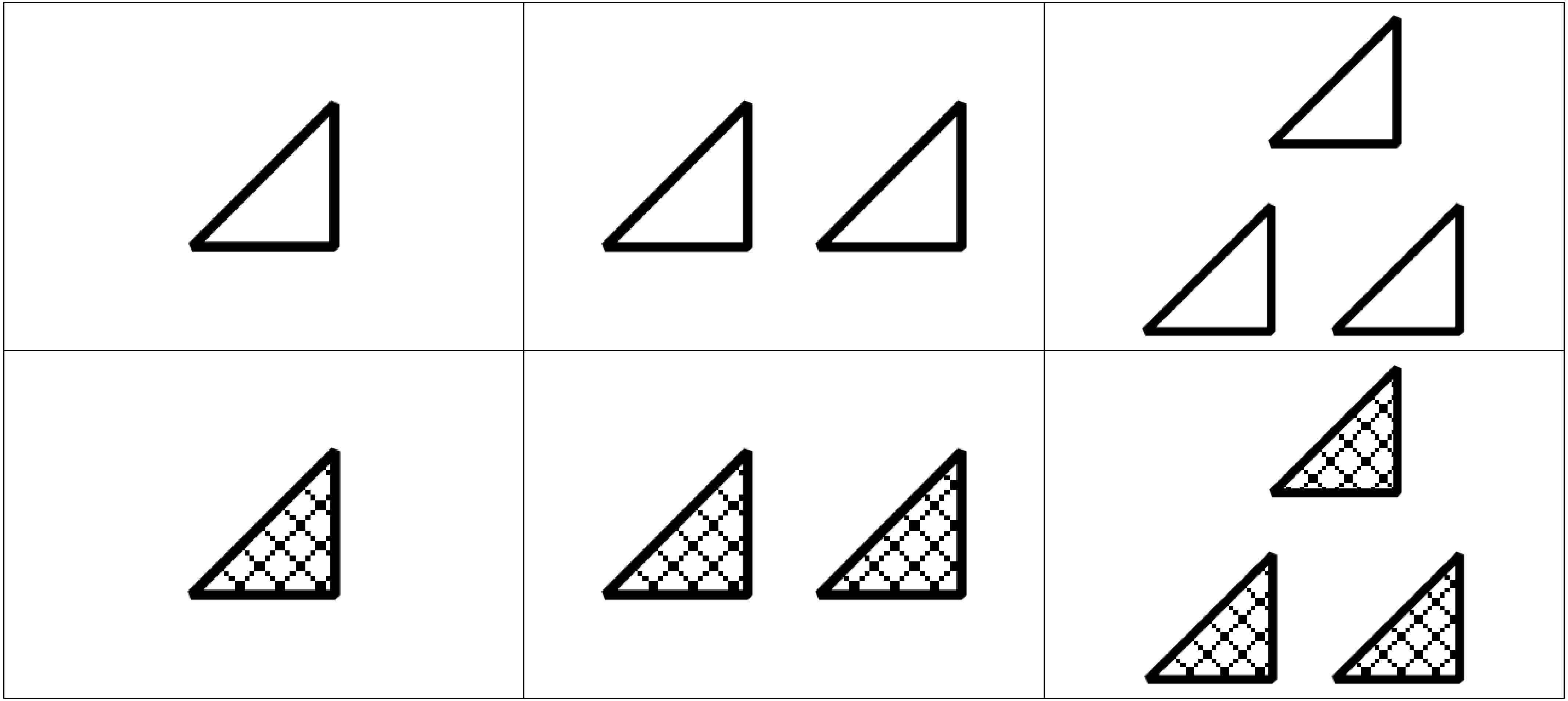
A player’s final score is calculated by counting the number of cards collected as Triangle Triples and subtracting the number of cards they still have in their hands (if any). The highest score wins.

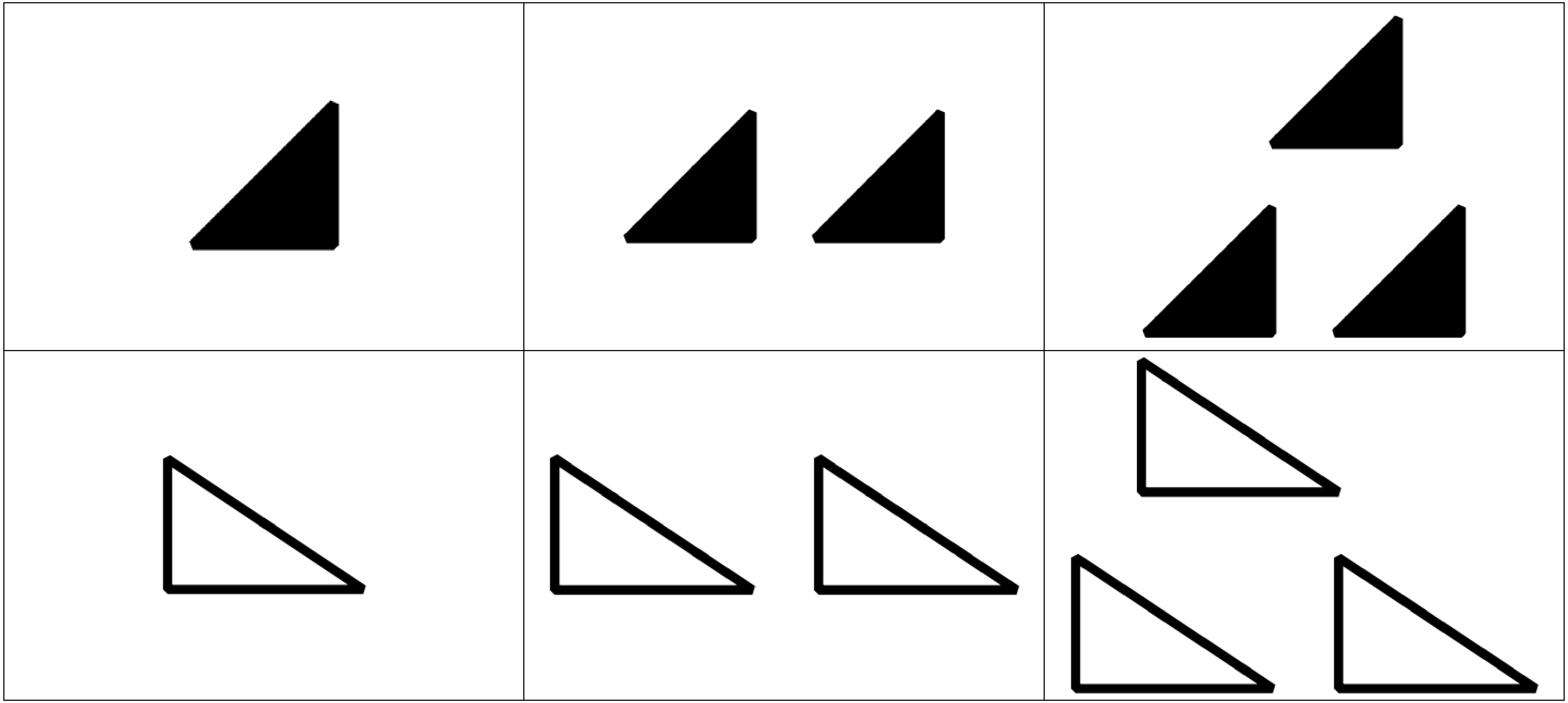


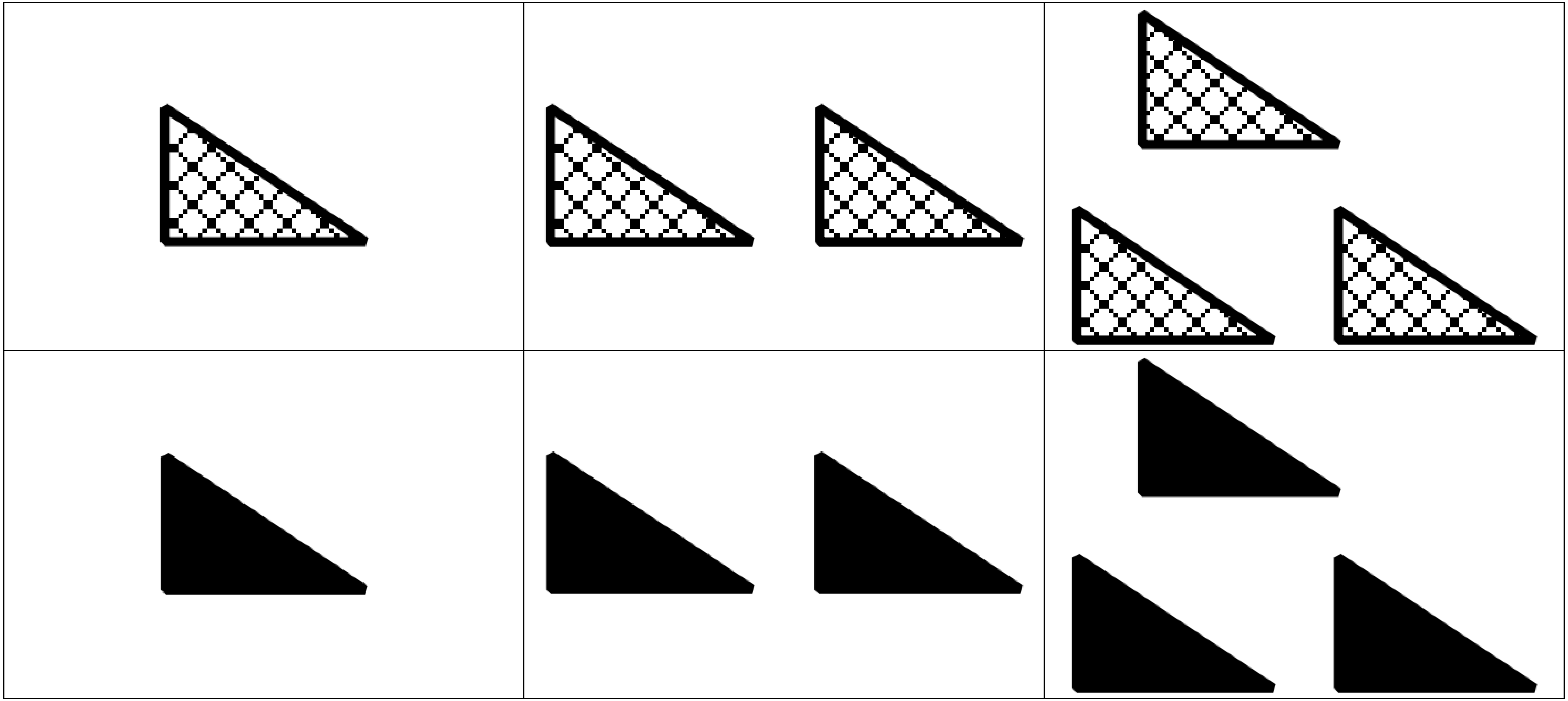


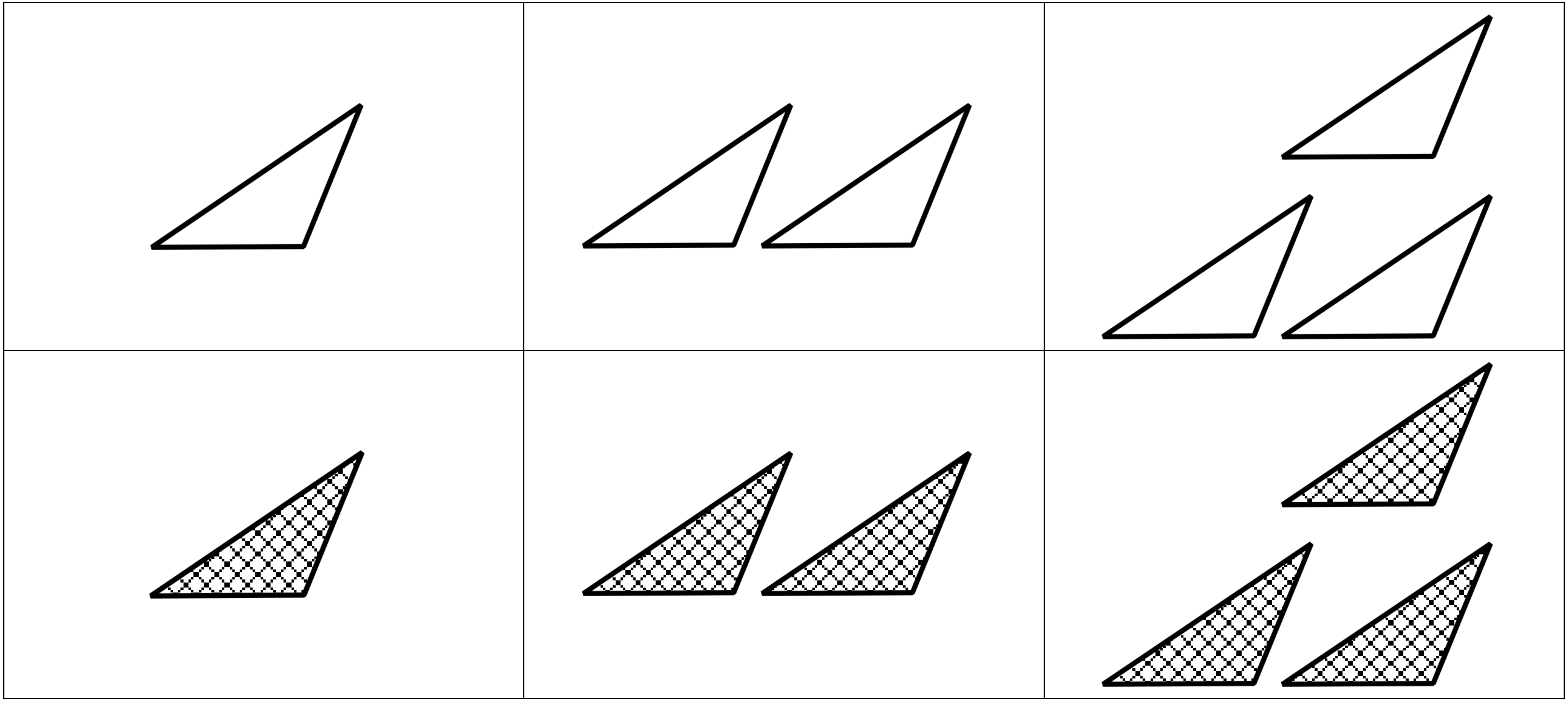


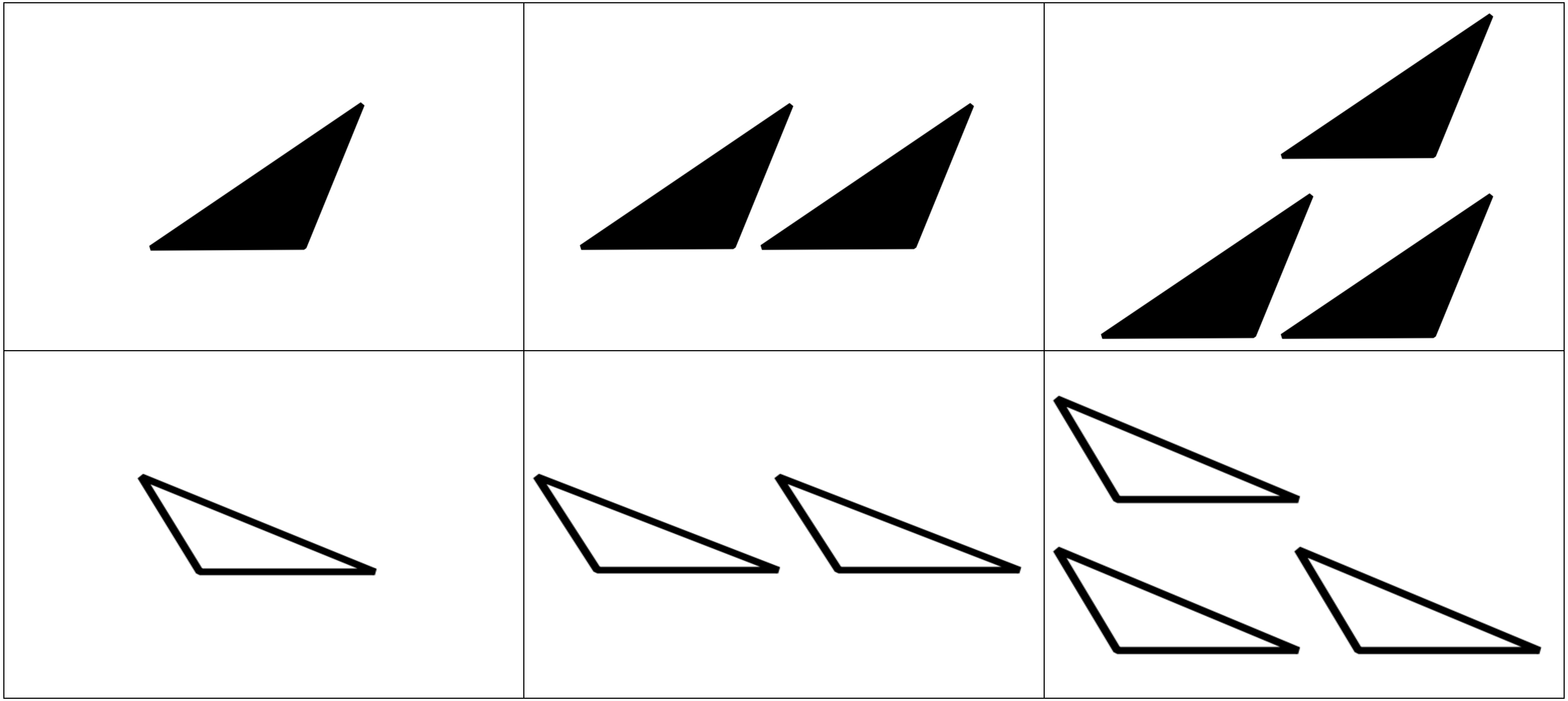


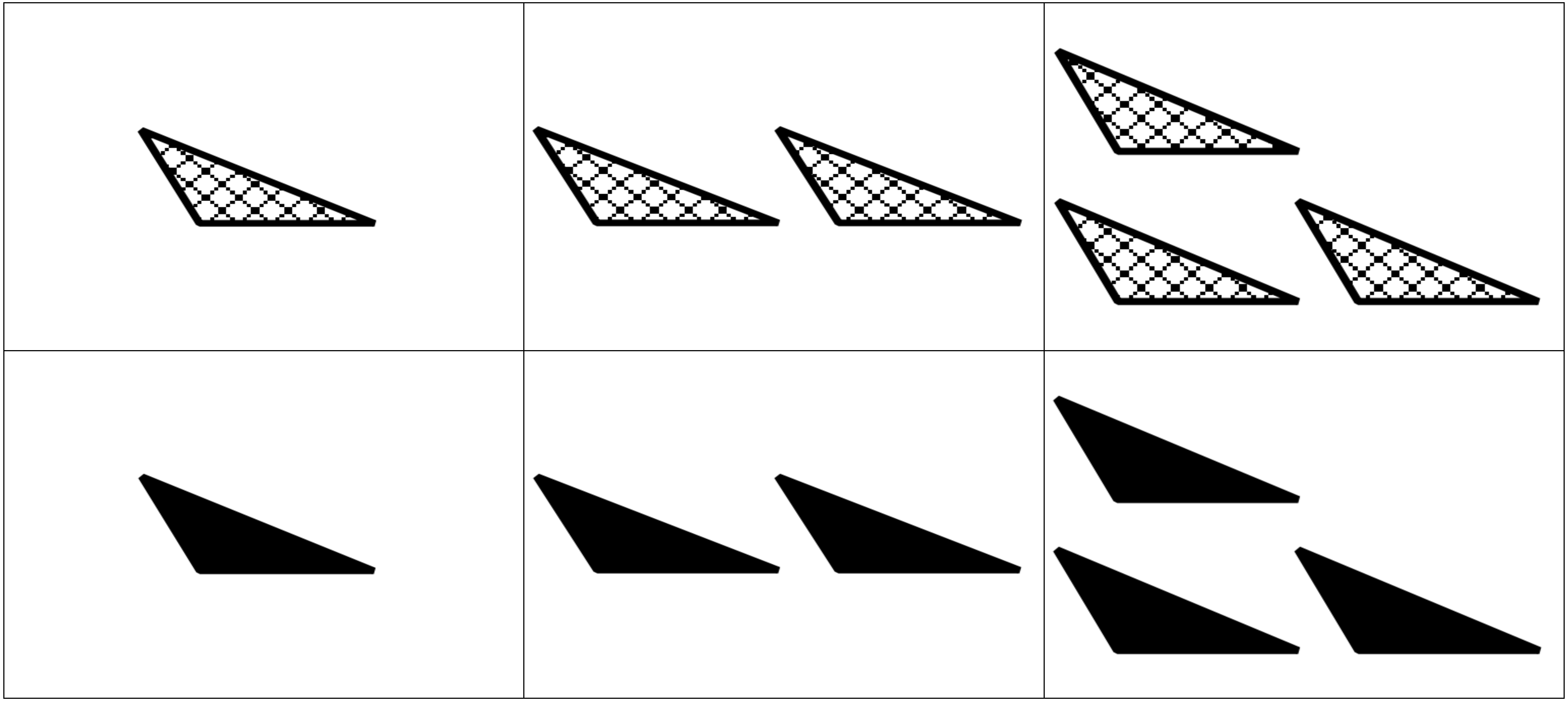












Activity 1 (Teacher-led Activity)

7. Cut out all the strips and use them to create as many different triangles as possible. Draw an accurate sketch of each triangle that you create on a separate piece of plain paper.

8. Compare your results with those of the student next to you.

9. Have a class discussion about the activity. Some questions to include;

    a. Did students use any system or method to create their triangles?

    b. Were there any strips that couldn't be put together to make triangles?

    c. If the students had to repeat the process with a different set of strips, how could they be sure they had made all the possible triangles?

10. In pairs, organise all the triangles that you created into different groups. It is up to each pair to decide how to group the triangles, but you need to be able to explain the groupings to the rest of the class.

11. Have a class discussion about the different groupings each pair has made. Have the class agree on the grouping that they like best.

12. On the same sheet of paper where you recorded your triangles, write a description of the grouping agreed upon in Question 5. Do this in your own words.

Activity 2

1. Using the Internet, or any other resources in the room, complete the definitions for the following terms.

Once you have written down the definition of each phrase, draw a picture to illustrate the concept.

Word/Phrase	Definition	Illustration/Example
Scalene triangle		
Isosceles triangle		
Equilateral triangle		
Acute-angled triangle		
Right-angled triangle		
Obtuse-angled triangle		

2. Have a look at the groups of triangles you created earlier. Re-write the description of each category using the terms above wherever possible.

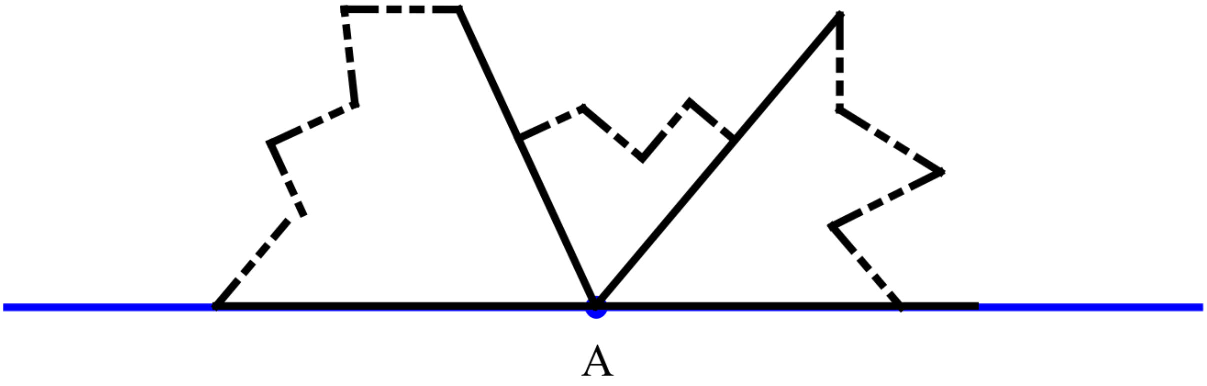
Activity 3

1. Below is a two-way table. The different angle properties of triangles are listed down the side and the different side properties of triangles are listed across the top. Draw a triangle in each box that meets the given criteria. If it can't be done, explain why not

	Scalene	*Isosceles*	*Equilateral*
Acute-angled			
Right-angled			
Obtuse-angled			

Activity 4

10. Using a protractor, measure the angle of a straight line at point A.



11. On a separate piece of plain paper, draw a large triangle of any sort.

12. Cut out your triangle.

13. Tear a corner off your triangle. Place this corner along the line above; making sure the tip of the corner is at point A.

14. Tear another corner off your triangle. Place this corner next to the first corner, again with the tip of the corner at point A.

15. Repeat the process with the last corner.

16. What do you notice?

17. Compare your answer with others in your class. Did they get the same result?

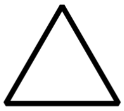
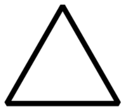
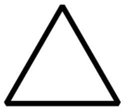
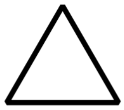
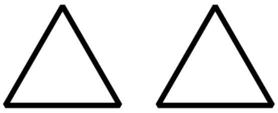
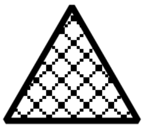
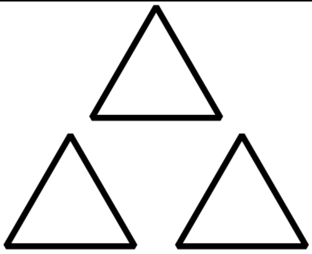
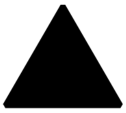
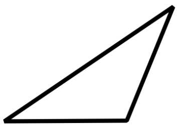
18. Based on this experiment, what can we say about the angles in any triangle?

Activity 5

Play a game of Triangle Triples: A game for 2 to 4 players. See details that follow.

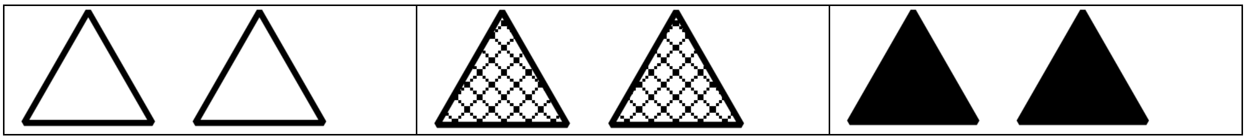
Triangle Triples - Rules

Aim: To identify as many triples as possible. Each card has four characteristics, as outlined below.

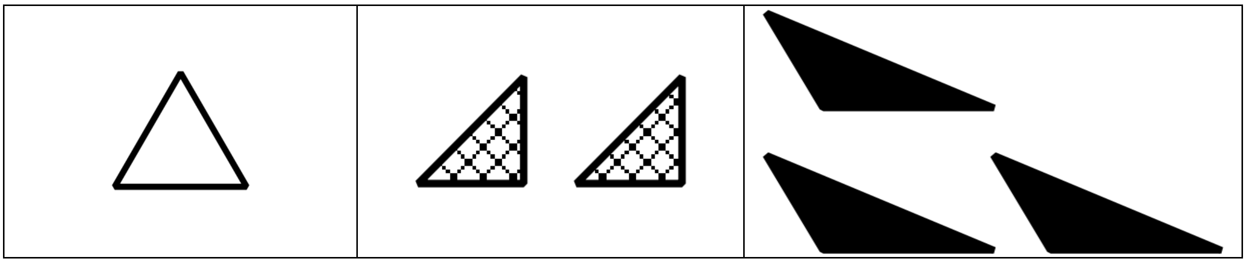
Number	Shading	Angle Properties	Side Properties
 one	 clear	 acute	 equilateral
 two	 shaded	 right	 isosceles
 three	 shaded	 Obtuse	 Scalene

A “Triangle Triple” consists of 3 cards in which each of the characteristics, when looked at separately, are either exactly the same or entirely different. See the examples below.

Examples

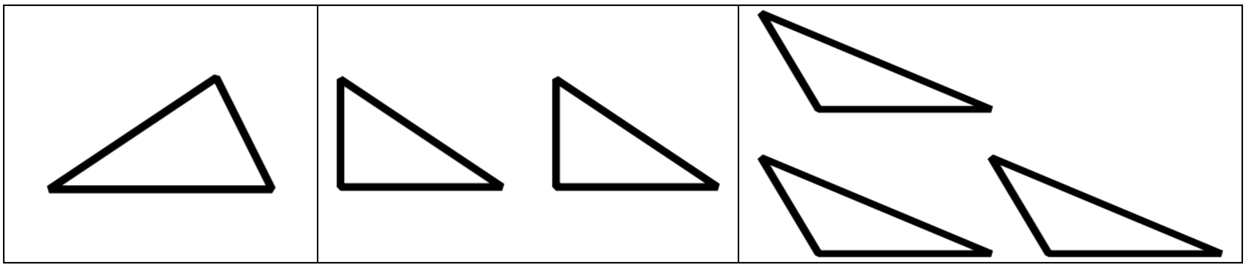


This is a Triangle Triple. All three cards have the same shapes, the same angle properties and the same side properties, and they all have different shading.

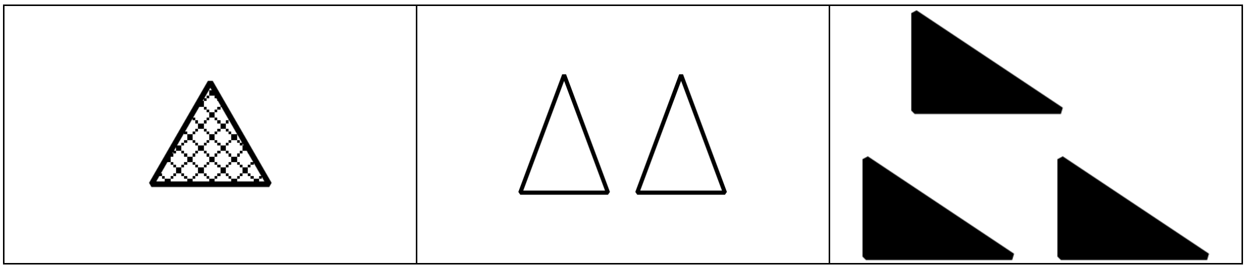


This is a Triangle Triple. All three cards have different shapes, different shading, different angle properties, and different side properties.

Examples (Continued)



This is a Triangle Triple. They all have the same shading and the same side properties (scalene) and they all have different numbers of shapes and different angle properties.



This is NOT a Triangle Triple. They all have a different number of shapes, they are all shaded differently and they all have different side properties. However, two cards have the same angle property (acute-angled), but one does not. Therefore this is not a Triangle Triple.

The Play

One player is nominated as the dealer. The dealer shuffles the cards and deals 6 cards to each player and places 6 more cards face up in the centre of play. The remaining cards become the stockpile.

Each player tries to make a “Triangle Triple” using any combination of cards in their hand and cards on the table. When a player thinks they have a Triangle Triple, they yell “Triangle Triple” and then they show the other players the relevant cards.

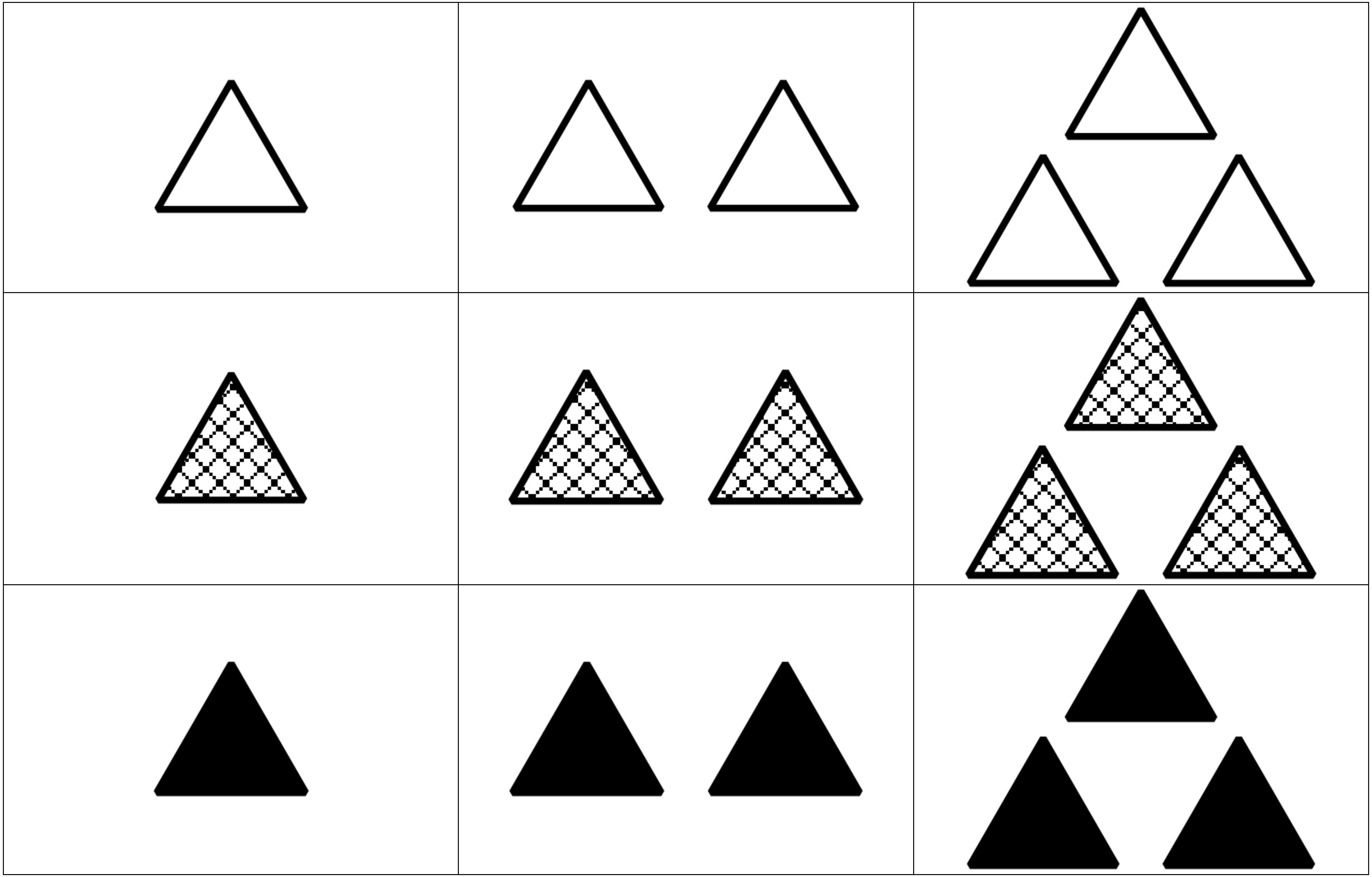
If their Triangle Triple is accepted, those cards are turned upside down and are out of play. (The player who got the Triangle Triple will use these at the end of the game to work out their score). The player who got the Triangle Triple will replace any cards that they used from their hand with cards from the stockpile. The dealer will replace any cards used from the centre with cards from the stockpile.

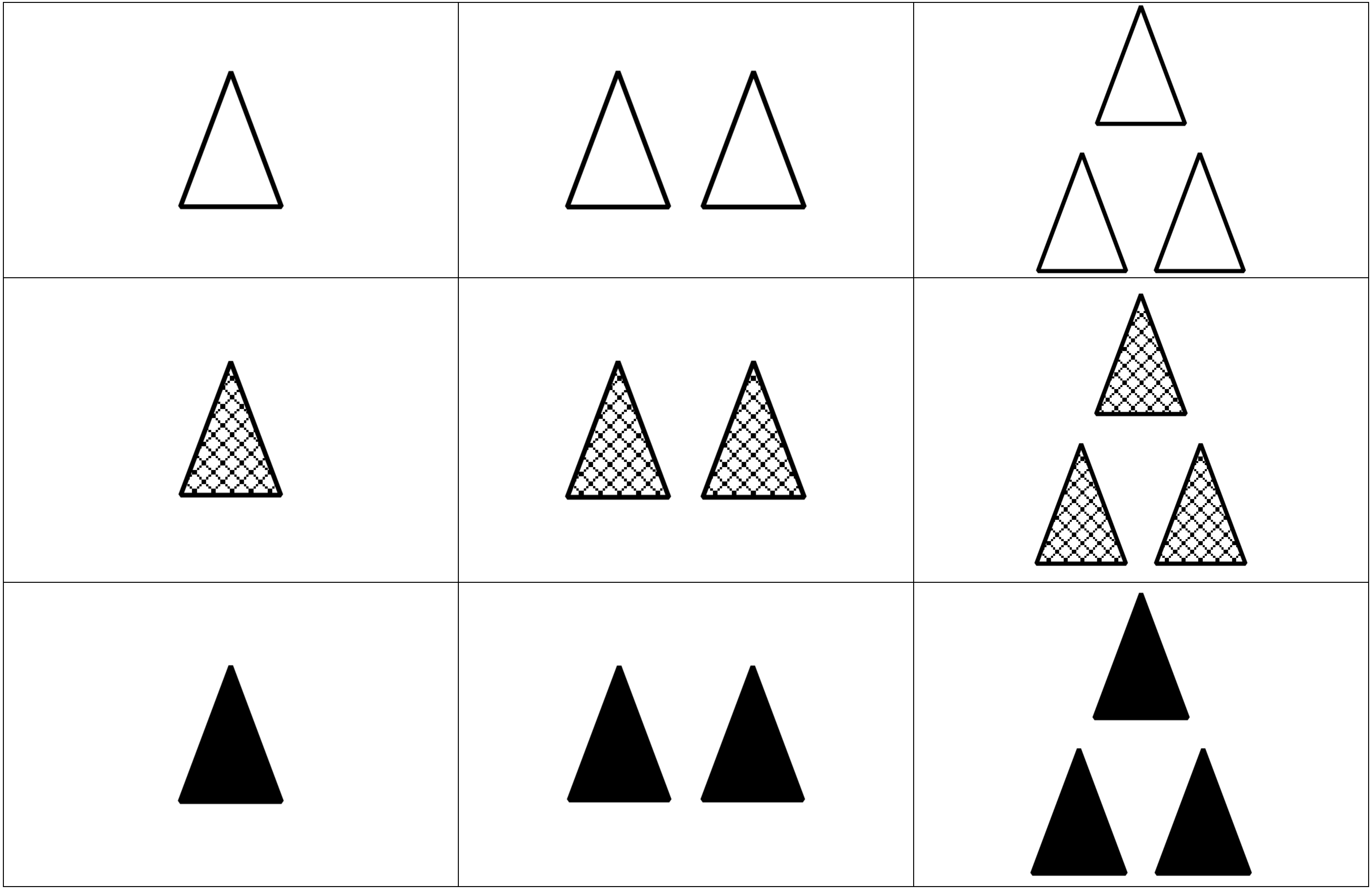
If their Triangle Triple is not accepted, all those cards remain face up on the table and the player does not collect any more cards.

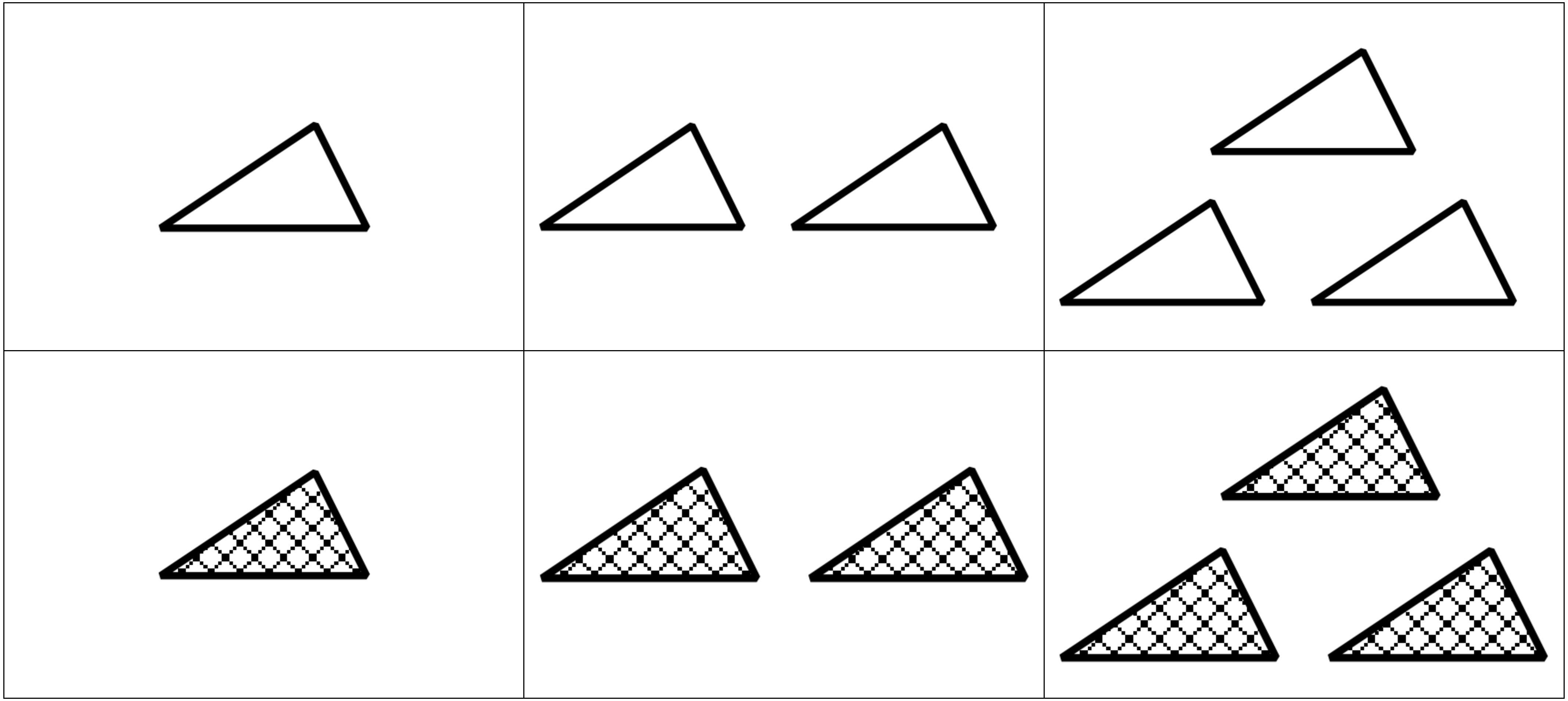
If no-one can make a move, then the dealer can elect to turn over 3 more cards from the stockpile.

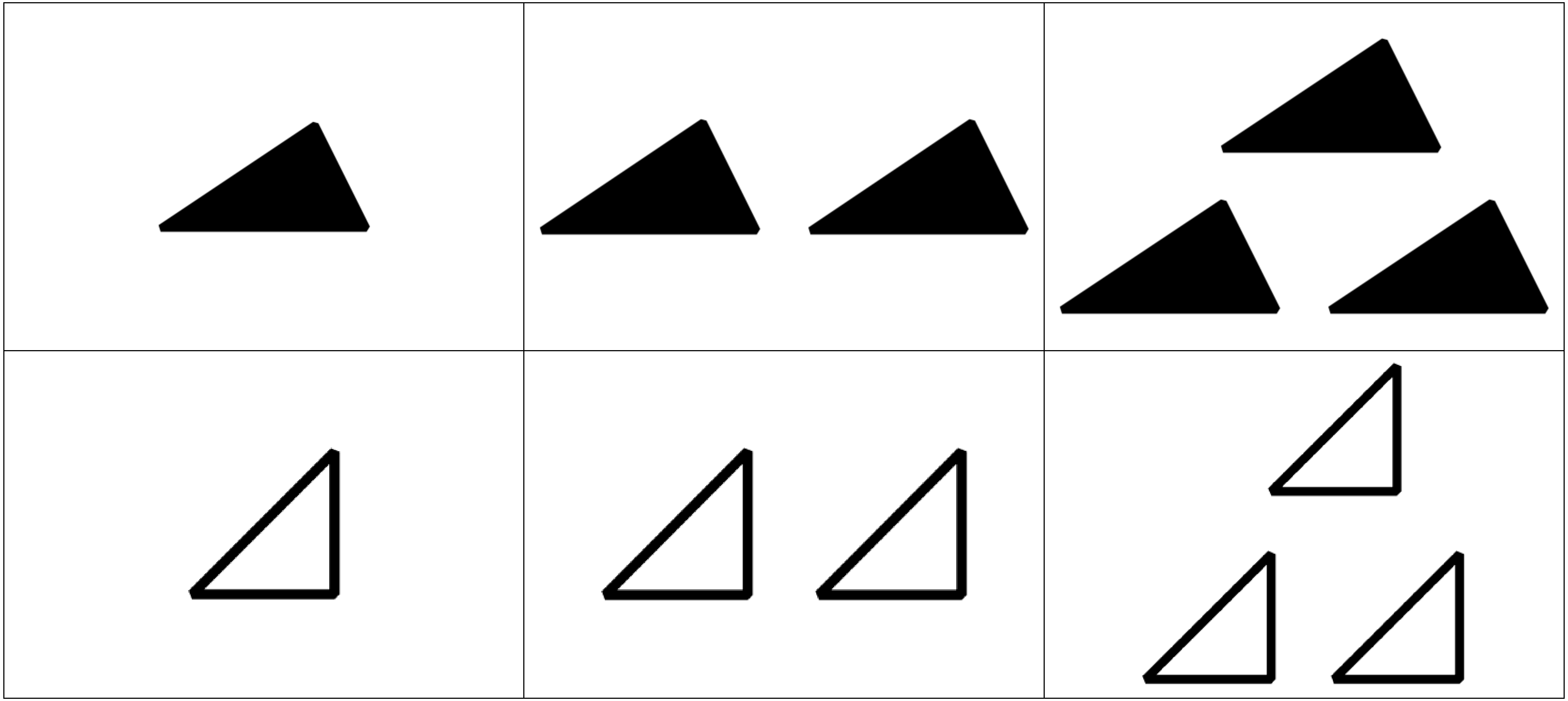
Play is over when there are no more moves to make.

