

1 Symmetry in Two-Dimensional Figures A figure has **symmetry** if there exists a rigid motion—reflection, translation, rotation, or glide reflection—that maps the figure onto itself. One type of symmetry is line symmetry.

KeyConcept Line Symmetry

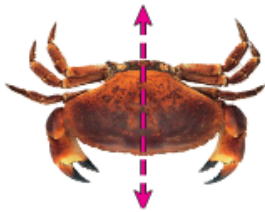
A figure in the plane has **line symmetry** (or *reflection symmetry*) if the figure can be mapped onto itself by a reflection in a line, called a **line of symmetry** (or *axis of symmetry*).



Real-World Example 1 Identify Line Symmetry

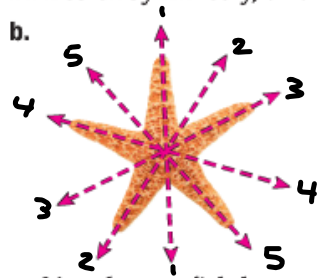
BEACHES State whether the object appears to have line symmetry. Write *yes* or *no*. If so, copy the figure, draw all lines of symmetry, and state their number.

a.



Yes; the crab has one line of symmetry.

b.



Yes; the starfish has five lines of symmetry.

c.

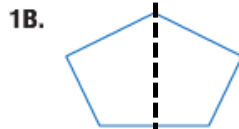


No; there is no line in which the oyster shell can be reflected so that it maps onto itself.

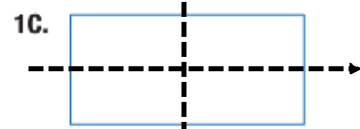
State whether the figure has line symmetry. Write *yes* or *no*. If so, copy the figure, draw all lines of symmetry, and state their number.



Parallelogram
no



pentagon
yes
1 line



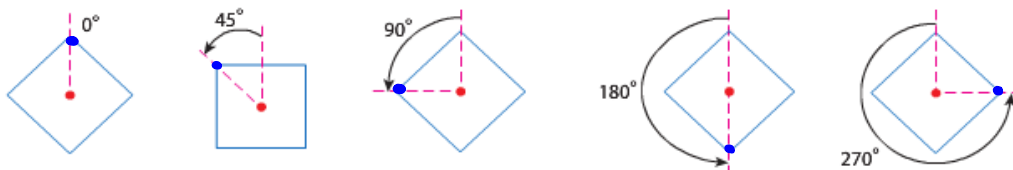
parallelogram-
rectangle
yes
2 lines
horizontal
vertical

Another type of symmetry is rotational symmetry.

KeyConcept Rotational Symmetry

A figure in the plane has **rotational symmetry** (or *radial symmetry*) if the figure can be mapped onto itself by a rotation between 0° and 360° about the center of the figure, called the **center of symmetry** (or *point of symmetry*).

Examples The figure below has rotational symmetry because a rotation of 90° , 180° , or 270° maps the figure onto itself.



The number of times a figure maps onto itself as it rotates from 0° to 360° is called the **order of symmetry**. The **magnitude of symmetry** (or angle of rotation) is the smallest angle through which a figure can be rotated so that it maps onto itself. The order and magnitude of a rotation are related by the following equation.

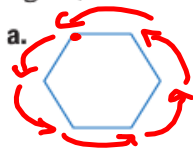
$$\text{magnitude} = 360^\circ \div \text{order}$$

The figure above has rotational symmetry of order 4 and magnitude 90° . → because

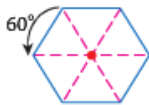
$$\frac{360}{4} = 90^\circ$$

Example 2 Identify Rotational Symmetry

State whether the figure has rotational symmetry. Write *yes* or *no*. If so, copy the figure, locate the center of symmetry, and state the order and magnitude of symmetry.



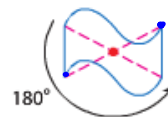
Yes; the regular hexagon has order 6 rotational symmetry and magnitude $360^\circ \div 6$ or 60° . The center is the intersection of the diagonals.



No; no rotation between 0° and 360° maps the right triangle onto itself.

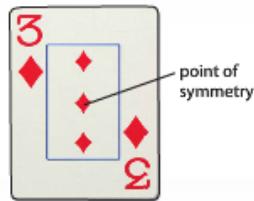


Yes; the figure has order 2 rotational symmetry and magnitude $360^\circ \div 2$ or 180° . The center is the intersection of the diagonals.



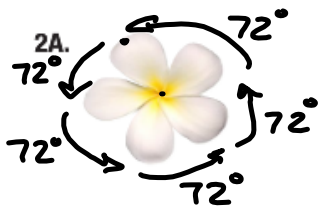
StudyTip

Point Symmetry A figure has *point symmetry* if the figure can be mapped onto itself by a rotation of 180° . A playing card exhibits point symmetry. It looks the same right-side up as upside down.



point symmetry:
looks the same
upside-down as
it does
right-side up.

State whether the flower appears to have rotational symmetry. Write *yes* or *no*. If so, locate the center of symmetry, and state the order and magnitude of symmetry.

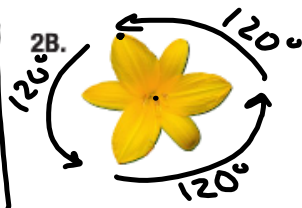


yes

order = 5

magnitude =

$$\frac{360}{5} = 72^\circ$$



yes

order = 3

magnitude =

$$\frac{360}{3} = 120^\circ$$

2C.



no

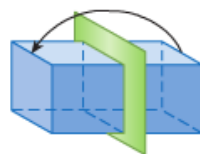
2 Symmetry in Three-Dimensional Figures

Three-dimensional figures can also have symmetry.

KeyConcept Three-Dimensional Symmetries

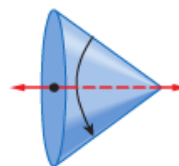
Plane Symmetry

A three-dimensional figure has **plane symmetry** if the figure can be mapped onto itself by a reflection in a plane.



Axis Symmetry

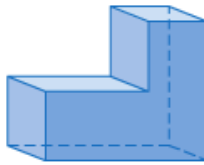
A three-dimensional figure has **axis symmetry** if the figure can be mapped onto itself by a rotation between 0° and 360° in a line.



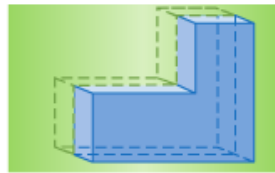
ReviewVocabulary
prism a polyhedron with two parallel congruent bases connected by parallelogram faces

State whether the figure has *plane* symmetry, *axis* symmetry, *both*, or *neither*.

a. L-shaped prism



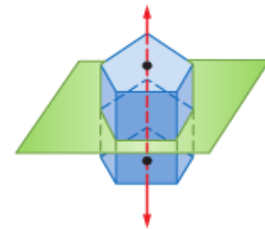
plane symmetry



b. regular pentagonal prism



both plane symmetry and axis symmetry



SPORTS State whether each piece of sports equipment appears to have *plane* symmetry, *axis* symmetry, *both*, or *neither* (ignoring the equipment's stitching or markings).

3A.



BOTH

3B.



NEITHER

3C.



PLANE

3D.



BOTH

