Performance Task Item: Designing a Package
Grade Level: High School Geometry

Focus Area: Applying Geometric Methods to Solve Design Problems
Essential Question: How are geometric designs used to solve problems in the real world?
Core Ideas:
- Understands attributes of geometric figures.
- Understands volume of three-dimensional shapes.
- Understands the volume of a sphere can be found when its radius is known.

Learning Targets:
- Students will use measures of geometric shapes to find the area and volume of a shape found in the real world.
- Students will apply properties of geometric shapes to solve real-world problems.
- Students will apply geometric methods to solve design problems.
- Students will explain their reasoning.

STANDARDS
Domain: Geometry-Modeling with Geometry
Content Standards:
- Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Supporting Standard:
- Know precise definitions of three-dimensional shapes.

Math Practice Standards:
MP 1: Make sense of problems and persevere in solving them.
MP 3: Construct viable arguments and critique the reasoning of others.
MP 4: Model with mathematics.
MP 6: Attend to precision.
MP 7: Look for and make use of structure

**Materials:**
- Performance Task
- Pencil
- Paper
- Calculator
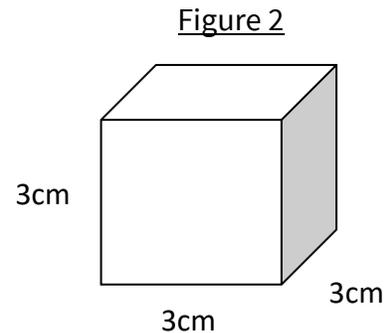
Task/Question 1:

DOK Level 1: Recall & Reproduction

Math Practice Standard:
- MP 6: Attend to precision.

A. Write the formula for finding the volume of a right cylinder:

B. Write the formula for finding the volume of a sphere:

C. Write the formula for finding the surface area of a right cylinder:

D. Write the formula for finding the volume of a cone:

E. Write the formula for finding the surface area of a rectangular prism:

F. Calculate the volume and surface area of each object (use 3.14 for Pi):

Figure 1

10cm

r = 5cm

Figure 2

3cm

3cm

3cm

V = _____ SA = _____

V = _____ SA = _____
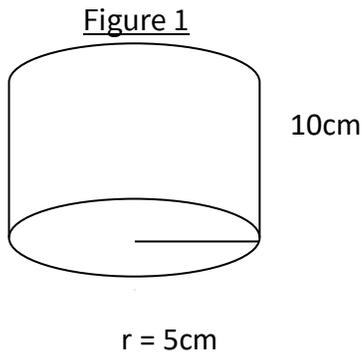
Task/Question 2:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:
- MP 1: Make sense of problems and persevere in solving them.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

A large ice-cream cone is on sale at Frosty Slab for $3.75. It is 8 inches tall and 4 inches across the base of the cone. When filling the ice-cream cone, the workers level the cone to the base.

A. Label the figure below with the correct ice-cream cone dimensions:

B. Find the volume of the cone in Task A:
(Use 3.14 for pi and round to the nearest tenth)

V = _____

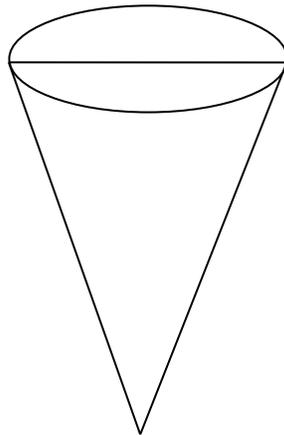**C.** Explain how you figured out the volume of the cone in Task B:

Task/Question 3:

DOK Level 2: Basic Application of Skills and Concepts

Math Practice Standards:
- MP 1: Make sense of problems and persevere in solving them.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

Tommy, from Tommy's Vending Machine Company, surveyed golf players regarding their need for extra golf balls before going out on the course. Several of the players said they had stopped to purchase more golf balls at a sports store on their way to the club. Tommy thought it would be advantageous to have them available at the site for purchase from his vending machine. However, he would need a container that could fit into his vending machines.