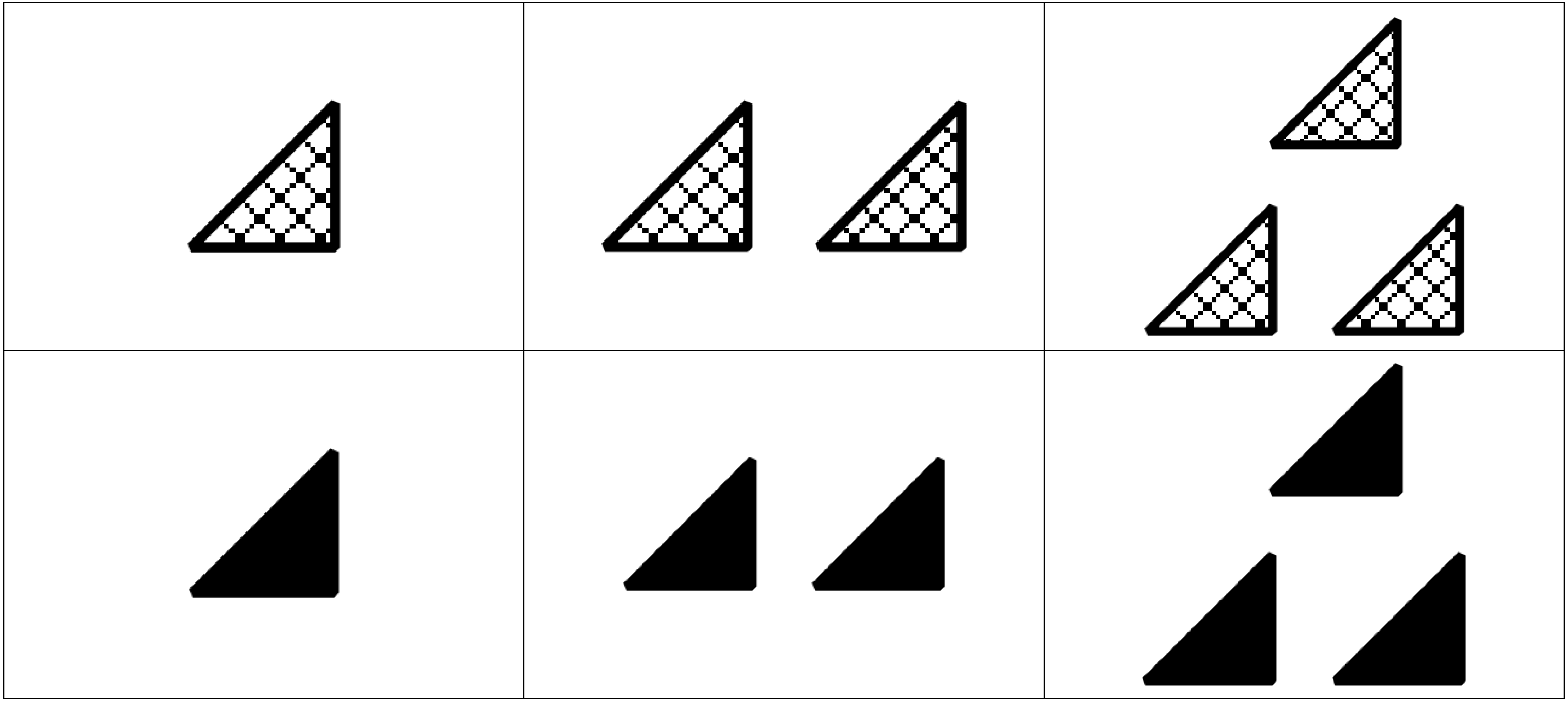
A player’s final score is calculated by counting the number of cards collected as Triangle Triples and subtracting the number of cards they still have in their hands (if any). The highest score wins.

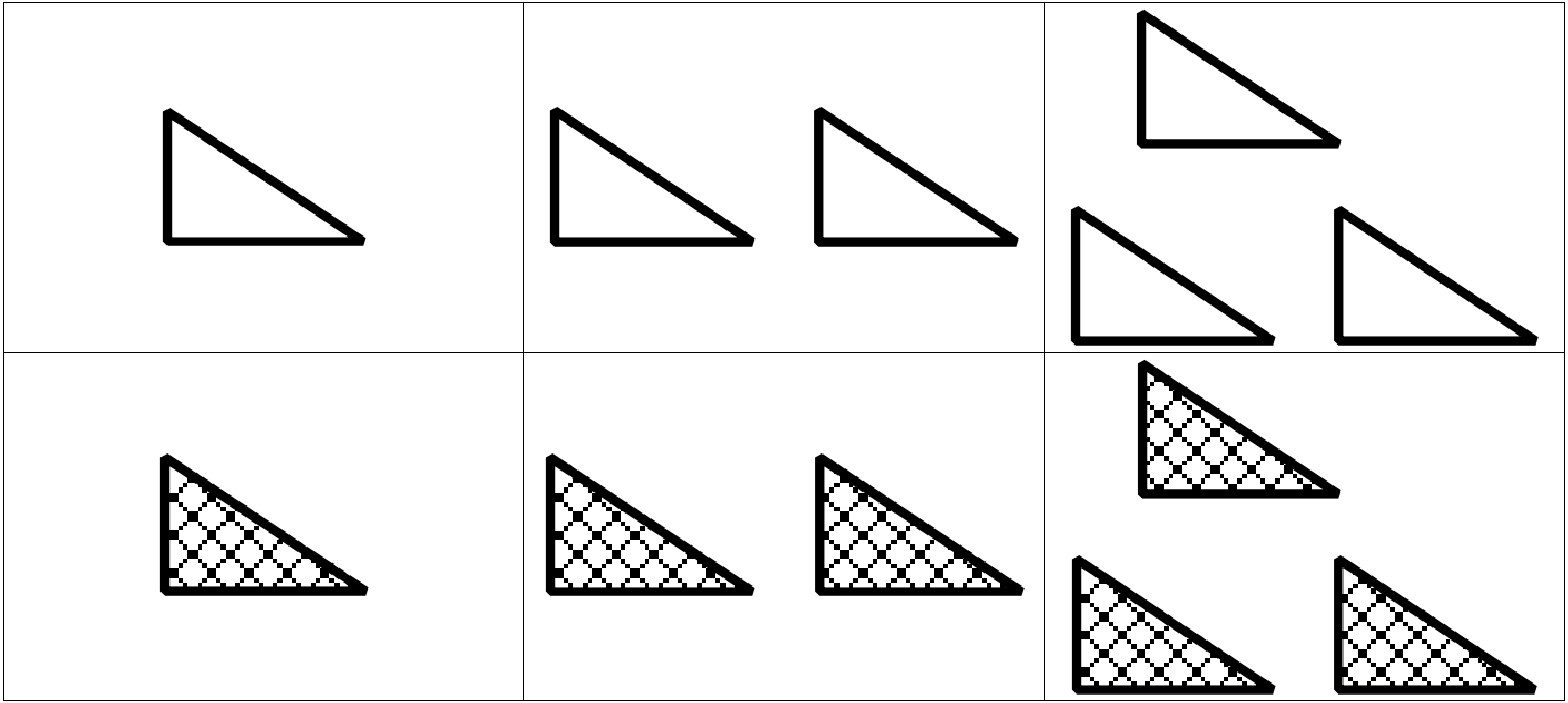


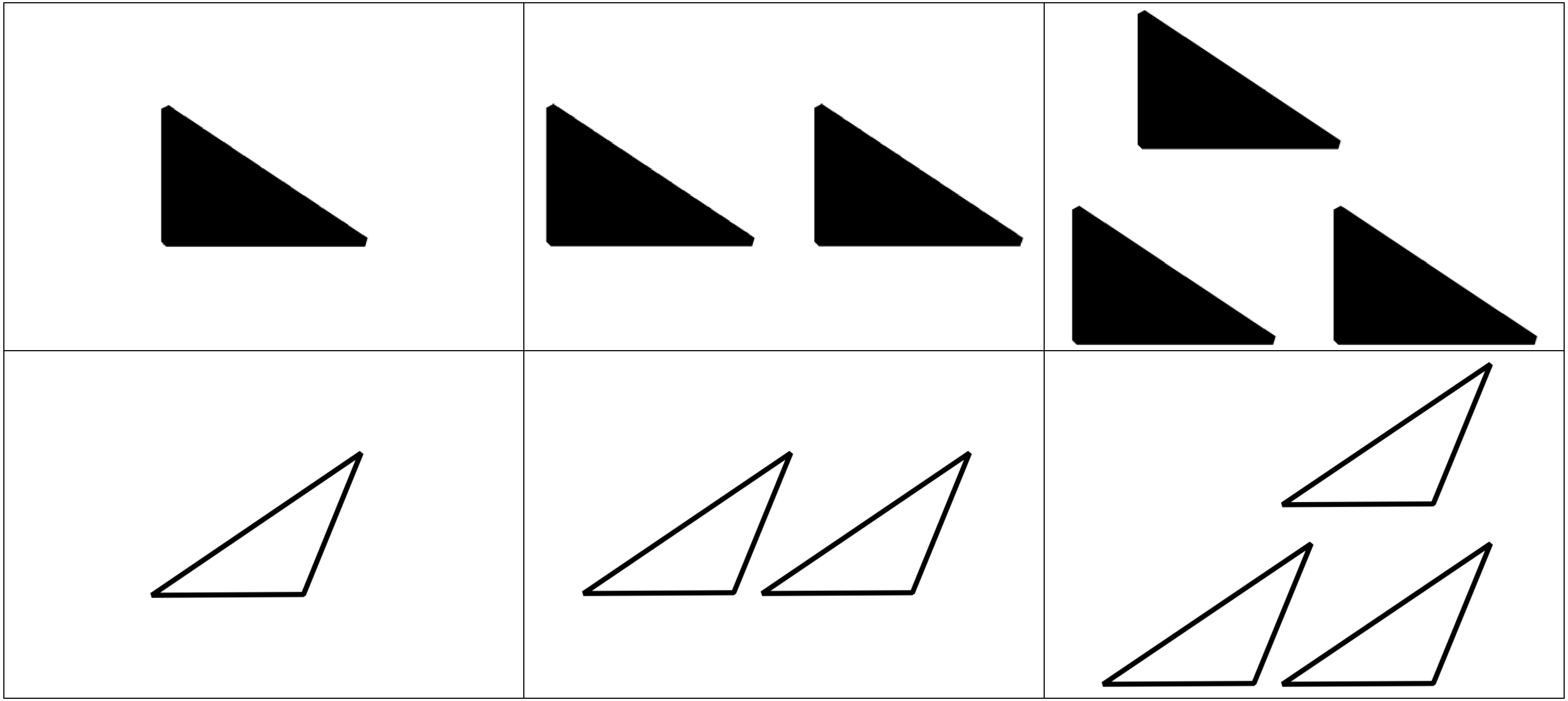


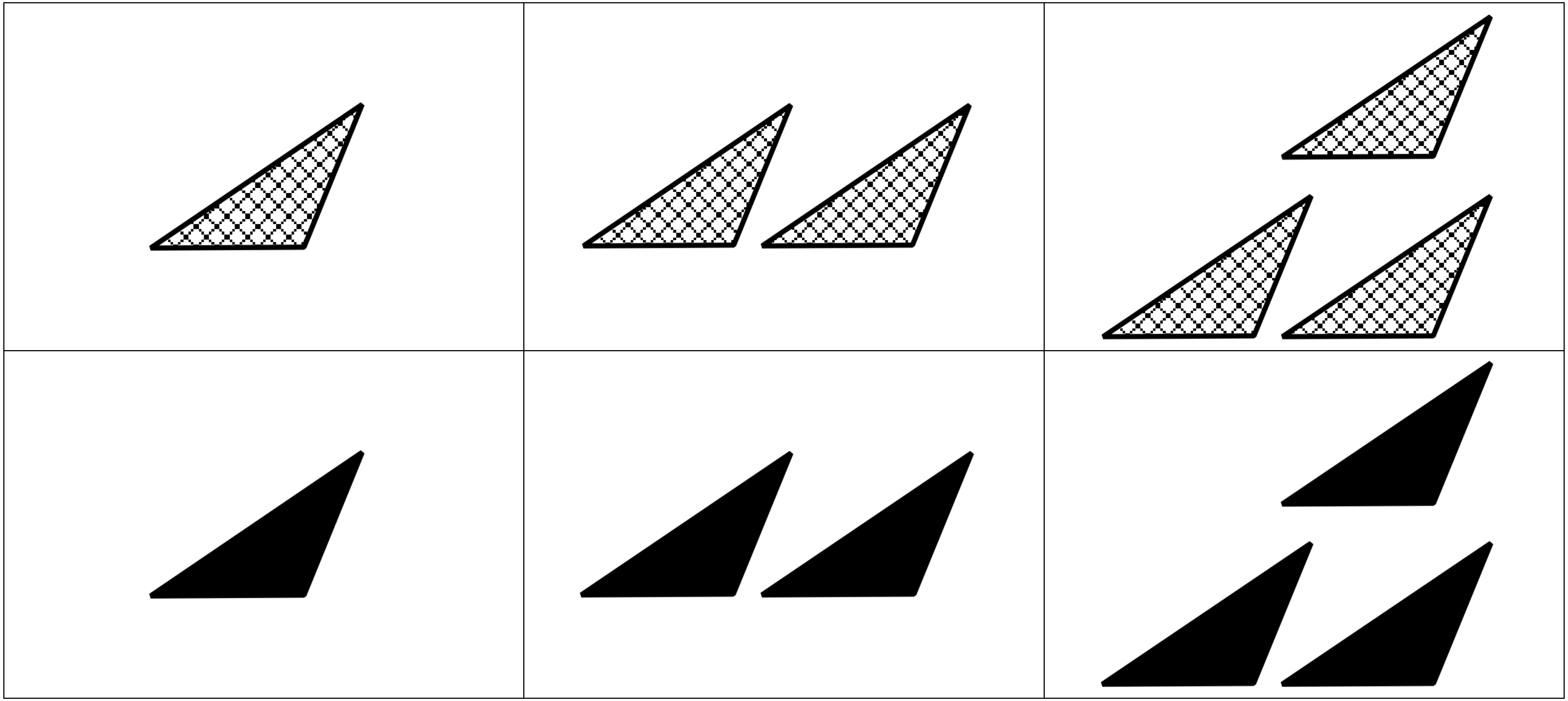


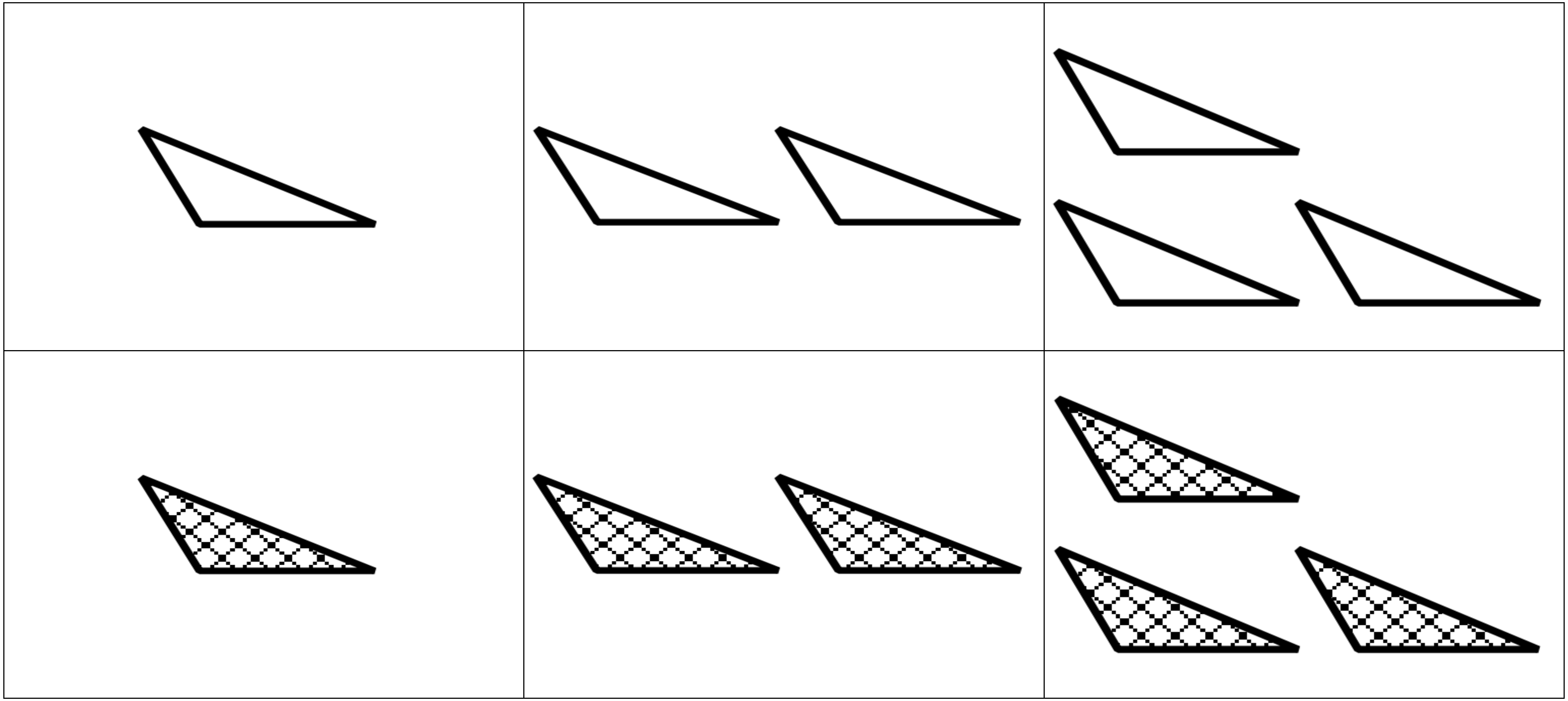


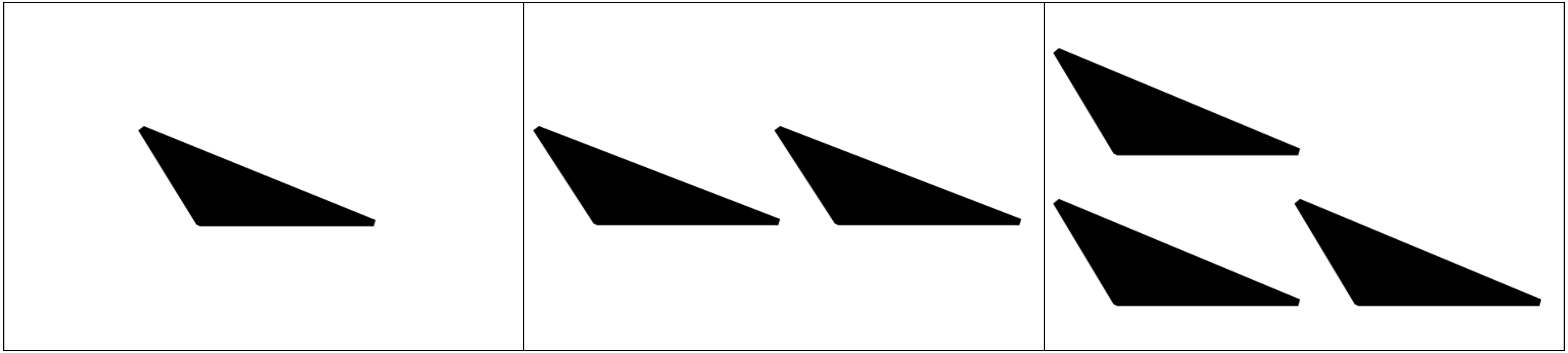












Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

Different Perspectives

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 205: DIFFERENT PERSPECTIVES

Overview

This task is designed to help students start do draw different views of 3-dimensional objects.

Students will need

- connector blocks or 1-cm or 2-cm cubes
- erasers
- grid paper
- isometric paper
- access to the internet (Activity 3 only)

Relevant content descriptions from the Western Australian Curriculum

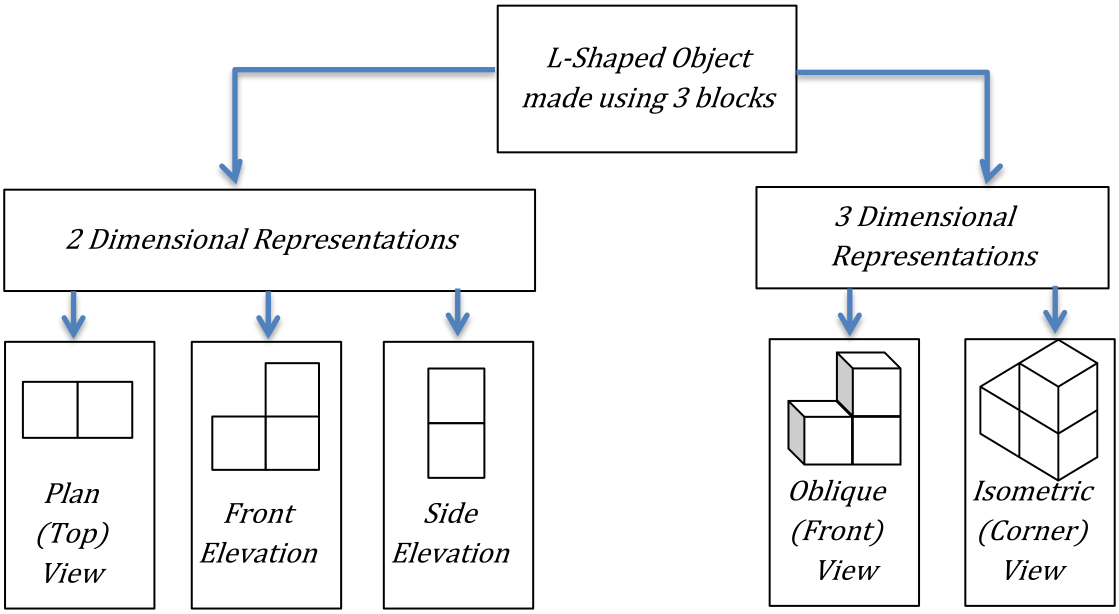
- Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)

Students can demonstrate

- *fluency* when they
  - can draw simple shapes using plan, front, side or oblique views
  - can draw simple using isometric paper
- *understanding* when they
  - understand that isometric views can be misleading and that they can create their own "impossible" shapes
  - can explain where different types of drawings would be useful
  - can explain how to make a drawing of an object look 3-dimensional
- *reasoning* when they
  - can build a given object using a minimum number of cubes
- *problem solving* when they
  - use scale to draw an accurate plan

Activity 1

The flow chart below shows the different ways we can represent 3-dimensional objects on paper.



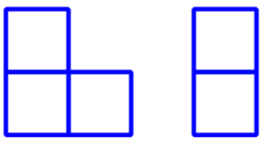
1. Which professions would use these types of drawings? Name as many as possible.
   Architects
   Draughts-people
   Builders

2. Using the cubes you have been given, make the shape shown above.

3. See if you can move your shape (or yourself!) so that you can see the shape as it is shown in each of the diagrams above.

4. Which two **elevations** are missing from the drawings above?
   Rear and another side

5. On the grid paper, draw the missing elevations.



Rear View Side View

6. Was there anything different between the front view and the back view? If so, what?

   Yes, the rear view was a mirror image of the front view because you are looking at the shape from a different angle.

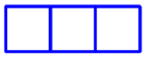
7. Was there anything different between the two side views? Can you explain why this is?

   No. Even though the two sides are physically different, the elevation drawings do not include any perspective, so the two views look the same.

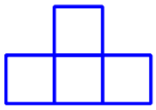
8. Place three connector cubes in a row on your desk. Now place one cube on top of the middle block to make a “T” shape.

9. On the grid paper or isometric paper you have been given, draw

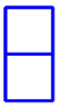
   a. Plan view

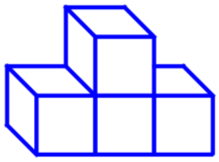
   b. Front elevation

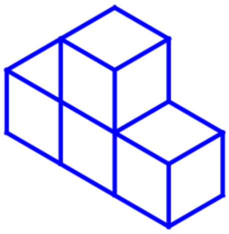
   c. Side elevation

   d. Oblique view

10. On the isometric paper you have been provided, draw an **isometric view** of your shape.



11. Compare your drawing with others in the class.

    Various answers for these questions:

    a. How did you start your drawing?

    b. How did you make the cube look 3-dimensional?

    c. Is there anything you would do differently next time you have to draw a shape?

Activity 2

1. Using the connector blocks you have been given, build any shape you can think of.

2. On grid paper or isometric paper, draw the following diagrams of your object.
   Various answers

   a. Plan view
   b. Front elevation
   c. Side elevation
   d. Isometric view

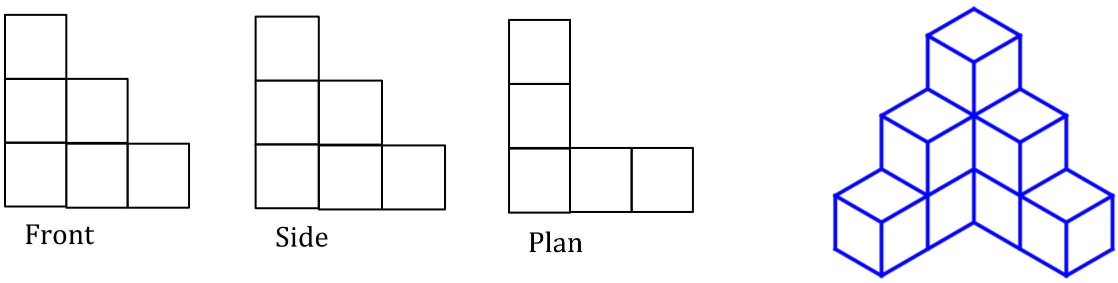
3. On isometric paper, draw the isometric view of your object. Various answers

4. Switch your drawings with someone else in the class. See if you can build each other's shape using only the drawings each of you has created.

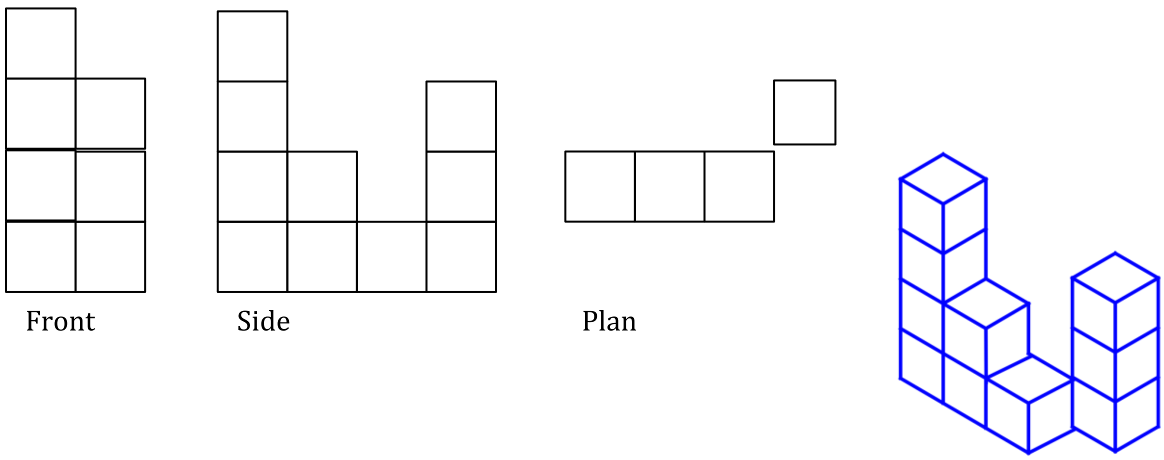
5. Make a different shape, and repeat the process. This time switch with someone different.

6. See if you can make the following shapes using your blocks.

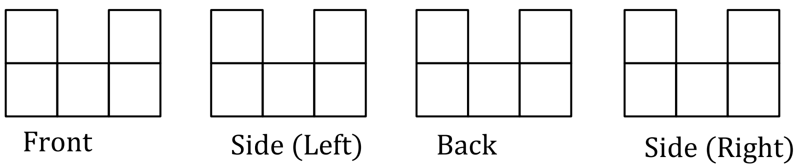
   a.

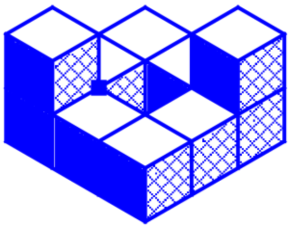


   b.

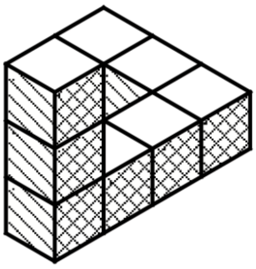


7. Can you build this shape using exactly 10 cubes?





8. The following shape looks like it is impossible, but you can build it using your connector blocks. See if you can make the shape.



9. Why did the shape in the previous question look impossible?
   Because it's drawn at an angle, it looks like the top of the tower is joined to the block in the back corner.

10. Build your own 'impossible' shape. Draw your shape on the isometric paper provided.

<u>Activity 3</u>

1. Plan views are often used by builders to show the layout of a house or building. Use the internet to look at different house plans that builders in your area can build.

2. What are some of the common features included in all of the plan views you have looked at?
   Kitchen, laundry, family room, dining room, bathroom/s, bedroom/s.

3. How do builders make sure that everything is shown at the correct size?
   They use a consistent scale throughout the plan.

4. You are going to draw a plan view of your classroom.

   a. What things need to be included in your plan?
      Teacher's desk, students' desk, whiteboards, cupboards, etc.

   b. How are you going to make sure that everything is the right size?
      By using a consistent scale.

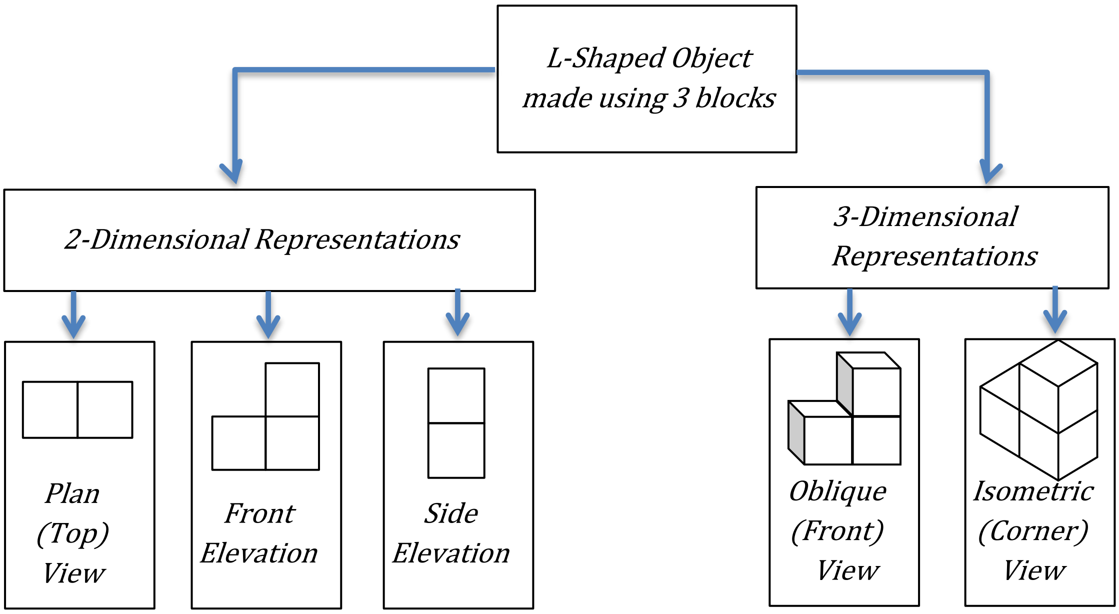
   c. Create your plan on the grid paper provided.
      Plans as appropriate.

5. Design your ideal bedroom and draw a plan of it. Be as creative as you like.

6. EXTENSION QUESTION: Draw a front view of the room you designed in Question 5; i.e., the view if you were standing in the doorway. Plans as appropriate.

Activity 1

The flow chart below shows the different ways we can represent 3-dimensional (3D) objects on paper.



1. Which professions would use these types of drawings? Name as many as possible.

2. Using the cubes you have been given, make the shape shown above.

3. See if you can move your shape (or yourself!) so that you can see the shape as it is shown in each of the diagrams above.

4. Which two **elevations** are missing from the drawings above?

5. On the grid paper, draw the missing elevations.

6. Was there anything different between the front view and the back view? If so, what?

7. Was there anything different between the two side views? Can you explain why this is?

8. Place three connector cubes in a row on your desk. Now place one cube on top of the middle block to make a “T” shape.

9. On the grid paper you have been given, draw
    a. Plan view
    b. Front elevation
    c. Side elevation
    d. Oblique view

10. On the isometric paper you have been provided, draw an **isometric view** of your shape.

11. Compare your drawing with others in the class.

    a. How did you start your drawing?

    b. How did you make the cube look 3-dimensional?

    c. Is there anything you would do differently next time you have to draw a shape?

<u>Activity 2</u>

1. Using the blocks you have been given, build any shape you can think of.

2. On grid paper, draw the following diagrams of your object

    a. Plan view
    b. Front elevation
    c. Side elevation
    d. Oblique view

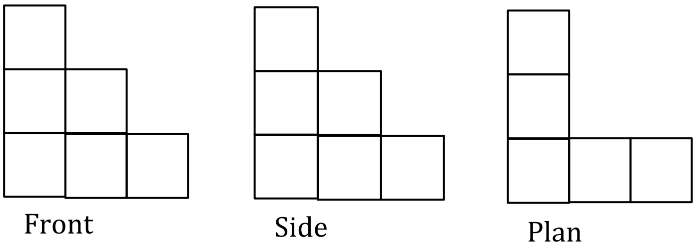
3. On isometric paper, draw the isometric view of your object.

4. Switch your drawings with someone else in the class. See if you can build each other’s shape using only the drawings each of you has created.

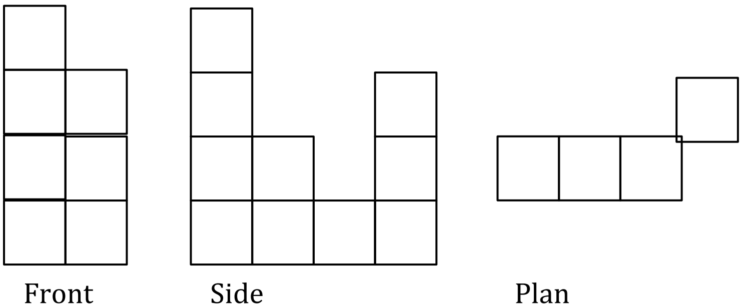
5. Make a different shape, and repeat the process. This time switch with someone different.

6. See if you can make the following shapes using your blocks

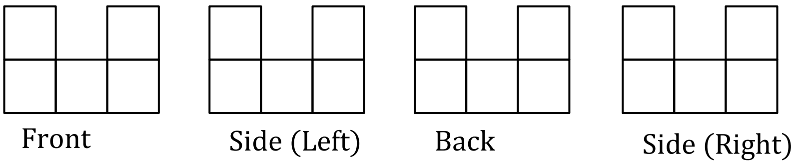
a.



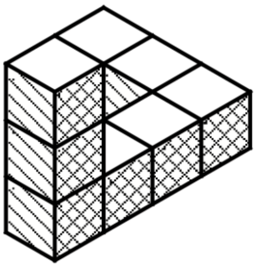
b.



7. Can you build this shape using exactly 10 cubes?



8. The following shape looks like it is impossible, but you can build it using your connector blocks. See if you can make the shape.



9. Why did the shape in the previous question look impossible?

10. Build your own ‘impossible’ shape. Draw your shape on the isometric paper provided.

Activity 3

1. Plan views are often used by builders to show the layout of a house or building. Use the internet to look at different house plans that builders in your area could build.

2. What are some of the common features included in all of the plan views you have looked at?

3. How do builders make sure that everything is shown at the correct size?

4. You are going to draw a plan view of your classroom.

    a. What things need to be included in your plan?

    b. How are you going to make sure that everything is the right size?

    c. Create your plan on the grid paper provided.

5. Design your ideal bedroom and draw a plan of it. Be as creative as you like.

6. EXTENSION QUESTION: Draw a front view of the room you designed in question 5; i.e., the view if you were standing in the doorway.

Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

Curious Coordinates

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 206: CURIOUS COORDINATES

Overview

This task introduces the concept of the Cartesian plane and allows students to explore various transformations of shapes in the plane.

Students will need

- coloured pencils
- scissors
- glue
- split pins

Relevant content descriptions from the Western Australian Curriculum

- Describe translations, reflections in an axis and rotations of multiples of 90 on the Cartesian plane using coordinates. Identify line and rotational symmetries (ACMMG181)

Students can demonstrate

- *fluency* when they
  - write ordered pairs for points on the Cartesian plane
  - plot points on the Cartesian plane
- *understanding* when they
  - represent transformations on the Cartesian plane
- *reasoning* when they
  - can predict the coordinates of a shape that has been transformed
- problem *solving* when they
  - work with transformations to create patterns

Introduction

This is the student's first page. Some tasks may be written solely for the teachers and give a series of activities for the teacher to do, so a student page will be unnecessary. Keep this introduction short: four to five lines of text. If more lines are needed, try to use illustrations to make the text attractive.

Activity 1 (Teacher-led Activity)

Put the "Dot Diagram" up on a whiteboard.

Ask a student up to the board.

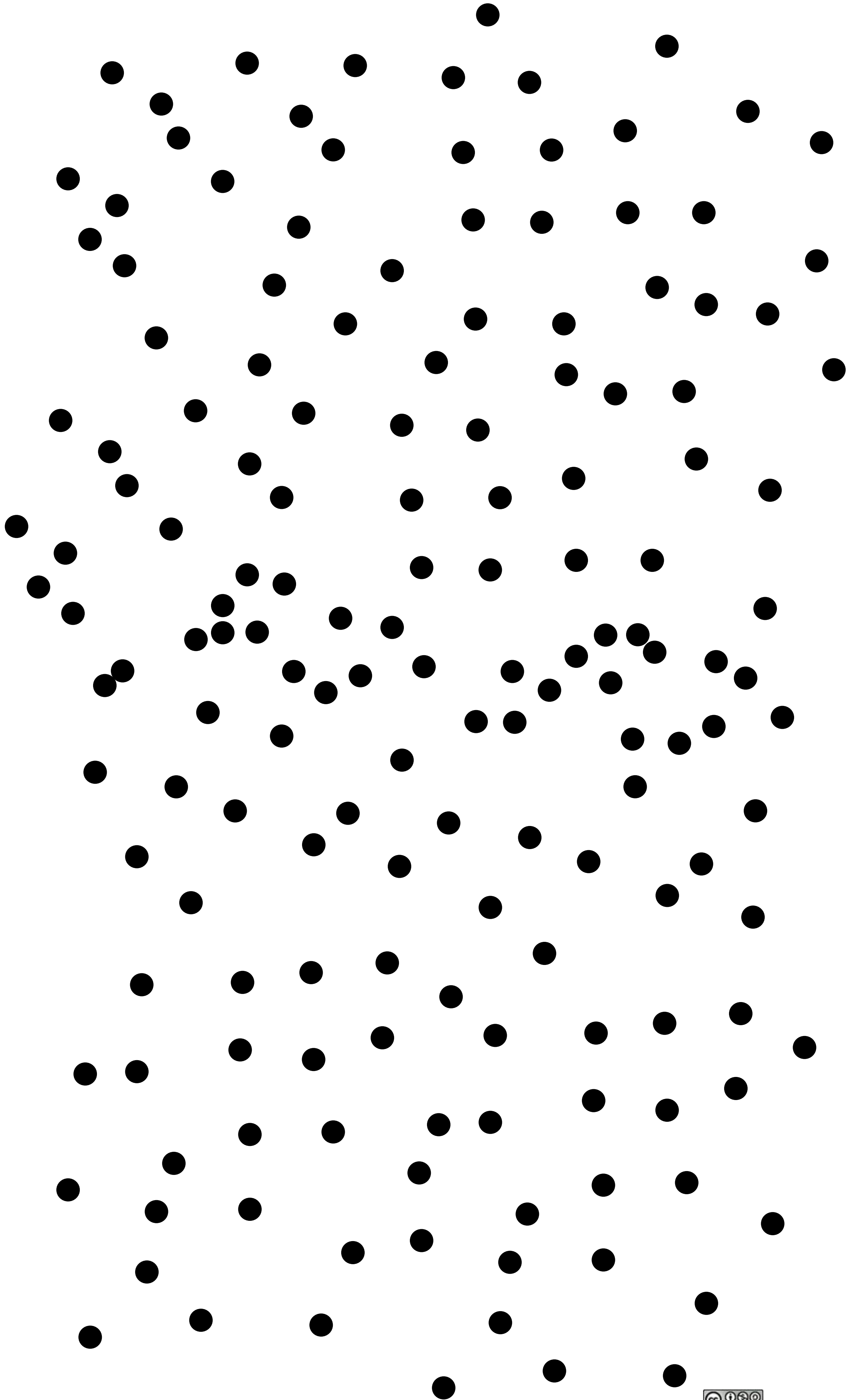
Ask another student to choose one of the dots. Without coming to the board, ask this second student to tell the first student which dot they have picked. This will quickly turn into an exercise in frustration.

Ask students to come up with a better method for locating a dot.

If they suggest labelling the dots, start doing this. Questions to ask students:
- How do you decide where to start labelling?
- What happens if we run out of letters or numbers?
- Is there some order to how we should label dots?
- What if we realise we've missed a few dots and have to add some more; would we need to go back and re-label everything?
- How could we avoid these problems? How do maps deal with this problem?

Once any type of grid reference system is suggested, introduce the Cartesian Plane by drawing it on the board. The origin should be somewhere near the middle of the dots. Remember to explain that the middle of the two axes is the starting point and that we have to crawl (move along the x-axis) before we can climb (move along the y-axis) .

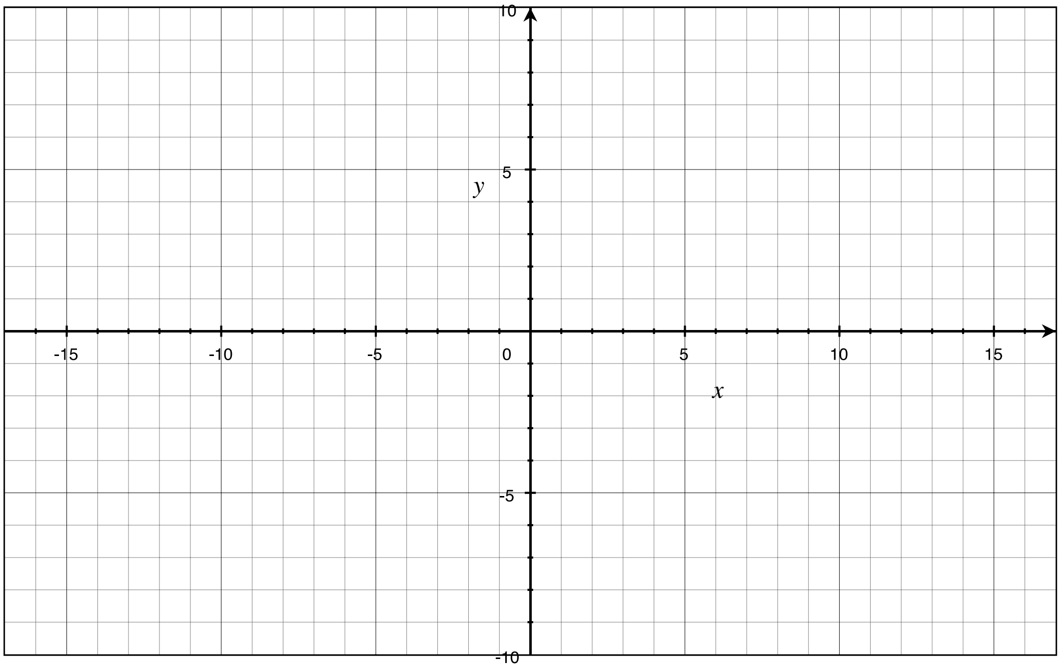
Ask third student to come up to the board and a fourth student to pick a dot. The fourth student should use coordinates to direct the third student to the correct dot. Repeat a few more times with different students, until the students have grasped the concept.



