Name _____ Date _____

Surface Area and Volume in the Real World

Solve the word problem below.

Kelly has a rectangular fish aquarium with an open top that measures 18 inches long, 8 inches wide, and 12 inches tall.

a. What is the maximum amount of water in cubic inches the aquarium can hold?

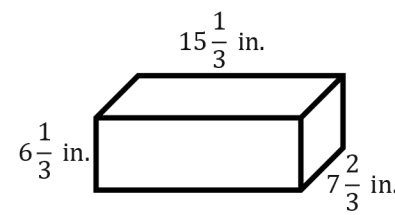
b. If Kelly wanted to put a protective covering on the four glass walls of the aquarium, how big does the cover have to be?

Solve each problem below.

1. Dante built a wooden, cubic toy box for his son. Each side of the box measures 2 feet.
   a. How many square feet of wood did he use to build the box?
   b. How many cubic feet of toys will the box hold?

2. A company that manufactures gift boxes wants to know how many different sized boxes having a volume of 50 cubic centimeters it can make if the dimensions must be whole centimeters.
   a. List all the possible whole number dimensions for the box.
   b. Which possibility requires the least amount of material to make?
   c. Which box would you recommend the company use? Why?

3. A rectangular box of rice is shown below. How many cubic inches of rice can fit inside?



4. The Mars Cereal Company has two different cereal boxes for Mars Cereal. The large box is 8 inches wide, 11 inches high, and 3 inches deep. The small box is 6 inches wide, 10 inches high, and 2.5 inches deep.
   a. How much more cardboard is needed to make the large box than the small box?
   b. How much more cereal does the large box hold than the small box?

5. A swimming pool is 8 meters long, 6 meters wide, and 2 meters deep. The water-resistant paint needed for the pool costs $\$6$ per square meter. How much will it cost to paint the pool?
   a. How many faces of the pool do you have to paint?
   b. How much paint (in square meters) do you need to paint the pool?
   c. How much will it cost to paint the pool?

6. Sam is in charge of filling a rectangular hole with cement. The hole is 9 feet long, 3 feet wide, and 2 feet deep. How much cement will Sam need?

7. The volume of Box D subtracted from the volume of Box C is 23.14 cubic centimeters. Box D has a volume of 10.115 cubic centimeters.

   a. Let C be the volume of Box C in cubic centimeters. Write an equation that could be used to determine the volume of Box C.

   b. Solve the equation to determine the volume of Box C.

   c. The volume of Box C is one-tenth the volume another box, Box E. Let E represent the volume of Box E in cubic centimeters. Write an equation that could be used to determine the volume of Box E, using the result from part (b).

   d. Solve the equation to determine the volume of Box E.

Solve the word problem below.

Kelly has a rectangular fish aquarium that measures 18 inches long, 8 inches wide, and 12 inches tall.

a. **What is the maximum amount of water the aquarium can hold?**

Volume of the Aquarium: $V = 18 \text{ in.} \times 8 \text{ in.} \times 12 \text{ in.} = 1728 \text{ in}^3$

The maximum amount of water the aquarium can hold is $1,728 \text{ cubic inches}$.

b. **If Kelly wanted to put a protective covering on the four glass walls of the aquarium, how big does the cover have to be?**

Surface Area of the Aquarium: $SA = 2(18 \text{ in.})(8 \text{ in.}) + 2(18 \text{ in.})(12 \text{ in.}) + 2(8 \text{ in.})(12 \text{ in.}) = 288 \text{ in}^2 + 432 \text{ in}^2 + 192 \text{ in}^2 = 912 \text{ in}^2$

We only need to cover the four glass walls, so we can subtract the area of both the top and bottom of the aquarium.

Area of Top: $A = 18 \text{ in.} \times 8 \text{ in.} = 144 \text{ in}^2$

Area of Bottom: $A = 18 \text{ in.} \times 8 \text{ in.} = 144 \text{ in}^2$

Surface Area of the Four Walls: $SA = 912 \text{ in}^2 - 144 \text{ in}^2 - 144 \text{ in}^2 = 624 \text{ in}^2$

Kelly would need 624 in^2 *to cover the four walls of the aquarium.*

Solve each problem below.

