

G.MG.A.2: Density

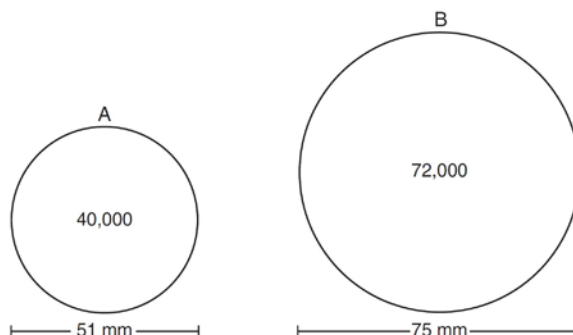
- 1 A shipping container is in the shape of a right rectangular prism with a length of 12 feet, a width of 8.5 feet, and a height of 4 feet. The container is completely filled with contents that weigh, on average, 0.25 pound per cubic foot. What is the weight, in pounds, of the contents in the container?
 - 1) 1,632
 - 2) 408
 - 3) 102
 - 4) 92
- 2 The density of the American white oak tree is 752 kilograms per cubic meter. If the trunk of an American white oak tree has a circumference of 4.5 meters and the height of the trunk is 8 meters, what is the approximate number of kilograms of the trunk?
 - 1) 13
 - 2) 9694
 - 3) 13,536
 - 4) 30,456
- 3 Molly wishes to make a lawn ornament in the form of a solid sphere. The clay being used to make the sphere weighs .075 pound per cubic inch. If the sphere's radius is 4 inches, what is the weight of the sphere, to the *nearest pound*?
 - 1) 34
 - 2) 20
 - 3) 15
 - 4) 4
- 4 A hemispherical tank is filled with water and has a diameter of 10 feet. If water weighs 62.4 pounds per cubic foot, what is the total weight of the water in a full tank, to the *nearest pound*?
 - 1) 16,336
 - 2) 32,673
 - 3) 130,690
 - 4) 261,381
- 5 A hemispherical water tank has an inside diameter of 10 feet. If water has a density of 62.4 pounds per cubic foot, what is the weight of the water in a full tank, to the *nearest pound*?
 - 1) 16,336
 - 2) 32,673
 - 3) 130,690
 - 4) 261,381
- 6 Seawater contains approximately 1.2 ounces of salt per liter on average. How many gallons of seawater, to the *nearest tenth of a gallon*, would contain 1 pound of salt?
 - 1) 3.3
 - 2) 3.5
 - 3) 4.7
 - 4) 13.3
- 7 The 2010 U.S. Census populations and population densities are shown in the table below.

State	Population Density $\left(\frac{\text{people}}{\text{mi}^2}\right)$	Population in 2010
Florida	350.6	18,801,310
Illinois	231.1	12,830,632
New York	411.2	19,378,102
Pennsylvania	283.9	12,702,379

Based on the table above, which list has the states' areas, in square miles, in order from largest to smallest?

- 1) Illinois, Florida, New York, Pennsylvania
- 2) New York, Florida, Illinois, Pennsylvania
- 3) New York, Florida, Pennsylvania, Illinois
- 4) Pennsylvania, New York, Florida, Illinois

- 8 During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish *A* has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish *B* has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.



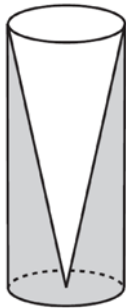
Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.

- 9 A wooden cube has an edge length of 6 centimeters and a mass of 137.8 grams. Determine the density of the cube, to the *nearest thousandth*. State which type of wood the cube is made of, using the density table below.

Type of Wood	Density (g/cm ³)
Pine	0.373
Hemlock	0.431
Elm	0.554
Birch	0.601
Ash	0.638
Maple	0.676
Oak	0.711

