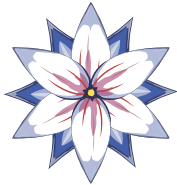


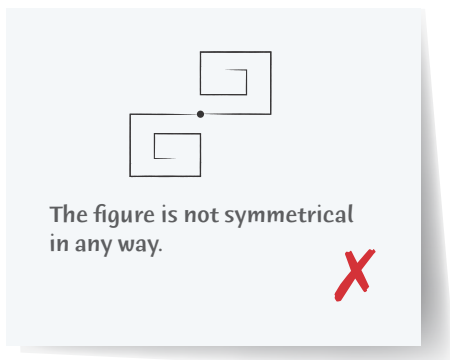


UNDERSTAND

12. **Construct Arguments** Is it possible for a figure to have reflectional symmetry and no rotational symmetry? Explain or give examples.
13. **Reason** Explain how you would find the angles of rotational symmetry for the figure shown.



14. **Mathematical Connections** A figure that has 180° rotational symmetry also has point symmetry. Write a conditional to relate those facts. Then, write the converse, inverse, and contrapositive.
15. **Look for Relationships** If a figure has 90° rotational symmetry, what other symmetries must it have?
16. **Error Analysis** Yumiko's work is shown below. What error did she make?



17. **Higher Order Thinking** Three types of rigid motion are translations, rotations, and reflections. A frieze pattern is a linear pattern that repeats, and it has translational symmetry. An example is shown below.



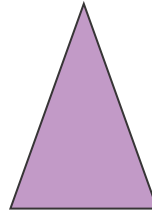
Find and name some occurrences of frieze patterns in the real world.

PRACTICE

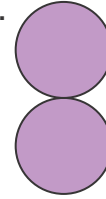
For Exercises 18 and 19, find all transformations that can be used to map each figure onto itself.

SEE EXAMPLE 1

18.



19.

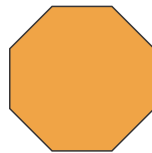


20. How many lines of symmetry does a regular five-pointed star have? SEE EXAMPLE 2



For Exercises 21 and 22, describe the rotational symmetries of each figure. SEE EXAMPLE 3

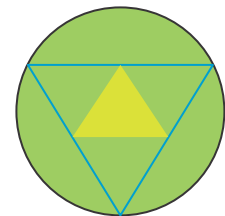
21.



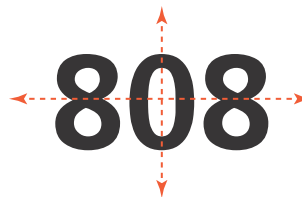
22.



23. What types of symmetry does the figure have? Explain. SEE EXAMPLE 4



24. When drawn in the style shown, the number 808 has horizontal and vertical reflectional symmetry, as well as 180° rotational symmetry.



What are some other combinations of numbers or letters with symmetry? Find at least three other combinations, and identify the types of symmetry for each. SEE EXAMPLE 5

APPLY

25. **Reason** How would you decide which flags show reflection symmetry? Rotational symmetry? No symmetry?



Canada



Sweden

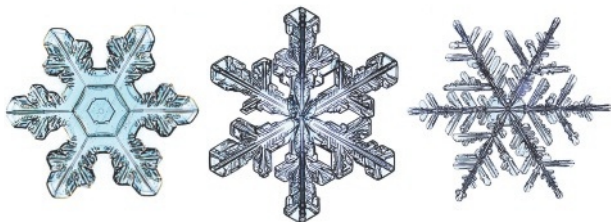


Jamaica



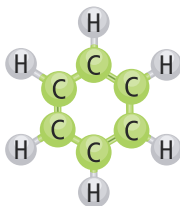
Saint Kitts and Nevis

26. **Look for Relationships** Make observations about the structure of each snowflake, and describe the types of symmetry that a snowflake can have.

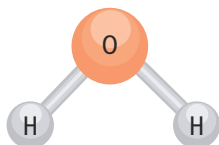


27. **Make Sense and Persevere** Describe the symmetries of each molecule shown.

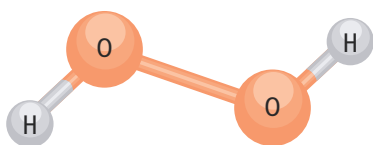
a. benzene



b. water

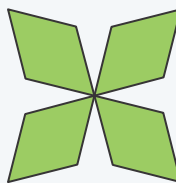


c. hydrogen peroxide



ASSESSMENT PRACTICE

28. Which types of symmetry does the figure display? Select all that apply.



- (A) reflectional symmetry across a vertical line
- (B) reflectional symmetry across a horizontal line
- (C) 120° rotational symmetry
- (D) 180° rotational symmetry

29. **SAT/ACT** Which letter can be mapped onto itself by a 180° rotation about its center?



30. **Performance Task** A client wants a graphic designer to create an emblem that has rotational symmetry of 90° and 180° . The client needs the colors of the emblem to be red, yellow, and blue. The emblem should also include the first letter of the company name, X.

Part A The designer begins his design with a polygon. What polygons can he use?

Part B If a figure has rotational symmetry of 90° and 180° , what type of reflectional symmetry does the figure have?

Part C Create two possible designs for the client.