9-5/9-6

Symmetry/Tessellations

OBJECTIVES

To identify and describe symmetry in geometric figures

Use transformations to draw tessellations.

Identify regular and semiregular tessellations and figures that will tessellate.

SYMMETRY

A figure has **symmetry** if there is a transformation of the figure such that the image coincides with the preimage.

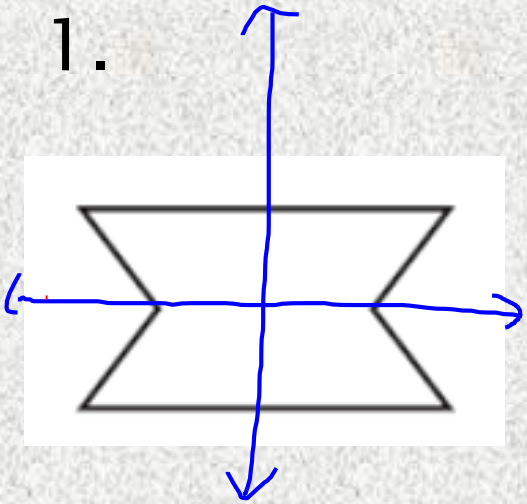
Line Symmetry

A figure has **line symmetry** (or reflection symmetry) if it can be reflected across a line so that the image coincides with the preimage. The **line of symmetry** (also called the axis of symmetry) divides the figure into two congruent halves.

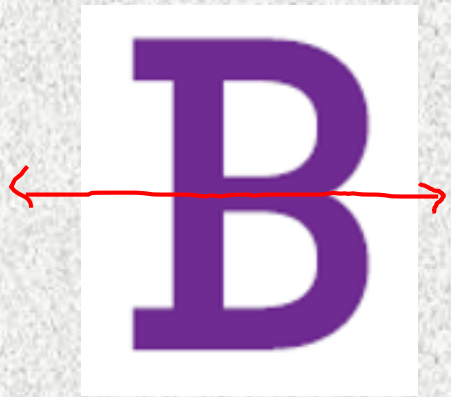
EXAMPLES

Tell whether each figure has line symmetry. If so, draw all possible lines of symmetry on the figure.

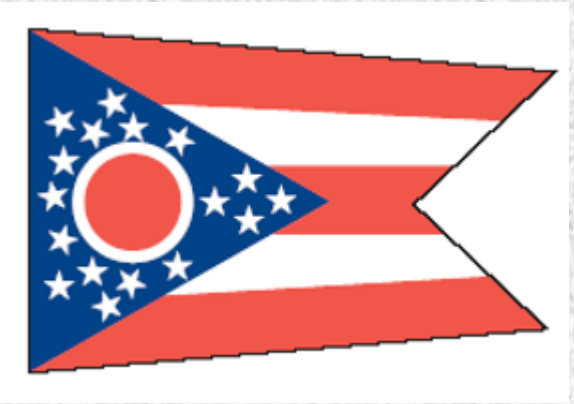
1.



2.



3.



no

SYMMETRY

Rotational Symmetry

A figure has **rotational symmetry** (or *radial symmetry*) if it can be rotated about a point by an angle greater than 0° and less than 360° so that the image coincides with the preimage.

The *angle of rotational symmetry* is the smallest angle through which a figure can be rotated to coincide with itself. The number of times the figure coincides with itself as it rotates through 360° is called the *order* of the rotational symmetry.

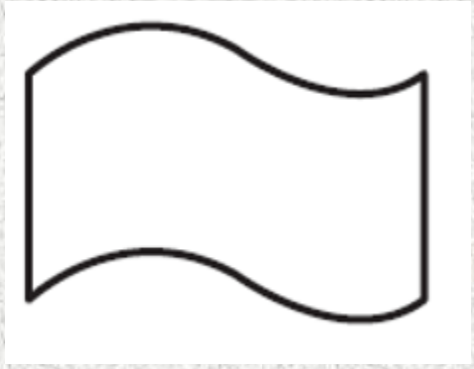
EXAMPLES

Tell whether each figure has rotational symmetry. If so, give the angle of rotation and the order.