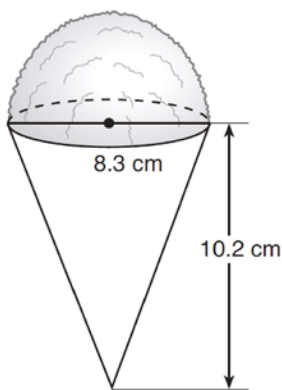
- 10 A contractor needs to purchase 500 bricks. The dimensions of each brick are 5.1 cm by 10.2 cm by 20.3 cm, and the density of each brick is 1920 kg/m³. The maximum capacity of the contractor’s trailer is 900 kg. Can the trailer hold the weight of 500 bricks? Justify your answer.
- 11 Trees that are cut down and stripped of their branches for timber are approximately cylindrical. A timber company specializes in a certain type of tree that has a typical diameter of 50 cm and a typical height of about 10 meters. The density of the wood is 380 kilograms per cubic meter, and the wood can be sold by mass at a rate of \$4.75 per kilogram. Determine and state the minimum number of whole trees that must be sold to raise at least \$50,000.
- 12 New streetlights will be installed along a section of the highway. The posts for the streetlights will be 7.5 m tall and made of aluminum. The city can choose to buy the posts shaped like cylinders or the posts shaped like rectangular prisms. The cylindrical posts have a hollow core, with aluminum 2.5 cm thick, and an outer diameter of 53.4 cm. The rectangular-prism posts have a hollow core, with aluminum 2.5 cm thick, and a square base that measures 40 cm on each side. The density of aluminum is 2.7 g/cm³, and the cost of aluminum is \$0.38 per kilogram. If all posts must be the same shape, which post design will cost the town less? How much money will be saved per streetlight post with the less expensive design?

- 13 Walter wants to make 100 candles in the shape of a cone for his new candle business. The mold shown below will be used to make the candles. Each mold will have a height of 8 inches and a diameter of 3 inches. To the *nearest cubic inch*, what will be the total volume of 100 candles?



Walter goes to a hobby store to buy the wax for his candles. The wax costs \$0.10 per ounce. If the weight of the wax is 0.52 ounce per cubic inch, how much will it cost Walter to buy the wax for 100 candles? If Walter spent a total of \$37.83 for the molds and charges \$1.95 for each candle, what is Walter's profit after selling 100 candles?

- 14 A snow cone consists of a paper cone completely filled with shaved ice and topped with a hemisphere of shaved ice, as shown in the diagram below. The inside diameter of both the cone and the hemisphere is 8.3 centimeters. The height of the cone is 10.2 centimeters.

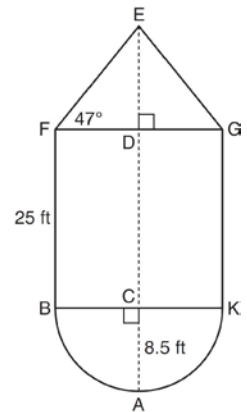


The desired density of the shaved ice is 0.697 g/cm^3 , and the cost, per kilogram, of ice is \$3.83. Determine and state the cost of the ice needed to make 50 snow cones.

- 15 The water tower in the picture below is modeled by the two-dimensional figure beside it. The water tower is composed of a hemisphere, a cylinder, and a cone. Let C be the center of the hemisphere and let D be the center of the base of the cone.



Source: <http://en.wikipedia.org>



If $AC = 8.5$ feet, $BF = 25$ feet, and $m\angle EFD = 47^\circ$, determine and state, to the *nearest cubic foot*, the volume of the water tower. The water tower was constructed to hold a maximum of 400,000 pounds of water. If water weighs 62.4 pounds per cubic foot, can the water tower be filled to 85% of its volume and *not* exceed the weight limit? Justify your answer.

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Answer Section

1 ANS: 3

$$V = 12 \cdot 8.5 \cdot 4 = 408$$

$$W = 408 \cdot 0.25 = 102$$

REF: 061507geo

2 ANS: 2

$$C = \pi d \quad V = \pi \left(\frac{2.25}{\pi} \right)^2 \cdot 8 \approx 12.8916 \quad W = 12.8916 \cdot 752 \approx 9694$$

$$4.5 = \pi d$$

$$\frac{4.5}{\pi} = d$$

$$\frac{2.25}{\pi} = r$$

REF: 081617geo

3 ANS: 2

$$\frac{4}{3} \pi \cdot 4^3 + 0.075 \approx 20$$

REF: 011619geo

4 ANS: 1

$$V = \frac{\frac{4}{3} \pi \left(\frac{10}{2} \right)^3}{2} \approx 261.8 \cdot 62.4 = 16,336$$

REF: 081516geo

5 ANS: 1

$$\frac{1}{2} \left(\frac{4}{3} \right) \pi \cdot 5^3 \cdot 62.4 \approx 16,336$$

REF: 061620geo

6 ANS: 2

$$\frac{11}{1.2 \text{ oz}} \left(\frac{16 \text{ oz}}{1 \text{ lb}} \right) = \frac{13.\bar{3}1}{\text{lb}} \quad \frac{13.\bar{3}1}{\text{lb}} \left(\frac{1 \text{ g}}{3.7851} \right) \approx \frac{3.5 \text{ g}}{1 \text{ lb}}$$

