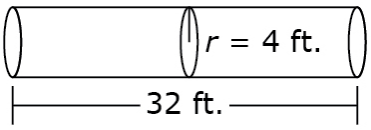
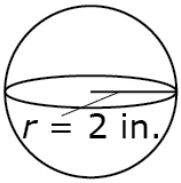
Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.	
Content Domain: **Geometry**	
Target I [a]: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. (DOK 1, 2)	
Standards: 8.G.C,8.G.9	**8.G.C Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.** **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
Related Below-Grade and Above-Grade Standards for Purposes of Planning for Vertical Scaling: 7.G.B,7.G.B.6 G-GMD.A, G-GMD.A.1, G-GMD.A.2, G-GMD.A.3, G-GMD.B, GMD.B.4, G-MG.A, G-MG.A.1, G-MG.A.2, G-MG.A.3	**Related Grade 7 standards** **7.G.B Solve real-world and mathematical problems involving angle measure, area, surface area, and volume.** **7 .G.B.6** Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. **Related High School Standards** **G-GMD.A Explain volume formulas and use them to solve problems.** **G-GMD.A.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.* **G-GMD.A.2** (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. **G-GMD.A.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. **G-GMD.B Visualize relationships between two-dimensional and three-dimensional objects.** **G-GMD.B.4** Identify the shape of two-dimensional cross-sections of three-dimensional objects, and identifies three-dimensional objects generated by rotations of two-dimensional objects. **G-MG.A Apply geometric concepts in modeling situations.** **G-MG.A.1** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). **G-MG.A.2** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). **G-MG.A.3** 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).
DOK Levels:	1, 2
Achievement Level Descriptors:	
RANGE Achievement Level	**Level 1** Students should be able to identify the key dimensions (i.e., radii, heights, circumferences, and diameters) of cones, cylinders,

Descriptor (Range ALD) Target I: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	and spheres.
	Level 2 Students should be able to identify the appropriate formula for the volumes of a cone, a cylinder, and a sphere and should be able to connect the key dimensions to the appropriate locations in the formula.
	Level 3 Students should be able to calculate the volumes of cones, cylinders, and spheres in direct and familiar mathematical and real-world problems.
	Level 4 Students should be able to solve unfamiliar or multi-step problems involving volumes of cones, cylinders, and spheres.
Evidence Required:	1. The student solves real-world problems by applying the formulas for the volumes of cylinders, cones, and spheres. 2. The student solves mathematical problems by applying the formulas for the volumes of cylinders, cones, and spheres.
Allowable Response Types:	Equation/Numeric; Multiple Choice, single correct response
Allowable Stimulus Materials:	Three-dimensional representations of cylinders, cones, and spheres
Construct-Relevant Vocabulary:	Volume, cylinder, cone, sphere, radius, diameter, area, base, pi
Allowable Tools:	Calculator
Target-Specific Attributes	It is expected that students will know and use the formulas for the volumes of cylinders, cones, and spheres.
Non-Targeted Constructs:	
Accessibility Guidance:	Item writers should consider the following Language and Visual Element/Design guidelines[1] when developing items. Language Key Considerations: • Use simple, clear, and easy-to-understand language needed to assess the construct or aid in the understanding of the context • Avoid sentences with multiple clauses • Use vocabulary that is at or below grade level • Avoid ambiguous or obscure words, idioms, jargon, unusual names and references Visual Elements/Design Key Considerations: • Include visual elements only if the graphic is needed to assess the construct or it aids in the understanding of the context • Use the simplest graphic possible with the greatest degree of contrast, and include clear, concise labels where necessary • Avoid crowding of details and graphics Items are selected for a student's test according to the blueprint,

[1] For more information, refer to the General Accessibility Guidelines at: http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/05/TaskItemSpecifications/Guidelines/AccessibilityandAccommodations/GeneralAccessibilityGuidelines.pdf

	which selects items based on Claims and targets, not task models. As such, careful consideration is given to making sure fully accessible items are available to cover the content of every Claim and target, even if some item formats are not fully accessible using current technology.[2]
Development Notes:	Tasks for this target will ask students to apply the formulas for volume of cylinders, cones and spheres to solve problems. Many of these tasks will contribute evidence to Claims 2 and 4.