Rabeesha, an engineer at Geometrics Design Corp., was hired by Tommy to design a cylindrical container for purchase. She was instructed to design a package to hold six golf balls in one vertical row.

A. If each golf ball has a radius of 0.84 inches, what must the height and diameter of the container be?

Dimensions: Diameter_____   Height _____

B. List the volume of the container from Task A (use 3.14 for Pi and round to the nearest tenth):

C. Explain how you figured out your dimensions for the container (Diameter & Height):

Task/Question 4:

DOK Level 3: Strategic Thinking and Reasoning

Math Practice Standards:
- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 7: Look for and make use of structure.

The container used in task/question 3 was too difficult for the company to make because of its dimensions. Rabeesha, the engineer, called Tommy to see if they could use different sized golf balls with a diameter of 1.75 inches. This measure would allow her to make a container using inch and half inch measures which would be much easier to make. To keep the cost down, Tommy agrees, but wants to keep the number of golf balls in each container to be ten or less.

A. How many golf balls will the container hold if you change all dimensions to meet Rabeesha's new design?

B. Draw a picture of the new design; label all the dimensions:

C. Calculate the volume of the new designed package

   V = _____

D. Justify and Defend how your process is the **most effective** way to determine the dimensions for the new package design:

Complete Performance Task Scoring Rubric
Designing a Package

	Depth of Knowledge Level	Points	Total Possible Points for Task	Total Points Earned by Student
Task 1:	1		7	
A. bh or pi x r² x h		1		
B. 4/3 x pi x r³		1		
C. 2 x pi x r² + pi x d x h		1		
D. 1/3 x pi x r² x h		1		
E. 2 (l w + l h + wh)		1		
F. Figure 1: V = 785 cm³ SA = 471cm²		1		
Figure 2: V = 27 cm³ SA = 54 cm²		1		
Task 2:	2		4	
A. Check drawing: the diameter is 4 so the radius is 2, h =8		1		
B. V = 33.5 cubic inches		1		
C. Answers will vary. Possible Explanation: "The formula uses the radius, but only the diameter is given; therefore, first, cut the diameter in half and then, use the formula. Since the ice-cream is leveled off I only need to finish the answer by rounding to the nearest tenth."		2		

Task 3:	3		4	
A. Diameter = 1.68 inches Height = 10.08 inches		1		
B. V = 22.3 cubic inches		1		
C. Answers will vary. Possible Explanation: "First, double the radius to get the distance across the base of the canister. Since Tommy wanted a vertical line of golf balls, I took the radius and doubled it to get the distance through one golf ball. Then, multiplied that number by six for the six golf balls. This gave me the height of the canister."		2		
Task 4:	3		6	
A. Number of golf balls: 8		1		
B. Must be a cube with side lengths of 3.5 inches 		2		
C. V = 42.875 cubic inches		1		
D. Answers will vary. Possible Justification: "If Rabeesha needs the dimensions of the container to be in half or whole inch measures, she cannot use Tommy's original shape. The cylindrical package would hold either 4 golf balls measuring 7 inches in height, 6 golf balls measuring 10.5 inches in height, 8 golf balls measuring 14 inches in height or 10 gold balls measuring 17.5 inches in height.		2		

However, this design would not work since Tommy wanted the golf balls to be in a single vertical row with a diameter of 1.75 inches. Also, the more golf balls in the container, the longer it gets making it more difficult to work in the vending machine. However, I figured out that Rabeesha can put two golf balls going across, back and up to make a container that holds 8 golf balls. Her container only needs to be 3.5 inches in length, width and height to hold the golf balls securely in place. There would be a row with 2 golf balls going across, back and up. A total of 8 golf balls in a 3.5 in cube. This amount has Tommy's count and Rabeesha's measures per requests."				
			TOTAL POINTS:	

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