REF: 061618geo

7 ANS: 1

$$\text{Illinois: } \frac{12830632}{231.1} \approx 55520 \quad \text{Florida: } \frac{18801310}{350.6} \approx 53626 \quad \text{New York: } \frac{19378102}{411.2} \approx 47126 \quad \text{Pennsylvania: } \frac{12702379}{283.9} \approx 44742$$

REF: 081720geo

8 ANS:

$$\frac{40000}{\pi \left(\frac{51}{2} \right)^2} \approx 19.6 \quad \frac{72000}{\pi \left(\frac{75}{2} \right)^2} \approx 16.3 \quad \text{Dish A}$$

REF: 011630geo

9 ANS:

$$\frac{137.8}{6^3} \approx 0.638 \quad \text{Ash}$$

REF: 081525geo

10 ANS:

No, the weight of the bricks is greater than 900 kg. $500 \times (5.1 \text{ cm} \times 10.2 \text{ cm} \times 20.3 \text{ cm}) = 528,003 \text{ cm}^3$.

$$528,003 \text{ cm}^3 \times \frac{1 \text{ m}^3}{100 \text{ cm}^3} = 0.528003 \text{ m}^3. \quad \frac{1920 \text{ kg}}{\text{m}^3} \times 0.528003 \text{ m}^3 \approx 1013 \text{ kg}.$$

REF: fall1406geo

11 ANS:

$$r = 25 \text{ cm} \left(\frac{1 \text{ m}}{100 \text{ cm}} \right) = 0.25 \text{ m} \quad V = \pi(0.25 \text{ m})^2(10 \text{ m}) = 0.625\pi \text{ m}^3 \quad W = 0.625\pi \text{ m}^3 \left(\frac{380 \text{ K}}{1 \text{ m}^3} \right) \approx 746.1 \text{ K}$$

$$n = \frac{\$50,000}{\left(\frac{\$4.75}{\text{K}} \right) (746.1 \text{ K})} = 14.1 \quad 15 \text{ trees}$$

REF: spr1412geo

12 ANS:

$$\text{C: } V = \pi(26.7)^2(750) - \pi(24.2)^2(750) = 95,437.5\pi$$

$$95,437.5\pi \text{ cm}^3 \left(\frac{2.7 \text{ g}}{\text{cm}^3} \right) \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) \left(\frac{\$0.38}{\text{kg}} \right) = \$307.62$$

$$\text{P: } V = 40^2(750) - 35^2(750) = 281,250 \quad \$307.62 - 288.56 = \$19.06$$

$$281,250 \text{ cm}^3 \left(\frac{2.7 \text{ g}}{\text{cm}^3} \right) \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) \left(\frac{\$0.38}{\text{kg}} \right) = \$288.56$$

REF: 011736geo

13 ANS:

$$V = \frac{1}{3} \pi \left(\frac{3}{2} \right)^2 \cdot 8 \approx 18.85 \cdot 100 = 1885 \quad 1885 \cdot 0.52 \cdot 0.10 = 98.02 \quad 1.95(100) - (37.83 + 98.02) = 59.15$$

REF: 081536geo

14 ANS:

$$V = \frac{1}{3} \pi \left(\frac{8.3}{2} \right)^2 (10.2) + \frac{1}{2} \cdot \frac{4}{3} \pi \left(\frac{8.3}{2} \right)^3 \approx 183.961 + 149.693 \approx 333.65 \text{ cm}^3 \quad 333.65 \times 50 = 16682.7 \text{ cm}^3$$

$$16682.7 \times 0.697 = 11627.8 \text{ g} \quad 11.6278 \times 3.83 = \$44.53$$

REF: 081636geo

15 ANS:

$$\tan 47 = \frac{x}{8.5} \quad \text{Cone: } V = \frac{1}{3} \pi (8.5)^2 (9.115) \approx 689.6 \quad \text{Cylinder: } V = \pi (8.5)^2 (25) \approx 5674.5 \quad \text{Hemisphere:}$$

$$x \approx 9.115$$

$$V = \frac{1}{2} \left(\frac{4}{3} \pi (8.5)^3 \right) \approx 1286.3 \quad 689.6 + 5674.5 + 1286.3 \approx 7650 \quad \text{No, because } 7650 \cdot 62.4 = 477,360$$

$$477,360 \cdot .85 = 405,756, \text{ which is greater than } 400,000.$$

REF: 061535geo