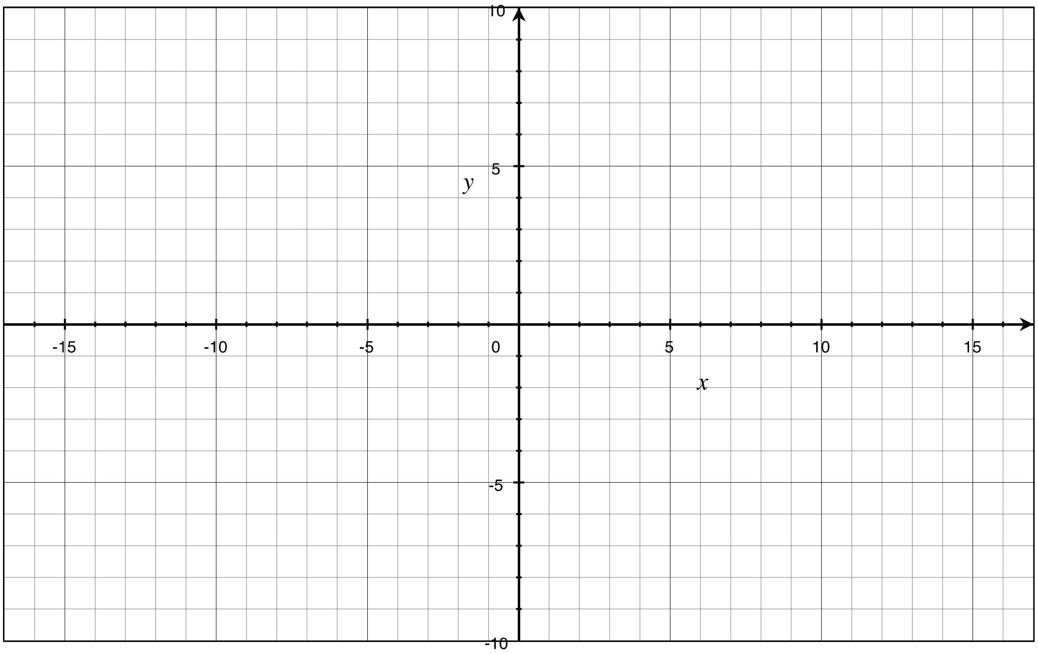
Activity 2

1. On the coordinate plane below and using only straight lines, draw a picture of anything you like.

2. On a separate sheet of paper, write down the coordinates of the starting point and ending point of each line you drew to make your picture.



3. Switch your set of coordinates with someone else and draw their picture below



Answers will vary for this task. The easiest way to check students' work is to compare a students' original drawing with the drawing their partner has completed using the coordinates they were given and investigating any differences.

Activity 3

Answers will vary for all of the following, depending on their placement of the object before transforming it.

1. Cut out the strip of paper and the shape above.

2. Glue one edge of the strip of paper to the centre of the shape. Fold the strip of paper so that sits inside your shape.

3. Place the shape (strip side up) anywhere on the Cartesian plane below and trace around the edge of your shape.

4. In the table provided, write down the coordinates of the four corners of your shape.

5. Slide your shape 2 units right and 3 units down. Record the new coordinates of your shape.

6. Move your shape back to its starting position.

7. Reflect your shape about the y-axis.

   If you are not sure how to do this, you can use the strip of paper you glued to your shape to help you. Without moving your shape, fold the strip of paper in the centre of your shape so that it just touches the y-axis. Keep the edge of the strip touching the y-axis turn your shape over the same way you would turn a page of a book.

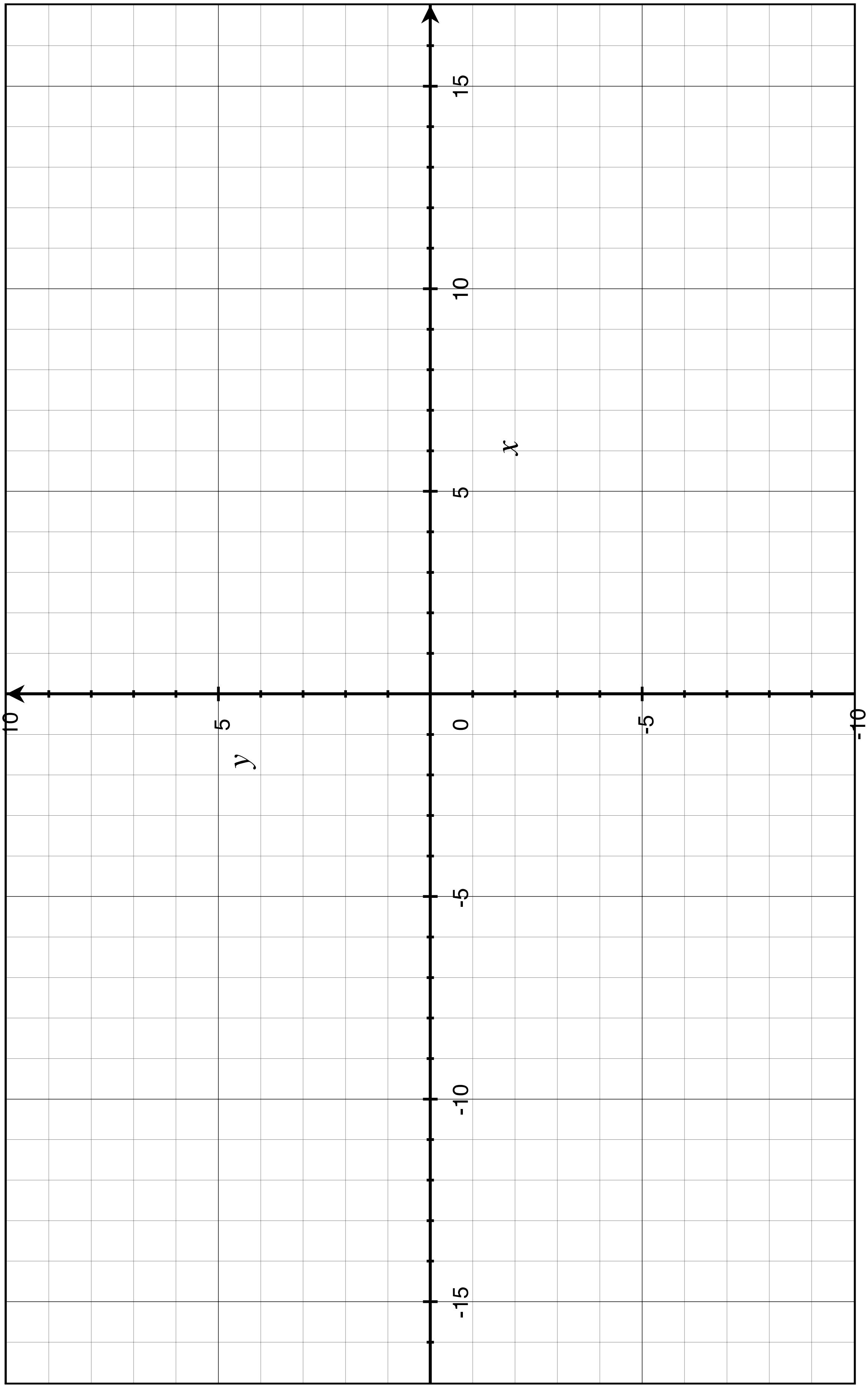
8. Trace around your shape and record the new coordinates of your shape.

9. Move your shape back to its starting position.

10. Reflect your shape about the x-axis. Trace around your shape and record the new coordinates of your shape.

11. Move your shape back to its starting position. Fold the strip of paper so that its free edge covers the origin. Place a split pin through the strip of paper and through the origin.

12. Keeping one corner fixed, rotate your shape 90°, 180°, 270°. After each rotation, trace around your shape and record the new coordinates


x
y
15
10
5
0
-5
-10
-15
10
5
-5
-10

	Original Coordinates	Coordinates after Translation	Coordinates after reflection about the y-axis	Coordinates after reflection about the x-axis	Coordinates after first rotation	Coordinates after second rotation	Coordinates after third rotation
My results	Answers will vary						

13. Collect the coordinates of 5 other people in your class.
    Answers will vary.

14. Compare the original coordinates to the coordinates after translation for each person.

    a. What patterns do you notice?
    b. How does this pattern relate to translations you made?
    c. If you were given the coordinates of a shape, then told that the shape was translated a units to the right and b units up, could you predict the coordinates of the shapes position now? How?

15. Compare the original coordinates to each of the other columns.
    a. What patterns do you notice?
    b. If you knew the original coordinates of a shape and given a transformation it underwent, could you predict the coordinates of the shape? How?
    c. If you were given the coordinates both before and after a shape was transformed, could you work out which transformation happened? How?

If the original coordinates are (x, y);

Translation a units right and b units up gives $(x + a, y + b)$
Reflection about the x-axis gives $(-x, y)$
Reflection about the y-axis gives $(x, -y)$
Rotation 90 degrees about the origin gives $(y, -x)$ or $(-y, x)$
Rotation 180 degrees about the origin gives $(-y, -x)$

Activity 4

Note: This activity can also be performed using a computer program such as Microsoft Paint.

1. In square above, draw any pattern you like and colour it in. This activity will work better if you make your pattern asymmetrical.

2. Cut out your square. This will become the template for your pattern.

3. Copy your pattern into the top left square in the grid provided.

4. Rotate your pattern 90° and copy the pattern into second square.

5. Rotate your pattern another 90° and copy the pattern into box **underneath** the second square

6. Rotate your pattern another 90° and copy the pattern into the box **underneath** the first square

7. Starting in the third square in the top row, repeat the process. Which other transformation could you have used to achieve the same result?

   You could translate the first four squares 2 units to the right.

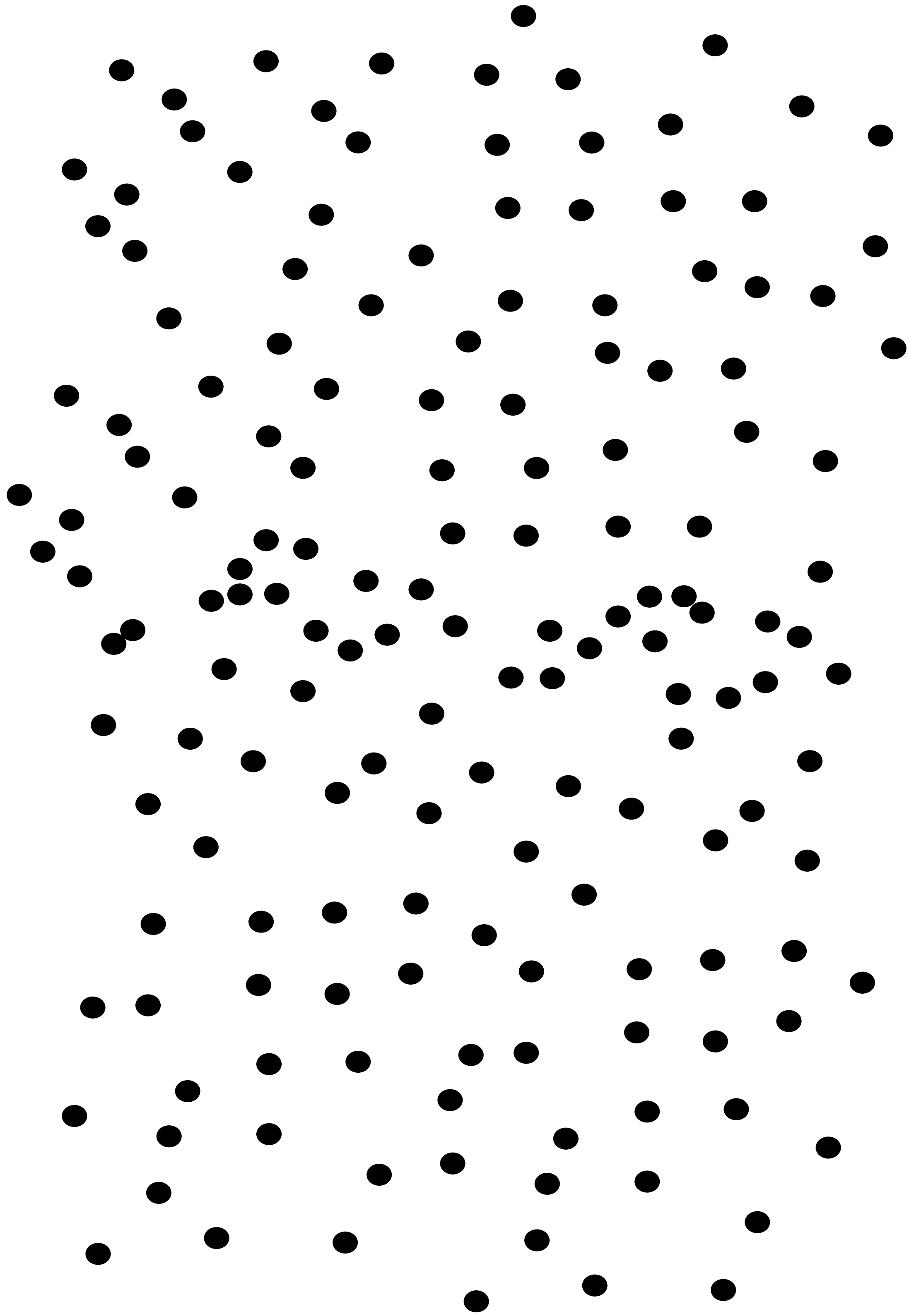
8. Reflect your pattern about the dotted line in the centre.

9. Go to the following website; http://www.zefrank.com/dtoy_vs_byokal/ and create your very own kaleidoscope pattern.

Answers will vary			

Activity 1 (Teacher-led Activity)

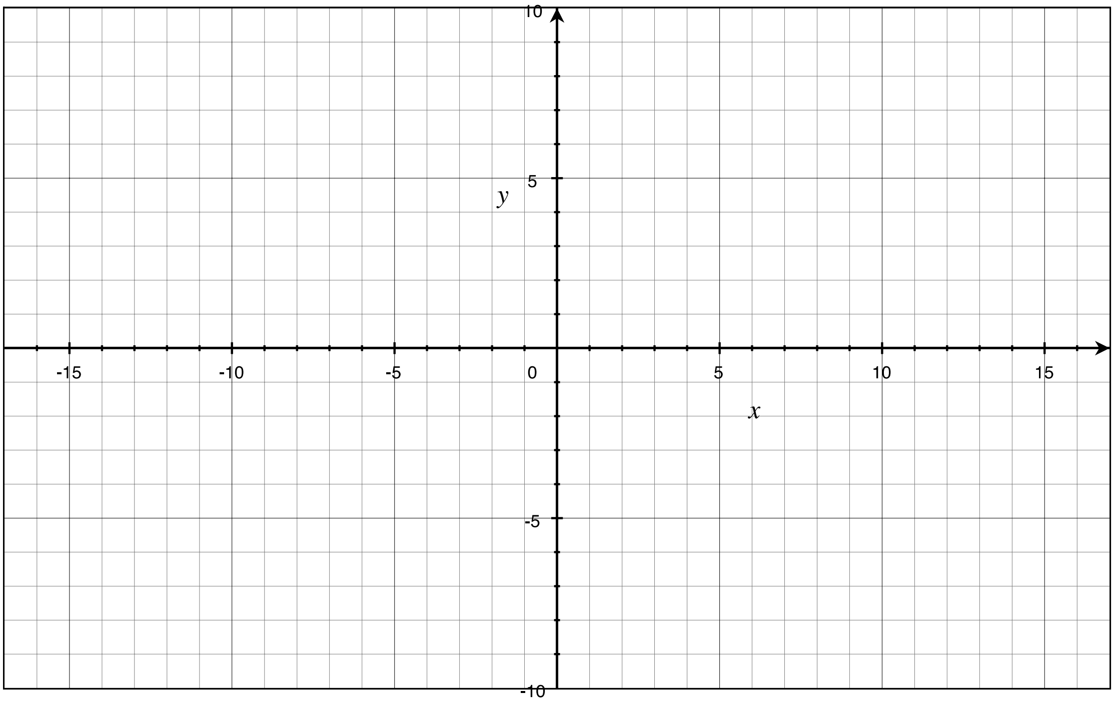
Your teacher will place the “Dot Diagram” that follows on a whiteboard and lead a discussion on a method of labelling the dots with your class.



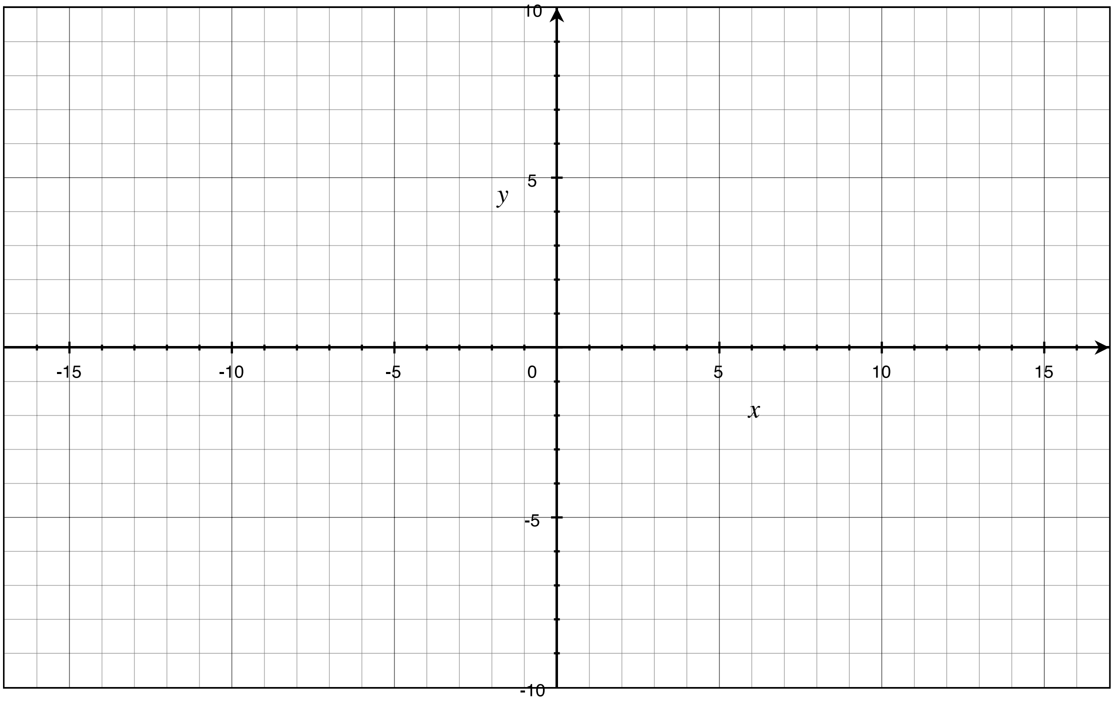
Activity 2

1. On the coordinate plane below and using only straight lines, draw a picture of anything you like.

2. On a separate sheet of paper, write down the coordinates of the starting point and ending point of each line you drew to make your picture.



3. Switch your set of coordinates with someone else and draw their picture below



Activity 3

1. Cut out the strip of paper and the shape above.

2. Glue one edge of the strip of paper to the centre of the shape. Fold the strip of paper so that sits inside your shape.

3. Place the shape (strip side up) anywhere on the Cartesian plane below and trace around the edge of your shape.

4. In the table provided, write down the coordinates of the four corners of your shape.

5. Slide your shape 2 units right and 3 units down. Record the new coordinates of your shape.

6. Move your shape back to its starting position.

7. Reflect your shape about the y-axis.

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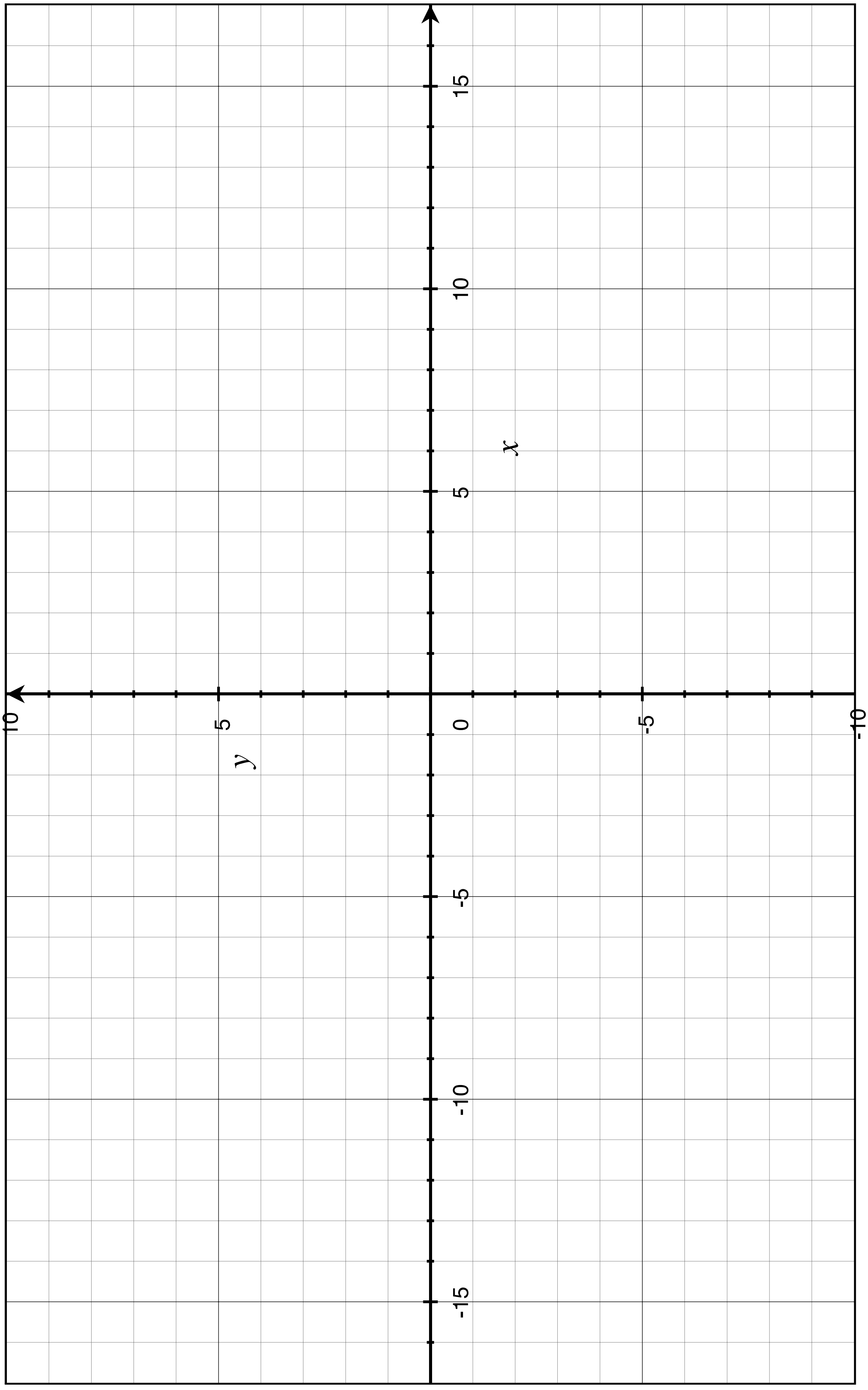
8. Trace around your shape and record the new coordinates of your shape.

9. Move your shape back to its starting position.

10. Reflect your shape about the x-axis. Trace around your shape and record the new coordinates of your shape.

11. Move your shape back to its starting position. Fold the strip of paper so that its free edge covers the origin. Place a split pin through the strip of paper and through the origin.

12. Keeping one corner fixed, rotate your shape 90°, 180°, 270°. After each rotation, trace around your shape and record the new coordinates


x
y
15
10
5
0
-5
-10
-15
10
5
-5
-10

	Original Coordinates	Coordinates after Translation	Coordinates after reflection about the y-axis	Coordinates after reflection about the x-axis	Coordinates after first rotation	Coordinates after second rotation	Coordinates after third rotation
My results							

13. Collect the coordinates of 5 other people in your class.

14. Compare the original coordinates to the coordinates after translation for each person.

    a. What patterns do you notice?
    b. How does this pattern relate to the translation you made?
    c. If you were given the coordinates of a shape, then told that the shape was translated *a* units to the right and *b* units up, could you predict the coordinates of the shapes position now? How?

15. Compare the original coordinates to each of the other columns.

    a. What patterns do you notice?
    b. If you knew the original coordinates of a shape and given a transformation it underwent, could you predict the coordinates of the shape? How?
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Activity 4

Note: This activity can also be performed using a computer program such as Microsoft Paint.

1. In square above, draw any pattern you like and colour it in (this activity will work better if you make your pattern asymmetrical).

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7. Starting in the third square in the top row, repeat the process.

a. Which other transformation could you have used to achieve the same result?

8. Reflect your pattern about the dotted line in the centre.

9. Go to the following website; http://www.zefrank.com/dtoy_vs_byokal/ and create your very own kaleidoscope pattern.

Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Parallel Lines

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 207: PARALLEL LINES

Overview

This task is designed to help students construct, name and use various types of angles. Some of the work is performed outside using chalk and string.

Students will need

- long piece of thick string or twine
- chalk
- protractors (Large white-board style ones will work best)
- scissors
- glue

Relevant content descriptions from the Western Australian Curriculum

- Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal (ACMMG163)
- Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)

Students can demonstrate

- *fluency* when they
  - construct parallel lines
  - match angle words to appropriate diagrams and definitions
- *understanding* when they
  - explain why angles on a line must add to 180°
  - explain why all angles at a point must add to 360°
- *reasoning* when they
  - use known angles and the properties of angles to determine unknowns

Activity 1

1. Using the chalk and any long straight edge (you can even use a long piece of string held taut at each end!), Person 1 rules a straight line on the ground and labels one end “A” and the other end “B”

2. Person 2 marks a point about half a metre above or below the line and labels it “C”

3. Person 3 draws a straight line that passes through points A and C. Make the line extend past point C.

4. Person 1 ties the string to the chalk.

5. Person 2 places the chalk on point C while Person 3 holds the string taut at Point A. Person 2 draws an arc that cuts through point C and the line AB. Label this point “D”.

6. Making sure the length of the string doesn’t chance, Person 3 picks up the string and walks to point C and holds it there.

7. Person 1 uses the chalk to draw another arc further along the AC line and extends the arc towards point B. Label the point where the arc crosses the AC line point “E”.

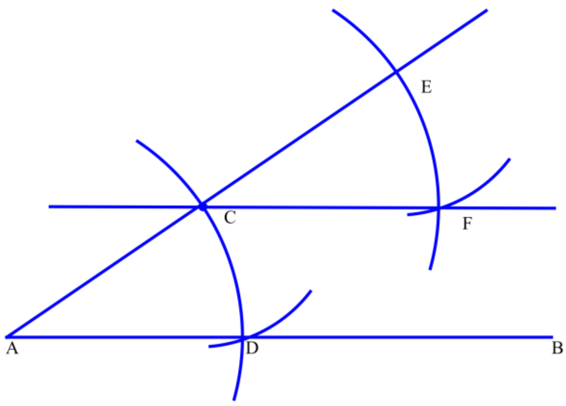
8. Person 3 places the chalk on point D while Person 2 holds the string taut at point C. Person 3 draws an arc that passes through point D.

9. Keeping the length of the string the same, Person 2 moves the string to point E. Person 1 draws another arc that cuts the curve that passes through point E. Label this point “F”.

10. Person 1 draws a straight line that passes through Point C and Point F.

11. Take a photo of your group’s work.

Completed work shown below.



Activity 2

1. Go back to your chalk drawing from activity 1. Rub out everything except your parallel lines (AB and CF)

2. Draw another straight line that cuts across the two parallel lines.

3. Take another photo.

4. Without measuring anything, have a look at all the angles you have created. Which ones do you think are the same? Which ones do you think are different?

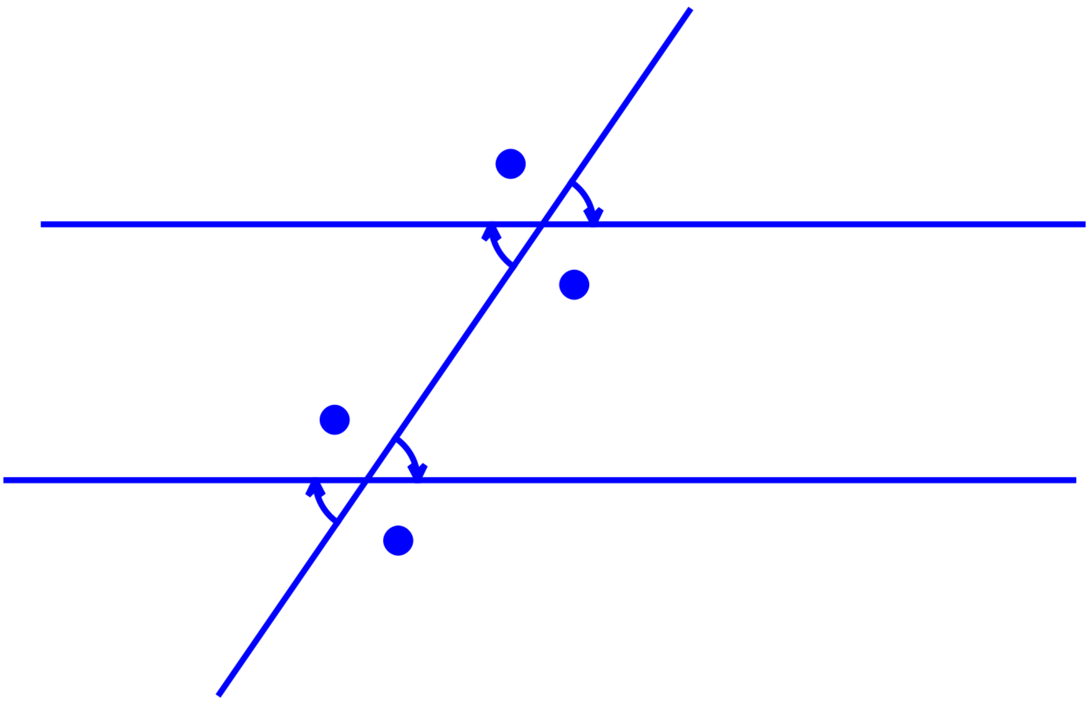
5. Measure the 8 angles that you have created. Which ones are the same? Which ones are different?
   Answer shown below.

6. Which angles add to 360°? Can you explain why?
   The angles at each intersection add to 360 because they are angles at a point.

7. Which pairs of angles add up to 180°? Why do you think this is?
   The pairs of angles that sit on a straight line add up to 180.
   Co-interior angles add to 180 because if they were put next to each other they would make a straight line.

8. Compare your results with the other groups in your class. Did they get the same results or did they find something different?
   Various answers

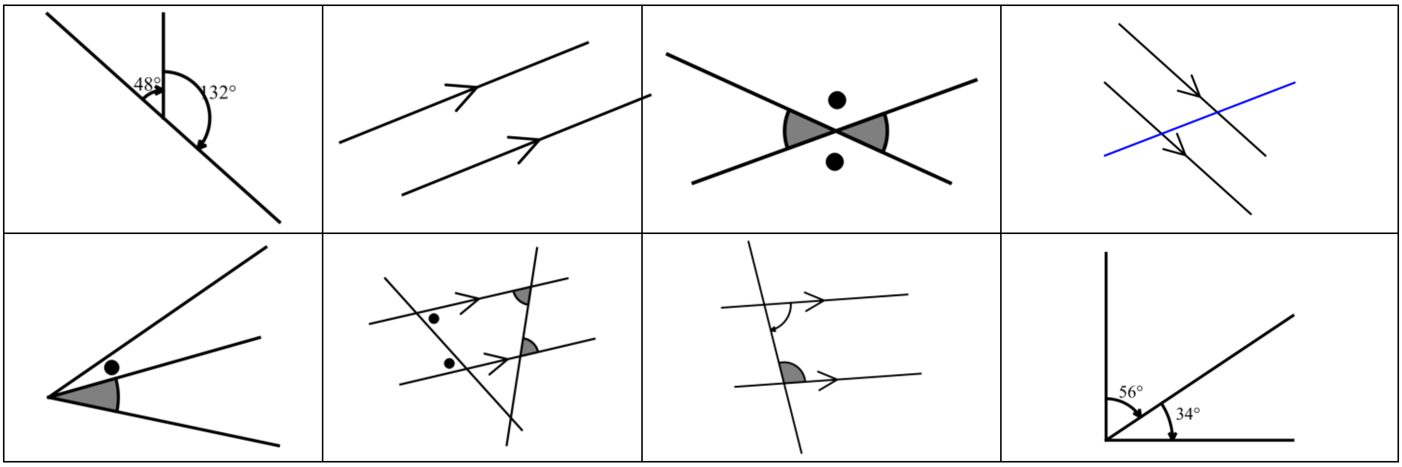
9. Summarise your findings on the diagram below (Do not measure the angles, just show which ones would be the same!):



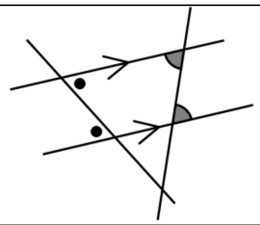
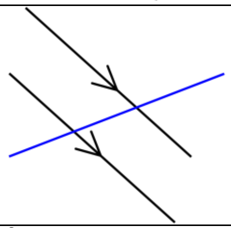
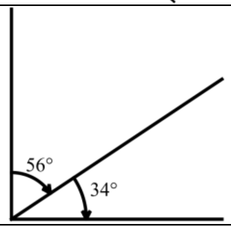
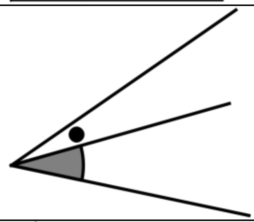
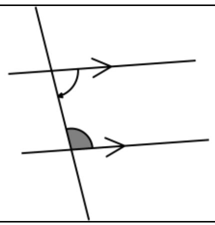
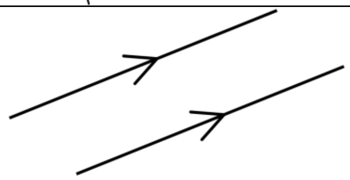
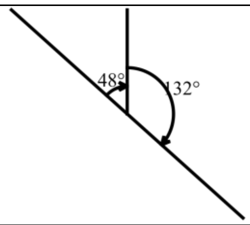
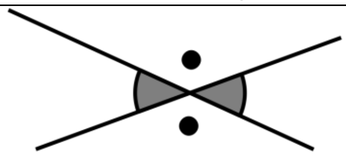
Activity 3

Working with a partner, cut out the following sets of cards, then match each title in the first table to its matching picture and definitions.

ALTERNATE ANGLES	TRANSVERSAL	COMPLEMENTARY ANGLES	ADJACENT ANGLES
CO-INTERIOR ANGLES	PARALLEL LINES	SUPPLEMENTARY ANGLES	VERTICALLY OPPOSITE ANGLES



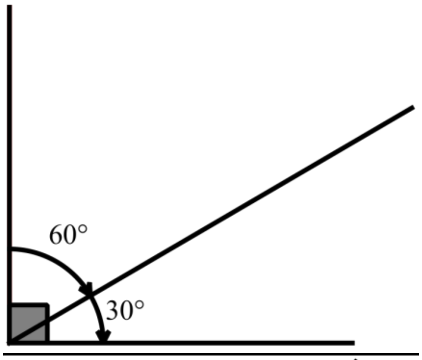
Angles that add to 90°	Angles that share a common side and a common vertex (corner)	A line that crosses two or more parallel lines	Angles that are on the same side of a transversal, bounded by two parallel lines and add to 180°
Lines that never meet and never get further away from each other; so they are always the same distance apart.	Angles that are opposite each other when two straight lines cross. They are equal in size.	Angles that add to 180°. That is, they form a straight line when they are put next to each other.	Formed by a transversal crossing two parallel lines. Alternate angles are the same size and form a 'backwards' or forwards "Z" shape

Alternate angles		Formed by a transversal crossing two parallel lines. Alternate angles are the same size and form a backwards or forwards “Z” shape
Transversal		A line that crosses two or more parallel lines
Complementary angles		Angles that add to 90°
Adjacent Angles		Angles that share a common side and a common vertex (corner).
Co-interior angles		Angles that are on the same side of a transversal, bounded by two parallel lines and add to 180°
Parallel lines		Lines that never meet and never get further away from each other; they are always the same distance apart.
Supplementary angles		Angles that add to 180°. That is, they form a straight line when they are put next to each other.
Vertically opposite angles		Angles that are opposite each other when two straight lines cross. They are equal in size.

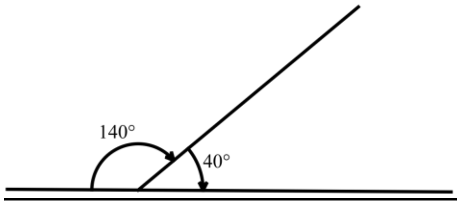
Activity 4

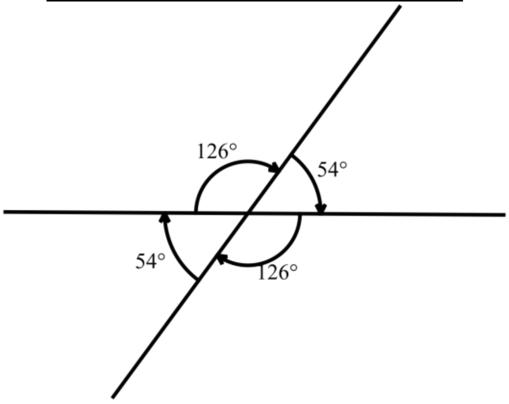
Determine the angle sizes in the following diagrams. Angle sizes as marked.

1.

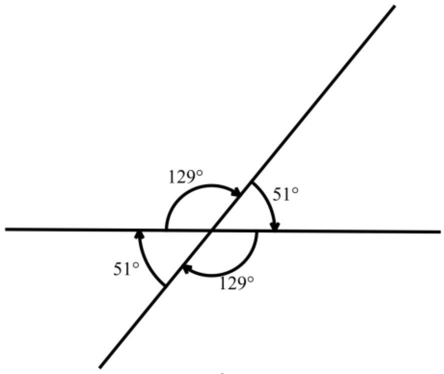


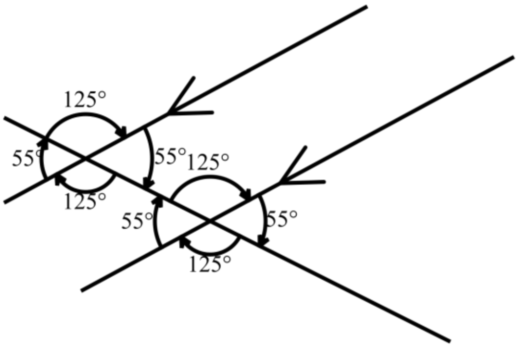
2.



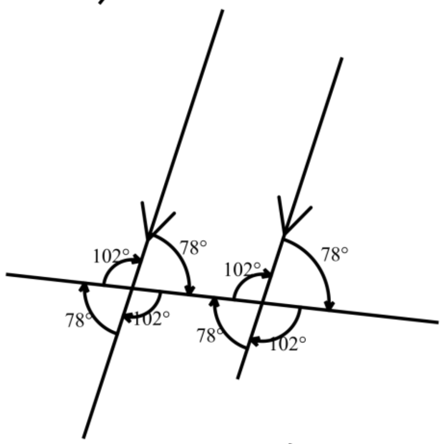


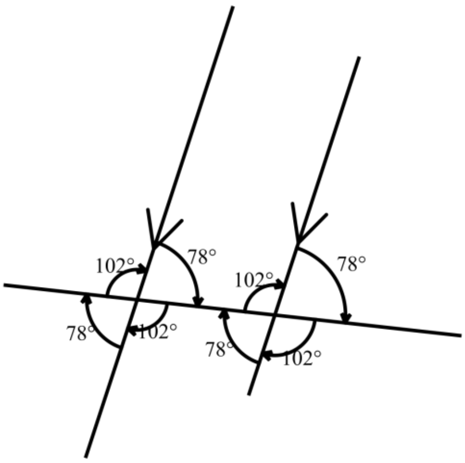
4.



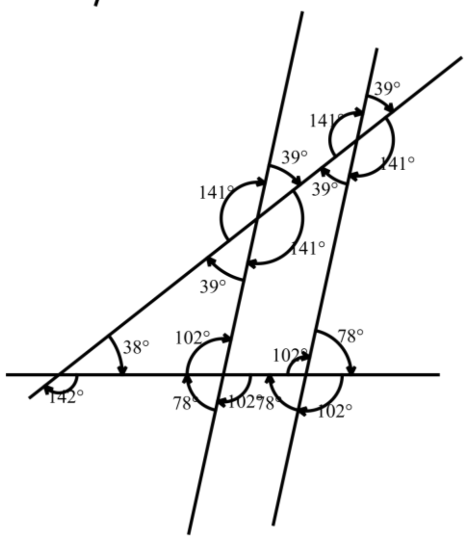


6.





8.



Activity 1

1. Using the chalk and any long straight edge (you can even use a long piece of string held taut at each end!), Person 1 rules a straight line on the ground and labels one end “A” and the other end “B”

2. Person 2 marks a point about half a metre above or below the line and labels it “C”

3. Person 3 draws a straight line that passes through points A and C. Make the line extend past point C.

4. Person 1 ties the string to the chalk.

5. Person 2 places the chalk on point C while Person 3 holds the string taut at Point A. Person 2 draws an arc that cuts through point C and another arc that cuts the line AB. Label this point “D”.

6. Person 3 picks up the string and walks to point C and holds it there.

7. Person 1 uses the chalk to draw another arc further along the AC line and extends the arc towards point B. Label this point “E”.

8. Person 3 places the chalk on point D while Person 2 holds the string taut at point C. Person 3 draws an arc that passes through point D and another arc that cuts the curve that passes through point E. Label this point “F”.

9. Person 1 draws a straight line that passes through Point C and Point F.

10. Take a photo of your group’s work.

Activity 2

1. Go back to your chalk drawing from activity 1. Rub out everything except your parallel lines (AB and CF)

2. Draw another straight line that cuts across the two parallel lines.

3. Take another photo.

4. Without measuring anything, have a look at all the angles you have created. Which ones do you think are the same? Which ones do you think are different?

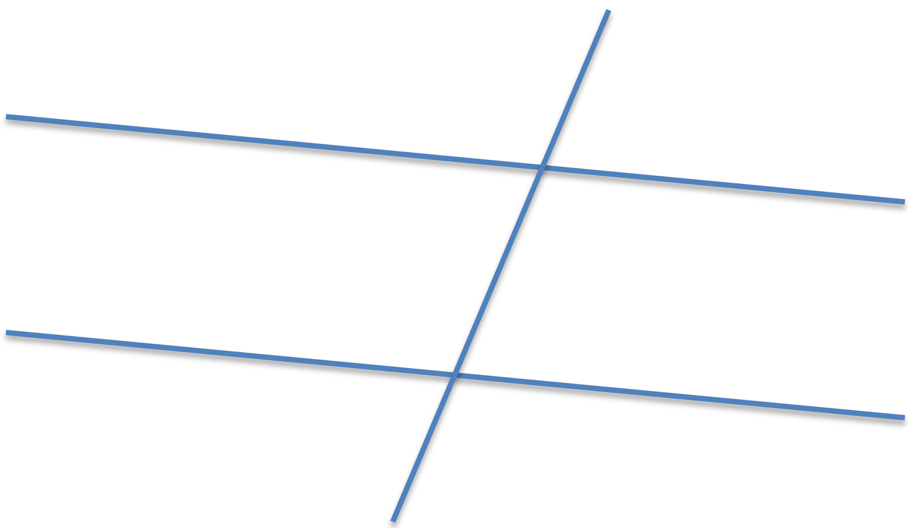
5. Measure the 8 angles that you have created. Which ones are the same? Which ones are different?

6. Which angles add to 360°? Can you explain why?

7. Which pairs of angles add up to 180°? Why do you think this is?

8. Compare your results with the other groups in your class. Did they get the same results or did they find something different?