1. **Dante built a wooden, cubic toy box for his son. Each side of the box measures 2 feet.**

a. **How many square feet of wood did he use to build the box?**

Surface Area of the Box: $SA = 6(2 \text{ ft})^2 = 6(4 \text{ ft}^2) = 24 \text{ ft}^2$

Dante would need 24 square feet *of wood to build the box.*

b. **How many cubic feet of toys will the box hold?**

Volume of the Box: $V = 2 \text{ ft.} \times 2 \text{ ft.} \times 2 \text{ ft.} = 8 \text{ ft}^3$

The toy box would hold 8 cubic feet *of toys.*

2. **A company that manufactures gift boxes wants to know how many different sized boxes having a volume of 50 cubic centimeters it can make if the dimensions must be whole centimeters.**

a. **List all the possible whole number dimensions for the box.**

Choice One: $1 \text{ cm} \times 1 \text{ cm} \times 50 \text{ cm}$

Choice Two: $1 \text{ cm} \times 2 \text{ cm} \times 25 \text{ cm}$

Choice Three: $1 \text{ cm} \times 5 \text{ cm} \times 10 \text{ cm}$

Choice Four: $2 \text{ cm} \times 5 \text{ cm} \times 5 \text{ cm}$

b. **Which possibility requires the least amount of material to make?**

Choice One: $SA = 2(1\text{ cm})(1\text{ cm}) + 2(1\text{ cm})(50\text{ cm}) + 2(1\text{ cm})(50\text{ cm}) = 2\text{ cm}^2 + 100\text{ cm}^2 + 100\text{ cm}^2 = 202\text{ cm}^2$

Choice Two: $SA = 2(1\text{ cm})(2\text{ cm}) + 2(1\text{ cm})(25\text{ cm}) + 2(2\text{ cm})(25\text{ cm}) = 4\text{ cm}^2 + 50\text{ cm}^2 + 100\text{ cm}^2 = 154\text{ cm}^2$

Choice Three: $SA = 2(1\text{ cm})(5\text{ cm}) + 2(1\text{ cm})(10\text{ cm}) + 2(5\text{ cm})(10\text{ cm}) = 10\text{ cm}^2 + 20\text{ cm}^2 + 100\text{ cm}^2 = 130\text{ cm}^2$

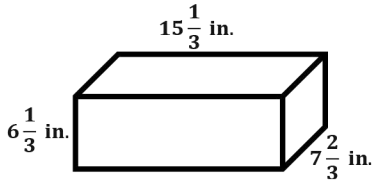
Choice Four: $SA = 2(2\text{ cm})(5\text{ cm}) + 2(2\text{ cm})(5\text{ cm}) + 2(5\text{ cm})(5\text{ cm}) = 20\text{ cm}^2 + 20\text{ cm}^2 + 50\text{ cm}^2 = 90\text{ cm}^2$

Choice Four requires the least amount of material because it has the smallest surface area.

c. **Which box would you recommend the company use? Why?**

I would recommend the company use the box with dimensions of $2\text{ cm} \times 5\text{ cm} \times 5\text{ cm}$ *(Choice Four) because it requires the least amount of material to make; so, it would cost the company the least amount of money to make.*

3. **A rectangular box of rice is shown below. How many cubic inches of rice can fit inside?**



Volume of the Rice Box: $V = 15\frac{1}{3}\text{ in.} \times 7\frac{2}{3}\text{ in.} \times 6\frac{1}{3}\text{ in.} = \frac{20102}{27}\text{ in}^3 = 744\frac{14}{27}\text{ in}^3$

