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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:

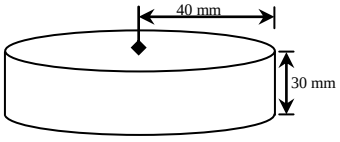
Example: Tyler is attempting to make and sell his own hockey pucks to raise money for his hockey team. If a standard puck has a radius of 40 mm, and a height of 30 mm, identify (1) the shape and measurement of the object, (2) the volume of vulcanized rubber he will need to pour into his mould.

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 mm^3 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 mm^3 B. 166,254 mm^3 C. 301,620 mm^3 D. 188,421.2 mm^3

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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. A cookie cake pan stands 2" tall and has a diameter of 16". How much cookie dough is needed to fill the pan?

2. Once it has cooled, the cookie cake is sliced into 8 slices of equal size. If one slice is removed, what is the volume of the remaining cookie cake?

3. A sno-cone has melted and has filled up its paper cup. What is the total volume if it is 3" tall with a radius of 1.5"?

4. A sheet of copy paper is rolled and its long ends are taped together. What object is created?

5. For question #4 above, determine the lateral surface area of the object. Then, determine its volume.

6. The object in #4 is then cut in half, creating two paper rolls. Predict the lateral surface area for the two new objects. Then, solve to determine the accuracy of your prediction.

7. How much sand would it take to fill an object that has a four-sided base and a triangle attached on each side of the base. One point from each triangle meets at a single point. The triangles are equilateral with a side measurement of 3".

8. A tissue box that is filled with sand. It is a 4 inch cube. Give the volume of sand in cubic inches.

9.A tub of oats that is 4" in diameter and 8" high. Find the volume of oats in mL if 1 cubic inch is equal to 16.387 mililiters.

10. A bottle of soda that has a radius of 38.1 millimeters and stands 152.4 millimeters tall. About 101.6 mm above its base, the bottle tapers in to a point. Find the volume in mililiters, if 1000 cubic millimeters is equal to 1 mililiter.

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Answer Key

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1. 402.124 in^3
2. 352.859 in^3
3. 7.069 in^3
4. cylinder
5. L=93.5; V=63.244
6. 46.75 in^3
7. 19.092 in^3
8. 64 in^3
9. 1647.4 mL
10. Volume is 77,685.6 mm^3 ≈ 77.686 mL