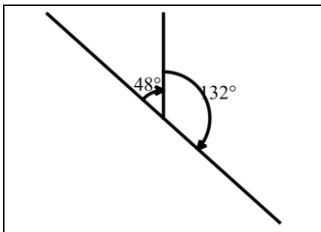
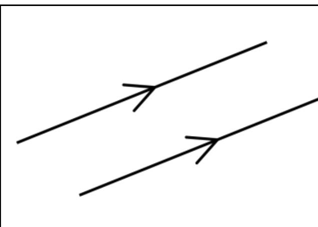
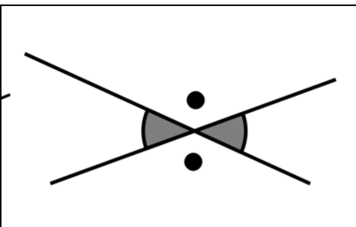
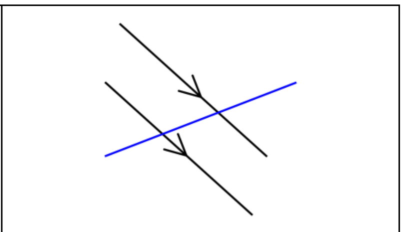
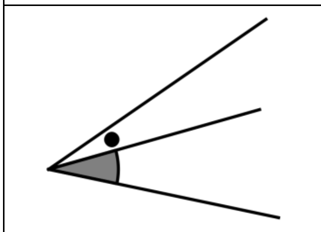
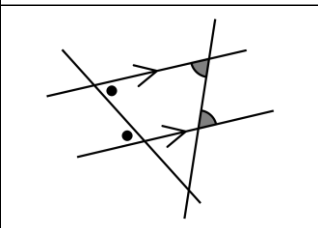
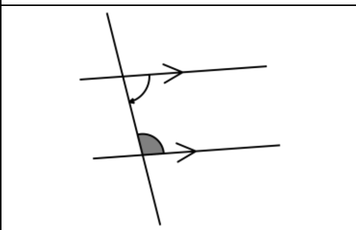
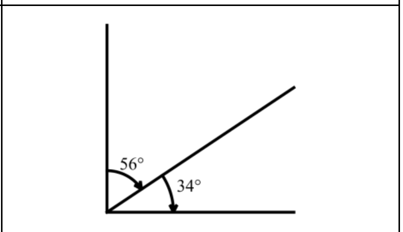
9. Summarise your findings on the diagram below (Do not measure the angles, just show which ones would be the same!):



Activity 3

Working with a partner, cut out the following sets of cards, then match each title in the first table to its matching picture and definitions.

ALTERNATE ANGLES	TRANSVERSAL	COMPLEMENTARY ANGLES	ADJACENT ANGLES
CO-INTERIOR ANGLES	PARALLEL LINES	SUPPLEMENTARY ANGLES	VERTICALLY OPPOSITE ANGLES

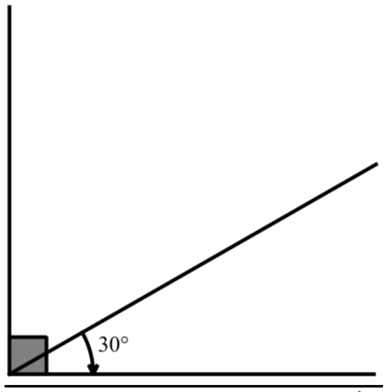
			
			

Angles that add to 90°	Angles that share a common side and a common vertex (corner)	A line that crosses two or more parallel lines	Angles that are on the same side of a transversal, bounded by two parallel lines and add to 180°
Lines that never meet and never get further away from each other; so they are always the same distance apart.	Angles that are opposite each other when two straight lines cross. They are equal in size.	Angles that add to 180°. That is, they form a straight line when they are put next to each other.	Formed by a transversal crossing two parallel lines. Alternate angles are the same size and form a 'backwards' or forwards "Z" shape

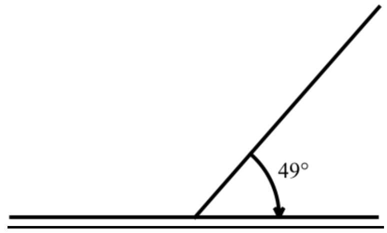
Activity 4

Determine the angle sizes in the following diagrams.

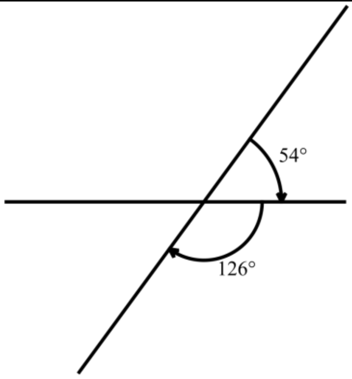
1.



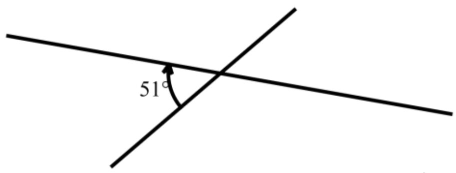
2.



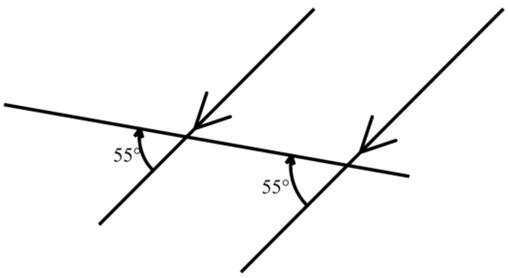
3.



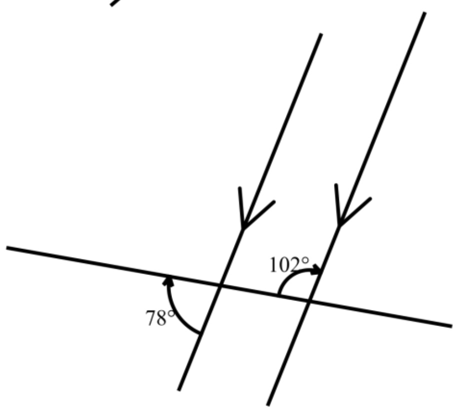
4.



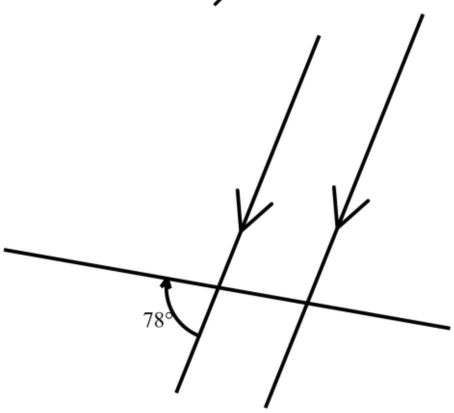
5.



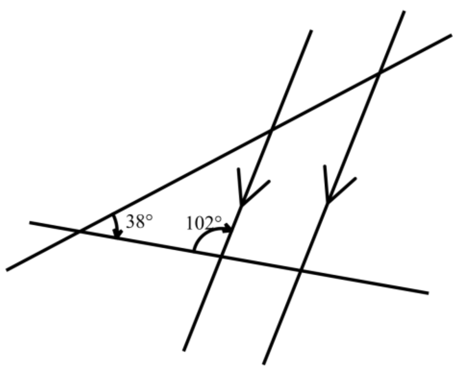
6.



7.



8.



Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Quirky Quadrilaterals

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 208: QUIRKY QUADRILATERALS

Overview

This task is designed to help students draw, identify and classify quadrilaterals based on their properties.

Students will need

- access to the internet
- ruler
- protractor

Relevant content descriptions from the Western Australian Curriculum

- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)

Students can demonstrate

- *fluency* when they
  - draw and describe quadrilaterals
- *understanding* when they
  - identify common properties of different quadrilaterals
  - identify properties are different in different quadrilaterals
- *reasoning* when they
  - construct quadrilaterals given a list of properties.
  - list properties given
- *problem solving* when they
  - identify lines of symmetry

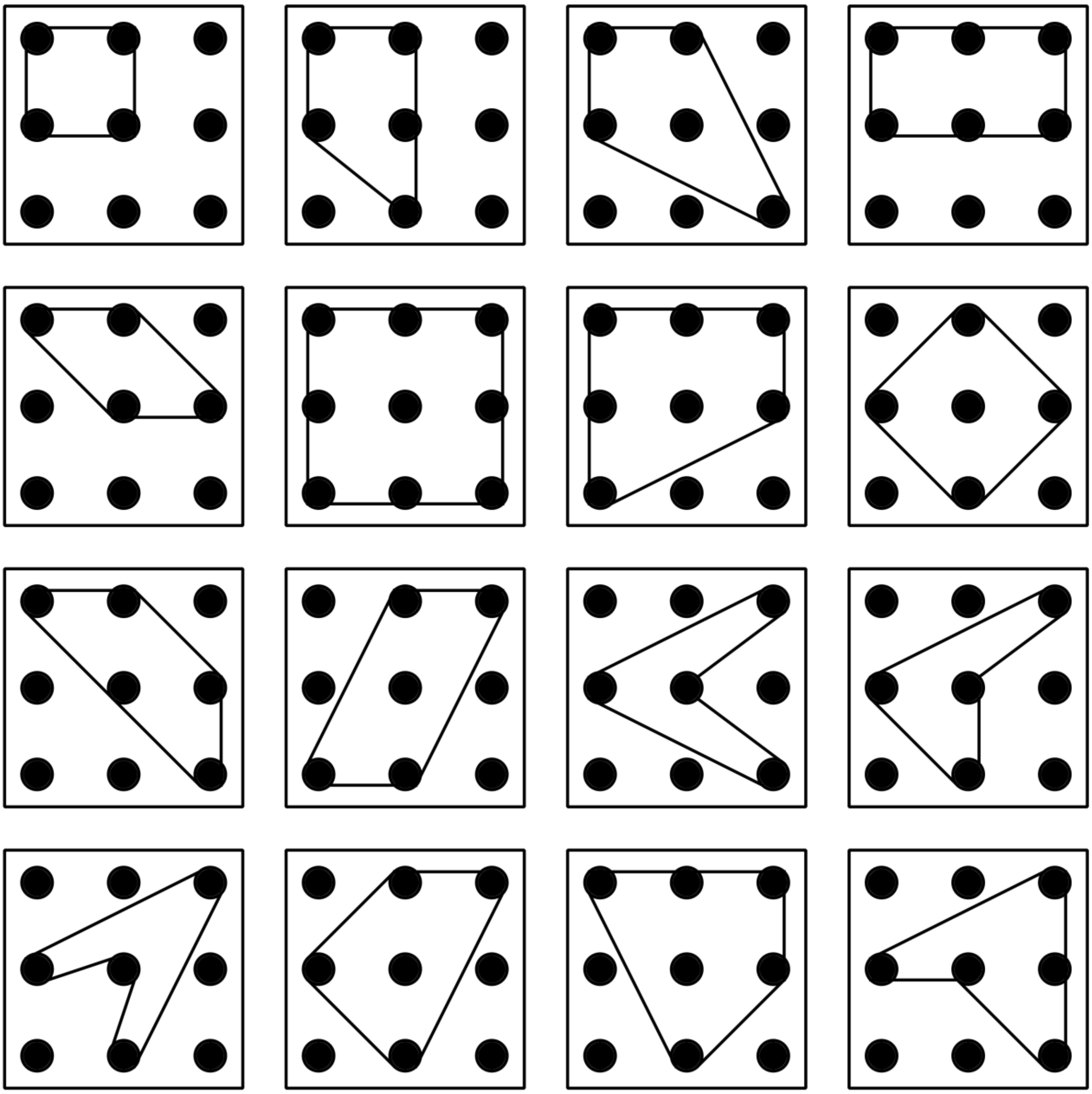
Activity 1

1. Using the internet, find a definition for each of the following words and draw an example

Word	Definition	Example
Quadrilateral	A polygon with four straight sides	Diagrams as appropriate
Lines of symmetry	An imaginary line where you could fold the object in half and have both halves match exactly	
Rotational symmetry	If an object can be rotated less than 360° about a point and still look the same, it has rotational symmetry	
Parallel lines	Two lines that are always exactly the same distance apart. They never get closer and never get further apart.	
Adjacent sides	Sides that are next to each other	
Opposite sides	Sides that face each other	
Perpendicular	At a 90° angle	
Bisect	To divide a line into two equal lengths	
Congruent	Identical in size and shape	

Activity 2

1. By joining any four dots in each 3 x 3 grid below, make as many non-congruent (i.e., different) quadrilaterals as possible. The first one is done for you.



. 2. Working with a partner, sort the shapes from Question 1 into different groups. You must have at least two groups (although you can have more) and you need to be able to explain to the rest of the class why you have grouped certain shapes together.

Various answers. Use this opportunity to have students identify parallelograms, rectangles, rhombuses, squares, trapeziums, kites.

Activity 2

For questions 1 to 5, students may choose to present their findings in various ways. A summary of quadrilateral properties are listed below. Have students note that a square is a rhombus, is a parallelogram, is a rectangle.

	# Lines of Symmetry	Rotational Symmetry?	# Pairs of Parallel Sides	Adjacent sides congruent?	Opposite sides congruent?	Total of angles	Adjacent angles equal?	Opposite angles equal?	Diagonals equal length?	Are diagonals perpendicular?	# Diagonals that are bisected
Kite	1	No	0	Yes	No	360°	No	Yes 1pair	No	Yes	2
Parallelogram	1	Yes	2	No	Yes	360°	No	Yes	No	No	2
Rectangle	2	Yes	2	No	Yes	360°	Yes	Yes	Yes	No	2
Rhombus	2	Yes	2	Yes	Yes	360°	No	Yes	No	Yes	2
Square	4	Yes	2	Yes	Yes	360°	Yes	Yes	Yes	Yes	2
Trapezium 1	0	No	1	No	No	360°	No	No	No	No	0
Trapezium 2 (isosceles)	1	No	1	No	Yes 1 pair	360°	No	No	Yes	No	0

1. Cut out each shape on the page below.
2. How many lines of symmetry does each shape have?
3. Does the shape have rotational symmetry?
4. For each shape, answer the following questions:
    a. How many pairs of parallel sides does the shape have?
    b. Measure the length of each side. Which sides are the same lengths? Which sides are different?
    c. Measure the sizes of all angles and add them all.
    d. Which angles are the same? Which are different?
5. Draw in the diagonals on each shape and answer the following questions;
    a. Are the diagonals equal in length?
    b. Do the diagonals meet at 90°?
    c. Do the diagonals bisect each other?

6. How are the two trapeziums different? Which properties are the same?
   In the isosceles trapezium, there is one pair of opposite sides that are equal and the diagonals are congruent. Everything else is the same.

7. Create a mind map that shows the properties of different quadrilaterals. Remember to include the properties of Kites, Parallelograms, Rectangles, Rhombuses, Squares and Trapeziums that you found in the questions above.

   Examples of mind maps can be found online here:
   http://www.tonybuzan.com/gallery/mind-maps/

   Relate mind-map responses to the table above.

8. Do rectangles and squares share any common properties? If so which ones?
   Yes, most properties are the same. However a rectangle does not have as many lines of symmetry, adjacent sides are not the same and its diagonals are not perpendicular.

   a. Based on your answer above, are squares a type of rectangle?
      Yes, a square has all the properties of a rectangle, plus a few more.

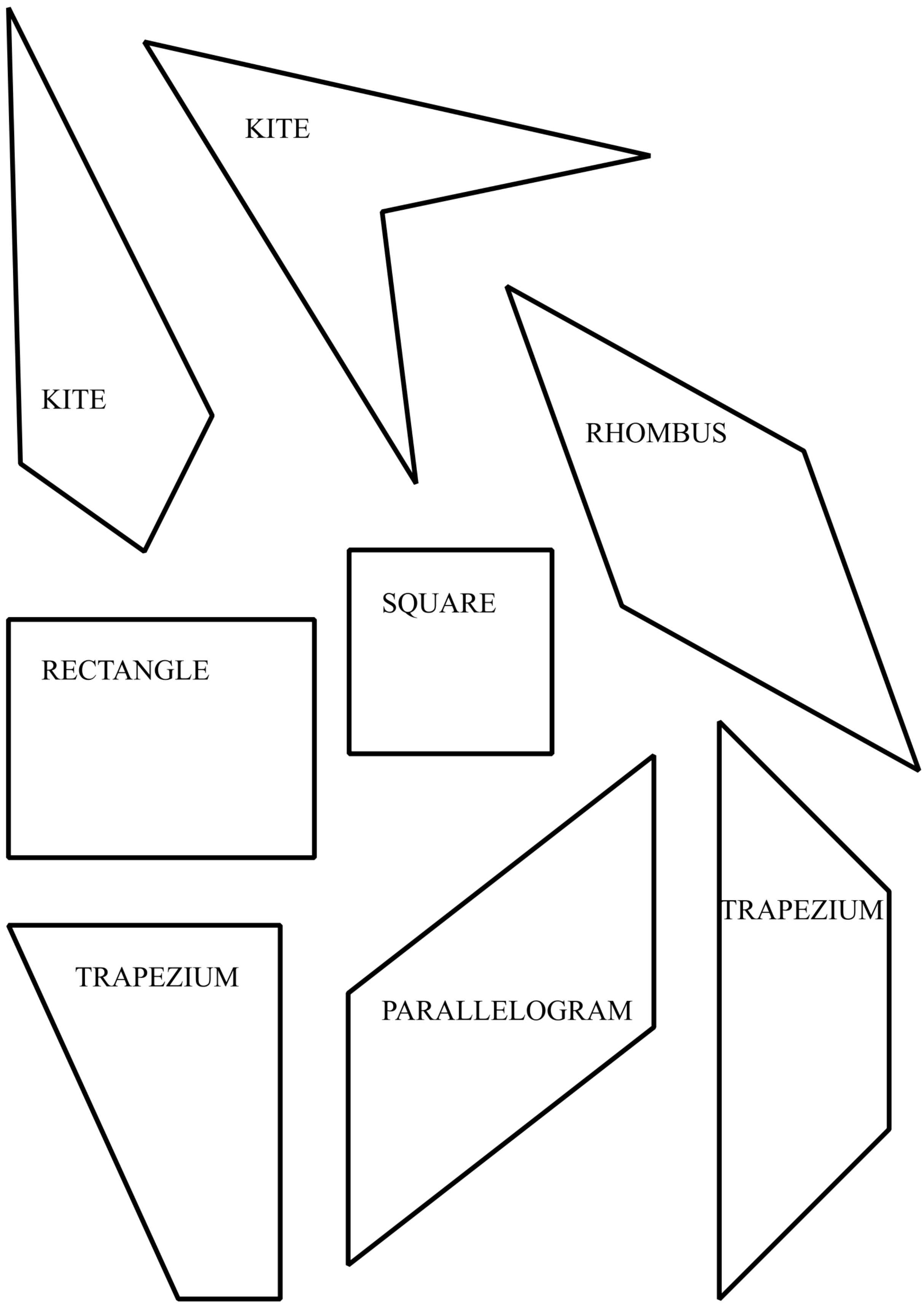
   b. Are rectangles a type of square? Why or why not?
      No, rectangles do not have all the properties of squares.

9. Are rhombuses a type of parallelogram? Why or why not?
   Yes a rhombus has all the properties of a parallelogram plus a few extras.

10. Are rhombuses a type of kite? Why or why not?
    Yes, a rhombus is just a special type of kite, because it has all the properties of a Kite and a few extras.

11. How many pairs of parallel sides does a kite have?
    None

12. Which properties do rectangles have that trapeziums do not have?
    Rectangles have rotational symmetry, an extra pair of parallel sides, two pairs of congruent sides, 90° angles and diagonals that bisect each other. A trapezium has none of these properties.


KITE
KITE
RHOMBUS
SQUARE
RECTANGLE
TRAPEZIUM
TRAPEZIUM
PARALLELOGRAM

Activity 3

1. Below is a list of properties belonging to a particular quadrilateral. See if you can sketch the shape
   a. The shape has congruent diagonals
   b. The diagonals bisect each other, but not at right angles
   c. The shape has at least one 10 cm side
   d. The shape has four equal angles
   e. The shape has at least one 5 cm side
   f. The shape has two pairs of parallel sides.

   A 5cm x 10cm rectangle

2. Could you leave out any of the properties listed above and still draw the correct shape?
   Yes.

3. Which properties could you leave out?

   Could leave out f, and also c and e if size is not important.

4. Draw a quadrilateral of your own in the space below.

   Various answers

5. On a separate piece of paper, write down a list of properties for your shape (you **may not** use the words: kite, parallelogram rectangle, rhombus, square or trapezium). Give the list to someone else in the class and see if they can draw an accurate sketch of your shape.

6. Were there any properties that your friend didn't need, in order to draw your shape? If so, which ones?

   Various answers

7. Repeat steps 3 and 4 but, this time, write the smallest list of properties that will allow an accurate sketch of your shape to be drawn.

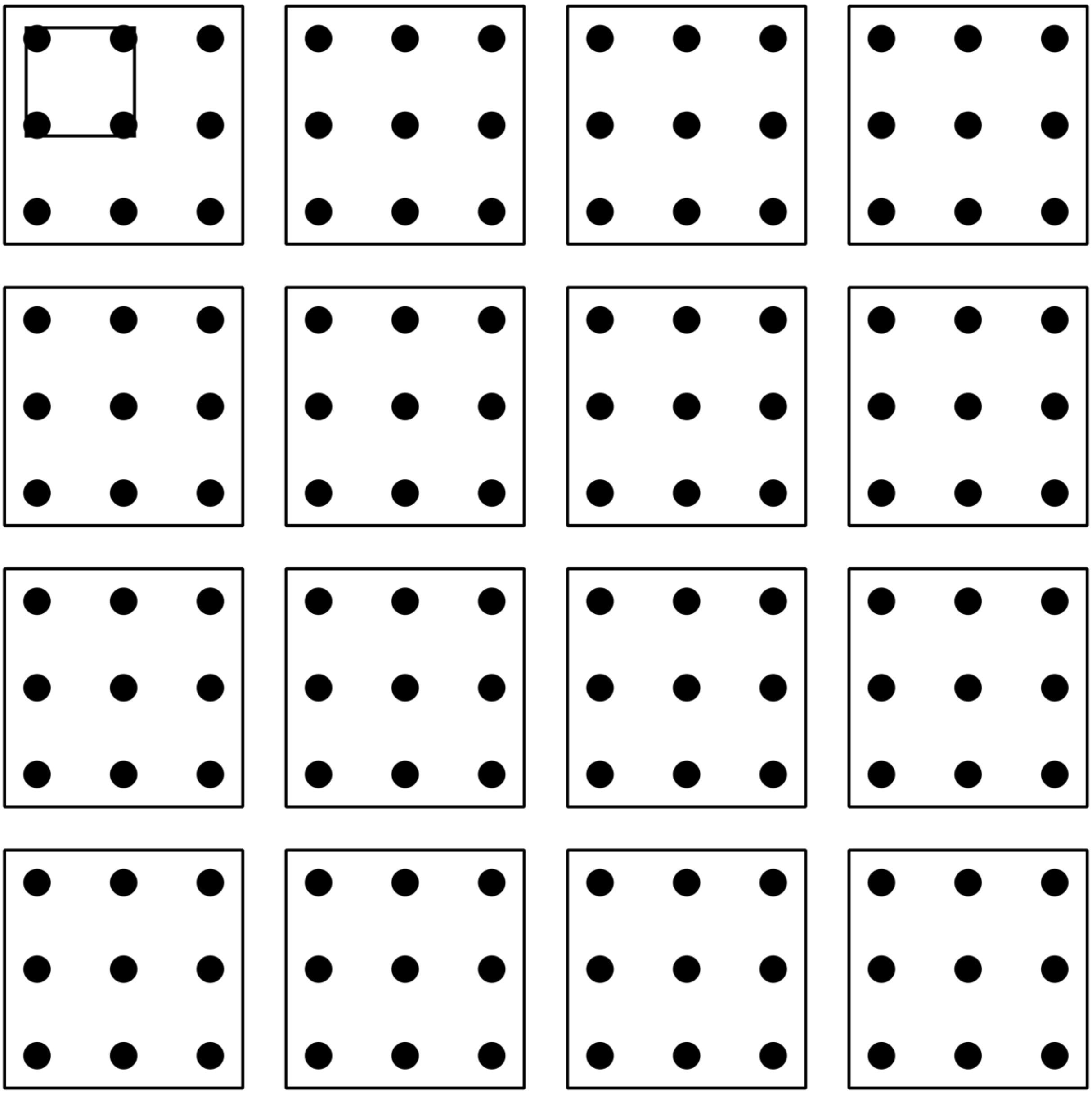
Activity 1

2. Using the internet, find a definition for each of the following words and draw an example.

Word	Definition	Example
Quadrilateral		
Lines of symmetry		
Rotational symmetry		
Parallel lines		
Adjacent sides		
Opposite sides		
Perpendicular		
Bisect		
Congruent		

Activity 2

1. By joining any four dots in each 3 x 3 grid below, make as many non-congruent (i.e., different) quadrilaterals as possible. The first one is done for you.



2. Working with a partner, sort the shapes from Question 1 into different groups. You must have at least two groups (although you can have more) and you need to be able to explain to the rest of the class why you have grouped certain shapes together.

Activity 2

1. Cut out each shape on the page below.

2. How many lines of symmetry does each shape have?

3. Does the shape have rotational symmetry?

4. For each shape, answer the following questions:
    a. How many pairs of parallel sides does the shape have?

    b. Measure the length of each side. Which sides are the same lengths? Which sides are different?

    c. Measure the sizes of all angles and add them all.

    d. Which angles are the same? Which are different?

5. Draw in the diagonals on each shape and answer the following questions;
    a. Are the diagonals equal in length?

    b. Do the diagonals meet at 90°?

    c. Do the diagonals bisect each other?

6. How are the two trapeziums different? Which properties are the same?

7. Create a mind map that shows the properties of different quadrilaterals. Remember to include the properties of Kites, Parallelograms, Rectangles, Rhombuses, Squares and Trapeziums that you found in the questions above.

    Examples of mind maps can be found online here:
    http://www.tonybuzan.com/gallery/mind-maps/

8. Do rectangles and squares share any common properties? If so which ones?

    a. Based on your answer above, are squares a type of rectangle?

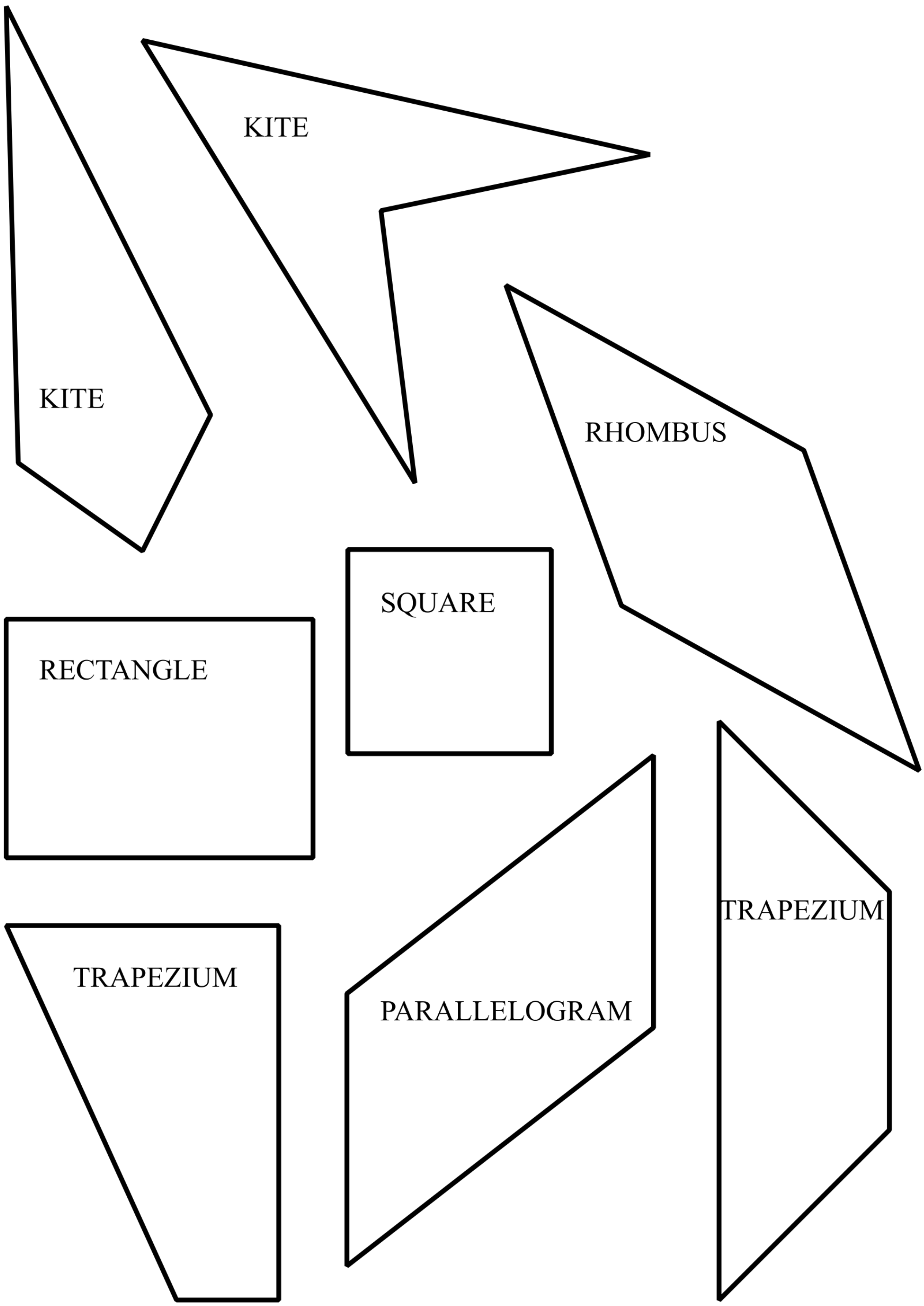
    b. Are rectangles a type of square? Why or why not?

9. Are rhombuses a type of parallelogram? Why or why not?

10. Are rhombuses a type of kite? Why or why not?

11. How many pairs of parallel sides does a kite have?

12. Which properties do rectangles have that trapeziums do not have?


KITE
KITE
RHOMBUS
SQUARE
RECTANGLE
TRAPEZIUM
TRAPEZIUM
PARALLELOGRAM

Activity 3

1. Below is a list of properties belonging to a particular quadrilateral. See if you can sketch the shape
    a. The shape has congruent diagonals
    b. The diagonals bisect each other, but not at right angles
    c. The shape has at least one 10cm side
    d. The shape has four equal angles
    e. The shape has at least one 5cm side
    f. The shape has two pairs of parallel sides.

2. Could you leave out any of the properties listed above and still draw the correct shape?

3. Which properties could you leave out?

4. Draw a quadrilateral of your own in the space below.

5. On a separate piece of paper, write down a list of properties for your shape (you **may not** use the words: kite, parallelogram rectangle, rhombus, square or trapezium). Give the list to someone else in the class and see if they can draw an accurate sketch of your shape.

6. Were there any properties that your friend didn't need, in order to draw your shape? If so, which ones?

7. Repeat steps 3 and 4 but, this time, write the smallest list of properties that will allow an accurate sketch of your shape to be drawn.

Department of Education

The Mathematical Association of Western Australia Inc. MAΣWA

Year 7 Mathematics

Measurement & Geometry Activity

Areas of Shapes

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 228: AREAS OF SHAPES

Overview

This task is an introduction to the area formulas for various shapes. Students start by deducing the formula for a rectangle, then use this formula to find the formulas for triangles and parallelograms.

Students will need

- grid paper
- scissors
- glue
- calculator (optional)

Relevant content descriptions from the Western Australian Curriculum

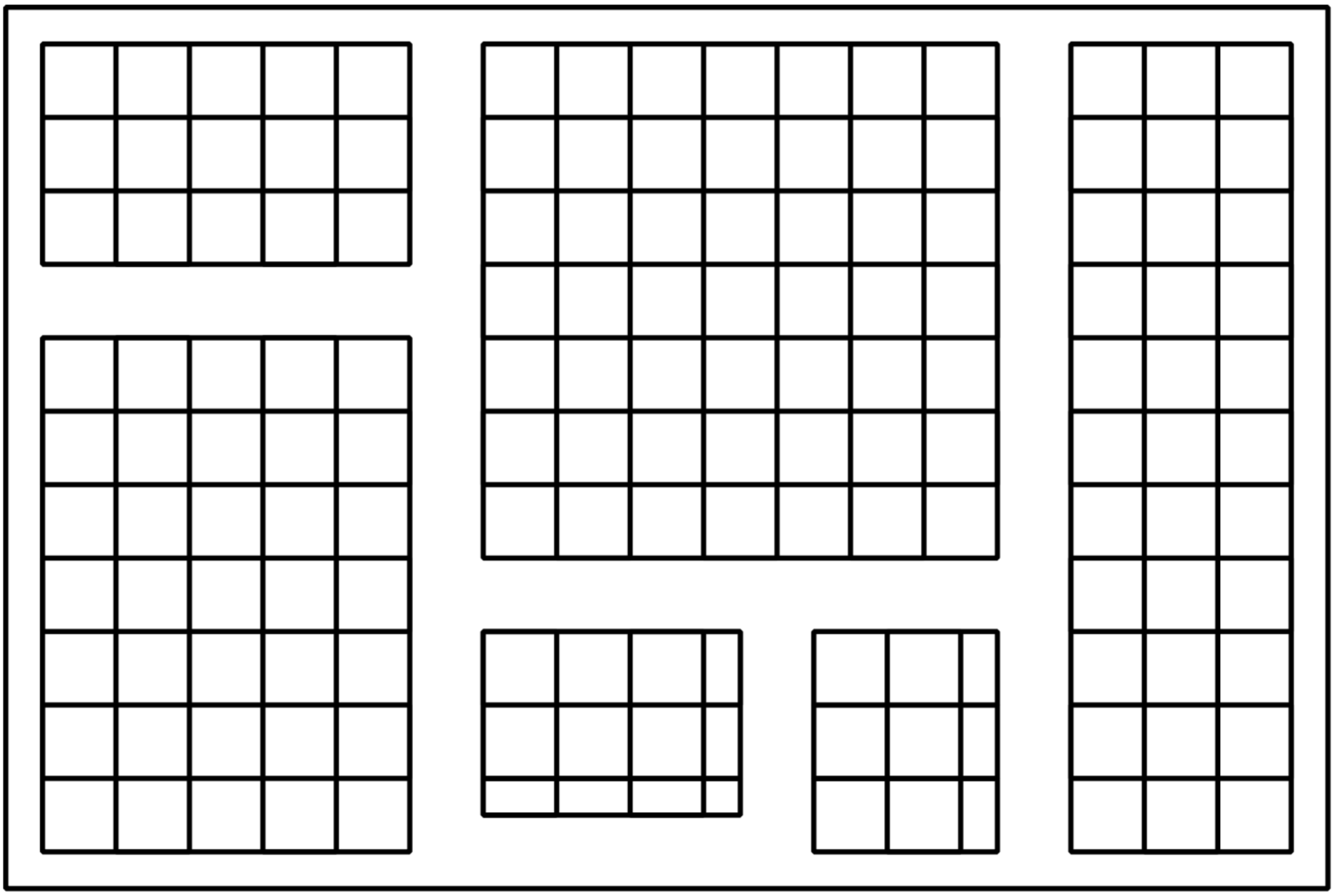
- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)

Students can demonstrate

- *fluency* when they
    - calculate areas of shapes
- *understanding* when they
    - connect the area of triangles to the area of rectangles
    - connect the area of parallelograms to the area of rectangles.
- *problem solving* when they
    - develop their own formulas for the area of different shapes

Activity 1

1. For each rectangle shown below, measure its length, its width and find its area by counting squares, then complete the table.



Rectangle #	Length (cm)	Width (cm)	Length x Width	Area (counting squares)
1	3	5	15	15
2	7	7	49	49
3	3	11	33	33
4	5	7	35	35
5	2.5	3.5	8.75	8.75
6	2.5	3	7.5	7.5

2. How do the numbers in the last two columns compare?

   They are the same

3. What formula could you use to find the area of a rectangle, instead of counting each square?

   Area = Length x Width; i.e., $A = l \times w$

Activity 2

1) On a piece of grid paper draw a rectangle (don't make it too small!).

2) What is the length of your rectangle?
Various answers

3) What is the height of your rectangle?
Various answers

4) What formula do you use to work out the area of a rectangle? Write it below.
Area = length x width =

5) Find the area of your rectangle, and write your answer below.
Various answers

6) Choose a point anywhere along the top edge of your rectangle and mark it with a dot. Draw a line from your chosen point to the bottom left hand corner of your rectangle. Draw another line from your chosen point to the bottom right hand corner of your rectangle.

7) Cut out your rectangle. Then cut along the lines you drew in Question 6.
Can you make two equal triangles using your pieces? Yes

8) What is the height of these triangles? How long are the bases of these triangles?
Various answers should be: The height of the rectangle. The base of the rectangle.

9) How do your answers above relate to the length and width of the original rectangle you drew?
They are the same.

10) Can you make two equal triangles using your pieces?
Yes

11) What is the height of these triangles? How long are the bases of these triangles?
Should be the same as the length and height (width) of the original rectangle.

12) How do your answers above relate to the length and height of the original rectangle you drew?
They are the same.

13) What is the total area of these two triangles? How do you know?
The same as the rectangle because nothing has been added or taken away.

14) What is the area of just one triangle? How did you work this out?
Half the area of the rectangle. Various explanations.

15) The formula for finding the area of a triangle is ½ x base x height. Can you explain why this works?
Various answers as appropriate.

Activity 3

1) On a piece of grid paper draw a different rectangle (don't make it too small!).

2) What is the length of your rectangle?
   Various answers

3) What is the height of your rectangle?
   Various answers

4) What formula do you use to work out the area of a rectangle? Write it below.
   Area = length x width

5) Find the area of your rectangle, and write your answer below.
   Various answers

6) Choose a point anywhere along the top edge of your rectangle and mark it with a dot.
   Draw a line from your chosen point to the bottom left hand corner of your rectangle.
   Cut out your rectangle. Then cut along the line you drew.
   Place both pieces of your rectangle on the desk.
   Take the piece on the left and slide it over the second piece until they are just touching.
   What shape have you created?
   A parallelogram.

7) What is the area of this shape? How do you know?
   Same as the rectangle, because nothing has been added or taken away.

8) Measure the slant length, height and the length of your new shape. Record them below.
   Various answers.

9) Which of these measurements relate to the length and width of your original rectangle?
   The length and height and are the same as the base and height (width) of the rectangle.
   The slant length isn't related.

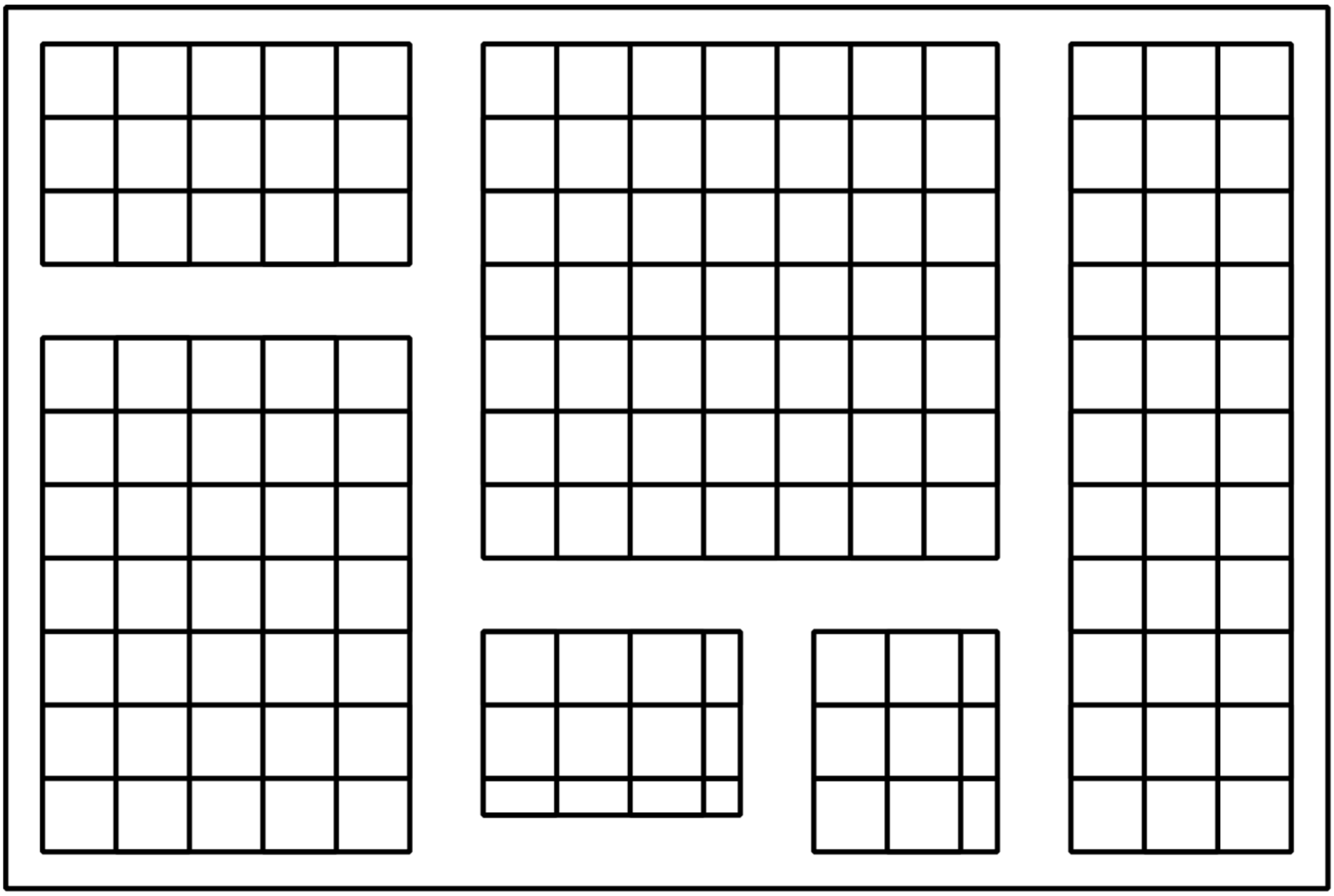
10) The formula for finding the area of a parallelogram is length x height (or length x width).

    a. What is meant by height in this case?
    The vertical or perpendicular distance (not slant length).

    b. Can you explain why this formula works?
    Various answers.

Activity 1

1. For each rectangle shown below, measure its length, its width and find its area by counting squares, then complete the table.



Rectangle #	Length (cm)	Width (cm)	Length x Width	Area (counting squares)

2. How do the numbers in the last two columns compare?

3. What formula could you use to find the area of a rectangle, instead of counting each square?

Activity 2

1) On a piece of grid paper draw a rectangle (don't make it too small!).

2) What is the length of your rectangle?

3) What is the height of your rectangle?

4) What formula do you use to find the area of a rectangle? Write it below.

5) Find the area of your rectangle, and write your answer below.

6) Choose a point anywhere along the top edge of your rectangle and mark it with a dot. Draw a line from your chosen point to the bottom left hand corner of your rectangle. Draw another line from your chosen point to the bottom right hand corner of your rectangle.

7) Cut out your rectangle. Then cut along the lines you drew in Question 6.
   Can you make two equal triangles using your pieces?

8) What is the height of these triangles? How long are the bases of these triangles?

9) How do your answers above relate to the length and width of the original rectangle you drew?

10) Can you make two equal triangles using your pieces?

11) What is the height of these triangles? How long are the bases of these triangles?

12) How do your answers above relate to the length and height of the original rectangle you drew?

13) What is the total area of these two triangles? How do you know?

14) What is the area of just one triangle? How did you work this out?

15) The formula for working out the area of a triangle is ½ x base x height. Can you explain why this works?

Activity 3

1) On a piece of grid paper draw a different rectangle (don't make it too small!)

2) What is the length of your rectangle?

3) What is the height of your rectangle?

4) What formula do you use to work out the area of a rectangle? Write it below.

5) Find the area of your rectangle, and write your answer below.

6) Choose a point anywhere along the top edge of your rectangle and mark it with a dot. Draw a line from your chosen point to the bottom left hand corner of your rectangle. Cut out your rectangle. Then cut along the line you drew. Place both pieces of your rectangle on the desk. Take the piece on the left and slide it over the second piece until they are just touching. What shape have you created?

7) What is the area of this shape? How do you know?

8) Measure the slant length, height and the length of your new shape. Record them below.

9) Which of these measurements relate to the length and width of your original rectangle?

10) The formula for finding the area of a parallelogram is length x height?

    a) What is meant by height, in this case?

    b) Can you explain why this formula works?

Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Volume

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 4: SIDES AND ANGLES

Overview

In this investigation, students are asked to measure the sides and angles of six different triangles; they then determine the perimeter. They record their results and are directed to look for relationships between the sides and the angles.

Students will need

- calculators
- protractors
- rulers

Relevant content descriptors from the Western Australian Curriculum

- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)
- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)

Students can demonstrate

- *fluency* when they
  - accurately measure sides and angles.
  - determine perimeter
- *understanding* when they
  - classify triangles
  - identify that the larger perimeter does not imply a larger area
- *reasoning* when they
  - apply their knowledge of measurements to draw conclusions about the relationships in the triangle
- *problem solving* when they
  - plan and execute processes to investigate other triangles as in Activity 7

In this investigation you will examine measurement relationships in triangles.

Activity 1

You are given a page of triangles numbered 1 to 6. Measure each side (in mm) and each angle (in degrees), calculate the perimeter and record the measurements in the table below.

	Sizes of angles (degrees)			Sum of all angles	Lengths of sides (mm)			Perimeter (mm)
Triangle	A	B	C		AB	BC	CA	
1	33	37	110	180	68	39	43	150
2	61	30	90	181	68	60	34	162
3	44	108	29	181	70	45	71	186
4	37	72	71	180	54	70	110	234
5	137	20	22	179	79	139	70	288
6	84	44	53	181	79	100	70	249

Note: These measurements are correct for the triangles when the object (Efofex) is 19.99 cm high and 15.82 cm wide.

