

Name: _____

Date: _____

Modeling: Applying Geometric Concepts

Whenever a student or teacher creates a three-dimensional, physical representation of a drawn object, he is creating a **model**. Models are a way of applying geometric concepts in the real world. There are three ways that we will address models in this worksheet:

1. To describe objects;
2. To identify density based on area and volume;
3. To solve a design problem.

We can use geometric shapes, their measures, and their properties to describe the following:

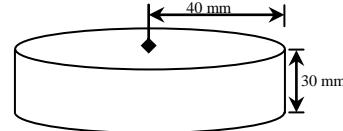
Example: Tyler is attempting to make and sell his own hockey pucks to raise money for his hockey team. If a standard puck has a radius of 40 mm, and a height of 30 mm, identify (1) the shape and measurement of the object, (2) the volume of vulcanized rubber he will need to pour into his mould.

Step 1: Identify the shape and measure of the object.

The hockey puck has parallel circular surfaces connected by a curved lateral surface, making it a cylinder.

Using the information provided, calculate the surface area of the base:

$$\pi r^2 = \pi(40\text{mm})^2 = \pi(1600\text{mm}^2) \approx 5,027 \text{ mm}^2$$



Step 2: Identify the volume of the cylinder.

Since we are given the dimensions of the surface areas, we can calculate the volume of vulcanized rubber required for each puck.

The volume of a cylinder with base area B and radius r and height h is $V = Bh$

$$V = (5027\text{mm}^2) \cdot (30\text{mm})$$

$$V = 150,810 \text{ mm}^3$$

For his project, Tyler would need to use 150,810 mm³ of vulcanized rubber for each puck he produces.

Problem Solving: After creating his first few homemade pucks, Tyler realizes that he has forgotten to figure in for the protective coating that surrounds the puck. If he used the same material for the coating, adding 2 mm all around, determine which of the following accurately describes the total amount of vulcanized rubber he will need to produce one puck.

- A. 177,337.6 mm³ B. 166,254 mm³ C. 301,620 mm³ D. 188,421.2 mm³

Name: _____

Date: _____

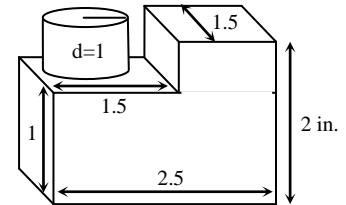
Practice Problem Solution:

In order to find the new total, we need to factor in an additional 2 mm all around the object. This changes our original measurements to a radius of 42 and a height of 34. As a result, the correct answer would be D above.

Practice. Use geometric properties to identify the object described. Solve.

1. John takes ten 4-inch cardboard circles and stacks them directly on top of each other. What shape is created?
2. If John then runs a string through the center of all the circles. He then angles the string to the right 30 degrees. What shape is created?
3. If each cardboard piece has a height of 0.2 inches, what is the lateral surface area of the object in question #1? The volume?
4. A mold for the toy train pictured below involves a simple base and a chimney. Find the volume of plastic needed to form the toy.

5. The wheels for #4 above are cast in a separate mold. If the wheels are 1" in diameter and 1" wide, find the total amount of plastic needed to form the toy.



6. A can of soda stands 5 inches tall and 3 inches in diameter. If filled to capacity, how much soda could be placed in the can?
7. A child is playing with her birthday party hat and unrolls it to reveal that it is only a single sheet of paper cut in the shape of an arc. She re-rolls it and creates what shape?
8. Not to be deterred by the shocking discovery mentioned in #7 above, the child promptly tapes the object and fills it half-way with birthday confetti. If the height of the object is 7" and it has a diameter of 5", determine the volume of confetti that has been placed inside.
9. Ashley creates her own bundt cake pan by combining a 10-inch tube pan with a 4-inch tube pan centered in the middle. If both pans stand 4 inches high, what is the volume of cake batter needed to fill it?
10. A librarian stacks novels onto a reshelfing cart. Since all of the books are the same size, the shape formed by the stacked books resembles a right prism. As she moves the cart, the books shift slightly, but stay together. Describe the shape that is formed.

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Answer Key

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1. Right cylinder
2. Oblique cylinder
3. $L=25.1327 \text{ in}^2$; $V=25.1327 \text{ in}^3$
4. 6.035 in^3
5. 9.177 in^3
6. 35.343 in^3
7. Cone
8. 5.7 in^3
9. 106.953 in^3
10. oblique prism