S1 Topic 6

Symmetry

Level: Key stage 3

Dimension: Measures, Shape and Space
Module: Learning Geometry through an Intuitive Approach
Unit: Symmetry

Student ability: Low to average

Content Objectives:

After completing the activity, students should be able to master the concepts of reflectional symmetry, axis of symmetry, rotational symmetry and centre of rotation and apply the concepts in solving word problems concerning symmetry.

Language Objectives:

After completing the activity, students should be able to:

- recognise and understand the English technical terms related to reflectional and rotational symmetry (e.g., *axis, line of symmetry, symmetrical figures, image, reflectional symmetry, rotational symmetry, centre of rotation, n-fold rotational symmetry*);
- understand the definition and characteristics of reflectional symmetry when explained in English (e.g., *This figure has the property of reflectional symmetry because it can be divided by a straight line into two parts such that one part is the mirror image of the other*);
- understand the definition and characteristics of rotational symmetry when explained in English (e.g., *This figure has the property of rotational symmetry because when it is rotated about the centre of rotation, the figure appears to be in exactly the same position as the original figures n times)*; and
- follow instructions in English on solving problems concerning symmetry and rotation and work on related problems written in English

Prerequisite knowledge:

Students have the experience of identifying the symmetrical objects in nature and in their

everyday lives.

Time: 2 lessons (80 minutes)

Procedure:

Lesson One – reflectional symmetry and axis of symmetry:

1. The teacher should first show students some symmetrical objects or symmetrical figures made out of folded paper and guide them to identify the characteristics of reflectional symmetry in a way that facilitates classroom interaction.

2. The teacher should then introduce the definition of reflectional symmetry and axis of symmetry.

3. The students should then complete exercise 1. The teacher may help the students if necessary. The exercises can provide students with opportunities to draw images representing the two concepts and enable the teacher to check students' understanding. If there is not enough time in class, the teacher can assign a few questions as homework.

Lesson Two – rotational symmetry:

4. The teacher should prepare a paper triangle fixed to a stick at one of its corners which enables the triangle to be rotated. The teacher can use the rotating triangle to introduce the term *centre of rotation*. The teacher should then rotate the triangle, dividing the rotation into 5 equal turns (each turn covering $72°$) to make up one complete revolution. The teacher should then draw the shape created at each rotation on the board. The final product should be a star-shaped figure on the board.

5. The teacher should then introduce the definition of rotational symmetry and order of rotational symmetry.

6. The students can then complete exercise 2 which provides them with the opportunity to mark the centre of rotation and distinguish the order of rotational symmetry of each of the four figures (a) to (d). The teacher can invite individual student to explain their answers and thus allow students to practise their oral skills in the class.

7. Finally, the teacher should assign worksheet 3 showing District Board logos as homework.

Explanatory Notes for Teachers:

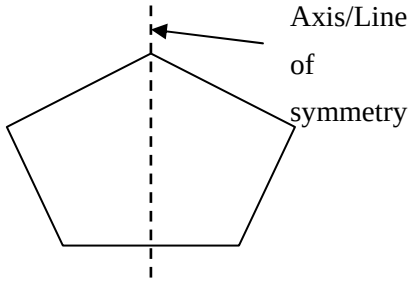
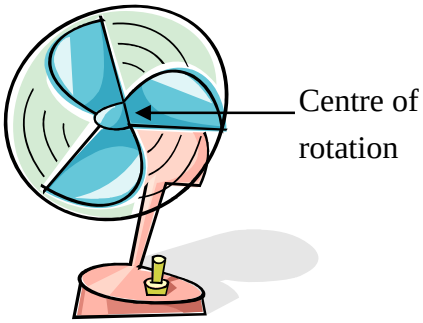
This extended learning activity covers the topic of Symmetry in the Form One Mathematics Curriculum. The topic should be taught using English as the medium of instruction. This should be possible as the topic involves basic concepts which are relatively easy to comprehend and which can be demonstrated by means of objects, graphic and board drawings. It is also a relatively independent topic with respect to other topics of geometry. The activity is divided into two sections covering reflectional symmetry and rotational symmetry respectively. As well as being relatively easy to demonstrate, the concept can be applied to students' daily lives since all students can easily find symmetrical objects around them, such as butterflies, scissors, mirrors and so forth. In addition, it is easy for students to recognise the pattern (for example: a star shape) created by rotating a figure about its centre of rotation.

1. The relevant vocabulary list which is enclosed for reference can provide teachers and student with a clear outline of the topic and serve as revision guidelines.

2. Each section of the exercise includes an exercise consisting of two or more questions. Teachers can assign those questions as classwork or homework to help in determining the degree of student understanding.