Activity 2

Examine the sum of the three angles in each of the 6 triangles.

1. What should your three angles in each triangle add up to? How do you know?

   180 degrees.

   Various answers: Learnt this earlier. I have shown this is the case here/in an earlier exercise. Teacher/friend told me. Reported in the textbook.

2. For each triangle what is the difference between your sum and the value that it should be?

Triangle	1	2	3	4	5	6
Difference						

3. Explain the size of this difference.

The difference could be due to inaccurate measurements or lack of precision with the protractor. Or it could be due to rounding to the nearest degree for each angle, in which case the total should be in the range 179-181 degrees.

Activity 3

1. Which triangle has the greatest perimeter?

   Triangle 5

2. Does the triangle with the greatest perimeter look like the triangle with the greatest area? Explain your answer?

   Triangle 6 looks like it has a larger area, which is the “space” within the sides.

3. How could you determine your answer to the previous question without doing any calculations?

   You can check by cutting up triangle 5 and seeing if it covers all, more than, or less than triangle 6. [it does not cover all of it.]

Activity 4

Classify each triangle by ticking under the description.

triangle	acute-angled	obtuse-angled	right-angled	isosceles	scalene	equilateral
1		✓			✓	
2			✓		✓	
3		✓			✓	
4	✓				✓	
5		✓			✓	
6	✓				✓	

Activity 5

1. For each triangle highlight (colour 1) on the table for Activity 1 the largest side and the largest angle.

2. For each triangle highlight (colour 2) on the table for Activity 1 the smallest side and the smallest angle.

3. Describe any patterns you can see in your highlighting.

	size of angles (degrees)			Sum of all angles	length of sides (mm)			perimeter (mm)
Triangle	A	B	C		AB	BC	CA	
1	33	37	110	180	68	39	43	150
2	61	30	90	181	68	60	34	162
3	44	108	29	181	54	70	110	186
4	37	72	71	180	70	45	71	234
5	137	20	22	179	79	139	70	288
6	84	44	53	181	79	100	70	249

- If C is the largest angle then the longest side is AB.
- If B is the largest angle then the longest side is CA.
- If A is the largest angle then the longest side is BC.

- If C is the smallest angle then the shortest side is AB
- If B is the smallest angle then the shortest side is CA
- If A is the smallest angle then the shortest side is BC

4. Describe the position of the smallest angle in each triangle in relation to the sides of the triangle.

   The shortest side is opposite the smallest angle in every triangle.

5. Describe the position of the largest angle in each triangle in relation to the sides of the triangle.

   The longest side is opposite the largest angle in every triangle.

6. Describe the position of the middle-sized angle in each triangle in relation to the sides of the triangle.

   The middle-sized angle is opposite the middle-sized side in every triangle.

7. Can you be sure that your conclusions in the last two questions are always true?

   Explain.

   Not at this point. Not every triangle can be checked but more triangles need to be checked and also different types of triangles; e.g., isosceles triangles.

Activity 6

Using the previous triangles and drawing extra triangles if needed, investigate these claims:

A. The longer the longest side is in a triangle, the greater is the perimeter.

B. The shorter the shortest side is in a triangle, the smaller is the perimeter.

By listing the perimeters in order, it can be seen that both of these statements are false.

Activity 7

From Activity 4, you will recognise that two types of triangles have not been examined.

1. Name the two types. Isosceles, equilateral

2. Accurately draw two examples of each type.

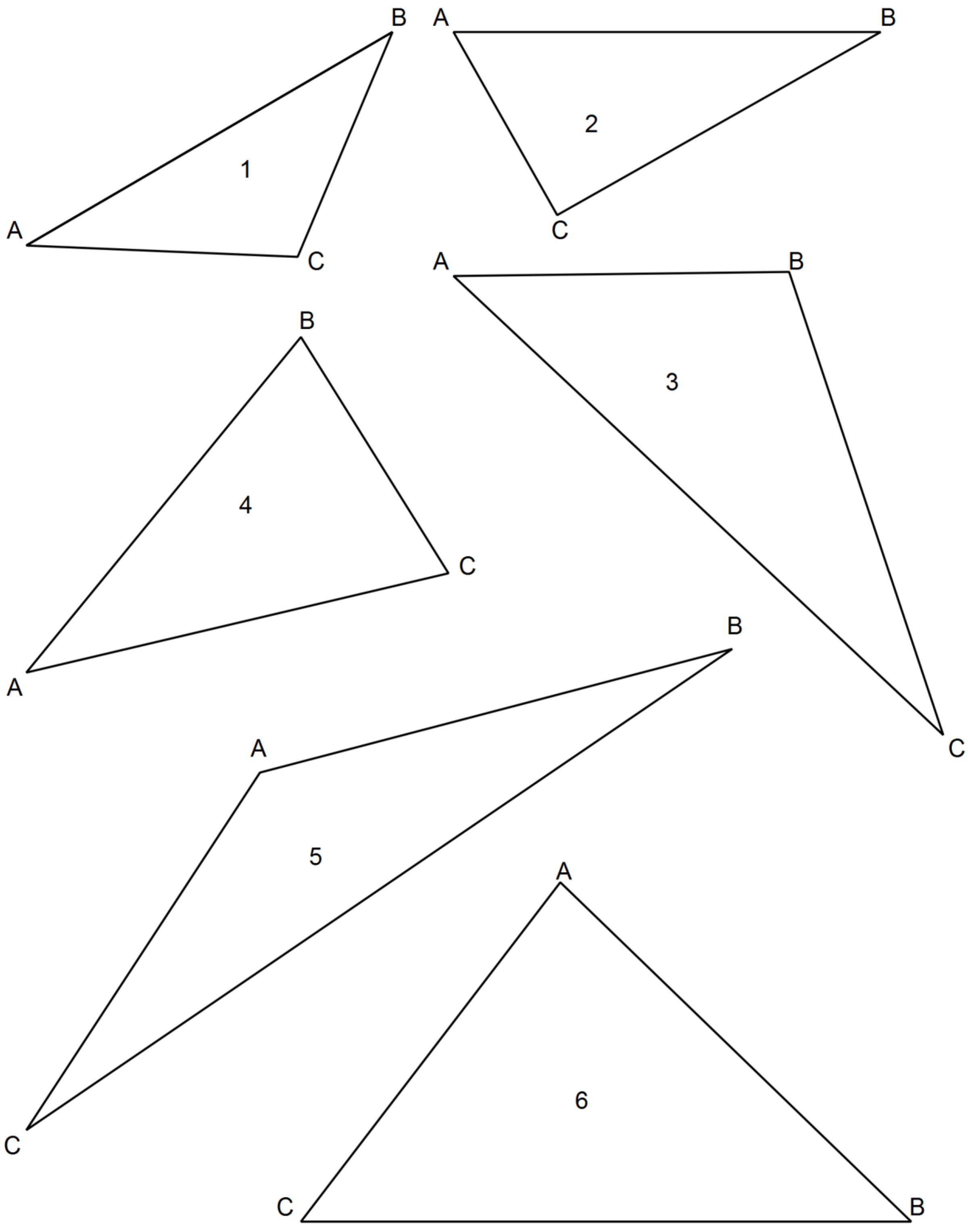
3. Do your conclusions from Activity 5 apply to these types of triangles?

Students should follow the processes outlined in this task to investigate this question.

Making a conclusion based on only two triangles is not sound, so they should share their results with others in the class. The conclusion will be the same.

Solutions are not provided, as they will vary within the class.

TRIANGLES



In this investigation you will examine measurement relationships in triangles.

Activity 1

You are given a page of triangles numbered 1 to 6. Measure each side (in mm) and each angle (in degrees). Calculate the perimeter and record the measurements in the table below.

	Sizes of angles (degrees)			Sum of all angles	Lengths of sides (mm)			Perimeter (mm)
Triangle	A	B	C		AB	BC	CA	
1								
2								
3								
4								
5								
6								

Activity 2

Examine the sum of the three angles in each of the 6 triangles.

1. What should your three angles in each triangle add up to? How do you know?

2. For each triangle what is the difference between your sum and the value that it should be?

Triangle	1	2	3	4	5	6
Difference						

3. Explain the size of this difference.

Activity 3

1. Which triangle has the greatest perimeter?

2. Does the triangle with the greatest perimeter look like the triangle with the greatest area? Explain your answer?

3. How could you determine your answer to the previous question without doing any calculations?

Activity 4

Classify each triangle by ticking under the description.

triangle	acute-angled	obtuse-angled	right-angled	isosceles	scalene	equilateral
1						
2						
3						
4						
5						
6						

Activity 5

1. For each triangle highlight (colour 1) on the table for Activity 1 the largest side and the largest angle.

2. For each triangle highlight (colour 2) on the table for Activity 1 the smallest side and the smallest angle.

3. Describe any patterns you can see in your highlighting.

4. Describe the position of the smallest angle in each triangle in relation to the sides of the triangle.

5. Describe the position of the largest angle in each triangle in relation to the sides of the triangle.

6. Describe the position of the middle-sized angle in each triangle in relation to the sides of the triangle.

7. Can you be sure that your conclusions in 4, 5 and 6 are always true?

   Explain.

Activity 6

Using the previous triangles and drawing extra triangles if needed, investigate these claims:

A. The longer the longest side is in a triangle, the greater is the perimeter.

B. The shorter the shortest side is in a triangle, the smaller is the perimeter.

Activity 7

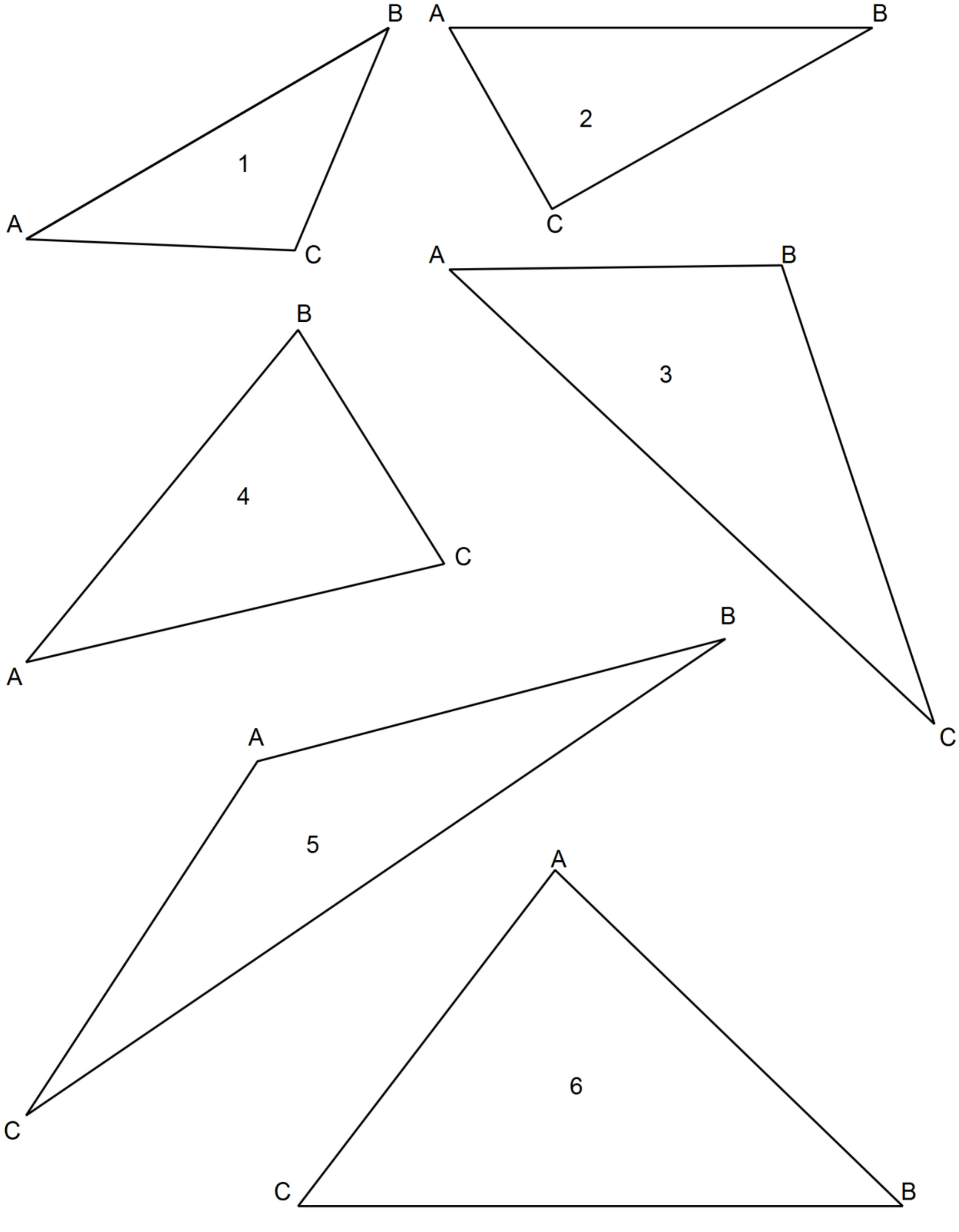
From Activity 4, you will recognise that two types of triangles have not been examined.

1. Name the two types.

2. Accurately draw two examples of each type.

3. Do your conclusions from Activity 5 apply to these types of triangles?

TRIANGLES



Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Triangle Features

Produced by a Department of Education - MAWA partnership project
written for the Year 7 Australian Curriculum

TASK 21: TRIANGLE FEATURES

Overview

For the first activity, students will probably find it easier to use a compass in their drawings. They could use a ruler to draw the longest side first and then use the compass to mark arcs which are the required distances from the ends of the first line. Students will need to understand that this allows them to draw the second and third sides of the required lengths. Activity 3 is provided to promote understanding of the heights of different triangles. This should help students with their future calculations of triangle area.

Students will need

- rulers
- compasses would be most beneficial
- protractors

Relevant content descriptions from the Western Australian Curriculum

- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)

Students can demonstrate

- *understanding* when they
  - realise the connection between the orientation of the triangle and the measure of its height
  - recognise different ways of determining the answer
- *reasoning* when they
  - apply their knowledge of geometric facts to draw conclusions about shapes
  - explain the rule connecting lengths of sides and impossible triangles
- *problem solving*
  - conduct the scaffolded investigation in Activity 3

Review Activity

There are two ways of classifying triangles, by their sides or by their types of angles.

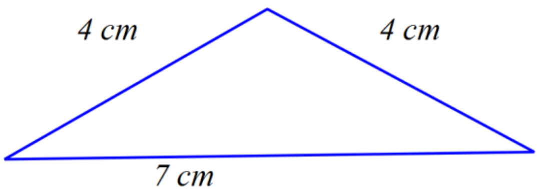
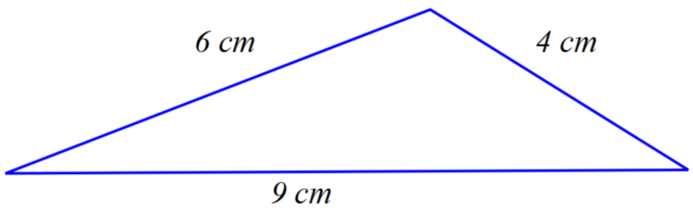
Using sides and angles, triangles can be classified as scalene, isosceles or equilateral.
Using angles triangles can be classified as right-angled, acute-angled or obtuse-angled.

Make a summary of the features of triangles that are classified as such.

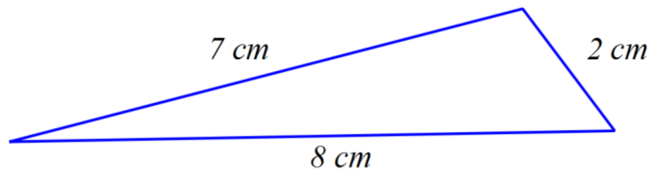
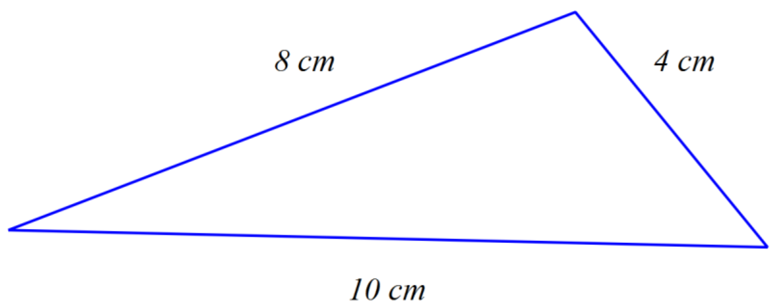
Class	Name	Feature of sides	Feature of angles
Classification by sides	Scalene	All sides have different lengths.	All angles are of a different size.
	Isosceles	Two sides are equal in length, and the third is a different length	Two angles are equal but not to the third. The equal angles are opposite the equal sides.
	Equilateral	All sides are equal in length.	All angles are equal. Each one is 60^o.
Classification by angles	Right-angled	The sides may be all different in length or two might be equal (but not 3).	One angle is 90^o; the other two angles are both acute.
	Acute-angled	The sides may all be the same length, all different or two may be the same and the third different.	All angles are less than 90^o.
	Obtuse-angled	The sides may all be different or two may be the same and the third different.	One angle is more than 90^o and the other two angles are both acute.

Activity 1

1. Where possible, draw triangles with the given dimensions. Write the length on each side.

Dimensions of sides	Drawing
7 cm 4 cm 3 cm	Cannot draw
7 cm 4 cm 4 cm	
9 cm 4 cm 4 cm	Cannot draw
9 cm 4 cm 6 cm	

2. Where possible, draw triangles with the given dimensions. Write the length on each side.

Dimensions of sides	Drawing
8 cm 2 cm 5 cm	Cannot draw
8 cm 2 cm 7 cm	
10 cm 4 cm 4 cm	Cannot draw
10 cm 4 cm 8 cm	

Compare your drawings with others in the class.

3. Summarise the results of Activity 1.
In each column, write the dimensions according to the possibility of drawing the triangle

Possible to draw	Impossible to draw
7 cm 4 cm 4 cm	7 cm 4 cm 3 cm
9 cm 4 cm 6 cm	9 cm 4 cm 4 cm
8 cm 2 cm 7 cm	8 cm 2 cm 5 cm
10 cm 4 cm 8 cm	10 cm 4 cm 4 cm

4. What conclusion can you make about the dimensions that a triangle must have for the triangle to exist?

The sum of the lengths of any two sides must be greater than the length of the third side.

5. Test your theory on a triangle that is not listed in the table above.

Answers will vary.

6. Use your conclusion to decide if triangles with the following dimensions can exist.

Dimensions of sides	Possible or not possible
16 cm 10 cm 4 cm	impossible because $10 + 4 < 16$
10 cm 20 cm 7 cm	impossible because $10 + 7 < 20$
2 m 1 m 2 m	possible
25 cm 20 cm 6 cm	possible
11 cm 5 cm 18 cm	impossible because $11 + 5 < 18$

Activity 2

1. Draw triangles below with the following angles – if possible. Where it is not possible, show the drawings you have tried and give reasons why the triangle is impossible to draw.

(a) 90°, 15°, 90° impossible.

Can't get the sides to meet because they are parallel. Angles add to more than 180°.

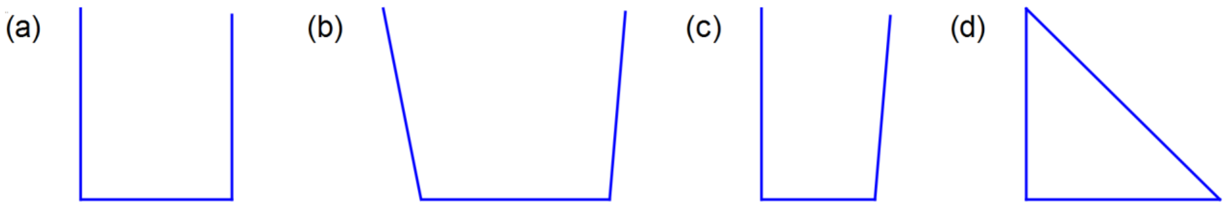
(b) 100°, 105°, 20° impossible.

Can't get the sides to meet because they are moving away from each other. Angles add to more than 180°.

(c) 90°, 105°, 45° impossible

Can't get the sides to meet because one is moving away from the other. Angles add to more than 180°.

(d) 90°, 45°, 45° possible



2. Write a summary of the “rules” governing angles that are possible in a triangle.

The three internal angles add to 180°.
There can only be one right angle in any triangle.
There can only be one obtuse angle in any triangle.
A triangle cannot have both a right angle and an obtuse angle.

Activity 3

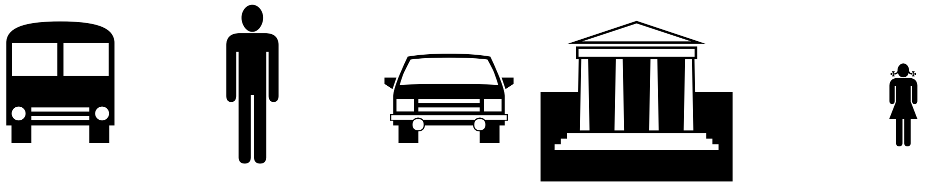
Investigation: *Can a triangle have different measurements for height?*

In this task the height of a triangle is considered. The height of any object is a measure of how far the object is from ground level. The measure must be made vertically or “straight up” from the ground.

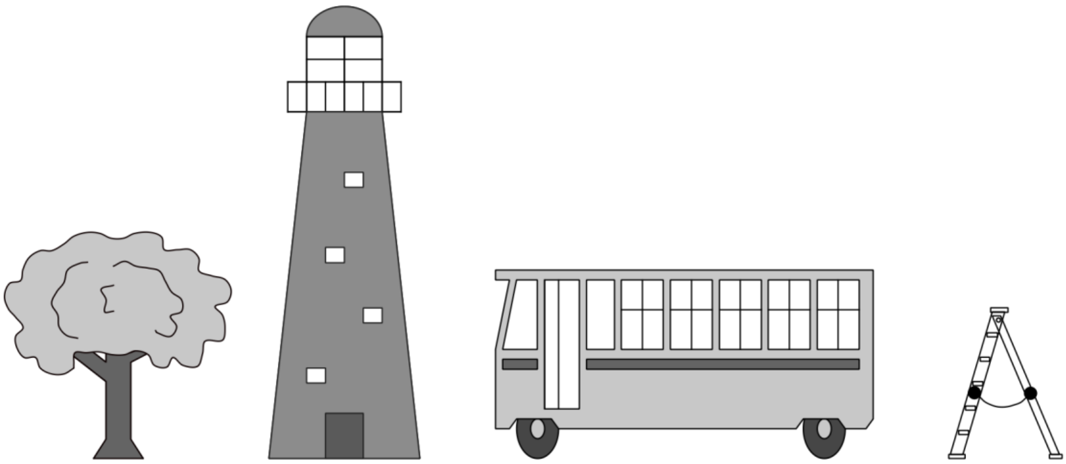
1. What is the angle the object forms with ground level when its height is measured?

    A right angle; i.e., 90^{o}.

2. How high are these people or objects in the diagrams provided?
Assume the bottom (base) of each one is at ground level.



16 mm   20 mm   12 mm   21 mm   11 mm

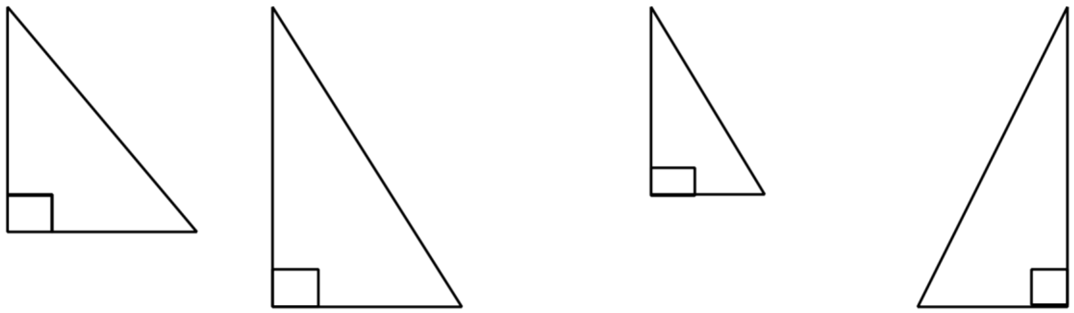


30 mm   60 mm   25 mm   20 mm

3. When you measured the height of these objects, how did you place your ruler?

    At right angles to the horizontal bottom of this sheet.

4. Measure the heights of these triangles.



30 mm 40 mm 25 mm 40 mm

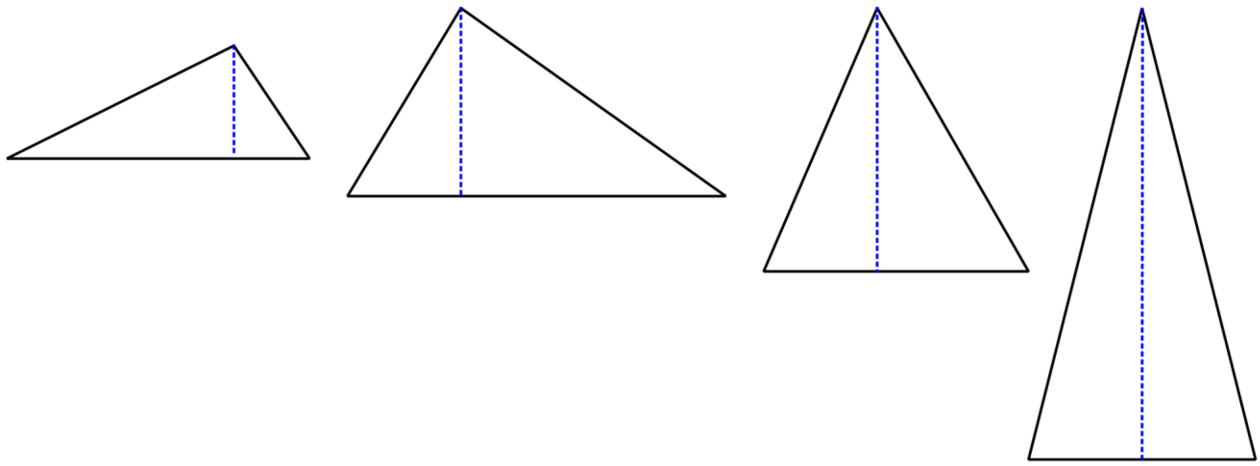
5. What types of triangles are they?

Right-angled triangles.

6. When measuring the height for these triangles, what are you also measuring?

The length of one of the sides.

7. These triangles do not have right angles and to measure the height, it is still the distance from the ground to the top of the triangle. Rule a line to mark the height and measure it.

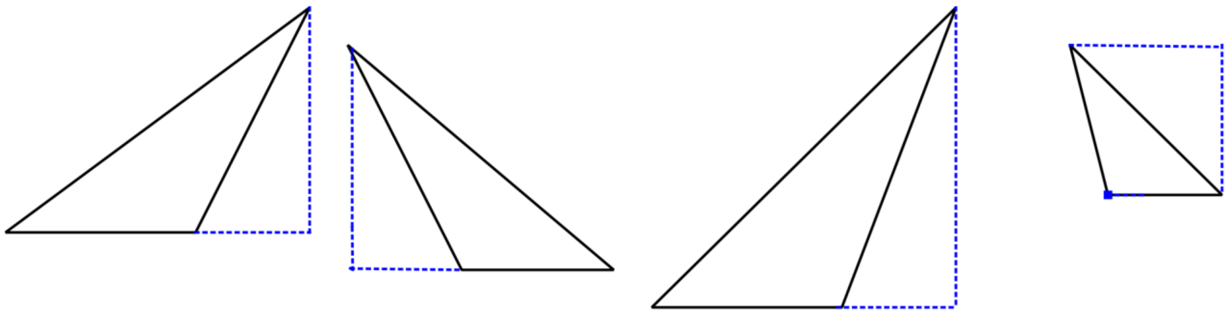


15 mm 25 mm 35 mm 60 mm

8. For these triangles the highest point of the triangle is directly above the opposite side. Describe what you needed to do to measure the height of the triangle.

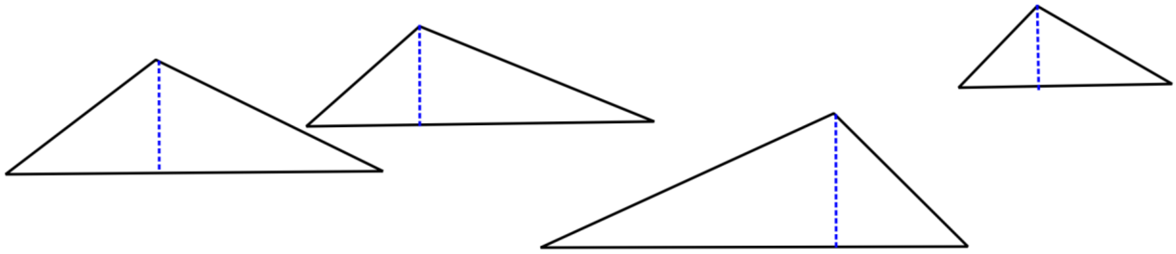
Make a right angle from the top of the triangle to the base.

9. To determine the heights of these triangles, follow the process used previously. Draw a line that is perpendicular from the top of the triangle to the horizontal and measure that line.



30 mm 30 mm 40 mm 20 mm

10. The four triangles above have been rotated and are reproduced below.
Measure the heights of the four triangles below.



15 mm 13 mm 18 mm 10 mm

11. What can you conclude? Can one triangle have two different heights? Explain

A triangle can have two different “heights”. It depends on the orientation of the triangle.

Review Activity

There are two ways of classifying triangles, by their sides or by their types of angles.

Using sides and angles, triangles can be classified as scalene, isosceles or equilateral.
Using angles triangles can be classified as right-angled, acute-angled or obtuse-angled.

Make a summary of the features of triangles that are classified as such.

Class	Name	Feature of sides	Feature of angles
Classification by sides	Scalene		
	Isosceles		
	Equilateral		All angles are equal. Each one is 60^{o}.
Classification by angles	Right-angled		
	Acute-angled		
	Obtuse-angled		

Activity 1

1. Where possible, draw triangles with the given dimensions. Write the length on each side.

Dimensions of sides	Drawing
7 cm 4 cm 3 cm	
7 cm 4 cm 4 cm	
9 cm 4 cm 4 cm	
9 cm 4 cm 6 cm	

2. Where possible, draw triangles with the given dimensions. Write the length on each side.

Dimensions of sides	Drawing
8 cm 2 cm 5 cm	
8 cm 2 cm 7 cm	
10 cm 4 cm 4 cm	
10 cm 4 cm 8 cm	

Compare your drawings with others in the class.

3. Summarise the results of Activity 1.
In each column, write the dimensions according to the possibility of drawing the triangle

Possible to draw	Impossible to draw

4. What conclusion can you make about the dimensions that a triangle must have for the triangle to exist?

5. Test your theory on a triangle that is not listed in the table above.

6. Use your conclusion to decide if triangles with the following dimensions can exist.

Dimensions of sides	Possible or not possible
16 cm 10 cm 4 cm	
10 cm 20 cm 7 cm	
2 m 1 m 2 m	
25 cm 20 cm 6 cm	
11 cm 5 cm 18 cm	

Activity 2

1. Draw triangles below with the following angles – if possible. Where it is not possible, show the drawings you have tried and give reasons why the triangle is impossible to draw.

(a) 90^{o}, 15^{o}, 90^{o}

(b) 100^{o}, 105^{o}, 20^{o}

(c) 90^{o}, 105^{o}, 45^{o}

(d) 90^{o}, 45^{o}, 45^{o}

2. Write a summary of the “rules” governing angles that are possible in a triangle.

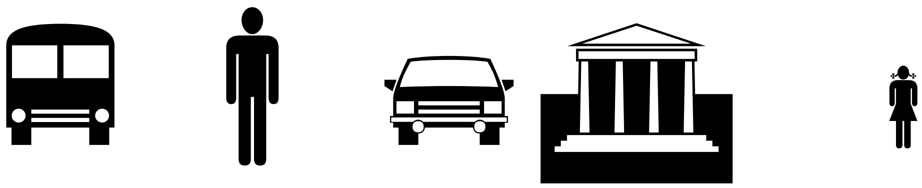
Activity 3

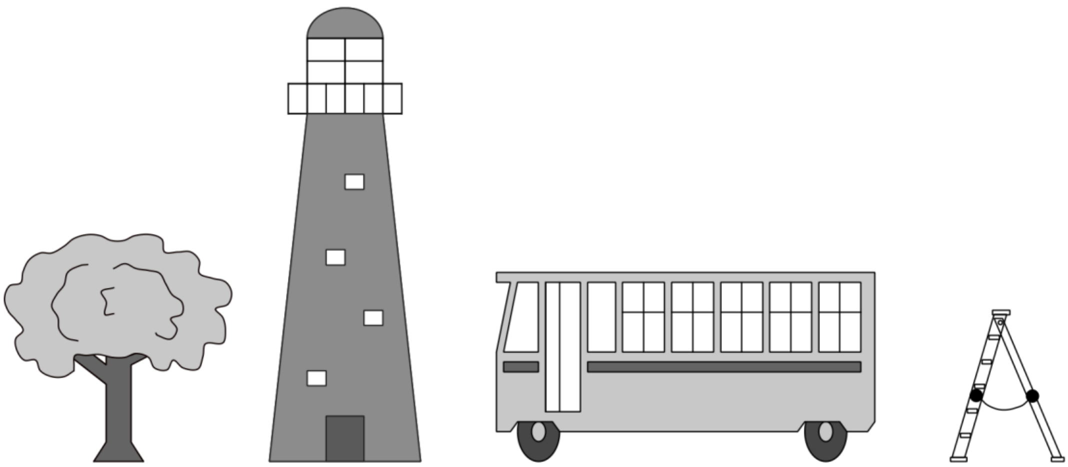
Investigation: *Can a triangle have different measurements for height?*

In this task the height of a triangle is considered. The height of any object is a measure of how far the object is from ground level. The measure must be made vertically or “straight up” from the ground.

1. What is the angle the object forms with ground level when its height is measured?

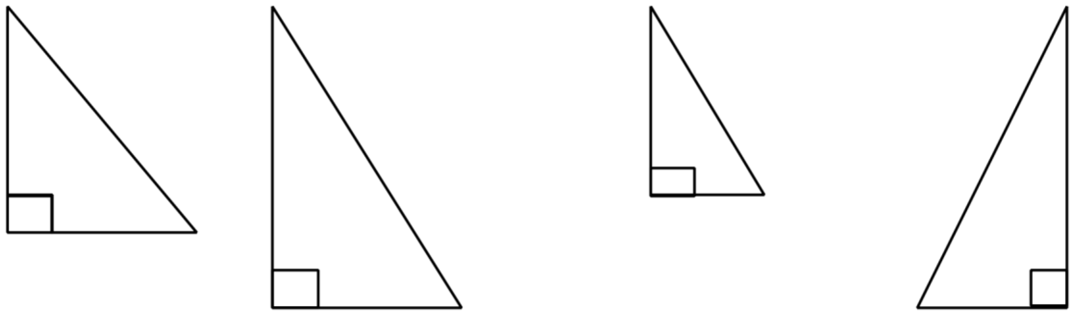
2. How high are these people or objects in the diagrams provided?
Assume the bottom (base) of each one is at ground level.





3. When you measured the height of these objects, how did you place your ruler?

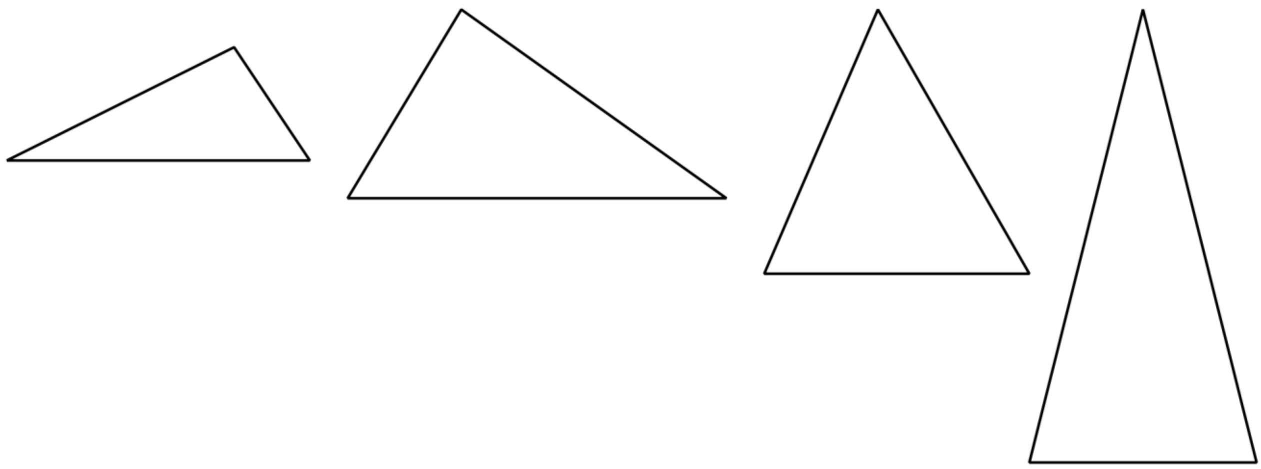
4. Measure the heights of these triangles.



5. What types of triangles are they?

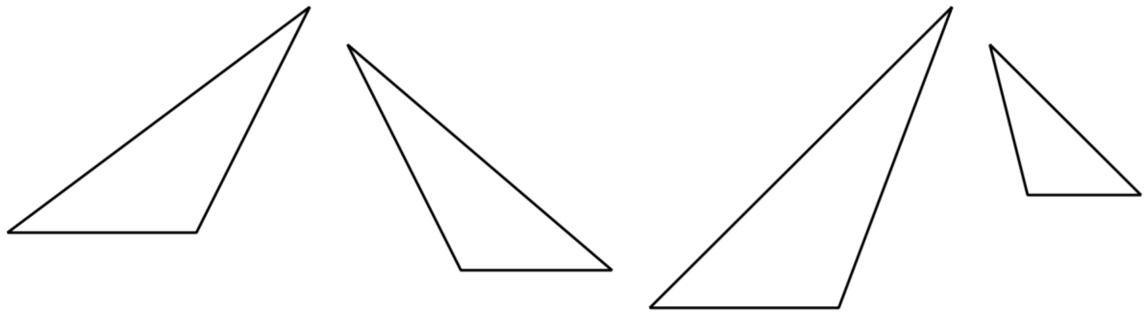
6. When measuring the height for these triangles, what are you also measuring?

7. These triangles do not have right angles and to measure the height, it is still the distance from the ground to the top of the triangle. Rule a line to mark the height and measure it.

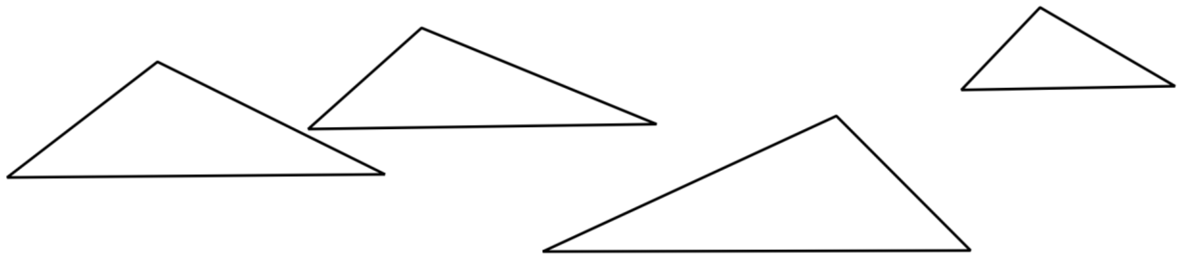


8. For these triangles the highest point of the triangle is directly above the opposite side. Describe what you needed to do to measure the height of the triangle.

9. To determine the heights of these triangles, follow the process used previously. Draw a line that is perpendicular from the top of the triangle to the horizontal and measure that line.



10. The four triangles above have been rotated and are reproduced below.
Measure the heights of the four triangles below.



11. What can you conclude? Can one triangle have two different heights? Explain

Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

Volume

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 35: VOLUME

Overview

This task requires the student to have an elementary understanding of volume, which they should have developed in their earlier years. It provides an opportunity for students to develop the formula for calculating the volume of rectangular prisms.

Students will need

- Centicubes or similar

Relevant content descriptions from the Western Australian Curriculum

- Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)
- Calculate volumes of rectangular prisms (ACMMG160)

Students can demonstrate

- *fluency* when they
  - calculate volumes of prisms
  - draw 3-D shapes in 2 dimensions
- *understanding* when they
  - connect the relationship between the dimensions of the prism and its volume
  - differentiate capacity and volume
  - determine possible dimensions for varying volumes
- *problem solving* when they
  - can determine the formula for the volume of a prism

<u>Introductory activities</u>

What do we measure when we measure volume?

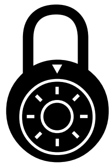
The amount of space that an object occupies

How is volume different from capacity?
Capacity measures what a container can hold; e.g., a milk carton may hold 2 L of milk.
Objects may have volume but no capacity; e.g., a brick.
Volume is a cubic measure whereas capacity is an amount, such as 2 litres.

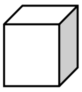
What are common units for measuring volume?

Cubic metres, cubic centimetres cubic millimetres; i.e. m^3, cm^3, mm^3

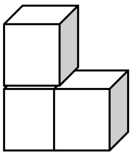
How can we determine the volume of an odd-shaped object; e.g., a padlock?



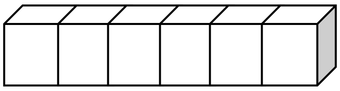
Place the object in water and measure the displacement (number of mL displaced = volume of object in cm^3). One mL has a volume of 1 cm^3.

If each  is 1 cm^3, determine the volume of the following 3-D shapes.

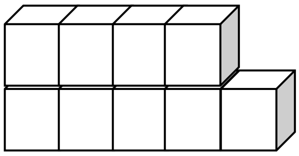
A: 3 cm^3



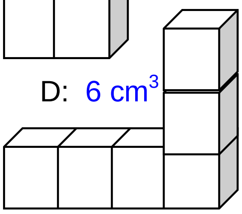
B: 6 cm^3



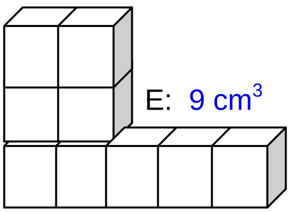
C: 9 cm^3



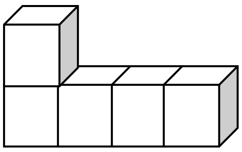
D: 6 cm^3



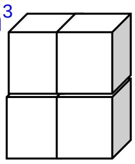
E: 9 cm^3



F: 5 cm^3

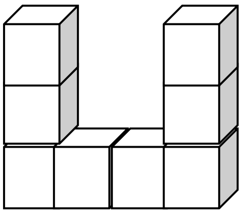


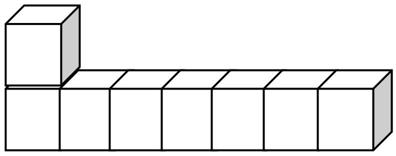
G: 4 cm^3

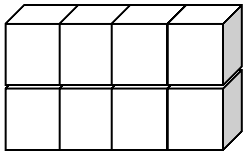


Activity 2

Using cubes with lengths or 1 cm or 2 cm, make 4 different shapes with a volume of 8 cm^3.







Activity 3

1. Collect 12 cubes, each 1 cm^3 and stack them so that they form a rectangular prism.
   What is the volume of the rectangular prism? 12 cm^3

2. How many different prisms were you able to make? 4
   [Note: Prisms are not different if you can flip them over or face them in another direction.]