[2] For more information about student accessibility resources and policies, refer to http://www.smarterbalanced.org/wordpress/wp-content/uploads/2014/08/SmarterBalanced_Guidelines.pdf

Task Model 1 **Response Type: Equation / Numeric; Multiple Choice, single correct response** **DOK Level 2** **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **Evidence Required:** 1. The student solves real-world problems by applying the formulas for the volumes of cylinders, cones, and spheres. **Tools:** Calculator	**Prompt Features:** The student is prompted to find the volumes or dimensions of cylinders, cones, or spheres in real-world scenarios. **Stimulus Guidelines:** • Context should be familiar to students 13 to 15 years old. • Use rational numbers in real-world context. • The pi symbol should be a part of the solution for each answer choice for some items. • Item difficulty can be adjusted via these methods: o Find the volume given the dimensions. o Find the dimensions given the volume. o Find the volume given the dimensions using fractions and decimals. o Find the dimensions given the volume using fractions and decimals. o No figure, write the expression from verbal text and find the volume. o Include extraneous measurements. **TM1** **Stimulus:** The student is presented with a situation that includes sufficient measurements of a cylinder, cone, or sphere. **Example Stem 1:** This figure shows the dimensions of a tanker truck. The tank forms a cylinder with a length of 32 feet and radius of 4 feet.  What is the volume, in cubic feet, of the tank? Round your answer to the nearest hundredth. **Example Stem 2:** A spherical baseball has a radius of 2 inches, as shown in the diagram.  What is the volume, in cubic inches, of the baseball? Round your answer to the nearest hundredth. **Rubric:** (1 point) The student gives the correct volume within a range to accommodate different acceptable values of pi (e.g., 1608.50; 33.51). **Response Type:** Equation/Numeric

Task Model 1

Response Type: Equation / Numeric; Multiple Choice, single correct response

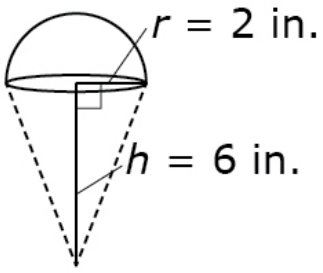
DOK Level 2

8.G.C.9
Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Evidence Required:
1. The student solves real-world problems by applying the formulas for the volumes of cylinders, cones, and spheres.

Tools: Calculator

Example Stem 3: An ice cream cone has a height of 6 inches and a radius of 2 inches as shown. The ice cream completely fills the cone, as well as the half-sphere above the cone.



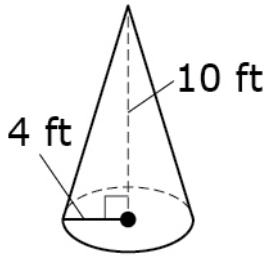
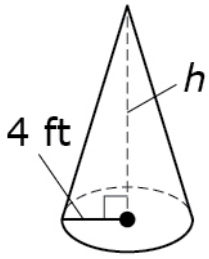
Which is closest to the total volume, in cubic inches, of the ice cream?

A. $\frac{16}{3}\pi$
B. 8π
C. $\frac{40}{3}\pi$
D. 20π

Answer Choice: The answer choices include the pi symbol as part of the solution. Incorrect answer choices show errors based on miscalculations such as multiplying instead of applying the exponent rule, including the height as a part of the formula for sphere.

Rubric: (1 point) The student gives the correct solution (e.g., C).

Response Type: Multiple Choice, single correct response

Task Model 2 **Response Type: Equation / Numeric** **DOK Level 2** **8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **Evidence Required:** 2. The student solves mathematical problems by applying the formulas for the volumes of cylinders, cones, and spheres. **Tools:** Calculator	**Prompt Features:** The student identifies the volumes or dimensions of cylinders, cones, or spheres in mathematical contexts. **Stimulus Guidelines:** Item difficulty can be adjusted via these methods: • Find the volume directly. • Solve for missing dimensions. • Use whole numbers, fractions, and decimals. • Use verbal descriptions instead of figures. • Include extraneous information. **TM2** **Stimulus:** Student is presented with a 3-dimensional object with measurements. **Example Stem 1:** A cone with radius 4 feet and height 10 feet is shown.  Enter the volume of the cone, in cubic feet. Round your answer to the nearest hundredth. **Example Stem 2:** A cone with radius 4 feet is shown. Its approximate volume is 165 cubic feet.  Enter the height of the cone, in feet. Round your answer to the nearest hundredth. **Rubric:** (1 point) The student gives the correct value within a range to accommodate different acceptable values of pi (e.g., 167.47; 9.85). **Response Type:** Equation/Numeric