3. The assignment is based on District Council logo signs of district councils, some of which apply the concept of reflection and / or rotation in design; this allows students to recognise how these concepts can be applied in their daily lives.

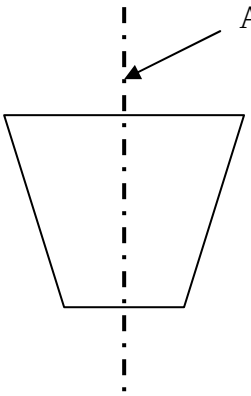
Suggested Vocabulary List for this chapter:

Axis / line of symmetry 對稱軸	
Symmetrical figures 對稱圖形	
Image 影像	
Reflectional symmetry 反射對稱	
Rotational symmetry 旋轉對稱	
Centre of rotation 旋轉中心	
n-fold rotational symmetry n重旋轉對稱 (This example is a three-fold rotational symmetry)	

Name: _____ Class: _____ ( )

Symmetry and Transformation

A) Reflectional Symmetry

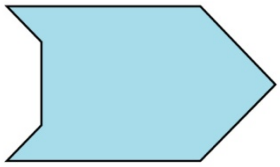


This figure can be divided by a straight line into two parts such that one part is the mirror image (image of reflection) of the other. This figure has the property of reflectional symmetry (反射對稱), and the line is called the axis of symmetry (對稱軸).

Exercise 1:

1. If the following figures have the property of reflectional symmetry, draw the axis of symmetry (some figures may have more than one axis of symmetry). If the figure does not have reflectional symmetry, mark an "X" next to it.

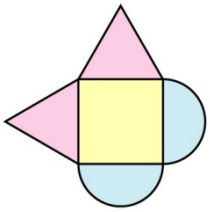
a)



b)

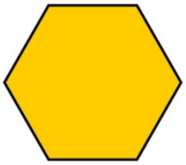
c)

d)



e)

f)



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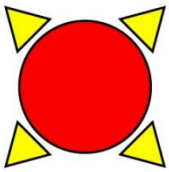

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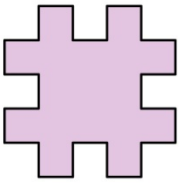
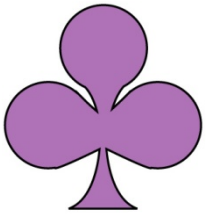


i)



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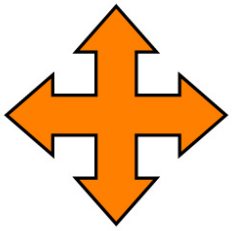
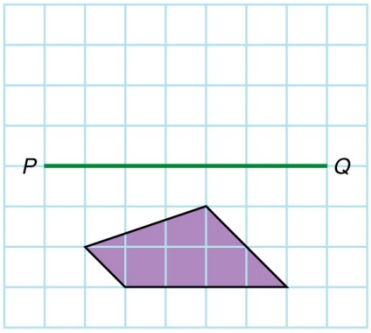
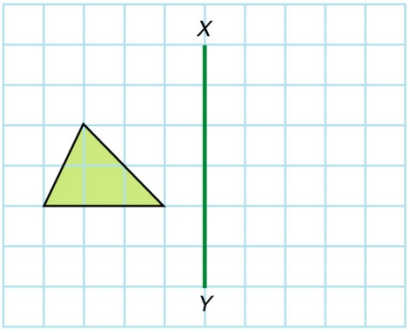


2. In the following figures, the solid straight lines are the axes of symmetry, draw the images of reflection to produce figures with reflectional symmetry properties.

a)



b)



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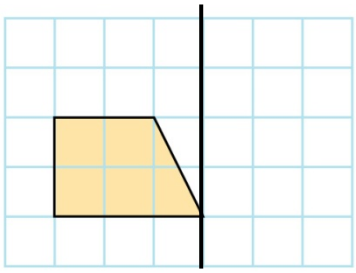

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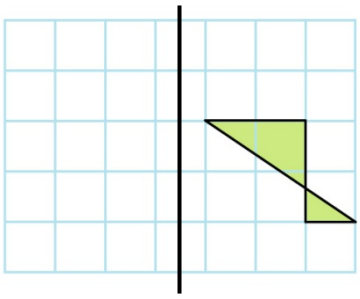
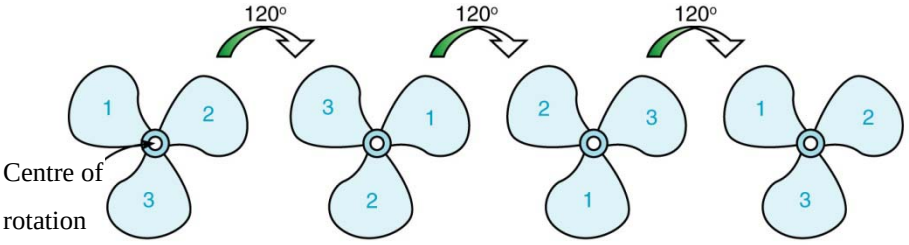


Name: _____ Class: _____ ( )

B) Rotational Symmetry



repeat once repeat twice repeat three times

When the figure is rotated about the centre of rotation (旋轉中心), the figure appears to be in exactly the same position as the original figure three times, and this figure is said to have rotational symmetry with order of rotational symmetry 3. We can also say that the figure has the property of 3-fold rotational symmetry.