4.

No rotational symmetry

5.



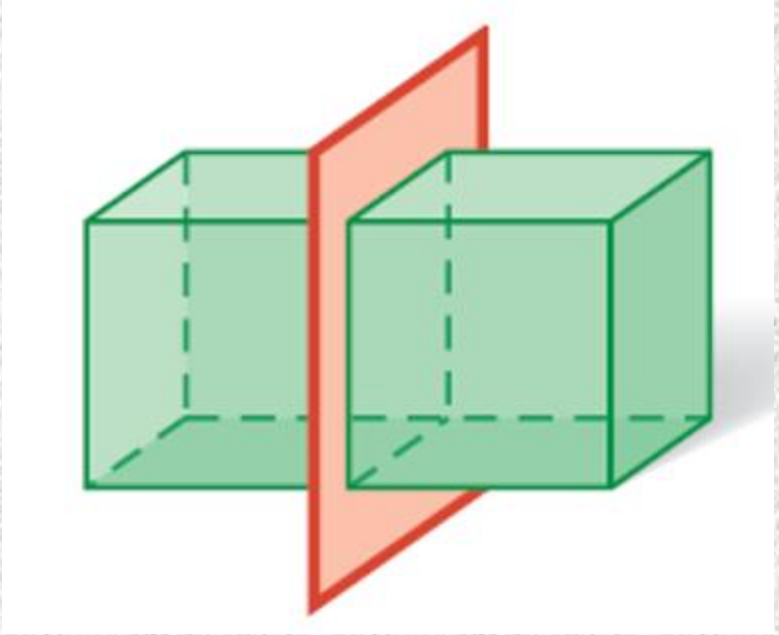
Yes – 180°
Order: 2

6.

Yes – 90°
Order: 4

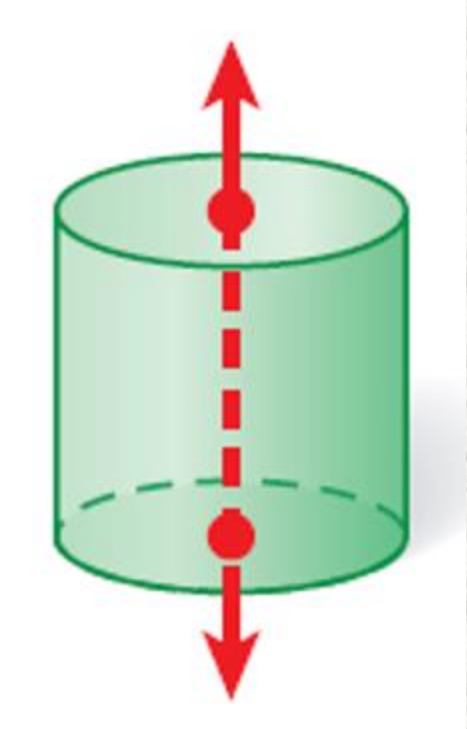
SYMMETRY

A three-dimensional figure has *plane symmetry* if a plane can divide the figure into two congruent reflected halves.



SYMMETRY

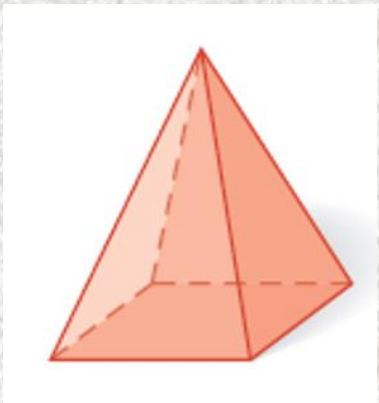
- A three-dimensional figure has *symmetry about an axis* if there is a line about which the figure can be rotated (by an angle greater than 0° and less than 360°) so that the image coincides with the preimage.



