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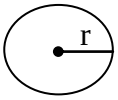
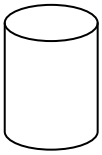
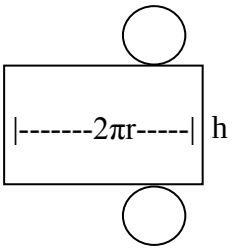
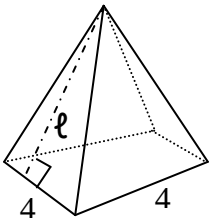
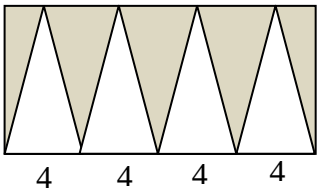
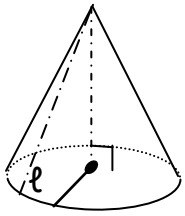
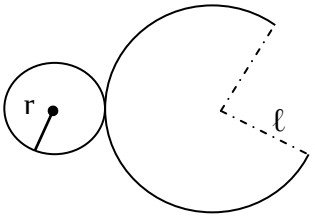
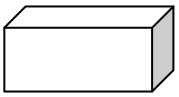
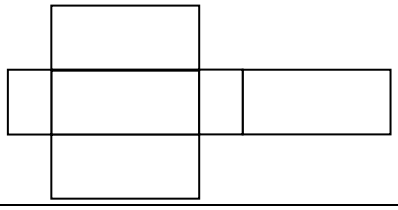
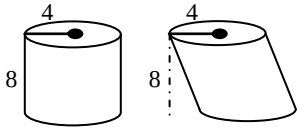
Geometric Measurement: Volume Formulas

Volume refers to the amount of space taken up by a three-dimensional object.
It helps to first be familiar with how to find the **total surface area** of a solid. We find this by looking at the shapes that the solid contains and adding the various areas together.

Item	Area Formula	Picture
Circle	$A = \pi r^2$	
Cylinder	$B = \pi r^2$ $L = 2\pi rh$ $S = L + 2B$	 
Regular Pyramid	$B = \ell \cdot w$ $L = \frac{1}{2}P\ell$ $S = \frac{1}{2}P\ell + B$	 
Cone	ℓ = slant height $L = \pi r\ell$ $S = L + B$, or $\pi r\ell + \pi r^2$	 
Prism	$V = lwh$	 

A famous mathematician, Cavalieri, argued that if the cross-section of two three-dimensional objects consistently had the same area, then those objects have the same volume.

Example: Two cylinders are laid out side-by-side but look different. Explain how we can use Cavalieri's principle to show they have the same volume.



Answer: A cross-section of both objects determines that they have the same area: 16π. Cavalieri proposed that if two objects

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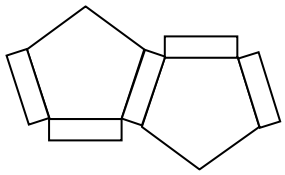
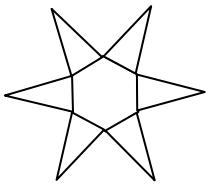
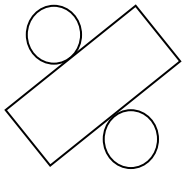
consistently had the same aurface area, then the two objects would be the same volume.

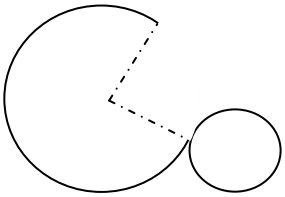
Practice.

1-4 Origami. The following pieces of cut paper are folded into three-dimensional geometric shapes. Identify the solid.

1. 

2. 

3. 

4. 

5-8. Identify the shape created by taking a cross-section of the following objects. Assume that the cross-section is parallel to the base of the object (if applicable).

5. A cone

6. A sphere

7. A regular pyramid

8. A cylinder

9. Rotations. What shape is created by rotating an equilateral triangle about a single vertex?

10. What solid is created by rotating and then folding together four isosceles triangles?

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Answer Key

Geometric Measurement: Volume Formulas

1. Pentagonal prism
2. Hexagonal pyramid
3. Cylinder
4. Cone
5. Circle
6. Circle
7. Square
8. Circle
9. Prism
10. Pyramid