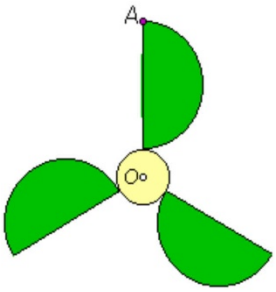
Exercise 2:

Each of the following figures has rotational symmetry.

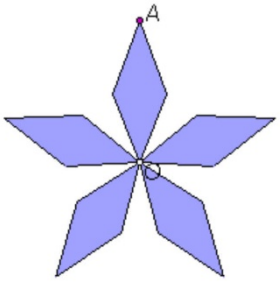
(i) Use a dot "." to mark the centre of rotation on each figure.

(ii) Find the order of rotational symmetry that of each of these figures has.

(a)



(b)



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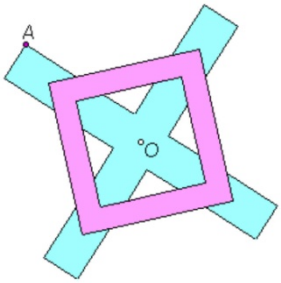


(d)

Symmetry

Name: _____ Class: _____ ( )

Exercise 3:

Here are the signs of the district councils in Hong Kong.

For signs that show symmetry, put a tick (✓) in the right hand circle.

For signs that do not, put a cross (×) in the circle.

For figures that show reflection, draw a dotted line to represent the axis of symmetry.

For figures that show rotation, mark the centre of rotation with a cross.










Question:

Can you find out which sign represents the district where your school is located?

Answer:

My school is in _____ district. The sign is:

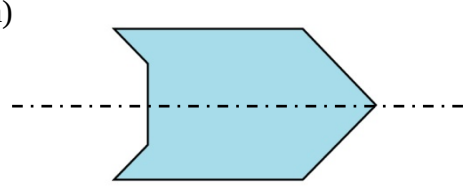
_____

Suggested answers:

Exercise 1:

1. If the following figures have reflectional symmetry property, draw the axis of symmetry (some figures may have more than one axis of symmetry). If not, mark an "X" next to it.

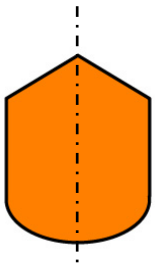
a)



b)

X

c)



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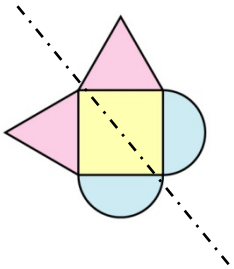
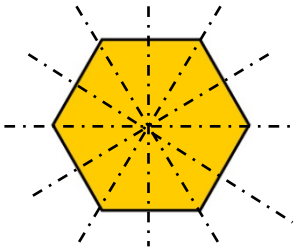


e)

No

f)



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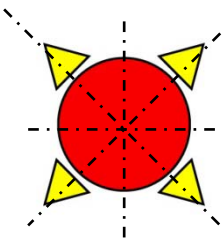

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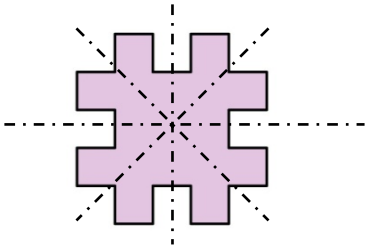
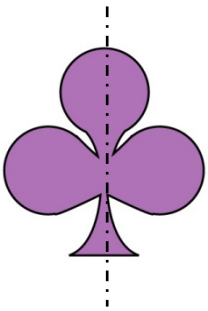


i)