EXAMPLES

Tell whether each figure has plane symmetry, symmetry about an axis, both, or neither.

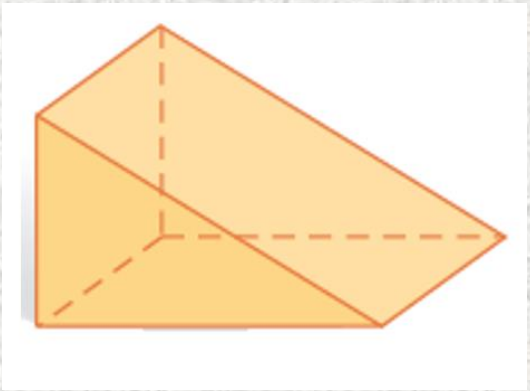
7.



Rectangular Base

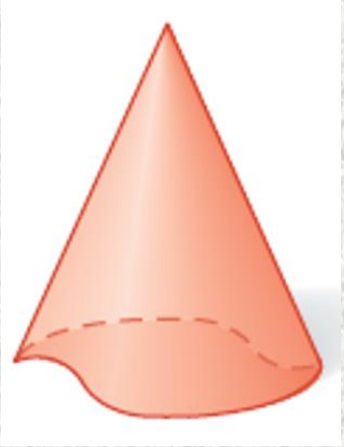
Both. Two planes, one axis.

8.



Plane symmetry. One plane.

9.



Symmetry about one axis

SYMMETRY

A pattern has **translation symmetry** if it can be translated along a vector so that the image coincides with the preimage.

A **frieze pattern** is a pattern that has translation symmetry along a line.

A pattern with **glide reflection symmetry** coincides with its image after a glide reflection.

EXAMPLES

Identify the symmetry in each wallpaper border pattern.

10. 

translation symmetry

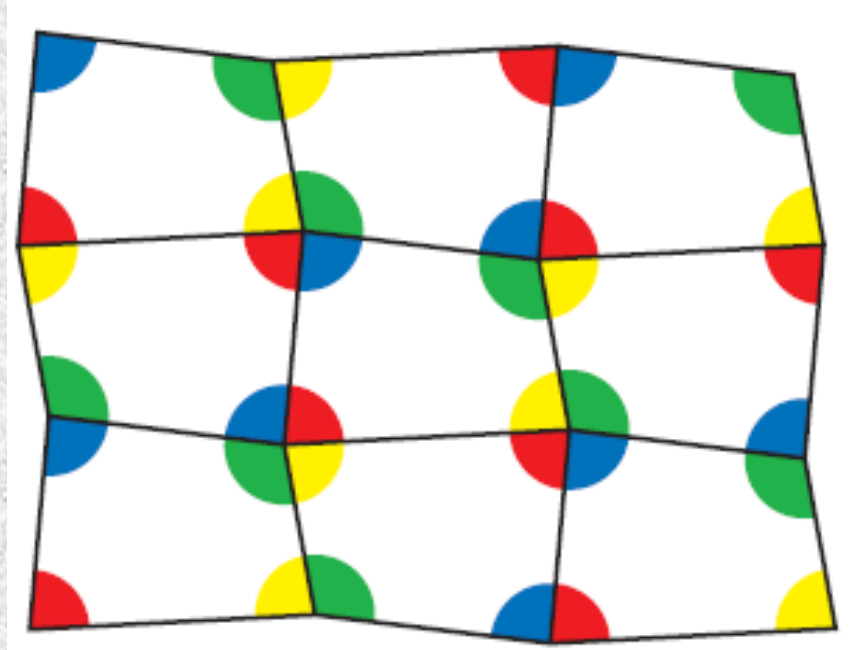
11. 

translation and glide reflection symmetry

TESSELLATION

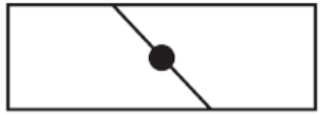
A **tessellation**, or *tiling*, is a repeating pattern that completely covers a plane with no gaps or overlaps. The measures of the angles that meet at each vertex must add up to 360°.