4. **The Mars Cereal Company has two different cereal boxes for Mars Cereal. The large box is 8 inches wide, 11 inches high, and 3 inches deep. The small box is 6 inches wide, 10 inches high, and 2.5 inches deep.**

a. **How much more cardboard is needed to make the large box than the small box?**

Surface Area of the Large Box: $SA = 2(8\text{ in.})(11\text{ in.}) + 2(8\text{ in.})(3\text{ in.}) + 2(11\text{ in.})(3\text{ in.}) = 176\text{ in}^2 + 48\text{ in}^2 + 66\text{ in}^2 = 290\text{ in}^2$

Surface Area of the Small Box: $SA = 2(6\text{ in.})(10\text{ in.}) + 2(6\text{ in.})(2.5\text{ in.}) + 2(10\text{ in.})(2.5\text{ in.}) = 120\text{ in}^2 + 30\text{ in}^2 + 50\text{ in}^2 = 200\text{ in}^2$

Difference: $290\text{ in}^2 - 200\text{ in}^2 = 90\text{ in}^2$

The large box requires 90 square inches *more material than the small box.*

b. **How much more cereal does the large box hold than the small box?**

Volume of the Large Box: $V = 8\text{ in.} \times 11\text{ in.} \times 3\text{ in.} = 264\text{ in}^3$

Volume of the Small Box: $V = 6\text{ in.} \times 10\text{ in.} \times 2.5\text{ in.} = 150\text{ in}^3$

Difference: $264\text{ in}^3 - 150\text{ in}^3 = 114\text{ in}^3$

The large box holds 114 cubic inches *more cereal than the small box.*

5. A swimming pool is 8 meters long, 6 meters wide, and 2 meters deep. The water-resistant paint needed for the pool costs $\$6$ per square meter. How much will it cost to paint the pool?

   a. How many faces of the pool do you have to paint?

      You will have to point 5 faces.

   b. How much paint (in square meters) do you need to paint the pool?

      $SA = 2(8\text{ m} \times 6\text{ m}) + 2(8\text{ m} \times 2\text{ m}) + 2(6\text{ m} \times 2\text{ m}) = 96\text{ m}^2 + 32\text{ m}^2 + 24\text{ m}^2 = 152\text{ m}^2$

      Area of Top of Pool: $8\text{ m} \times 6\text{ m} = 48\text{ m}^2$

      Total Paint Needed: $152\text{ m}^2 - 48\text{ m}^2 = 104\text{ m}^2$

   c. How much will it cost to paint the pool?

      $104\text{ m}^2 \times \$6 = \$624$

      It will cost $\$624$ to paint the pool.

6. Sam is in charge of filling a rectangular hole with cement. The hole is 9 feet long, 3 feet wide, and 2 feet deep. How much cement will Sam need?

   $V = 9\text{ ft.} \times 3\text{ ft.} \times 2\text{ ft.} = 54\text{ ft}^3$

   Sam will need 54 cubic feet of cement to fill the hole.

7. The volume of Box D subtracted from the volume of Box C is 23.14 cubic centimeters. Box D has a volume of 10.115 cubic centimeters.

   a. Let C be the volume of Box C in cubic centimeters. Write an equation that could be used to determine the volume of Box C.

      $C - 10.115\text{ cm}^3 = 23.14\text{ cm}^3$

   b. Solve the equation to determine the volume of Box C.

      $C - 10.115\text{ cm}^3 + 10.115\text{ cm}^3 = 23.14\text{ cm}^3 + 10.115\text{ cm}^3$

      $C = 33.255\text{ cm}^3$

   c. The volume of Box C is one-tenth the volume of another box, Box E. Let E represent the volume of Box E in cubic centimeters. Write an equation that could be used to determine the volume of Box E, using the result from part (b).

      $33.255\text{ cm}^3 = \frac{1}{10}E$

   d. Solve the equation to determine the volume of Box E.

      $33.255\text{ cm}^3 \div \frac{1}{10} = \frac{1}{10}E \div \frac{1}{10}$

      $332.55\text{ cm}^3 = E$