(1) You have been tasked with making a homemade cleaning solution. The spray bottle that you are going to fill with the cleaning solution is shown. The cleaning solution should be one part vinegar and one part water.

(a) What two three-dimensional shapes make up the spray bottle?

(b) If you fill the bottle with the vinegar first, do you think that you would need to stop filling the bottle with vinegar before reaching the top of the cylinder, after, or even to where the top of the cylinder meets the bottom of the cone? Explain your reasoning.
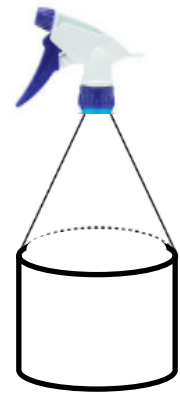
diagram not drawn to scale

(c) What information would you need to accurately determine where to stop filling the bottle with vinegar?

(d) Now, let's say that the total height of the spray bottle up to where the nozzle screws on is 24 cm, the height of the cylindrical part is 6 cm, and the diameter of the base is 9 cm. Use this information to determine where exactly you should stop filling with vinegar in order to have equal parts vinegar and water. Was your prediction from above correct?

(2) An Ocean Life Museum management team is in the process of choosing one of two possible aquarium options for a new exhibit. Option 1 consists of a right cylinder with a cone inserted in as its base (the water would be between the cylinder and cone) as shown in the diagram below. The tip of the cone touches the center of the top of the cylinder. This aquarium option would be built into a pillar in the center of the exhibit room. Option 2 consists of a half of a sphere and it would be built so that it protrudes from the exhibit room ceiling as shown in the diagram below.

5 ft.

10 ft.   10 ft.
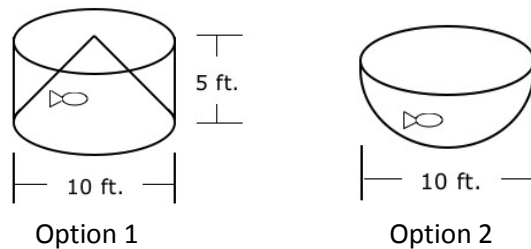
Option 1   Option 2

(a) How many cubic feet of water will aquarium option 1 hold?

(b) How many cubic feet of water will aquarium option 2 hold?

(c) Which aquarium option should the management team choose if they are trying to maximize the volume of their new aquarium?

(3) **COLLEGE PREP**: The cone and the cylinder have equal bases and equal heights. If the volume of the cone is 30 cm^3, what is the volume of the cylinder?
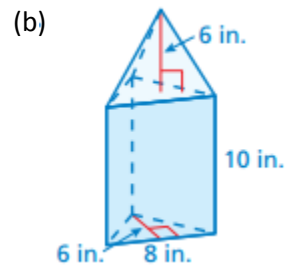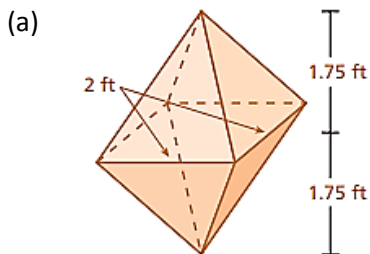
(4) **HONORS**: A square pyramid is contained within a cone. Both share a height of 20 cm. The square base of the pyramid has an edge of 10 cm. What is the volume of the cone?

(5) Given a cube with an edge of 8 inches and a sphere with a diameter of 8 inches, calculate the volume remaining in the cube if the sphere is inserted into the cube.

(6) **HONORS**: Using the diagrams below, determine how much water in cubic inches it would take to make ten Lego brick ice cubes.

$\vdash \frac{5}{8}$ in. $\dashv$

$\frac{3}{8}$ in.

$\frac{3}{16}$ in.

$\frac{5}{4}$ in.

$\frac{1}{16}$ in.
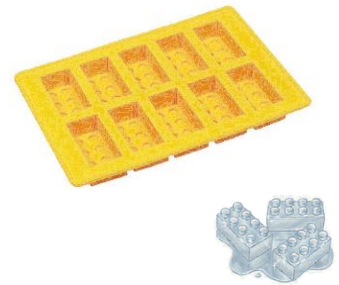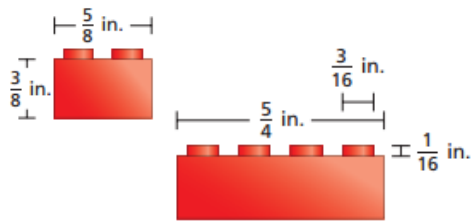
(7) Find the volume of the composite solid shown below.

(a)

2 ft

1.75 ft

1.75 ft

(b)

6 in.

10 in.

6 in.   8 in.

(8) **COLLEGE PREP**: An Argentine peso is formed with an inner portion and an outer silver ring as shown below.
(a) Using the given measurements, find the volume of the outer silver ring.

8.5 mm

11.5 mm

2.2 mm

(b) How would the volume of the silver ring change if the coin were only half as thick?