LESSON 12.1

NAME _____ DATE _____

Reteaching with Practice

For use with pages 719–726

GOAL **Use properties of polyhedra and use Euler's Theorem**

VOCABULARY

A **polyhedron** is a solid that is bounded by polygons that enclose a single region of space.

The polygons that a polyhedron is bounded by are called **faces**.

An **edge** of a polyhedron is a line segment formed by the intersection of two faces.

A **vertex** of a polyhedron is a point where three or more edges meet.

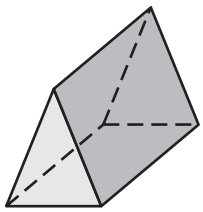
A polyhedron is **regular** if all of its faces are congruent regular polygons.

Theorem 12.1 Euler's Theorem
The number of faces (F), vertices (V), and edges (E) of a polyhedron are related by the formula $F + V = E + 2$.

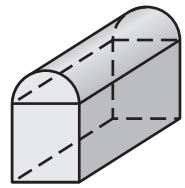
EXAMPLE 1 *Identifying Polyhedra*

Determine whether each solid is a polyhedron. Explain your reasoning.

a.



b.



SOLUTION

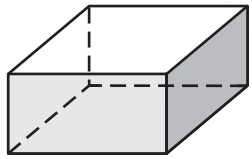
a. This is a polyhedron. All of its faces are polygons (2 triangles and 3 rectangles), which form a solid enclosing a single region of space.

b. This is not a polyhedron. Some of its faces are not polygons.

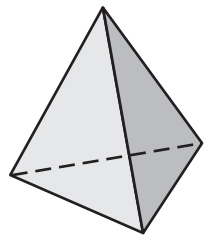
Exercises for Example 1

Determine whether each solid is a polyhedron. Explain your reasoning.

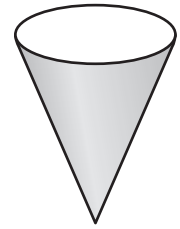
1.



2.



3.



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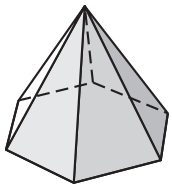
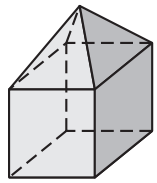
EXAMPLE 2 Analyzing Solids

For each polyhedron, count the number of faces, vertices, and edges.

a.



b.



SOLUTION

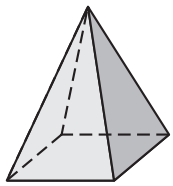
a. The polyhedron has 7 faces, 7 vertices, and 12 edges.

b. The polyhedron has 9 faces, 9 vertices, and 16 edges.

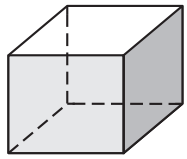
Exercises for Example 2

Count the number of faces, vertices, and edges.

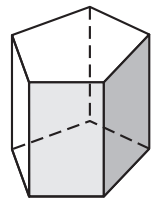
4.



5.

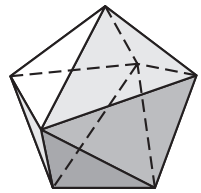


6.



EXAMPLE 3 Using Euler's Theorem

Calculate the number of vertices of the solid, given that it has 10 faces, all triangles.



SOLUTION

The 10 triangles alone would have $10(3) = 30$ edges. Because each side in the solid is shared by two of these triangles, the total number of edges in the solid is half of this, or 15. Now use Euler's Theorem to find the number of vertices.

$F + V = E + 2$	Write Euler's Theorem.
$10 + V = 15 + 2$	Substitute.
$V = 7$	Solve for V.

Exercise for Example 3

7. Calculate the number of vertices of the solid, given that it has 7 faces; 2 pentagons and 5 triangles.