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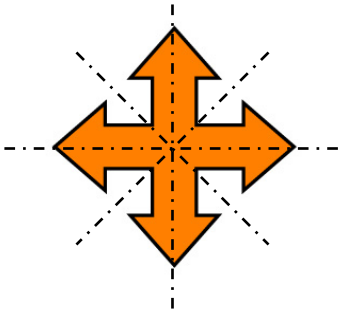
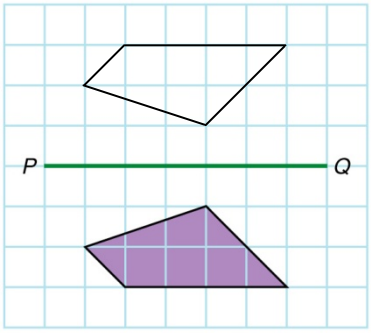
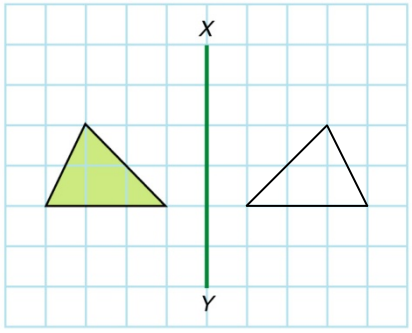


2. In the following figures, the solid straight lines are the axes of symmetry, draw the images of reflection to produce figures with reflectional symmetry properties.

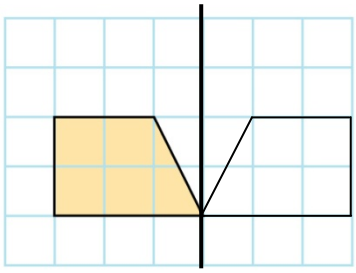
a)



b)



c)



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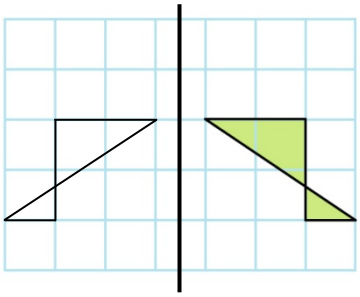


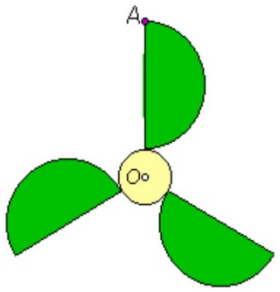
Exercise 2:

Each of the following figures has rotational symmetry.

(iii) Use a dot "." to mark the centre of rotation on each figure.

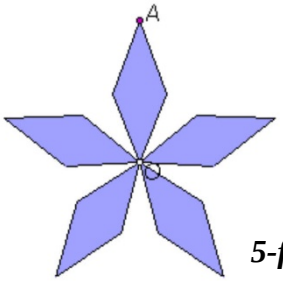
(iv) Find the order of rotational symmetry that of each of these figures has.

(a)



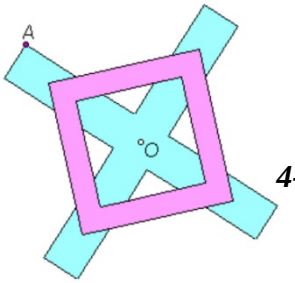
3-fold

(b)



5-fold

(c)



4-fold

(d)

4-fold

Symmetry

Suggested answers:

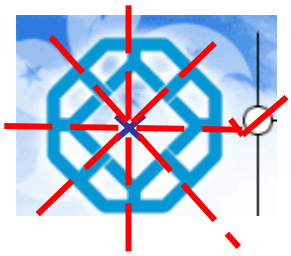
Here are the signs of the district councils in Hong Kong.

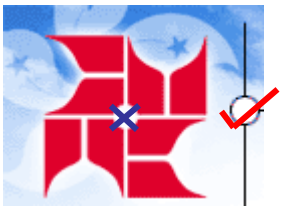
For signs that show transformation, put a tick (✓) in the right hand circle.

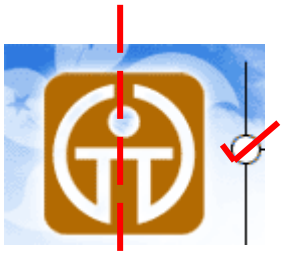
For signs that do not, put a cross (×) in the circle.

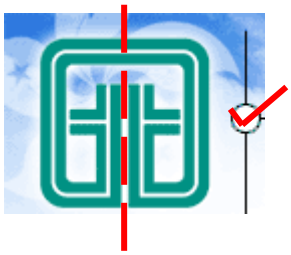
For figures that show reflection, draw a dotted line to represent the axis of symmetry.

For figures that show rotation, mark the centre of rotation with a cross.

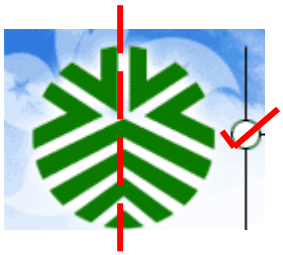













Question

Can you find out which sign represents the district where your school is located?

Answer:

My school is in _____ district. The sign is:

_____