In the tessellation shown, each angle of the quadrilateral occurs once at each vertex. Because the angle measures of any quadrilateral add to 360°, any quadrilateral can be used to tessellate the plane. Four copies of the quadrilateral meet at each vertex.



TESSELLATION

Copy the given figure and use it to create a tessellation.



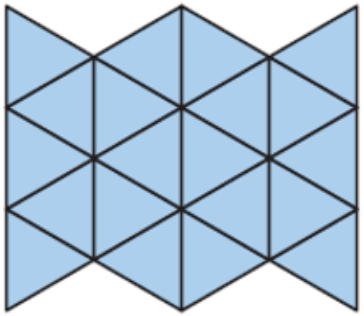
Step 1 Rotate the quadrilateral 180° about the midpoint of one side.

Step 2 Translate the resulting pair of quadrilaterals to make a row of quadrilateral.

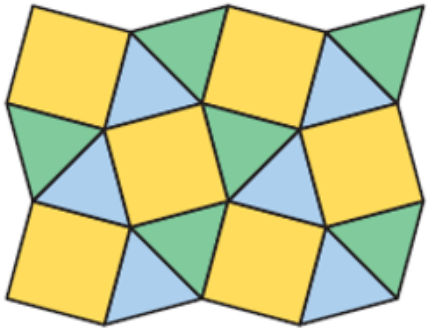
Step 3 Translate the row of quadrilaterals to make a tessellation.

TESSELLATION

A **regular tessellation** is formed by congruent regular polygons. A **semiregular tessellation** is formed by two or more different regular polygons, with the same number of each polygon occurring in the same order at every vertex.



Regular tessellation



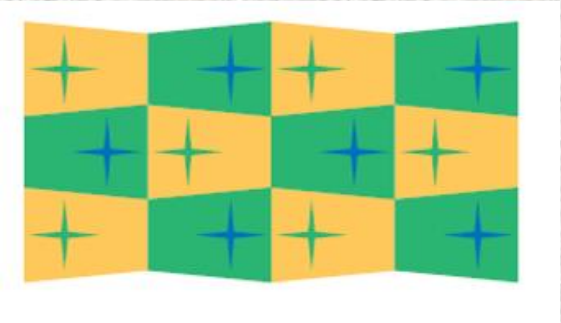
Semiregular tessellation

Every vertex has two squares and three triangles in this order: square, triangle, square, triangle, triangle.

EXAMPLES

Tell whether each tessellation is regular, semiregular, or neither.

12.

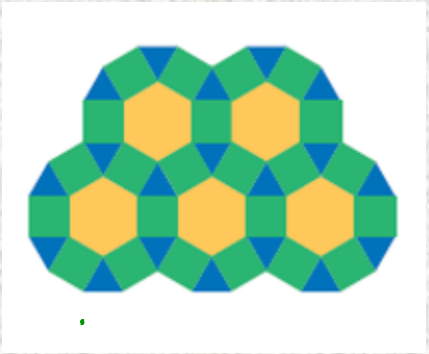


Irregular polygons are used in the tessellation. It is neither regular nor semiregular.

13.

Only triangles are used. The tessellation is regular.

14.



A hexagon meets two squares and a triangle at each vertex. It is semiregular.

LEARNING RUBRIC

- Got It: Create tessellations
- Almost There: Identify types of tessellations
- Moving Forward: Identify plane symmetry and axis symmetry
- Getting Started: Identify line and point symmetry

HOMEWORK

- 9-5 Pages 637-638: 14,16,18,20,22,30,32
- 9-6 Page 647: 16,18,22,24,28,32,34