3. Summarise the dimensions of the prisms that you have made.

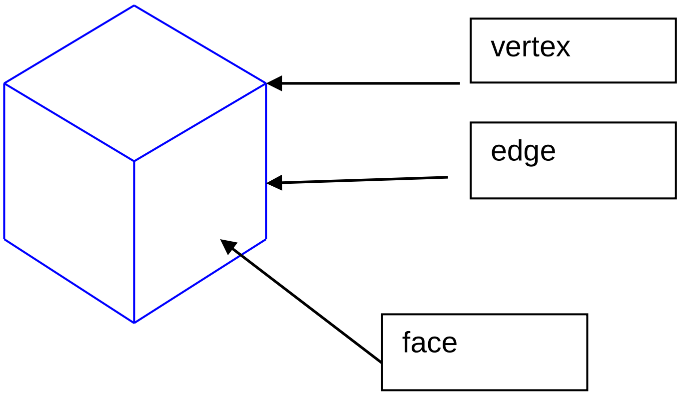
   12 x 1 x 1   3 x 4 x 1   2 x 2 x 3   6 x 2 x 1

4. Repeat the process described above, but using a different number of cubes.
   Numbers of cubes to consider are: 10, 16, 18, 20, 24, 25, 30, 36

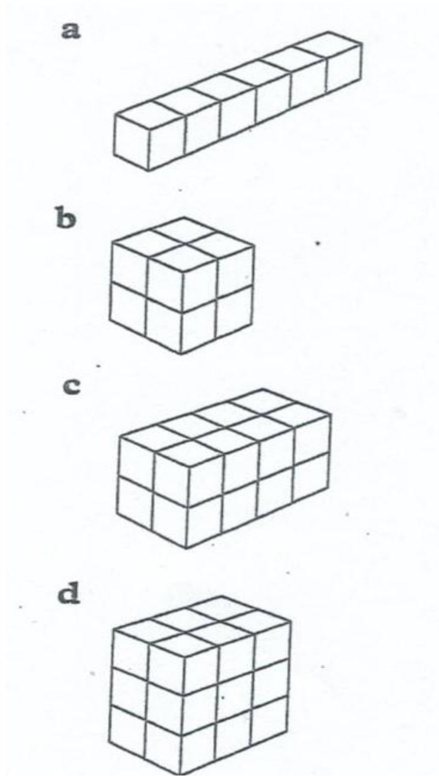
   10 = 2 x 5 x 1 = 10 x 1 x 1
   16 = 4 x 4 x 1 = 2 x 2 x 4 = 2 x 8 x 1
   18 = 6 x 3 x 1 = 2 x 9 x 1 = 2 x 3 x 3
   20 = 2 x 2 x 5 = 4 x 5 x 1 = 1 x 1 x 20 = 10 x 2 x 1
   24 = 6 x 4 x 1 = 8 x 3 x 1 = 1 x 1 x 24 = 2 x 12 x 1 = 2 x 3 x 4 = 2 x 6 x 2
   25 = 1 x 1 x 25 = 5 x 5 x 1
   30 = 15 x 2 x 1 = 5 x 6 x 1 = 1 x 1 x 30 = 2 x 3 x 5 = 3 x 10 x 1
   36 = 6 x 6 x 1 = 4 x 9 x 1 = 1 x 1 x 36 = 2 x 3 x 6 = 2 x 18 x 1 = 3 x 12 x 1 = 3 x 3 x 4

5. If you had 100 cubes to stack as a tower in the shape of a rectangular prism, what would be the height of the highest tower? The lowest tower?
   100; 1

6. Use a ruler to draw an isometric diagram of a cube with each side equal to 2 cm. On your diagram, label a face, edge and vertex

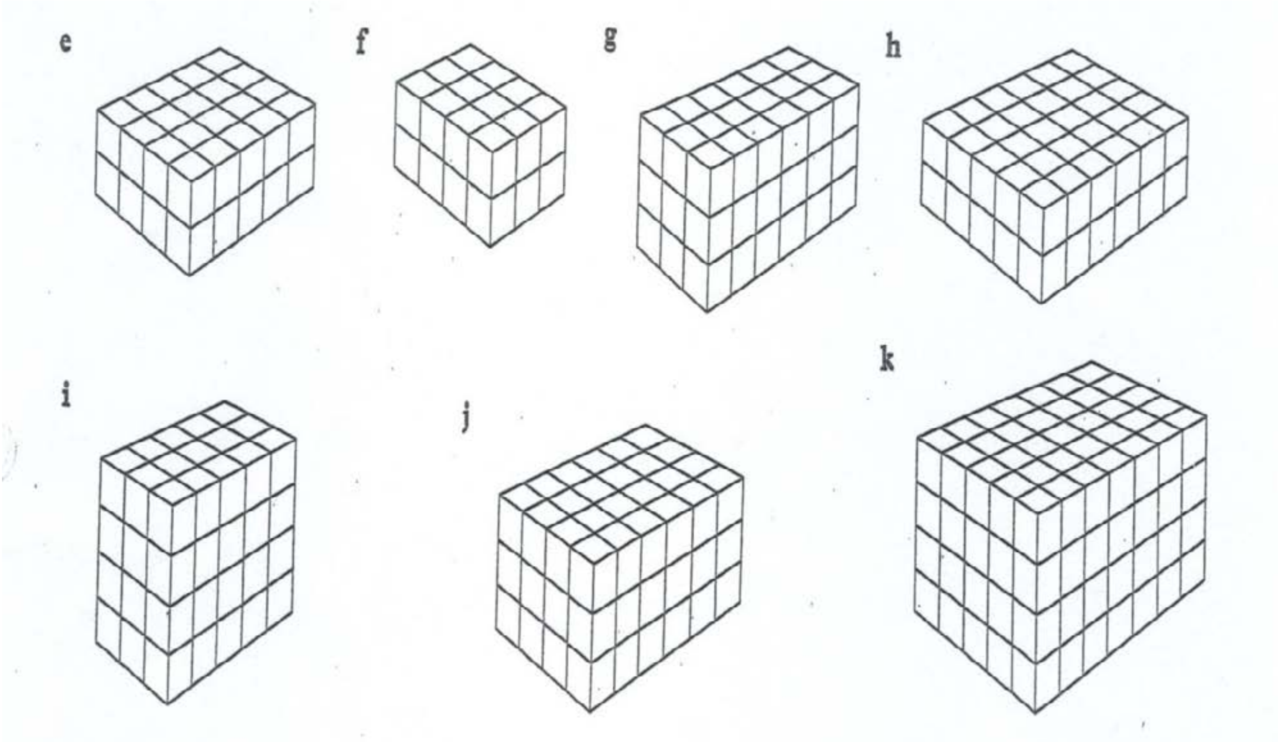


Activity 4



For each of the shapes pictured on this page determine the width, length and height and complete the table on the next page. The shapes consist of cubes 1 cm x 1 cm x 1 cm.
Assume the length is the number of cubes from the centre of the diagram out to the right and the width is the number of cubes from the centre out to the left.

All shapes are of one particular type. Which type is it? Justify your choice.


e
f
g
h
i
j
k

1. Complete the table below for the shapes **a** to **k** on the previous page.

shape	Length (cm) l	Width (cm) w	Height (cm) h	Volume (cm^3) V
a.	6	1	1	6
b.	2	2	2	8
c.	4	2	2	16
d.	3	2	3	18
e.	5	4	2	40
f.	3	4	2	24
g.	6	3	3	54
h.	6	5	2	60
i.	5	3	4	60
j.	6	4	3	72
k.	7	5	4	140

2. Describe how you can determine the volume without counting all the cubes. Provide your description in words and symbols.

Multiply the length by the width by the height to determine the volume.

Volume = length x width x height

$V = l \times w \times h$

Volume = area of the base (or top) of rectangle x height

Activity 5

Use the rule you have developed in Activity 4 to “work backwards” to determine some possible dimensions for different rectangular prisms.

	Length (cm) *l*	Width (cm) *w*	Height (cm) *h*	Volume (cm^3) *V*
1	3	3	1	9
2	2	2	3	12
3	1	1	21	21
4	1	7	3	21
5	2	2	8	32
6	1	1	32	32
7	4	4	2	32
8	4	8	1	32
9	9	4	1	36
10	2	3	3	36
11	6	2	3	36
12	5	10	1	50
13	1	1	50	50
14	25	2	1	50
15	8	8	1	64
16	4	4	4	64
17	2	2	16	64
18	1	1	100	100
19	10	10	1	100
20	10	2	5	100

Some of the above cases will have other possible solutions.

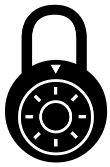
Activity 1

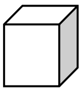
What do we measure when we measure volume?

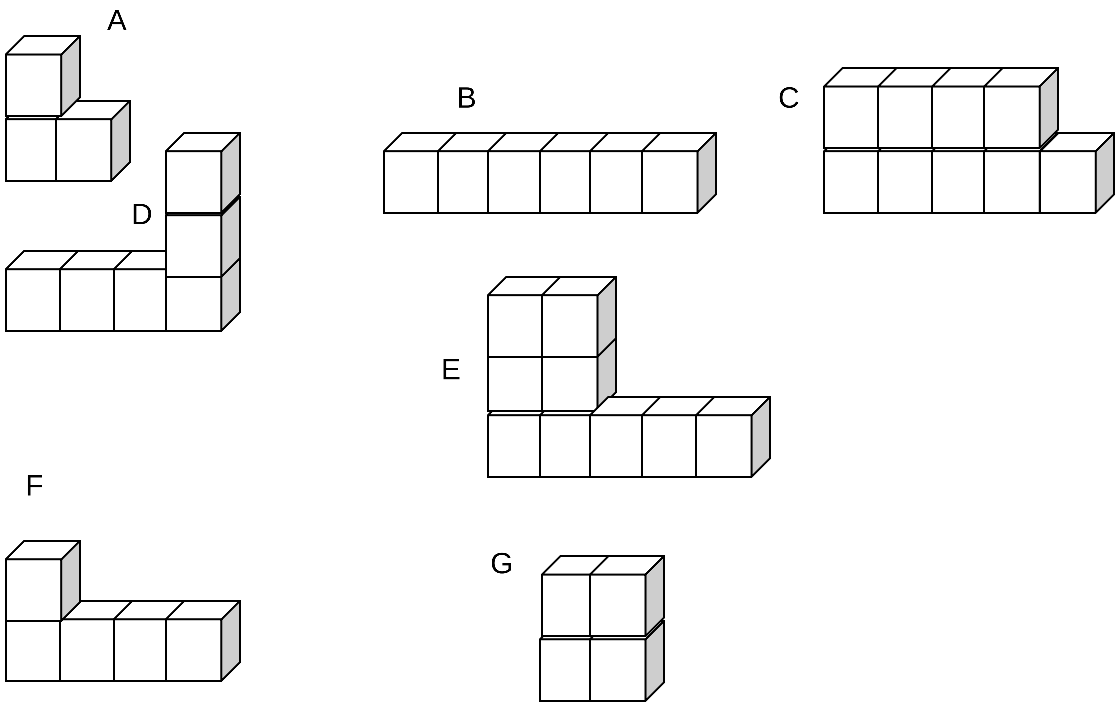
How is volume different from capacity?

What are common units for measuring volume?

How can we determine the volume of an odd-shaped object e.g. a padlock?



If each  is 1 cm^3, determine the volume of the following 3-D shapes.



Activity 2

Using cubes with lengths or 1 cm or 2 cm, make 4 different shapes with a volume of 8 cm^3. Draw three diagrams of your shapes.

Activity 3

1. Collect 12 cubes, each 1 cm^3 and stack them so that they form a rectangular prism. What is the volume of the rectangular prism?

2. How many different prisms were you able to make?

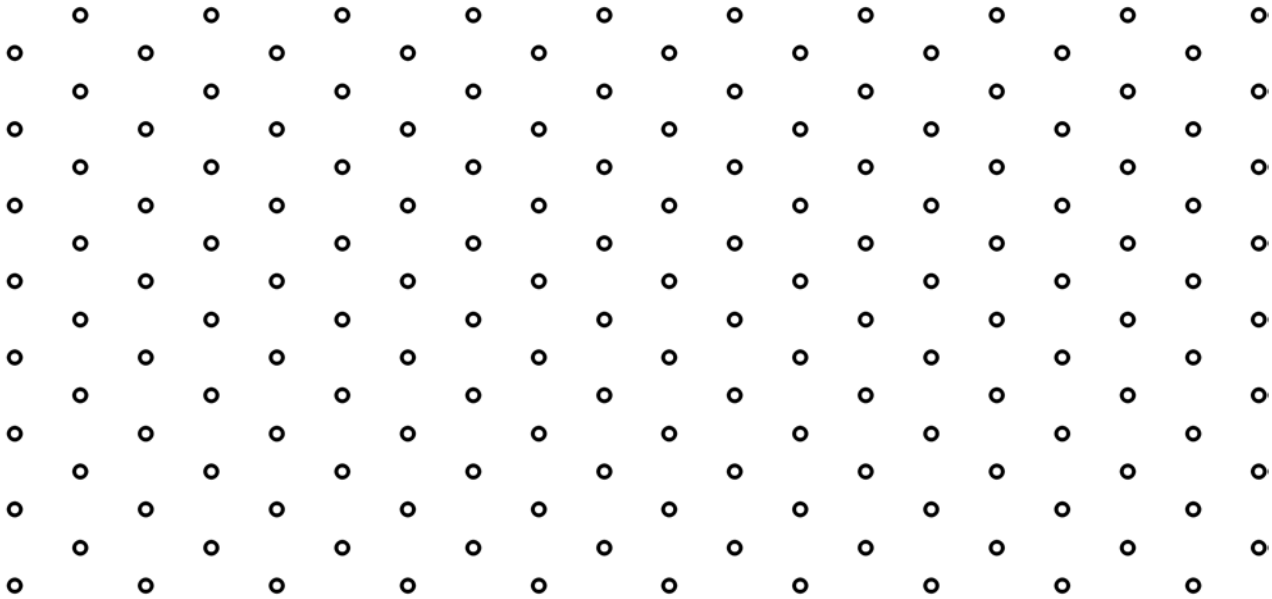
[Note: Prisms are not different if you can flip them over or face them in another direction.]

3. Summarise the dimensions of the prisms that you have made.

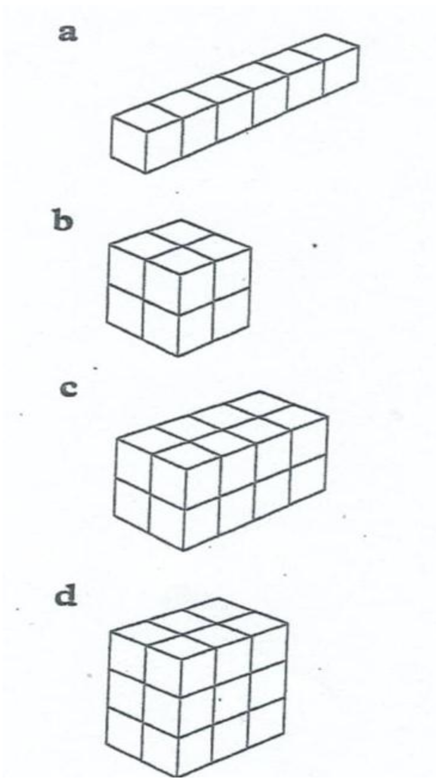
3. Repeat the process described above, but using a different number of cubes.
   Numbers of cubes to consider are: 10, 16, 18, 20, 24, 25, 30, 36

4. If you had 100 cubes to stack as a tower in the shape of a rectangular prism, what would be the height of the highest tower? The lowest tower?

5. Use a ruler to draw an isometric diagram of a cube with each side equal to 2 cm.
   On your diagram, label a face, edge and vertex

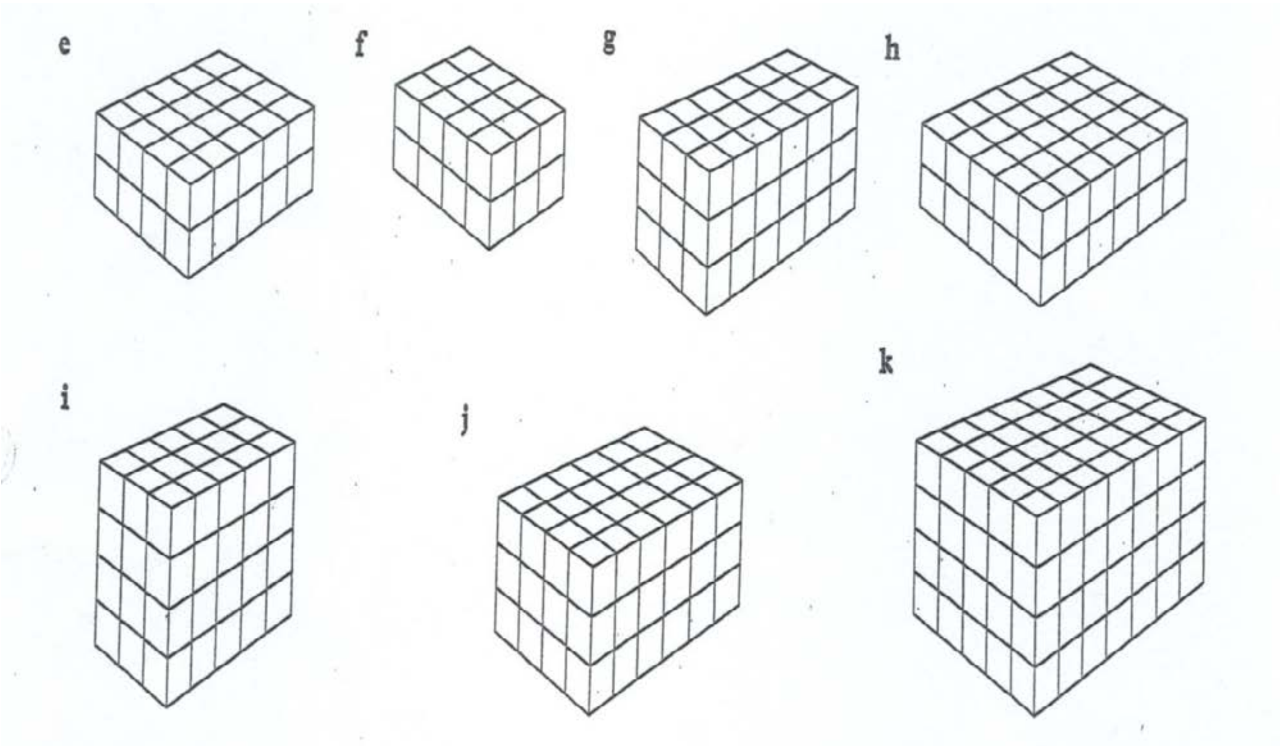


Activity 4



For each of the shapes pictured on this page determine the width, length and height and complete the table on the next page. The shapes are made of cubes 1 cm x 1 cm x 1 cm. Assume the length is the number of cubes from the centre of the diagram out to the right and the width is the number of cubes from the centre out to the left.

All shapes are of one particular type. Which type is it? Justify your choice.



1. Complete the table below for the shapes **a.** to **k**. on the previous page.

shape	Length (cm) l	Width (cm) w	Height (cm) h	Volume (cm^3) V
a.				
b.				
c.				
d.				
e.				
f.				
g.				
h.				
i.				
j.				
k.				

2. Describe how you can determine the volume without counting all the cubes. Provide your description in words and symbols.

Activity 5

Use the rule you have developed in Activity 4 to “work backwards” to determine some possible dimensions for different rectangular prisms.

	Length (cm) l	Width (cm) w	Height (cm) h	Volume (cm^3) V
1				9
2				12
3				21
4				21
5				32
6				32
7				32
8				32
9				36
10				36
11				36
12				50
13				50
14				50
15				64
16				64
17				64
18				100
19				100
20				100

Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

Pool Side

Produced by a Department of Education - MAWA partnership project

written for the Year 7 Australian Curriculum

TASK 103: POOL SIDE

Overview

In this task, students will investigate the relationship between the area and the perimeter of a variety of shapes. They will work independently to make choices, interpret, model and investigate the ideal shape for a pool under the constraints given. They will be required to design their investigation and plan their approach to seek a solution. They should consider how working backwards might be effective and reflect on the strategies used by reviewing their work or that of their peers.

Students will need

- calculators
- graph paper

Relevant content descriptors from the Western Australian Curriculum

- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)

Students can demonstrate

- *fluency* when they
    - recognise what each shape looks like
    - consider how to record information in a logical manner
- *understanding* when they
    - attempt to work backwards to aid computation
    - find a solution to the problem
- *reasoning* when they
    - reflect on their work and seek to improve
- *problem solving* when they
    - identify processes to use to solve the problem

The school has decided to build a swimming pool to allow students to practise their swimming in the hope of winning the swimming carnival this year. You have been asked to submit a design for the shape of the pool to maximise its surface area.

The pool can be any shape you like, however there are two restrictions: All sides of the pool must be straight and it must have a **maximum perimeter** of 240 metres.

Using your knowledge of calculating area you must decide what shape the pool should be. The total perimeter **must be no more than** 240 metres and it must have the largest possible surface area.

1. Investigate the following shapes:
    - square
    - rectangle
    - composite shapes

Show what each shape listed above looks like?

To extend students, include triangles and parallelograms. Students will need to use Pythagoras's Theorem if using these shapes.

Square

Rectangle

Composite Shape

2. How will you record all of the information logically? What processes will you use?

Use a table with 5 columns labelled shape, length, width, perimeter, and area.
Draw a picture of each shape.
Ensure the length and width give a perimeter of 240 m.
Use the measurements to calculate the area.

3. Are there any processes working backwards that may help you?

Halve 240 m to give 120 m.
Find numbers that add to 120.

4. What shape allows for the greatest area with a perimeter or no more than 240 m?

Encourage students to use a systematic method, such as the table below, to discover that a 60 m x 60 m square pool with a perimeter of 240 m has a maximum area of 3600 square metres.

Shape	Length	Width	Perimeter	Area
	60 m	60 m	240 m	3600 m^2
	110 m	10 m	240 m	1100 m^2
	100 m	20 m	240 m	2000 m^2
	90 m	30 m	240 m	2700 m^2
	80 m	40 m	240 m	3200 m^2
	70 m	50 m	240 m	3500 m^2
	60 m 40 m 20 m	60 m 40 m 20 m	240 m	2000 m^2

5. Now that you have a solution, is there anything that you could have done differently to reduce the workload of the task?

Answers will vary. Use this question for a plenary/feedback session.

The school has decided to build a swimming pool to allow students to practise their swimming in the hope of winning the swimming carnival this year. You have been asked to submit a design for the shape of the pool to maximise its surface area.

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1. Investigate the following shapes:
   - square
   - rectangle
   - composite shapes

Show what each shape listed above looks like?

2. How will you record all of the information logically? What processes will you use?

3. Are there any processes working backwards that may help you?

4. What shape allows for the greatest area with a perimeter or no more than 240 m?

5. Now that you have a solution, is there anything that you could have done differently to reduce the workload of the task?

Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

Tiling Total

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 110: TILING TOTAL

Overview

In this task, students will use their knowledge of area and perimeter to solve authentic problems. They will be required to formulate solutions by choosing appropriate methods, recognise patterns, and communicate these mathematically.

No special aids required

Relevant content descriptions from the Western Australian Curriculum

- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)
- Describe translations, reflections in an axis, and rotations of multiples of 90° on the Cartesian plane using coordinates. Identify line and rotational symmetries (ACMMG181)

Students can demonstrate

- *fluency* when they
    - calculate the number of tiles required
    - calculate the number of border pieces required
- *understanding* when they
    - formulate a general rule for determining the border requirements
- *reasoning* when they
    - describe their tile pattern mathematically
- *problem solving* when they
    - calculate room length and width using number of tiles and border pieces
    - create a pattern using reflection, rotation and translation

Activity 1

Luke has started a new job for a local tiling company. The company only installs porcelain tiles with a protective skirting border that must be installed on the bottoms of the walls around the edge of the room. The tiles are 1 m^2 and the border pieces are 1 m in length and 10 cm wide.

Use this information to complete the installer's guide below.
Drawing diagrams may assist you.

Room	Length	Width	Number of Tiles	Number of Border Pieces
Room 1	2	1	2	6
Room 2	4	2	8	12
Room 3	7	4	28	22
Room 4	5	3	15	16
Room 5	8	4	32	24
Room 6	11	6	66	34

Activity 2

Luke has worked out the number of tiles and border pieces he will require for his next jobs but he forgot to make note of the room sizes. Can you use the information given to work this out? Complete the table below.

	Length	Width	Number of Tiles	Number of Border Pieces
Room 1	4	3	12	14
Room 2	6	2	12	16
Room 3	17	2	34	38
Room 4	9	8	72	34
Room 5	12	6	72	36

Activity 3

Luke needs to have a general rule so it's quick and easy to work out the border required for a job. For a room with length l and width w, write a rule for determining N, the number or border pieces. Write the rule in a different way.

$N = 2l + 2w$

OR

$N = 2(l + w)$

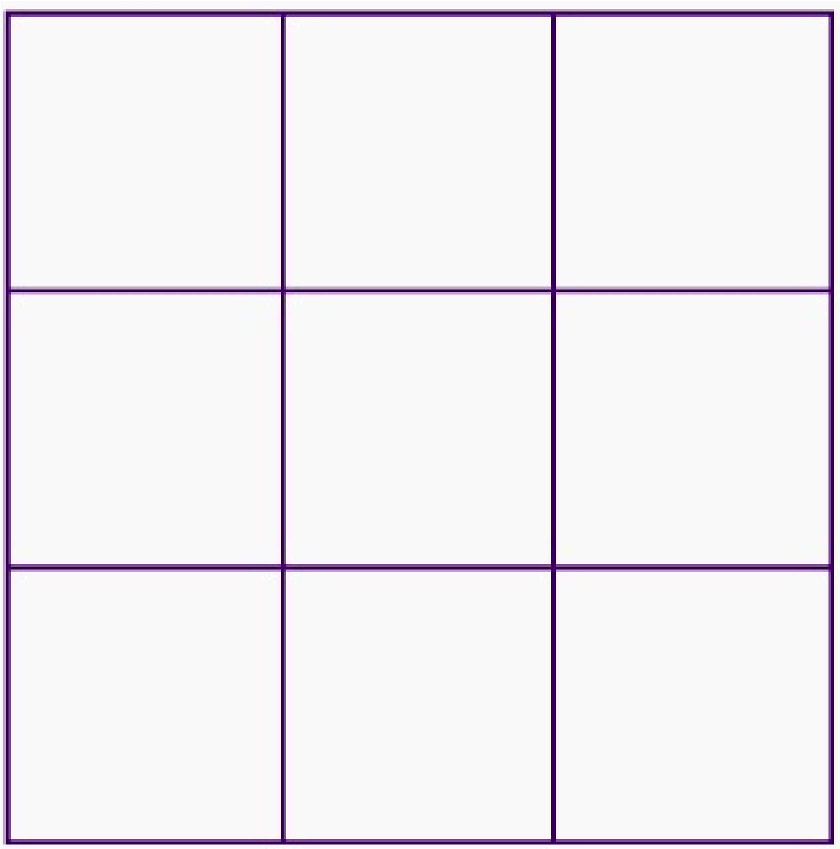
OR

Any other acceptable rule

Activity 4

Luke wants to expand the business and offer customers other tiles and designs. He has decided to design his own tile using transformations. He will design one square and reflect, rotate and translate it to create a pattern for his tiles.

1. Using the grid below, create a possible design for Luke.
   Answers will vary



2. Using mathematical language, describe in detail how you have created the above design.
   Answers will vary

Activity 1

Luke has started a new job for a local tiling company. The company only installs porcelain tiles with a protective skirting border that must be installed on the bottoms of the walls around the edge of the room. The tiles are 1 m^2 and the border pieces are 1 m in length and 10 cm wide.

Use this information to complete the installer's guide below.
Drawing diagrams may assist you.

Room	Length	Width	Number of Tiles	Number of Border Pieces
Room 1	2	1		
Room 2	4	2		
Room 3	7	4		
Room 4	5	3		
Room 5	8	4		
Room 6	11	6		

Activity 2

Luke has worked out the number of tiles and border pieces he will require for his next jobs but he forgot to make note of the room sizes. Can you use the information given to work this out? Complete the table below.

	Length	Width	Number of Tiles	Number of Border Pieces
Room 1			12	14
Room 2			12	16
Room 3			34	38
Room 4			72	34
Room 5			72	36

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Luke needs to have a general rule so it's quick and easy to work out the border required for a job. For a room with length *l* and width *w*, write a rule for determining *N*, the number or border pieces. Write the rule in a different way.

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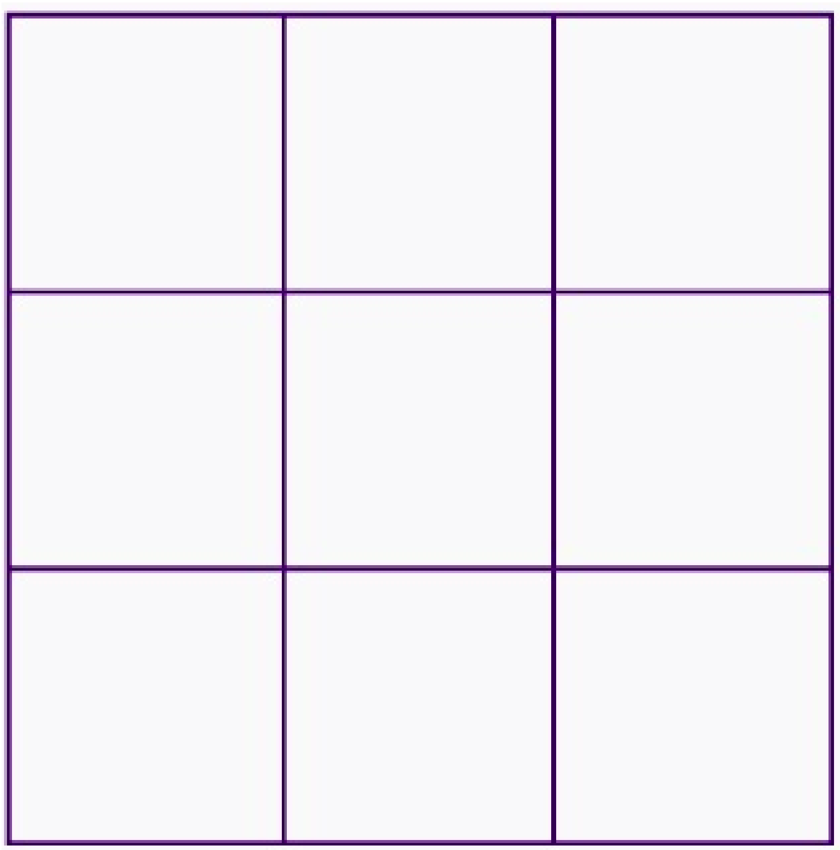


2. Using mathematical language, describe in detail how you have created the above design.

Department of Education

Year 7 Mathematics

Measurement & Geometry Activity

What's My Shape?

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 114: WHAT'S MY SHAPE?

Overview

In this task, students will be required to describe an array of shapes to another student who will be required to draw the shapes. Students will be required to describe their thinking mathematically and interpret mathematical information. They will need to readily recall facts and communicate them in various ways to explain their thinking.

Students will need

- a barrier; students could use a book
- shape sets one and two
- access to the internet/textbooks

Relevant content descriptors from the Western Australian Curriculum

- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)
- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)
- Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal (ACMMG163)

Students can demonstrate

- *fluency* when they
  - recall readily the angle and side properties of triangles and quadrilaterals
- *understanding* when they
  - communicate mathematically the properties that they can recall
- *reasoning* when they
  - explain how all the properties are linked to form a particular shape
- *problem solving* when they
  - communicate angle and side properties in various ways to aid another student's understanding

Activity

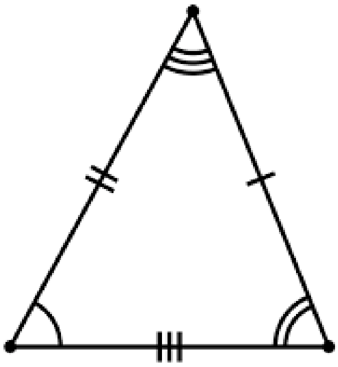
Students should pair up; they should sit facing each other. They will need to put a barrier between the two of them so that neither of them can see the other's work. Student 1 will need to describe each shape, on Shape Set 1 on the next page, without telling the other what it is. They must use mathematical language and describe the shape by its angle and side properties. Student 2 is to draw the shape using the information from Student 1. When Student 2 has drawn all of the shapes, Student 1 should mark the work of Student 2.

They should then use Shape Set 2 and switch roles. Students could receive the shape set and research, using Internet or textbooks, how to describe each shape before they begin the task.

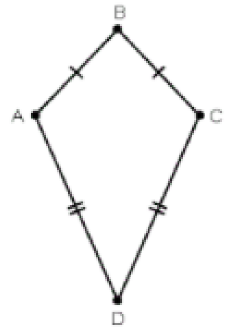
As a plenary, have a class feedback session and discuss the good and bad points about the other student's instructions. Ask the students to write a note on how their partner could improve their instructions and how they could improve their own instructions.

Shape Set 1

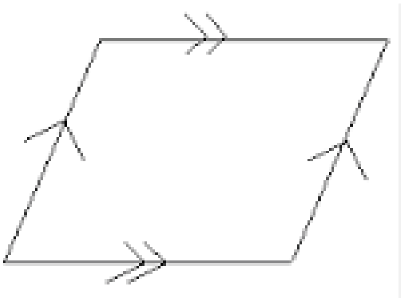
Scalene triangle



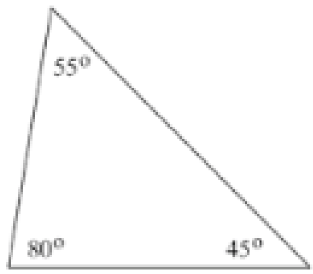
Kite



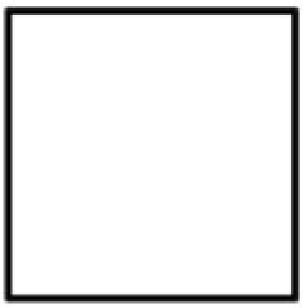
Rhombus



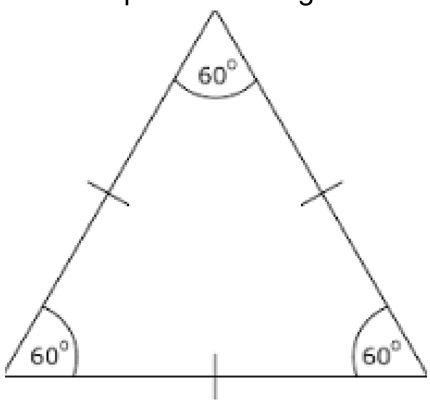
Acute-angled triangle



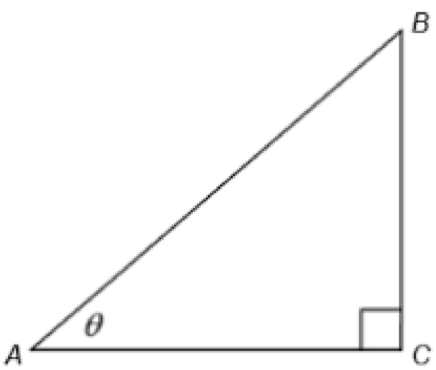
Square



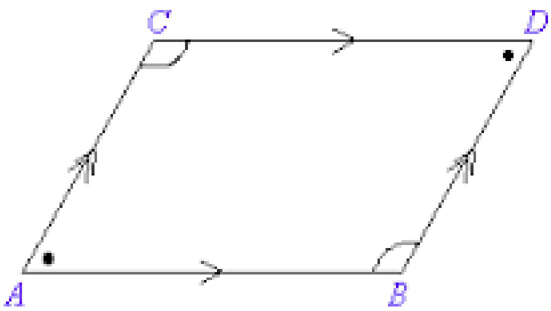
Equilateral triangle



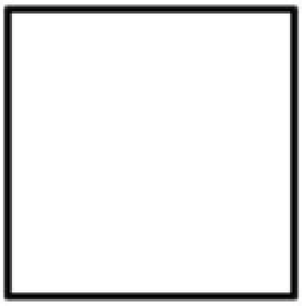
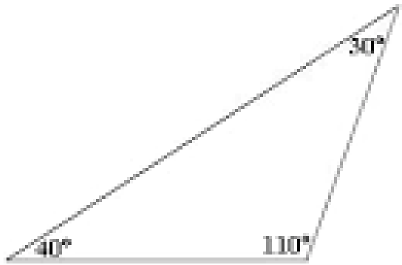
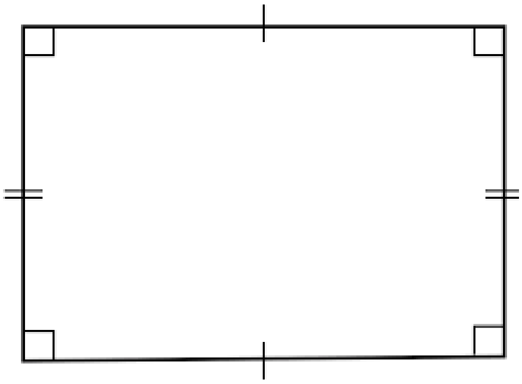
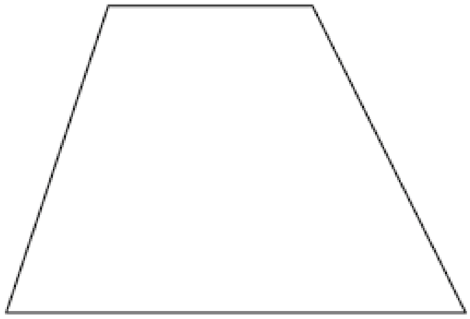
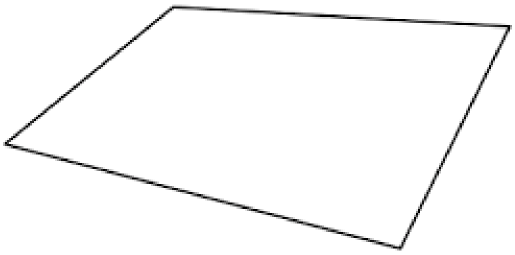
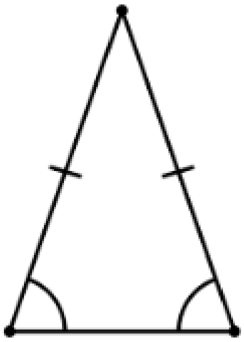
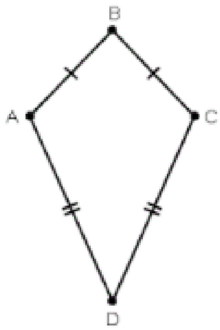
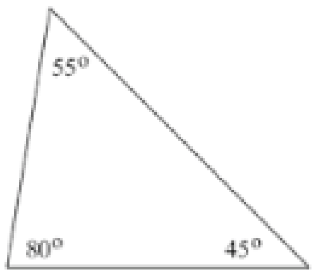
Right-angled triangle



Parallelogram



Shape Set 2

Square 	Obtuse-angled triangle 
Rectangle 	Trapezium 
Irregular quadrilateral 	Isosceles triangle 
Kite 	Acute-angled triangle 

Activity

For this activity you will need a partner. Sit facing your partner. Put a barrier between the two of you so that neither of you can see the other's work.

Student 1 describes each shape, on Shape Set 1 on the next page, without telling Student 2 what it is. Mathematical language must be used to describe the shape by its angle and side properties. Student 2 draws the shape using the information from Student 1.

When Student 2 has drawn all of the shapes, Student 1 should mark the work of Student 2.

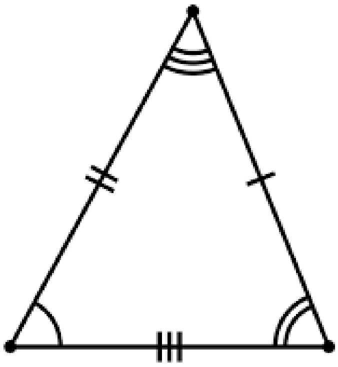
Then, switch roles and repeat the exercise using Shape Set 2.

As a follow-up, discuss with other classmates, the good and weak points about each of your instructions to each other.

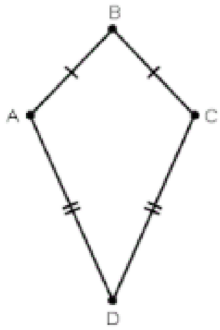
Write notes on how you could improve the instructions to each other.

<u>Shape Set 1</u>

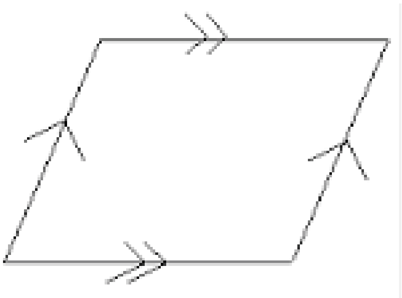
Scalene triangle



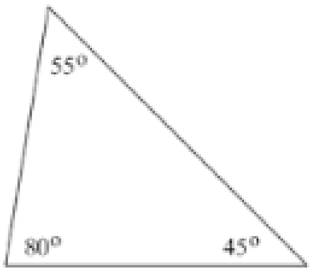
Kite



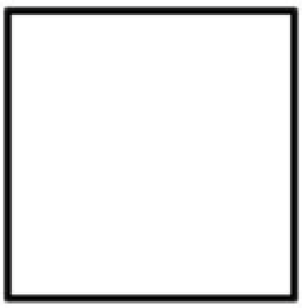
Rhombus



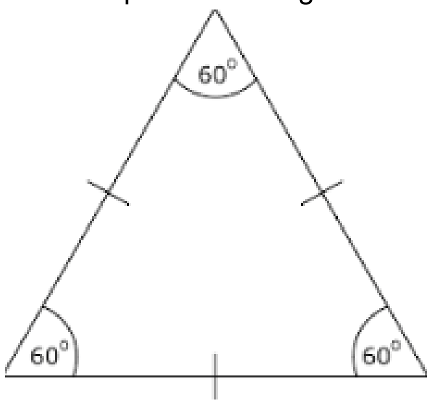
Acute-angled triangle



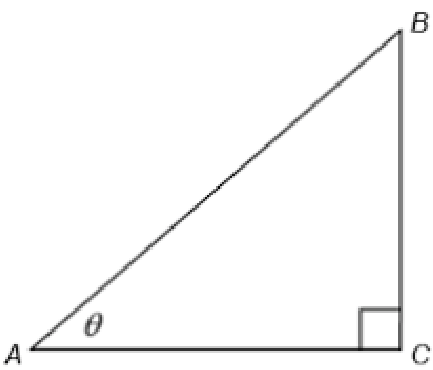
Square



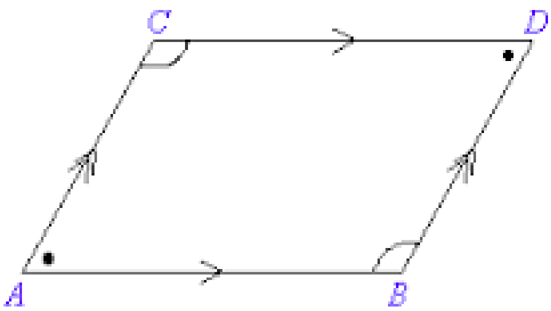
Equilateral triangle



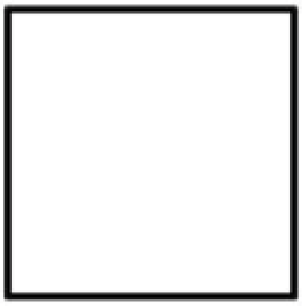
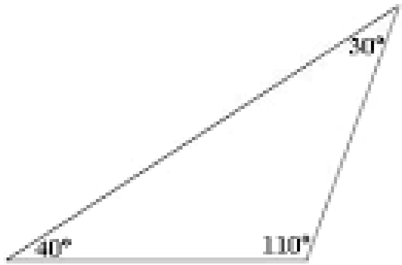
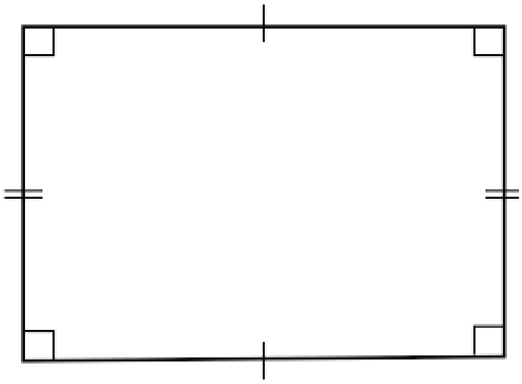
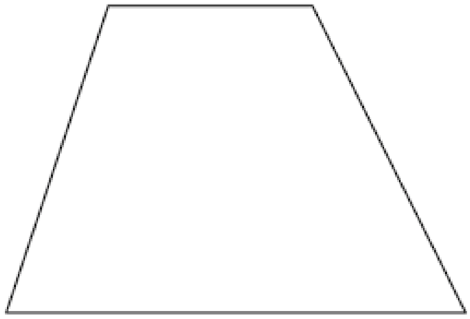
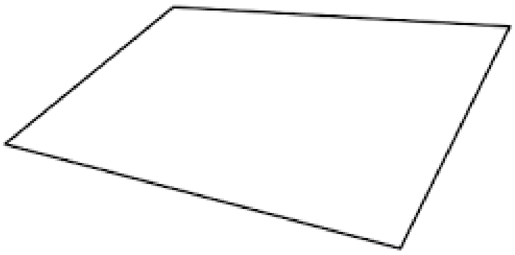
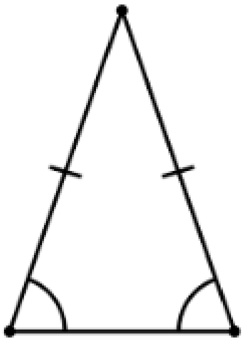
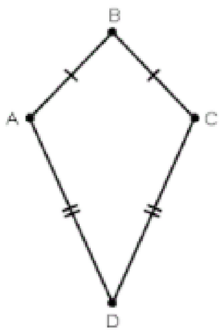
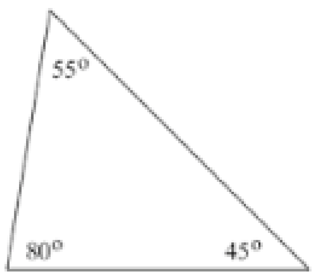
Right-angled triangle



Parallelogram



Shape Set 2

Square 	Obtuse-angled triangle 
Rectangle 	Trapezium 
Irregular quadrilateral 	Isosceles triangle 
Kite 	Acute-angled triangle 

Department of Education

The Mathematical Association of Western Australia Inc.

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

How Many Squares?

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 117: HOW MANY SQUARES?

Overview

In this task, students will investigate how many squares are on a chessboard – an 8 x 8 grid. They will need to consider the different ways to arrange different sized squares within the different sized grids. They will need to make links between related concepts and apply these links to problem situations. They will then need to adapt this known procedure to an unknown context to find solutions.

Students will need

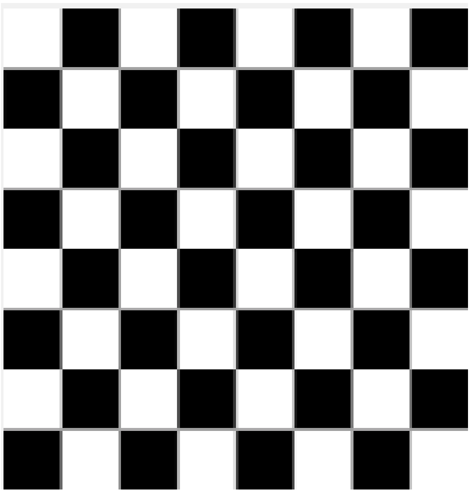
- 1-cm grid paper

Relevant content descriptions from the Western Australian Curriculum

- Investigate index notation and represent whole numbers as products of powers of prime numbers (ACMNA149)
- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)

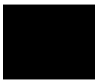
Students can demonstrate

- *fluency* when they
    - calculate how many squares within the grids
- *understanding* when they
    - calculate how many squares are on a chessboard
- *reasoning* when they
    - identify the pattern of square numbers
    - use their pattern to predict how many squares on a 10 x 10 grid
- *problem solving* when they
    - apply their pattern to attempt to find how many rectangles on a chessboard

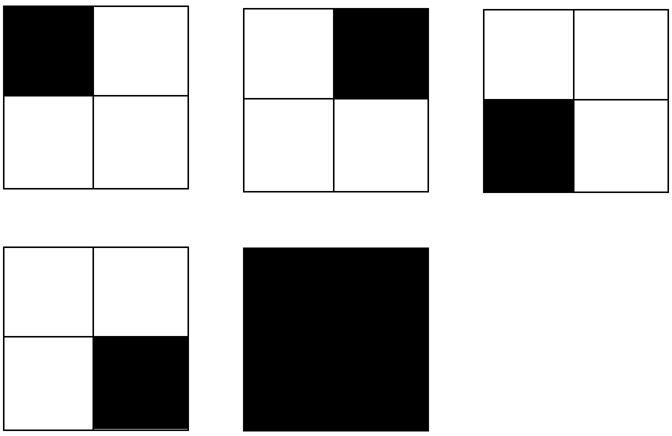


A chessboard is a black and white 8 x 8 board as shown to the left. How many squares are on a chessboard? It's not 64, as we need to include not only the 1 x 1 squares but the 2 x 2, 3 x 3 etc.

Let's take a look at some of the smaller squares first.



This is a 1 x 1 square. It contains 1 square.



This is a 2 x 2 square. It contains 5 squares as shown on the left.

Each of the 4 smaller squares and then the larger square.

Activity 1

In the table below, the 1 x 1 and 2 x 2 squares have been completed.
Use and extend this method to help you find how many squares are on a chessboard. Use your grid paper and shading to help if required.

1. How many squares are on a chessboard?
204

	Number of 1 x 1 Squares	Number of 2 x 2 Squares	Number of 3 x 3 Squares	Number of 4 x 4 Squares	Number of 5 x 5 Squares	Number of 6 x 6 Squares	Number of 7 x 7 Squares	Number of 8 x 8 Squares	Total
1 x 1	1	0	0	0	0	0	0	0	1
2 x 2	4	1	0	0	0	0	0	0	5
3 x 3	9	4	1	0	0	0	0	0	14
4 x 4	16	9	4	1	0	0	0	0	30
5 x 5	25	16	9	4	1	0	0	0	55
6 x 6	36	25	16	9	4	1	0	0	91
7 x 7	49	36	25	16	9	4	1	0	140
8 x 8	64	49	36	25	16	9	4	1	204

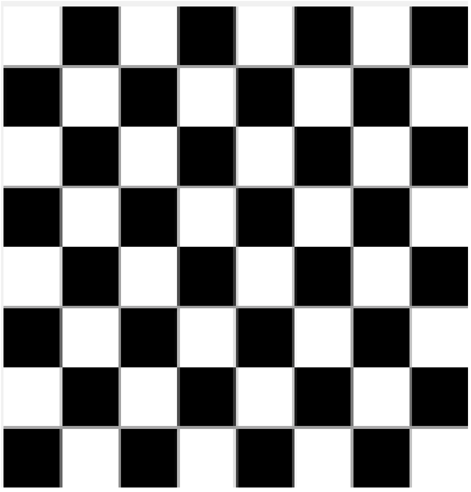
2. Can you identify a pattern in the table?
Reading the columns, from left to right, it is the square numbers, with a zero added to the beginning of each column.
Or anything similar referencing the square numbers.

3. Could you have used this pattern to help you find out how many squares are on a chessboard with drawing, shading and counting?
To find the solution for 8 x 8, you need to add all of the square numbers from 1 to 8.
This can be used to find how many squares on a board of any size.

4. Use the pattern you have identified to calculate how many squares would be on a 10 x 10 board.
100 + 81 + 64 + 49 + 36 + 25 + 16 + 9 + 4 + 1 = 385

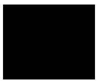
Activity 2: Extension

Can you extend your technique from Activity 1 to identify how many rectangles are on a chessboard (8 x 8)?
Techniques will vary. Total of 1296 possible rectangles on a chessboard.

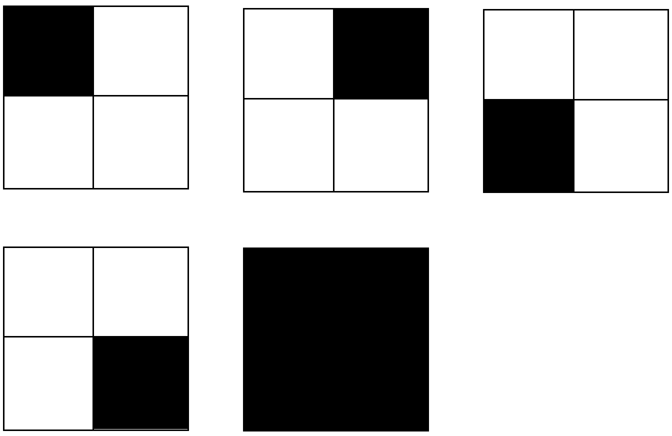


A chessboard is a black and white 8 x 8 board as shown to the left. How many squares are on a chessboard? It's not 64, we need to include not only the 1 x 1 squares but the 2 x 2, 3 x 3 etc.

Let's take a look at some of the smaller squares first.



This is a 1 x 1 square. It contains 1 square.



This is a 2 x 2 square. It contains 5 squares as shown on the left.

Each of the 4 smaller squares and then the larger square.

Activity 1

In the table below, the 1 x 1 and 2 x 2 squares have been completed.
Use and extend this method to help you find how many squares are on a chessboard. Use your grid paper and shading to help if required.

1. How many squares are on a chessboard?

	Number of 1 x 1 Squares	Number of 2 x 2 Squares	Number of 3 x 3 Squares	Number of 4 x 4 Squares	Number of 5 x 5 Squares				Total
1 x 1	1	0	0	0	0				1
2 x 2	4	1	0	0	0				5
3 x 3									
4 x 4									
5 x 5									

2. Can you identify a pattern in the table?

3. Could you have used this pattern to help you work out how many squares are on a chessboard with drawing, shading and counting?

4. Use the pattern you have identified to calculate how many squares would be on a 10 x 10 board.

Activity 2: Extension

Can you extend your technique from activity 1 to identify how many rectangles are on a chessboard (8 x 8)?

Department of
Education

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

Draw It

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 118: DRAW IT

Overview

In this task, students are required to draw 3-dimensional shapes based on plan views, front views and side views of those shapes. They will need to reflect on their previous work and interpret new information to amend their drawings. They will require an understanding of 3-dimensional shapes and should be able to connect different views to those shapes. Students will then need to reason mathematically to explain their thinking.

Students will need

- isometric paper (optional)
- multilink cubes or centicubes (optional)

Relevant content descriptions from the Western Australian Curriculum

- Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)

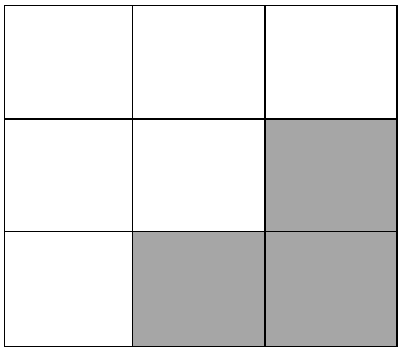
Students can demonstrate

- *fluency* when they
  - draw a 3-dimensional shape on isometric paper
- *understanding* when they
  - connect the plan view and the front view to alter the original shape
- *reasoning* when they
  - write a convincing argument, using mathematical reasoning, as to why their drawing is correct
- *problem solving* when they
  - connect all 3 views of the shape to draw a correct 3-dimensional shape

DRAW IT **Solutions and Notes to Teachers**

Activity 1

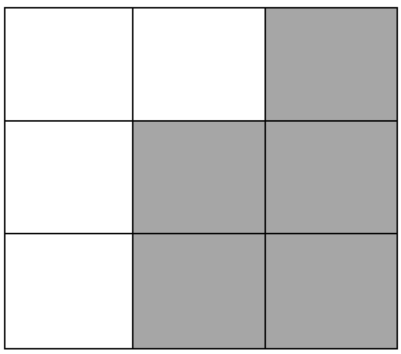
Lucy has made a 3-dinemsional shape using 7 multilink cubes. She has drawn a plan view, a front view and a side view of her shape. She has given Jack the plan view, as below, and asked him to draw what he thinks the shape might look like. Use the isometric dot paper below to draw a 3-dimensional shape that Jack might draw.



Drawings can vary. Check that the drawing meets the plan view requirements.

Activity 2:

After Jack has drawn a possible 3-dimensional shape, Lucy gives him the front view too, as shown below.



1. Looking at the plan view and the front view, does your drawing match?
   Answers will vary.

2. What have you not done correctly?
   Answers will vary.

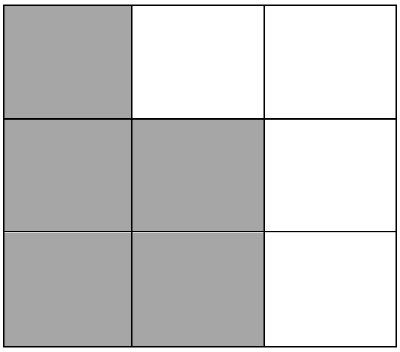
3. What have you done correctly?
   Answers will vary.

4. Use the isometric dot paper below to draw a 3-dimensional shape that Jack might draw now that he has both the plan view and the front view.

   Drawings can vary. Check that drawings meet both the plan view and front view requirements.

Activity 3:

After Jack has drawn a possible 3-dimensional shape, Lucy then gives him the last view, the side view, as shown below.

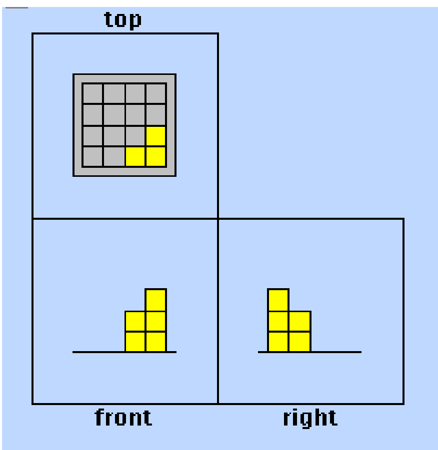


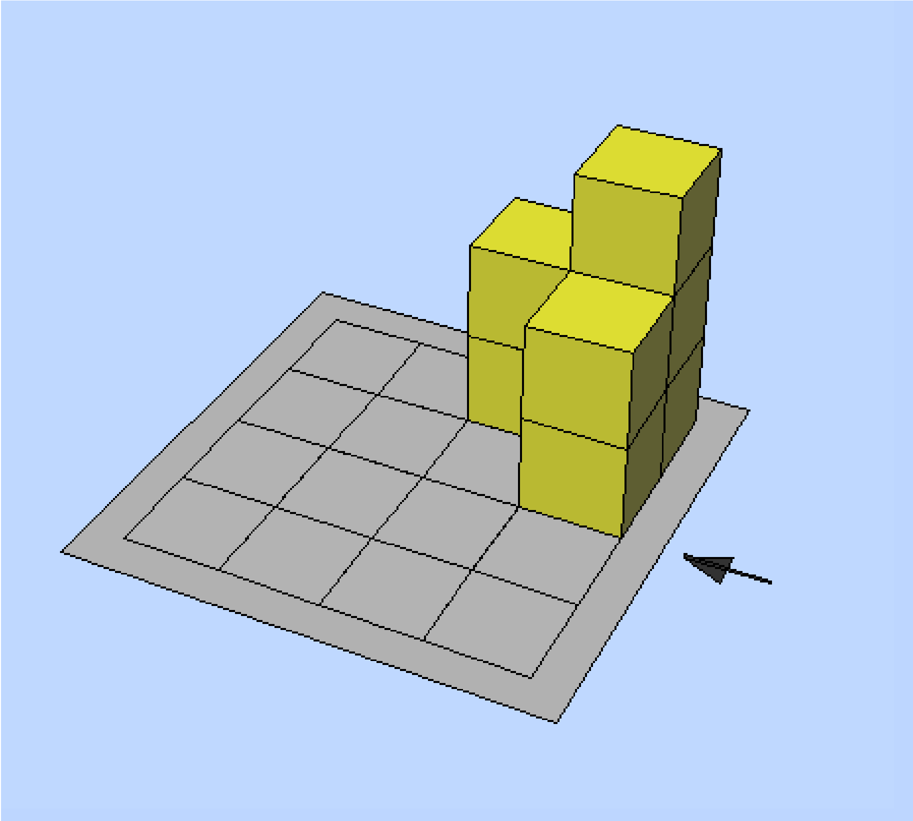
1. Looking at all three views of the 3-dimensional shape, does your drawing match?
   Answers will vary.

2. What have you not done correctly?
   Answers will vary.

3. What have you done correctly?
   Answers will vary.

4. Use the isometric dot paper to draw a 3-dimensional shape that Jack might draw now that he has all views of the 3-dimensional shape.





Activity 4:

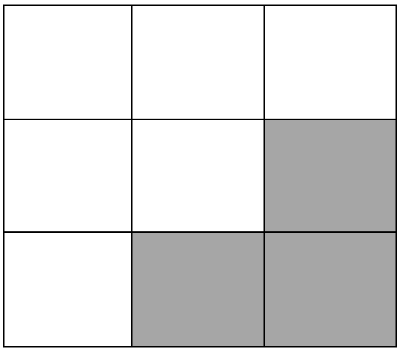
How do you know you are correct? Write a convincing argument, using mathematical reasoning, to explain why your diagram is the correct 3-dimensional presentation of this figure.

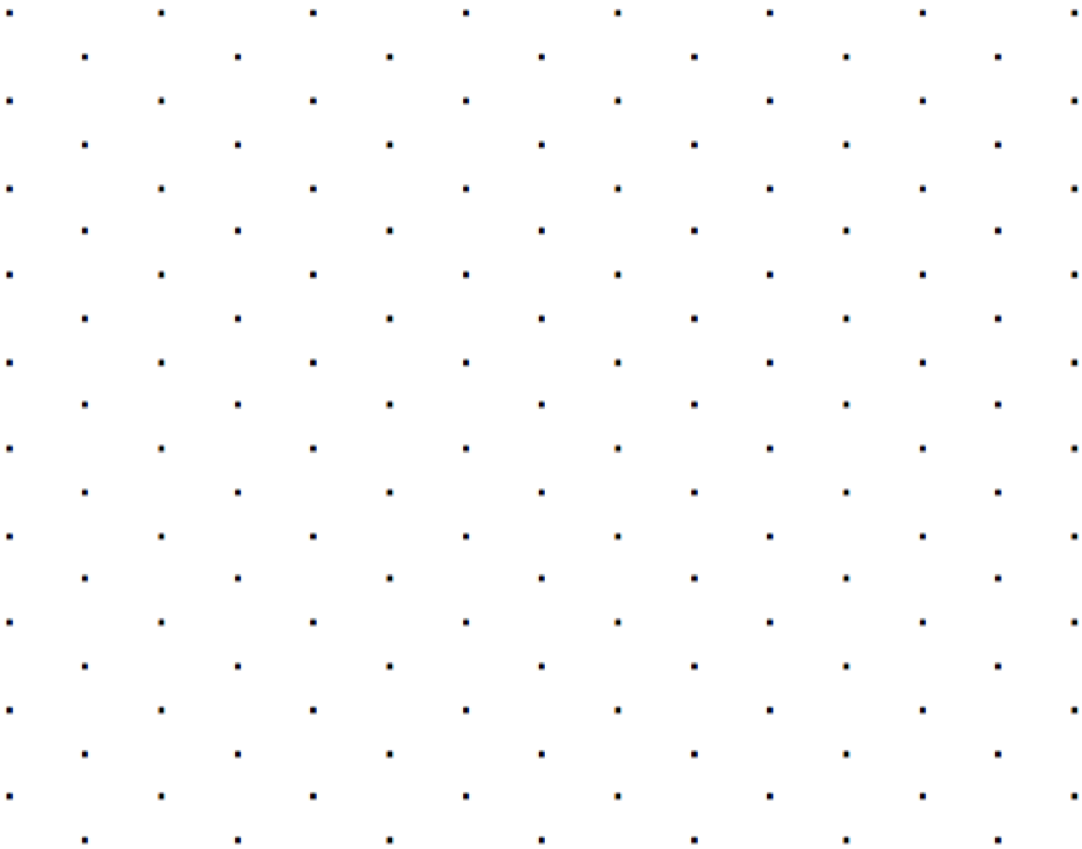
Use this as a plenary activity. Have a selection of students come to the board and show their work and explain mathematically why their answer is the correct shape, before actually revealing the correct shape. You could make some models to pass around so the students can study them and compare them to their drawings.

Alternatively, have them make the shape, using multilink cubes, based on their drawings.

<u>Activity 1</u>

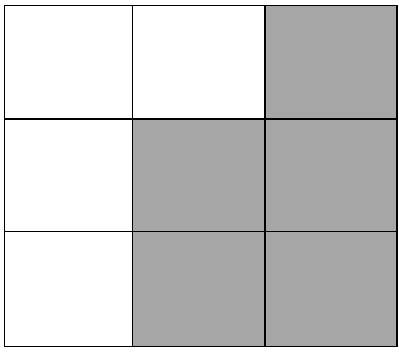
Lucy has made a 3-dinemsional shape using 7 multilink cubes. She has drawn a plan view, a front view and a side view of her shape. She has given Jack the plan view, as below, and asked him to draw what he thinks the shape might look like. Use the isometric dot paper below to draw a 3-dimensional shape that Jack might draw.





Activity 2:

After Jack has drawn a possible 3-dimensional shape, Lucy gives him the front view too, as shown below.

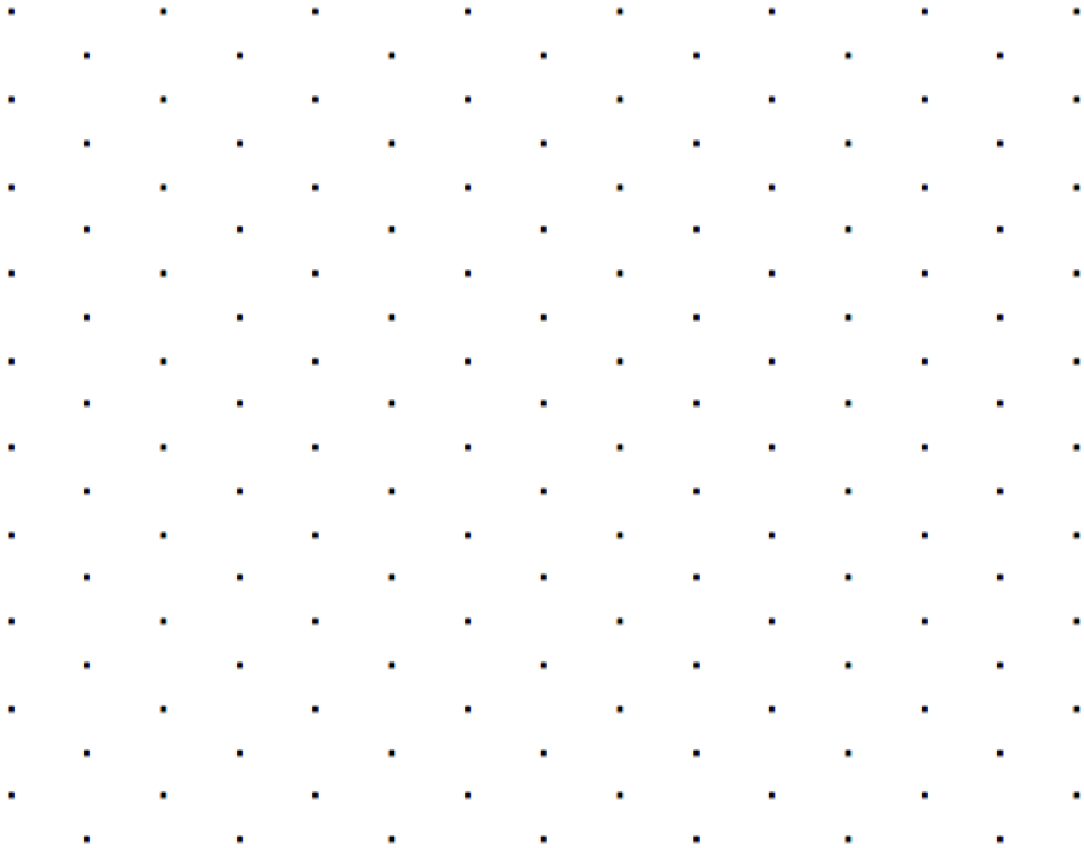


1. Looking at the plan view and the front view, does your drawing match?

2. What have you not done correctly?

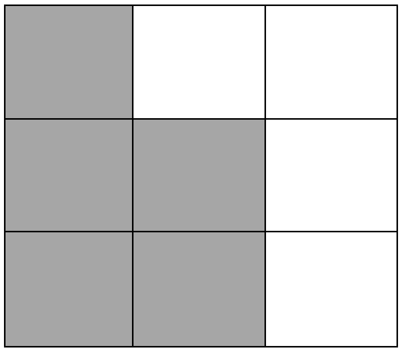
3. What have you done correctly?

4. Use the isometric dot paper to draw a 3-dimensional shape that Jack might draw now that he has both the plan view and the front view.



Activity 3:

After Jack has drawn a possible 3-dimensional shape, Lucy then gives him the last view, the side view, as shown below.

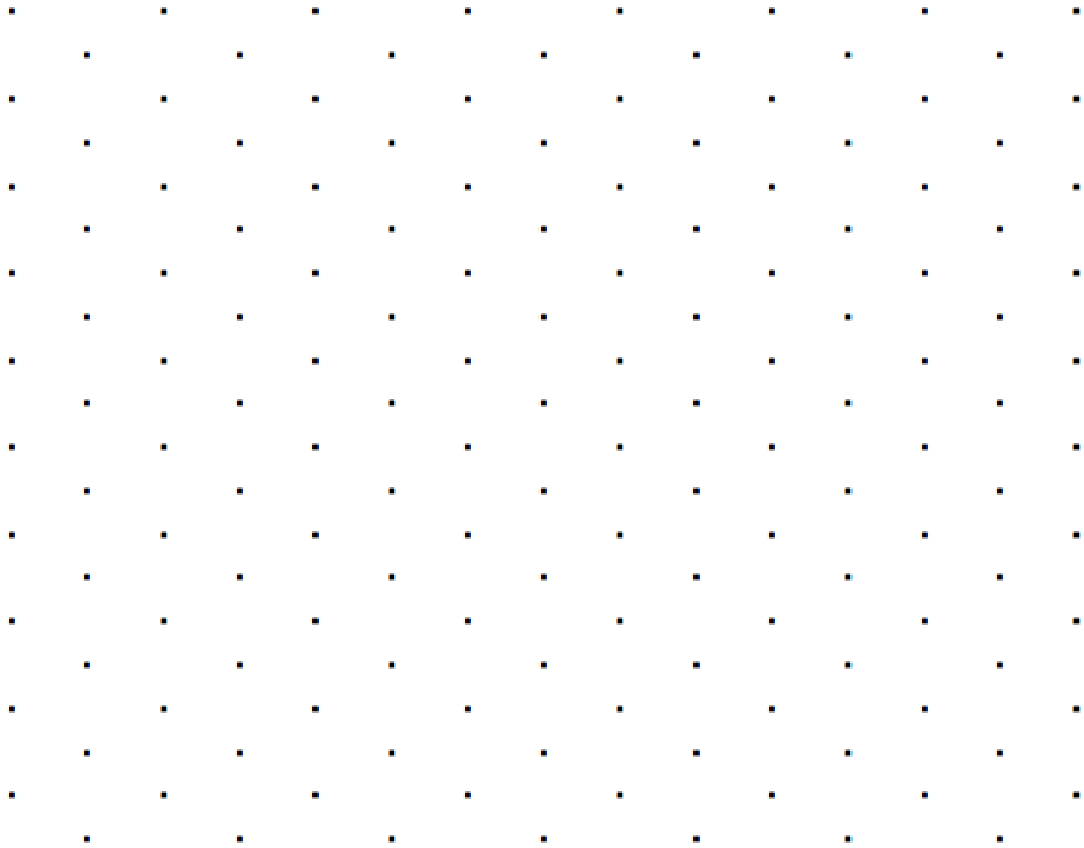


1. Looking at all three views of the 3-dimensional shape, does your drawing match?

2. What have you not done correctly?

3. What have you done correctly?

4. Use the isometric dot paper below to draw a 3-dimensional shape that Jack might draw now that he has all views of the 3-dimensional shape.



Activity 4:

How do you know you are correct? Write a convincing argument, using mathematical reasoning, to explain why your diagram is the correct 3-dimensional presentation of this figure.

Department of Education

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

Angle to Angle

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 119: ANGLE TO ANGLE

Overview

In this task, students will investigate the use of the angle sum of a triangle in finding the angle sum of other shapes. They will be required to carry out known procedures efficiently and use their results to investigate problem situations. They will need to explain their mathematical thinking and transfer their learning from one problem to another.

Students will need

- Protractor

Relevant content descriptions from the Western Australian Curriculum

- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)

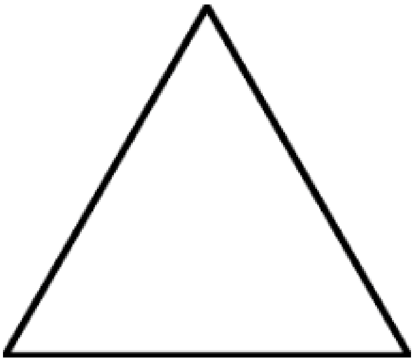
Students can demonstrate

- *fluency* when they
  - use a protractor efficiently to determine angle sizes
- *understanding* when they
  - use the angle sizes to calculate angle sum
- *reasoning* when they
  - explain the connection between adding an extra side and angle sum of a shape
- *problem solving* when they
  - develop a rule to find the angle sum of any shape
  - use this rule to find the angle sum of 10- and 20-sided shapes

Activity 1

1. A triangle is a 3-sided shape. Using a protractor, find the size of each of the three angles in the following triangles. Add the angle sizes together to get the angle sum.

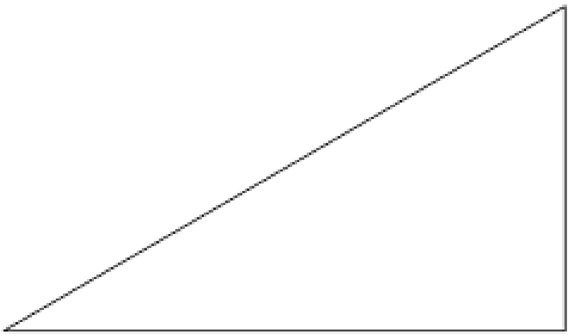
a.



Angle Sizes: As appropriate

Angle Sum: 180°

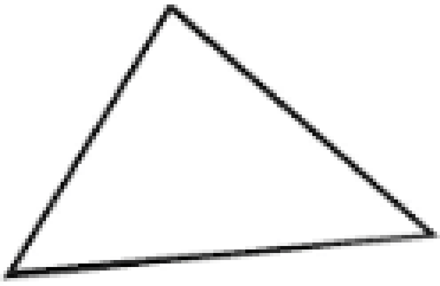
b.



Angle Sizes: As appropriate

Angle Sum: 180°

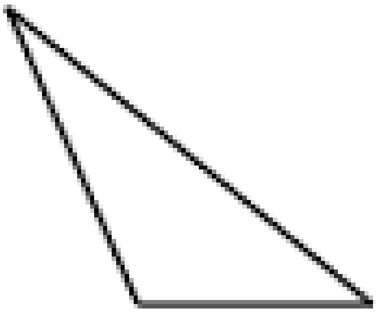
c.



Angle Sizes: As appropriate

Angle Sum: 180°

d.



Angle Sizes: As appropriate

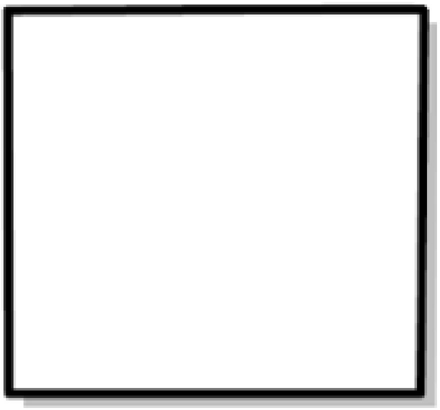
Angle Sum: 180°

2. What do you notice about the four angle sums you have found?
All of the triangles have an angle sum of 180°.

Activity 2:

1. A quadrilateral is a 4-sided shape. Using a protractor, find the size of each of the four angles in the following quadrilaterals. Add the angle sizes together to get the angle sum.

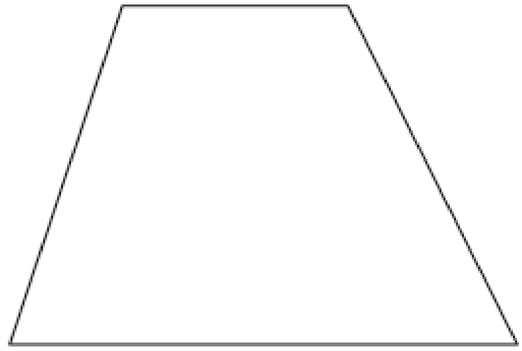
a.



Angle Sizes: As appropriate

Angle Sum: 360°

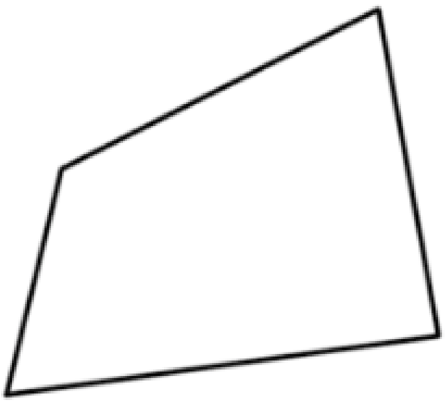
b.



Angle Sizes: As appropriate

Angle Sum: 360°

c.



Angle Sizes: As appropriate

Angle Sum: 360°

d.

Angle Sizes: As appropriate

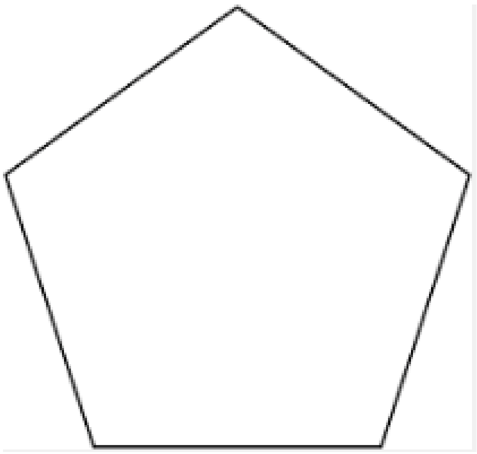
Angle Sum: 360°

2. What do you notice about the four angle sums you have found?
All of the quadrilaterals have an angle sum of 360^{0}.

Activity 3:

1. A pentagon is a 5-sided shape. Using a protractor, find the size of each of the five angles in the following pentagons. Add the angle sizes together to get the angle sum.

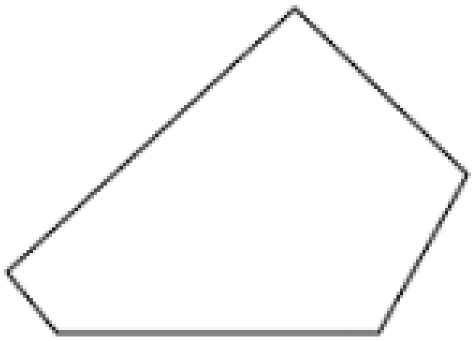
a.



Angle Sizes: As appropriate

Angle Sum: 540°

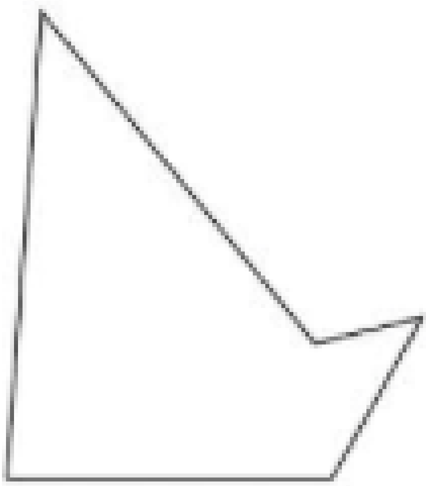
b.



Angle Sizes: As appropriate

Angle Sum: 540°

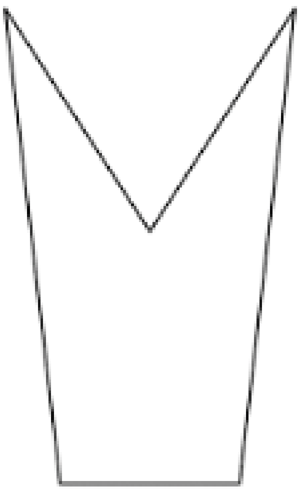
c.



Angle Sizes: may vary with printing

Angle Sum: 540°

d.



Angle Sizes: may vary with printing

Angle Sum: 540°

2. What do you notice about the four angle sums you have found?
All of the pentagons have an angle sum of 540°.

Activity 4:

You may want to continue with 6, 7, 8 etc. sided shapes if students do not see a pattern.

1. Complete the following table:

	Triangle	Quadrilateral	Pentagon
Angle Sum	180	360	540

2. Each time we added an extra side, what did you notice about he angle sum?
   It increases by 180^o.

3. Explain how we could find the angle sum of any polygon, regardless of the number of sides.
   Take the number of sides, subtract 2 and multiply it by 180^o.
   For a triangle, $(3 – 2) \times 180 = 180^0$.

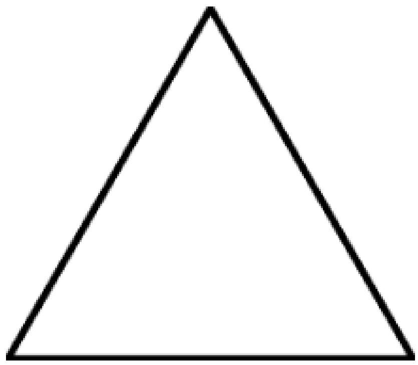
4. Create a mathematical rule to represent your explanation above.
   Angle sum (S) = [number of sides (n) – 2] x 180^o
   $S = 180(n – 2)$

5. Use your rule to find the angle sum of a 10-sided polygon, then find the angle sum of a twenty-sided shape.
   $S = (10 – 2) \times 180^o = 1440^o$
   $S = (20 – 2) \times 180^o = 3240^o$

Activity 1

1. A triangle is a 3-sided shape. Using a protractor, find the size of each of the three angles in the following triangles. Add the angle sizes together to get the angle sum.

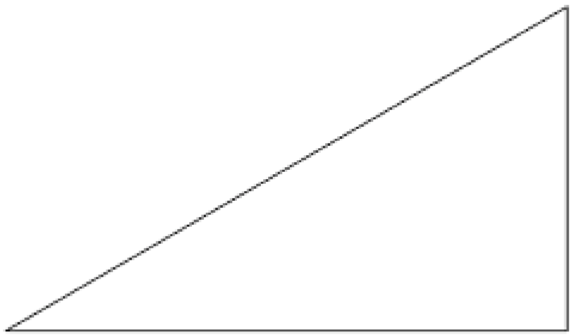
a.



Angle Sizes:

Angle Sum:

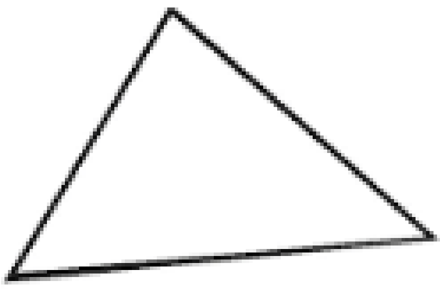
b.



Angle Sizes:

Angle Sum:

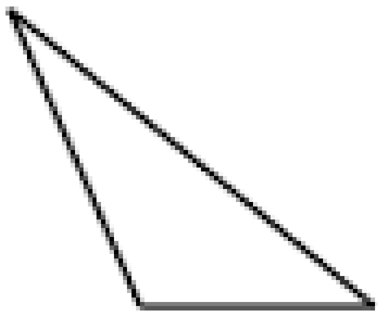
c.



Angle Sizes:

Angle Sum:

d.



Angle Sizes:

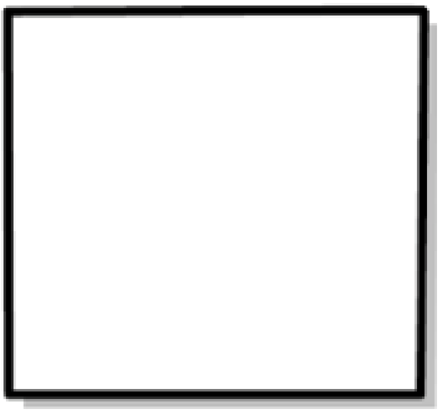
Angle Sum:

2. What do you notice about the four angle sums you have found?

Activity 2:

1. A quadrilateral is a 4-sided shape. Using a protractor, find the size of each of the four angles in the following quadrilaterals. Add the angle sizes together to get the angle sum.

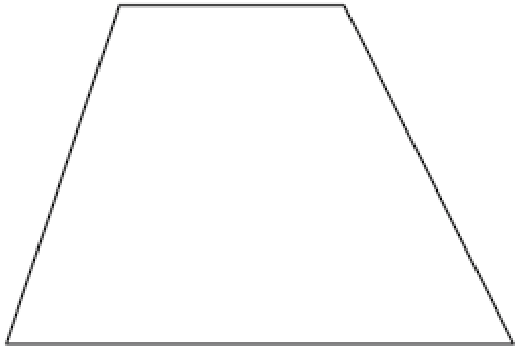
a.



Angle Sizes:

Angle Sum:

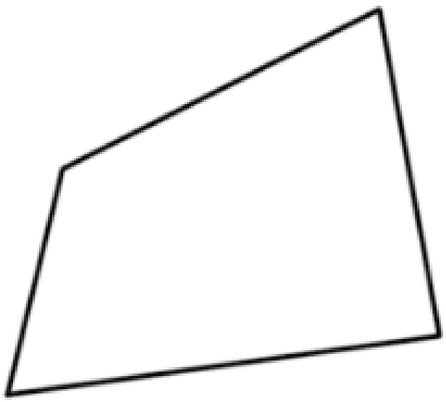
b.



Angle Sizes:

Angle Sum:

c.



Angle Sizes:

Angle Sum:

d.

Angle Sizes:

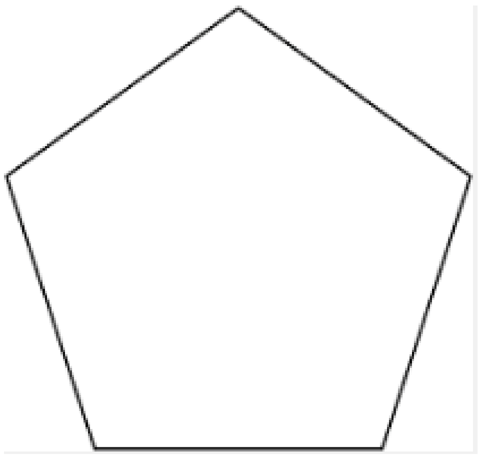
Angle Sum:

2. What do you notice about the four angle sums you have found?

Activity 3:

1. A pentagon is a 5-sided shape. Using a protractor, find the size of each of the five angles in the following pentagons. Add the angle sizes together to get the angle sum.

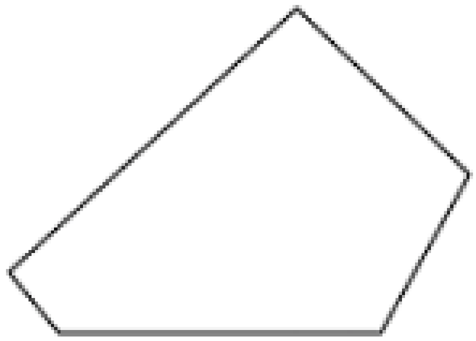
a.



Angle Sizes:

Angle Sum:

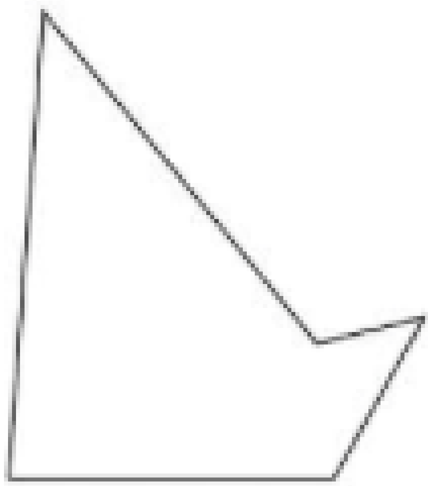
b.



Angle Sizes:

Angle Sum:

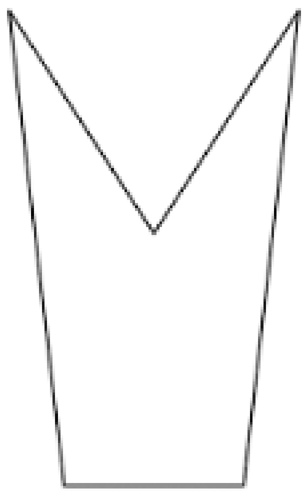
c.



Angle Sizes:

Angle Sum:

d.



Angle Sizes:

Angle Sum:

2. What do you notice about the four angle sums you have found?

Activity 4:

1. Complete the following table:

	Triangle	Quadrilateral	Pentagon
Angle Sum			

2. Each time we added an extra side, what did you notice about he angle sum?

3. Explain how we could find the angle sum of any shape, regardless on the number of sides.

4. Create a mathematical rule to represent your explanation above.

5. Use your rule to find the angle sum of a 10-sided shape. Find the angle sum of a twenty-sided shape

Department of
Education

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

Parallel or Not?

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT
WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 122: PARALLEL OR NOT?

Overview

In this task, students will investigate the conditions necessary for two lines to be parallel. They will be required to link concepts to investigate a problem situation and communicate solutions effectively. They will need to explain their thinking mathematically when they transfer their learning from one concept to another.

Students will need

- protractor
- access to the internet – if the topic has not been covered in class

Relevant content descriptions from the Western Australian Curriculum

- Investigate conditions for two lines to be parallel and solve simple numerical problems using reasoning (ACMMG164)
- Identify corresponding, alternate and co-interior angles when two straight lines are crossed by a transversal (ACMMG163)

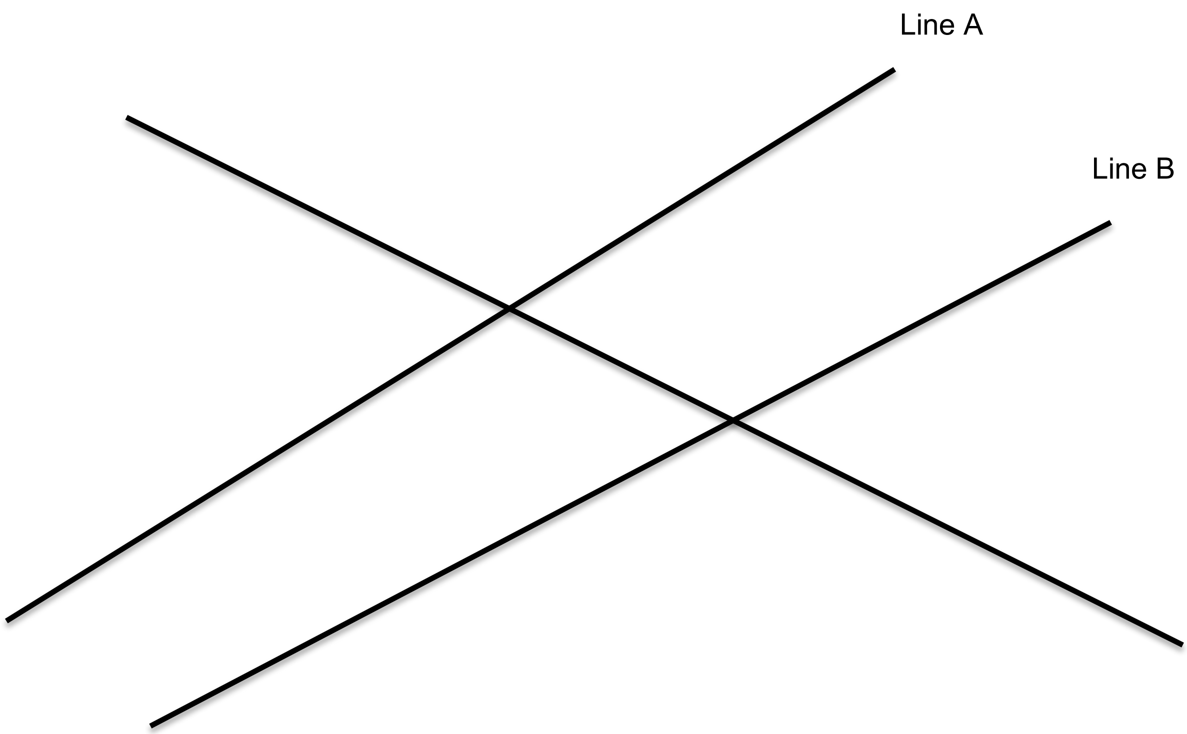
Students can demonstrate

- *fluency* when they
    - measure angles correctly
- *understanding* when they
    - identify the use of corresponding, alternate and co-interior angles
- *reasoning* when they
    - explain the conditions necessary for two lines to be parallel
- *problem solving* when they
    - formulate a coherent argument that the two lines are not parallel

Activity 1

During a study period at school Jane was working on her piece of coursework for Visual Art and Lance was revising for his up-coming mathematics test. Lance noticed that a piece of Jane's work didn't look right. He told her that the lines she had drawn were not parallel, thus skewing her piece. Jane was not convinced, as they looked parallel to her.

Below is the section of work that Lance was questioning. Using a protractor and your understanding of parallel lines, investigate whether line A and line B are parallel.



This activity would be suitable to use after students have looked at corresponding, alternate and co-interior angles, but before any explicit class work is done on parallel lines. This can be used as an introductory task. Allow students to have access to the Internet and/or textbooks as required.

Activity 2

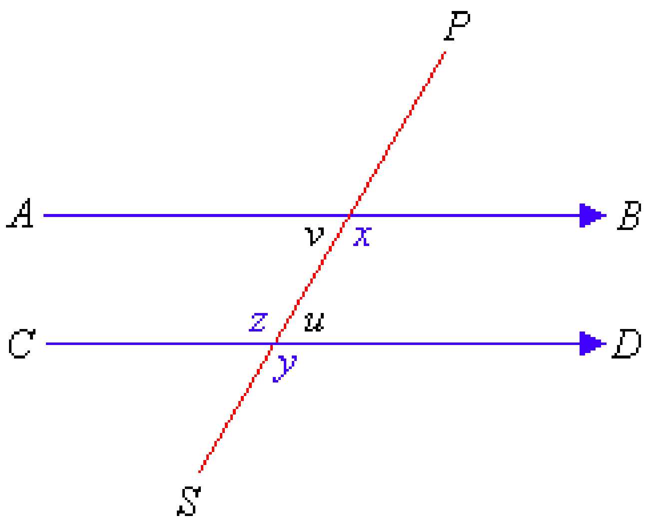
1. Explain how to efficiently use a protractor to measure an angle.

1. Place the origin over the point, or vertex, of the angle you want to measure.
2. Align the ‘bottom’ line of the angle with the baseline.
3. Follow the top line of the angle up to the measurements on the protractor's arc.
4. Do not get confused by the numbers on the bottom.

2. In the diagram above there are 3 lines. What is the purpose of the unlabelled line?

The third line is called a transversal. A transversal is a line that crosses at least two other lines. It is used to help us identify whether or not the other lines are parallel. We can do this by looking at the angles created between the transversal and proposed parallel lines.

3. Explain what conditions are necessary for two lines to be parallel.



- z and x (and u and v) are alternate angles
- x and y are corresponding angles
- u and x (and z and v) are co-interior angles
- y and z are vertically opposite angles

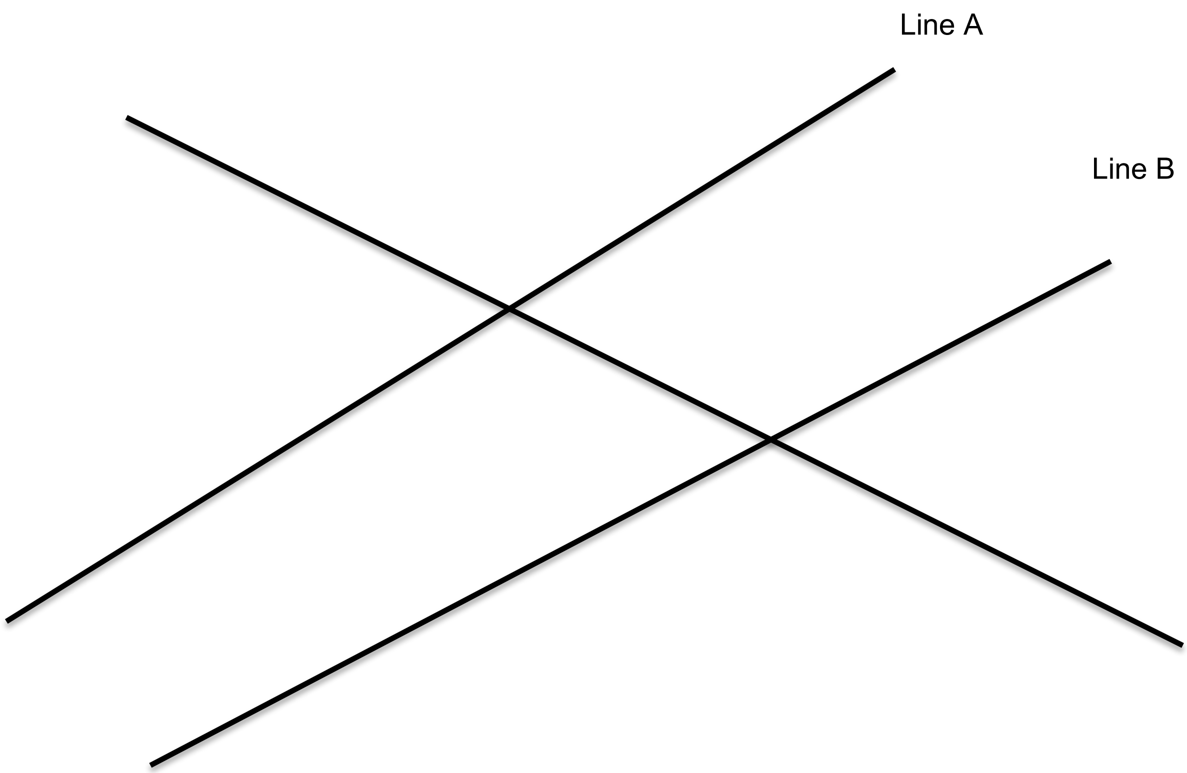
4. Construct a mathematical argument that Lance can present to Jane to convince her that her lines are, or are not, parallel.

Answers will vary, but should refer to the angle relationships above as justification.

Activity 1

During a study period at school Jane was working on her piece of coursework for Visual Art and Lance was revising for his up-coming mathematics test. Lance noticed that a piece of Jane's work didn't look right. He told her that the lines she had drawn were not parallel, thus skewing her piece. Jane was not convinced, as they looked parallel to her.

Below is the section of work that Lance was questioning. Using a protractor and your understanding of parallel lines, investigate whether line A and line B are parallel.



Activity 2

1. Explain how to efficiently use a protractor to measure an angle.

2. In the diagram above there are 3 lines. What is the purpose of the unlabelled line?

3. Explain what conditions are necessary for two lines to be parallel.

4. Construct a mathematical argument that Lance can present to Jane to convince her that her lines are, or are not, parallel.

Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Same View

Produced by a Department of Education - MAWA partnership project
written for the Year 7 Australian Curriculum

TASK 128: SAME VIEW

Overview

In this task, students will investigate different shapes that can have the same plan, front and side views. They will be required to make predictions based on information given and then investigate whether their predictions where correct. They will explain their thinking and justify conclusions reached. They will make connections between related ideas and adapt their skills to new tasks.

Students will need

- Isometric paper
- Grid paper
- Multilink cubes

Relevant content descriptions from the Western Australian Curriculum

- Draw different views of prisms and solids formed from combinations of prisms (ACMMG161)

Students can demonstrate

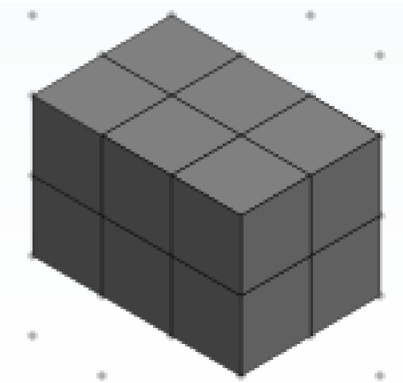
- *fluency* when they
    - draw the correct plan, front and side views of the shapes
- *understanding* when they
    - correctly predict if two shapes will have the same plan, front and side views
- *reasoning* when they
    - explain why two shapes may or may not have the same plan, front and side views
- *problem solving* when they
    - design two different shapes that have the same plan, front and side views

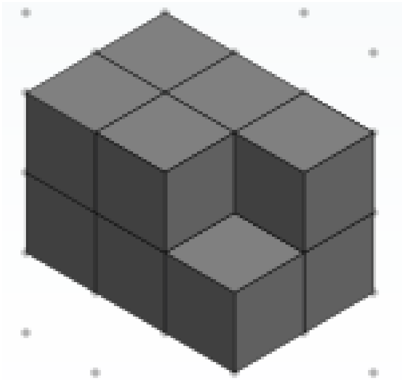
<u>Activity 1</u>

For the following pairs of isometric drawings -

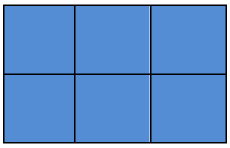
1. Predict whether you can use the same plan, front and side views.
2. Draw each plan, front and side view to determine whether you were correct.
3. For any pair that you can use the same plan, front and side view, explain why.
4. For any pair that you cannot use the same plan, front and side view, explain why not.

<u>Pair 1:</u>

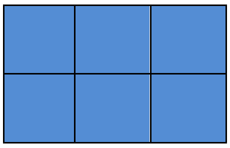




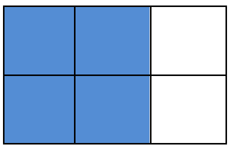
Plan



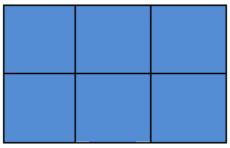
Front



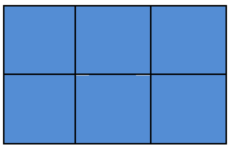
Side



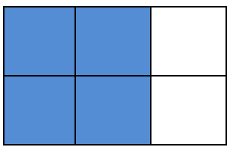
Plan



Front

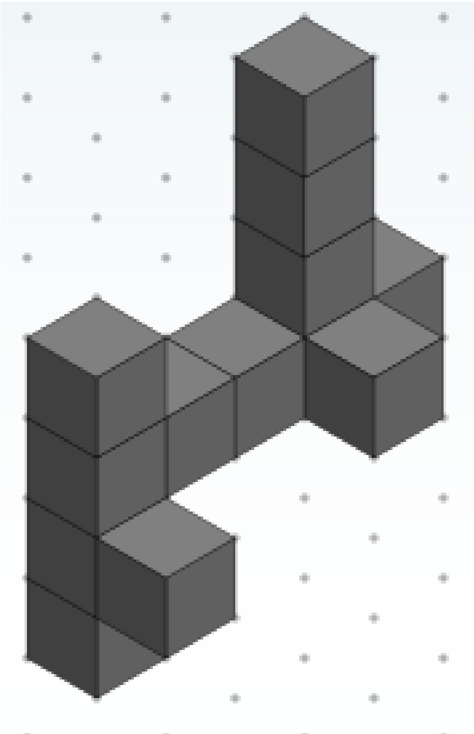


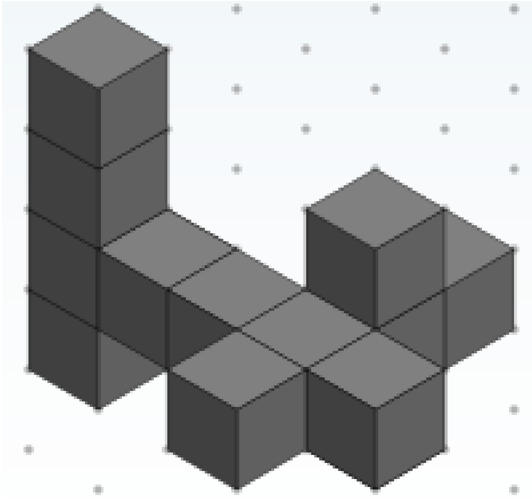
Side



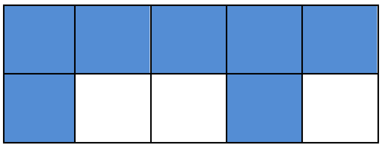
These two shapes have the same plan, front and side view. There is only one cube missing in the second shape. With each view, there is a cube behind the missing cube, which fills that space on the drawing.

Pair 2:

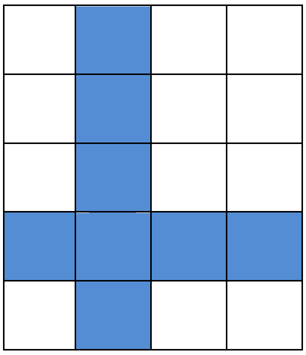




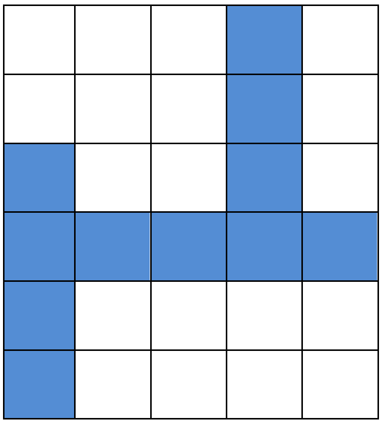
Plan



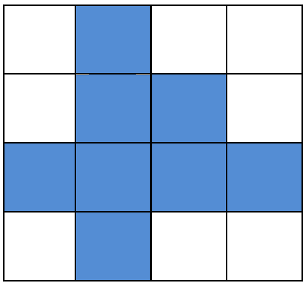
Plan



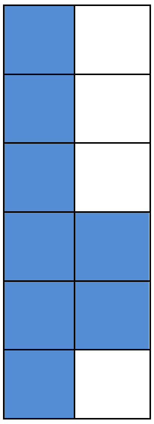
Front



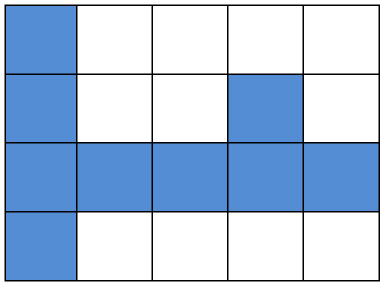
Front



Side



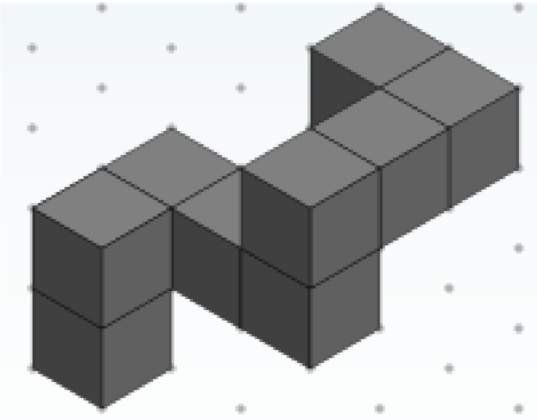
Side

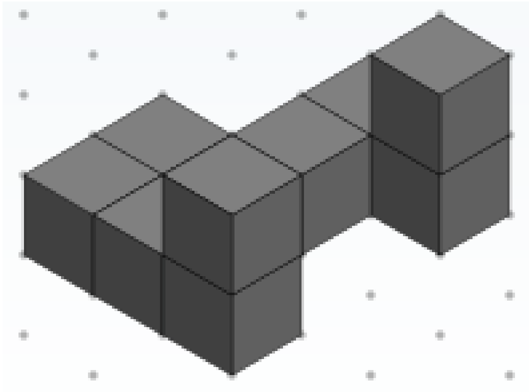


These two shapes do not have the same plan, front and side view. The first shape has a maximum height of 6 cubes whereas the second shape only has a maximum height of 4 cubes.

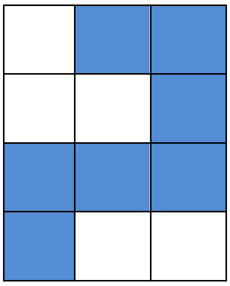
Answers will vary.

Pair 3:

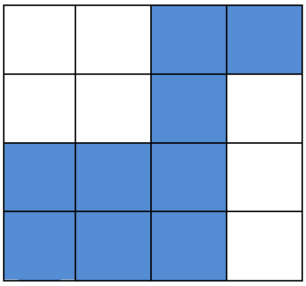




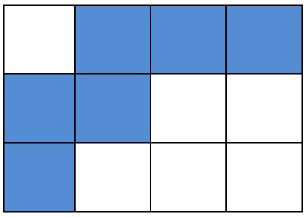
Plan



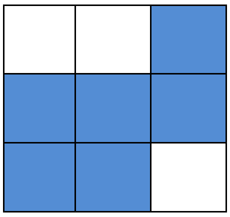
Plan



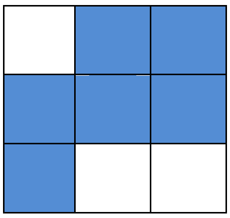
Front



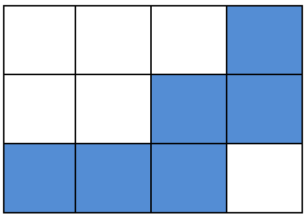
Front



Side



Side



These two shapes do not have the same plan, front and side view. Both shapes have a different widths and heights, and the second shape has a block of 4 cubes that the first shape does not have.

Answers will vary.

Activity 2

Design two shapes that are different but have the same plan, front and side view.
You should provide an isometric drawing, the plan view, the front view and the side view of both shapes. Explain how it is possible to have two different shapes with the same plan, front and side view.

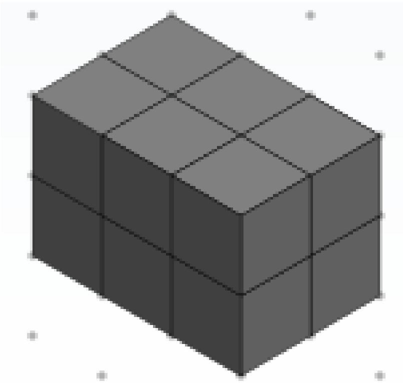
Answers will vary.

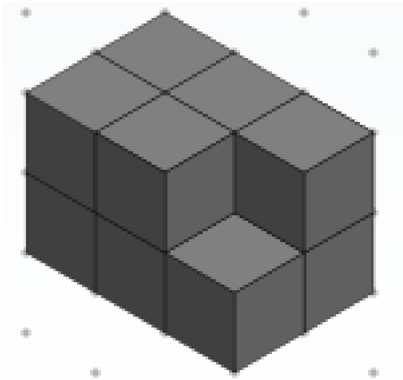
<u>Activity 1</u>

For the following pairs of isometric drawings -

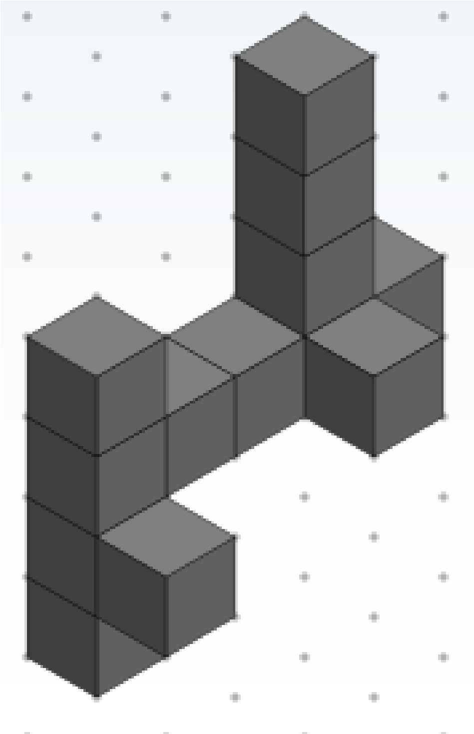
1. Predict whether you can use the same plan, front and side views.
2. Draw each plan, front and side view to determine whether you were correct.
3. For any pair that you can use the same plan, front and side view, explain why.
4. For any pair that you cannot use the same plan, front and side view, explain why not.

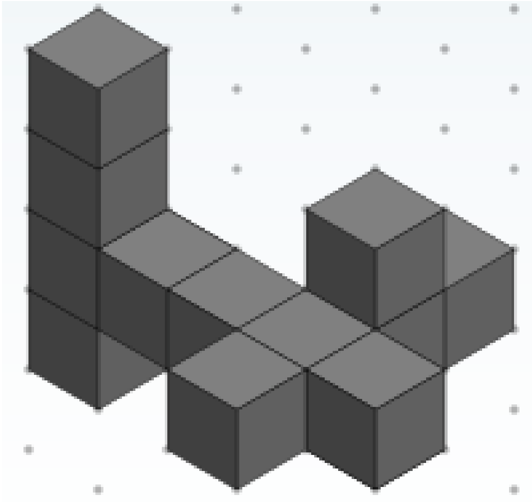
<u>Pair 1:</u>



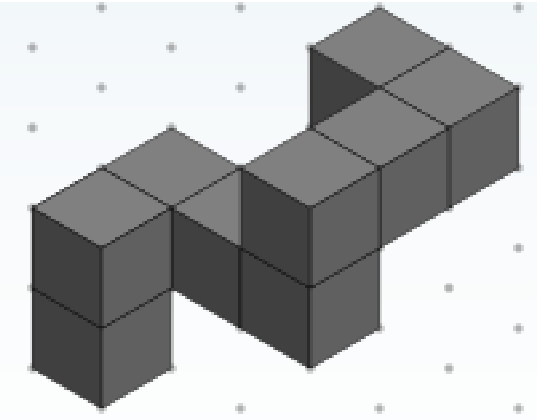


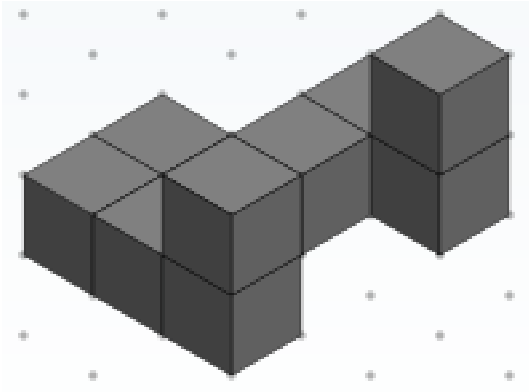
Pair 2:





Pair 3:





Activity 2

Design two shapes that are different but have the same plan, front and side view.
You should provide an isometric drawing, the plan view, the front view and the side view of both shapes. Explain how it is possible to have two different shapes with the same plan, front and side view.

Department of Education

The Mathematical Association of Western Australia Inc.

Year 7 Mathematics

Measurement & Geometry Activity

Hall of Frame

Produced by a Department of Education - MAWA partnership project

Written for the Year 7 Australian Curriculum

TASK 131: HALL OF FRAME

Overview

In this task, students will investigate whether a specified number of photograph frames can be hung on an allocated wall space. They must be able to carry out procedures flexibly and efficiently and adapt these procedures to a problem situation. They will need to plan their approach, use their mathematics to represent a meaningful situation, reach conclusions and justify their strategies.

Students will need

- calculator
- centimetre grid paper

Relevant content descriptions from the Western Australian Curriculum

- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)

Students can demonstrate

- fluency when they
    - calculate the area of the wall space
    - calculate the area of the photographs
- understanding when they
    - decide correctly whether they can fit all of the photographs on the allocated wall space
    - decide correctly whether they could use one wall and which wall
- problem solving when they
    - draw a scaled plan of how to hang all of the photographs on the allocated walls

Jacob and May have recently moved into a new house. They want to hang all of their photographs in the hallway so they can admire them as they enter the house. There are two possible wall areas that they can use; one is 1.8 metres high and 1.3 metres wide. The other is 1.8 metres high and 2.3 metres wide.

Activity 1

They don't mind how they are placed between the two wall areas but they must hang all of the frames, have a gap of 5 cm between each frame (on all sides) and the frames must have a geometric pattern. They have the following 50 frames to hang:

- four 60 cm x 40 cm
- six 40 cm x 20 cm
- one 10 cm x 30 cm
- five 20 cm x 10 cm
- fifteen 15 cm x 10 cm
- ten 25 cm x 20 cm
- four 10 cm x 5 cm
- three 20 cm x 15 cm
- two 15 cm x 15 cm

1. What is the total area of each wall space?

   1.8 x 1.3 = 2.34 m^2
   1.8 x 2.3 = 4.14 m^2

2. What is the total area of their photographs?

   0.6 x 0.4 = 0.24 x 4 = 0.96 m^2
   0.4 0.2 = 0.08 x 6 = 0.48 m^2
   0.1 x 0.3 = 0.03 x 1 = 0.03 m^2
   0.2 x 0.1 = 0.02 x 5 = 0.1 m^2
   0.15 x 0.1 = 0.015 x 15 = 0.225 m^2
   0.25 x 0.2 = 0.05 x 10 = 0.5 m^2
   0.1 x 0.05 = 0.005 x 4 = 0.02 m^2
   0.2 x 0.15 = 0.03 x 3 = 0.09 m^2
   0.15 x 0.15 = 0.0225 x 2 = 0.045 m^2

   0.96 + 0.48 + 0.03 + 0.1 + 0.225 + 0.5 + 0.02 + 0.09 + 0.045 = 2.45 m^2

3. Could they fit all of their photographs on the allocated walls, ignoring the 5 cm gaps?

   Yes

4. Could they use just one wall? If so, which one?

   They could use the second wall but not the first.

Activity 2

Remembering that Jacob and May would like a 5 cm gap between frames and a geometric design, draw a scaled plan of how they could hang all of their photographs on the allocated wall space. Use your 1-cm grid paper.

- They could make scaled photographs using coloured card to help them place the photographs.
- Help the students set a scale, for example, 1 cm represents 10 cm.
- This means they will require half a square, 5 cm, between photographs.
- This could be split into two tasks, have them draw a plan for one wall, then a second plan using both walls.
- Answers will vary.

Jacob and May have recently moved into a new house. They want to hang all of their photographs in the hallway so they can admire them as they enter the house. There are two possible walls that they can use; one is 2.6 metres high and 1.8 metres wide. The other is 2.6 metres high and 3.4 metres wide.

Activity 1

They don't mind how they are placed between the two walls but they must hang all of the frames, have a gap of 5 cm between each frame (on all sides) and the frames must have a geometric pattern. They have the following 50 frames to hang:

- four 60 cm x 40 cm
- six 40 cm x 20 cm
- one 10 cm x 30 cm
- five 20 cm x 10 cm
- fifteen 15 cm x 10 cm
- ten 25 cm x 20 cm
- four 10 cm x 5 cm
- three 20 cm x 15 cm
- two 15 cm x 15 cm

1. What is the total area of each wall space?

2. What is the total area of their photographs?

3. Could they fit all of their photographs on the allocated walls, ignoring the 5 cm gaps?

4. Could they use just one wall? If so, which one?

Activity 2

Remembering that Jacob and May would like a 5 cm gap between frames and a geometric design, draw a scaled plan of how they could hang all of their photographs on the allocated wall space. Use your 1-cm grid paper.

Department of Education

The Mathematical Association of Western Australia Inc.

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

One Triangle

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 132: ONE TRIANGLE

Overview

In this task, students will investigate whether there is more than one way to draw a triangle given three values of either side or angle. They will need to use a compass, protractor and ruler to draw given triangles to scale and will then need to measure to find the value of missing measurements. Students are then required to justify their findings mathematically to prove their conclusions either true or false.

Students will need

- calculator
- compass
- protractor
- centimetre grid paper – optional

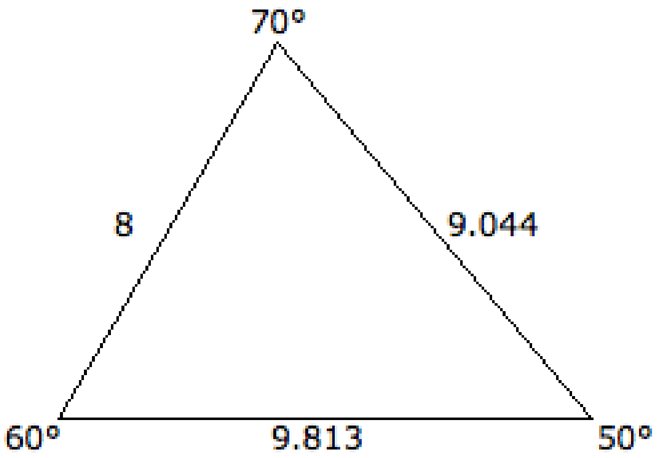
Relevant content descriptions from the Western Australian Curriculum

- Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)
- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)
- Classify triangles according to their side and angle properties and describe quadrilaterals (ACMMG165)

Students can demonstrate

- *fluency* when they
  - recognise that the angle sum of a triangle is 180^0
  - draw the given angles and sides
- *understanding* when they
  - calculate/measure the missing angles and sides
  - find another way to draw the triangle with the given measurements
  - understand the angle size of the missing angle will not change when given two angles
  - understand that a change in side length will affect the area of the triangle
- *reasoning solving* when they
  - explain their findings mathematically
- *problem solving* when they
  - investigate the effects of changing the known values of a triangle

Joe was asked to draw a triangle with angle sizes 60^0 and 70^0 and a side length of 8 cm. He used a protractor, compass and ruler to draw his triangle. He was then required to find the missing side lengths, angle size and total area of the triangle. He used a ruler and protractor to find these missing values. He rounded all of his answers to one decimal place. This is what he produced:



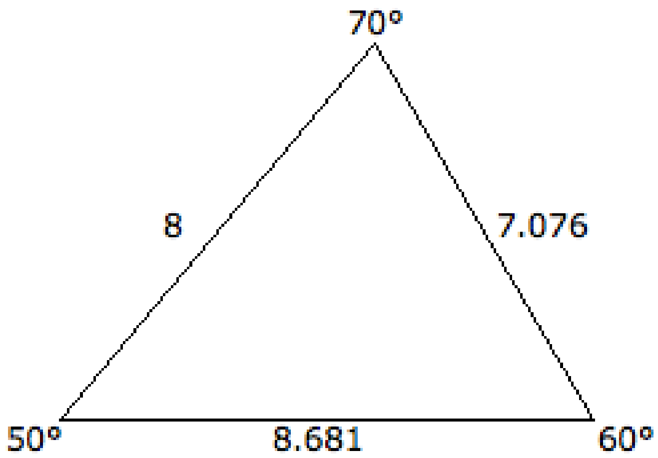
Height = 6.9 cm
Area = 34.0 cm^2

Jack was impressed that Joe had got the 'correct answer'. However, the teacher stated that there might be other 'correct answers'. How is this possible?

Activity 1

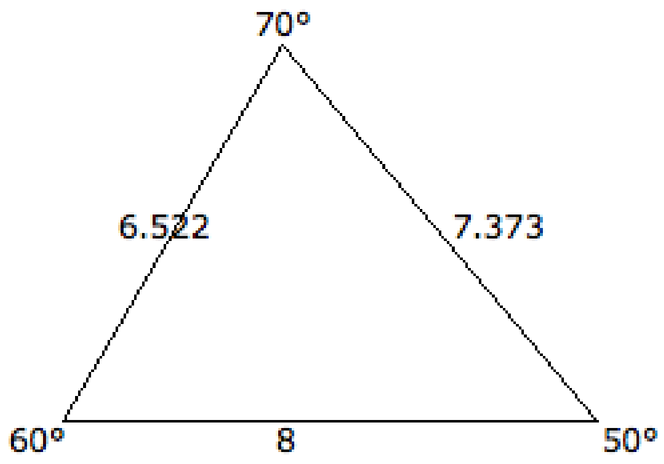
1. Investigate the different ways a triangle with angle sizes 60^0 and 70^0 and a side length of 8 cm can be drawn.

(i)



Height: 6.1 cm
Area: 26.5 cm^2

(ii)



Height: 5.7 cm
Area: 22.8 cm^2

2. Will the missing angle always be the same size? Explain you answer.

   The missing angle will always be 50^0.
   The angles of a triangle must add to 180^0.
   180 – 70 – 60 = 50

3. Will the missing sides always be the same length? Explain your answer.

   No the side lengths will not always be the same.
   The positions of the angles will affect the lengths of the sides.

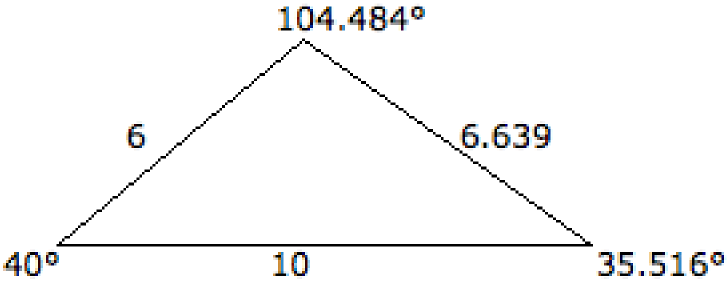
4. Will the area always be the same? Explain your answer.

   No, the area will not always be the same.
   The side lengths will not always be the same, and this has a direct effect on the area.

Activity 2

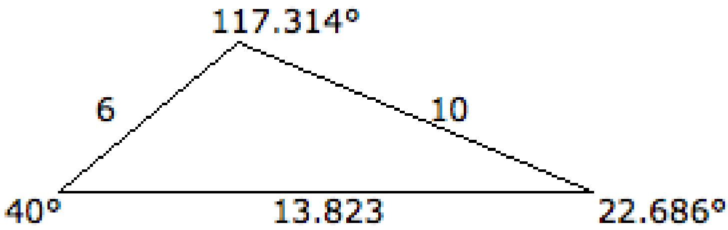
What if we changed the values given to one side and two angles? Let's look at a triangle with side lengths of 10 cm and 6 cm and an angle size of 40^0. Is there only one way of drawing this triangle? Investigate and explain your findings.

(i)



Height: 3.9 cm
Area: 19.5 cm^2

(ii)



Height: 3.9 cm
Area: 26.7 cm^2

There are two possible ways of drawing the given triangle. Other ways are just different orientations of the same triangle.

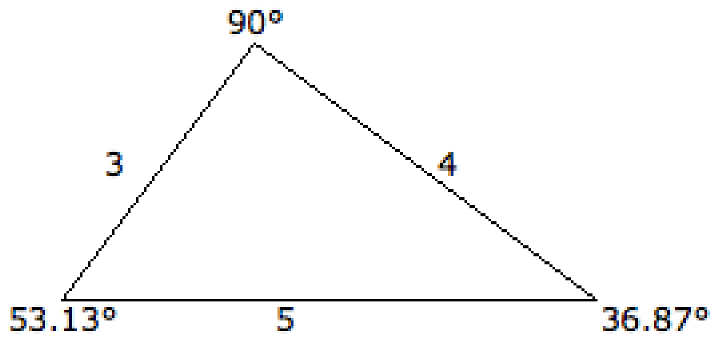
Activity 3

What if we changed the values given to three angles? Let's look at a triangle with angle sizes of 50^0, 90^0, and 40^0. Is there only one way of drawing this triangle? Investigate and explain your findings.

When given the three angle sizes, there is no impact on the side length. There is an infinite number of different triangles that could meet this specification. They are all similar triangles of different sizes.

Activity 4

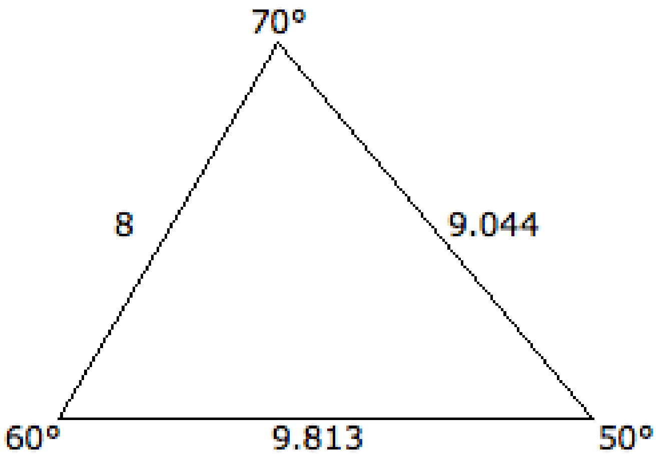
What if we changed the values given to three sides? Let's look at a triangle with side lengths of 3 cm, 4 cm, and 5 cm. Is there only one way of drawing this triangle? Investigate and explain your findings.



Height: 2.4 cm
Area: 6 cm^2

There is only one possible way to draw this triangle. Other ways are just different orientations of the same triangle.

Joe was asked to draw a triangle with angle sizes 60^0 and 70^0 and a side length of 8 cm. He used a protractor, compass and ruler to draw his triangle. He was then required to find the missing side lengths, angle size and total area of the triangle. He used a ruler and protractor to find these missing values. He rounded all of his answers to one decimal place. This is what he produced:



Height = 6.9 cm
Area = 34 cm^2

Jack was impressed that Joe had got the 'correct answer'. However, the teacher stated that there might be other 'correct answers'. How is this possible?

Activity 1

1. Investigate the different ways a triangle with angle sizes 60^0 and 70^0 and a side length of 8 cm can be drawn.

2. Will the missing angle always be the same size? Explain you answer.

3. Will the missing sides always be the same length? Explain your answer.

4. Will the area always be the same? Explain your answer.

Activity 2

What if we changed the values given to one side and two angles? Let's look at a triangle with side lengths of 10 cm and 6 cm and an angle size of 40^0. Is there only one way of drawing this triangle? Investigate and explain your findings.

Activity 3

What if we changed the values given to three angles? Let's look at a triangle with angle sizes of 50^0, 90^0, and 40^0. Is there only one way of drawing this triangle? Investigate and explain your findings.

Activity 4

What if we changed the values given to three sides? Let's look at a triangle with side lengths of 3 cm, 4 cm, and 5 cm. Is there only one way of drawing this triangle? Investigate and explain your findings.

Department of Education

The Mathematical Association of Western Australia Inc. MAΣWA

YEAR 7 MATHEMATICS

Measurement & Geometry Activity

Triangle Angles

PRODUCED BY A DEPARTMENT OF EDUCATION - MAWA PARTNERSHIP PROJECT

WRITTEN FOR THE YEAR 7 AUSTRALIAN CURRICULUM

TASK 137: TRIANGLE ANGLES

Overview

In this task, students will investigate whether the angle sum of polygons can be found using the angle sum of a triangle. Students will make connections between related concepts and progressively apply the familiar to develop new ideas. They will develop a more sophisticated approach to proving, explaining and generalising.

Students will need

- calculator
- protractor

Relevant content descriptions from the Western Australian Curriculum

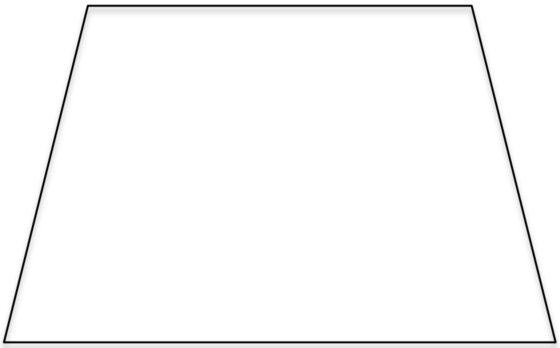
- Demonstrate that the angle sum of a triangle is 180° and use this to find the angle sum of a quadrilateral (ACMMG166)

Students can demonstrate

- *fluency* when they
  - name the quadrilateral shown
  - measure angles correctly to calculate angle sum
- *understanding* when they
  - check that Suzie's idea is correct
  - write a rule algebraically
- *reasoning* when they
  - explain why this method works for other quadrilaterals and polygons
  - describe a general rule for this method
- *problem solving* when they
  - apply the method to other quadrilaterals
  - apply the method to other polygons

Miss Brady asked her students to draw a quadrilateral and work out, using a protractor, what the angles in that quadrilateral add up to.

Suzie drew the following quadrilateral:



Activity 1

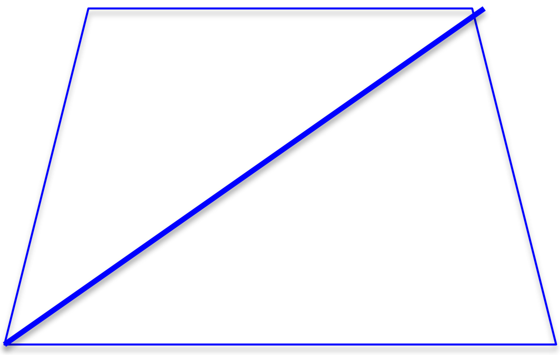
1. Name the quadrilateral that Suzie drew.
   Trapezium

2. Using a protractor, work out what the angles in Suzie's quadrilateral should add up to.
   360^0

Activity 2

Suzie notices that if she draws a diagonal on her quadrilateral, as shown below, it forms two triangles. Suzie knows that the angles in a triangle add up to 180^0, she wonders that if it means the angles in her quadrilateral should add up to 2×180^0, which is 360^0.

1. Re-draw Suzie's quadrilateral with the diagonal drawn in and check that her idea is correct.



Each triangle adds to 180^0. $180^0 + 180^0 = 360^0$
When the angles of the trapezium are measured and added, they add to 360^0.
Her idea is correct.

2. Will this method work for other quadrilaterals? Check at least three other quadrilaterals.
   Yes this idea can be applied to other quadrilaterals.
   Check that students have given three other examples.

3. Can this idea be used with polygons with more than four sides? Check at least three other polygons.
   Yes this idea can be applied to other polygons.
   Check that students have given three other examples.

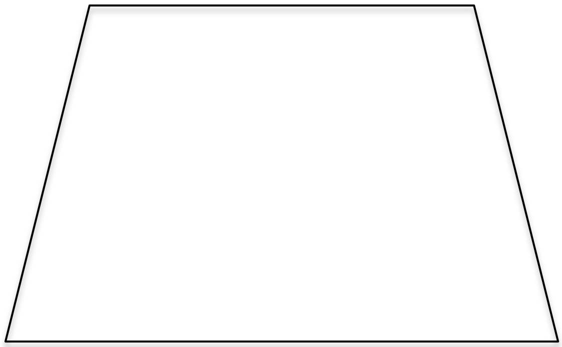
4. Explain why this method does or doesn't work.
   Answers will vary.
   This method works because we can divide any polygon, from one vertex to another vertex, into a number of triangles. None of the angles will meet in the middle of the shape.

5. Describe a general rule that could be used to determine the angle sum in any polygon.
   Take the number of sides and subtract 2. Multiplied this answer by 180^0.

6. Can you write your rule algebraically, where n is the number of sides of a polygon?
   $(n – 2)180^0$

Miss Brady asked her students to draw a quadrilateral and work out, using a protractor, what the angles in that quadrilateral add up to.

Suzie drew the following quadrilateral:



Activity 1

1. Name the quadrilateral that Suzie drew.

2. Using a protractor, find the sum of the angles in Suzie's quadrilateral.

Activity 2

Suzie notices that if she draws a diagonal on her quadrilateral, as shown, it forms two triangles. Suzie knows that the angles in a triangle add to 180^0, she wonders if that means the angles in her quadrilateral add to 2×180^0, which is 360^0.

1. Re-draw Suzie's quadrilateral with the diagonal drawn in, and check that her idea is correct.

2. Will this method work for other quadrilaterals? Check at least three other quadrilaterals and record your findings

3. Can this idea be used with polygons with more than four sides? Check at least three other polygons.

4. Explain why this method does or doesn’t work.

5. Describe a general rule that could be used to determine the angle sum in any polygon.

6. Can you write your rule algebraically?