<< **KEY CONCEPTS** >>

- There are a number of real-world applications involving the surface area of three-dimensional objects.
- The surface area of a three-dimensional object is the sum of the areas of all the outer faces of the object.
- Nets can be used to help visualize the faces of a three-dimensional object. A net is a two-dimensional drawing that shows the object "unfolded" so all its surfaces are visible.
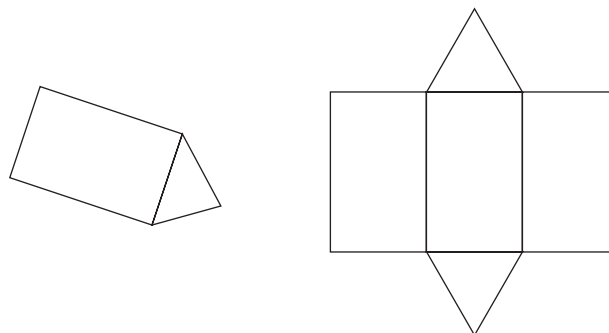
Example

You have been commissioned to design a door for a washing machine. The door of the washing machine will be a square that measures 22 in. by 22 in. with an area cut out for a circular window with diameter 8 in. The depth of the door is 3 in. Determine the surface area of the door of the washing machine to the nearest tenth of a square inch.

Solution

Calculate the total area of the front and the back of the door.
$A = 2s^2$
$\quad = 2 \times 22^2$
$\quad = 968$

Calculate the area of the circular window. The diameter of the window is 8 in., so the radius is 4 in.
$A = \pi r^2$
$\quad = \pi(4)^2$
$\quad = 50.265\ldots$

Calculate the area of the four outside edges of the door.
$A = 4(\ell \times w)$
$\quad = 4(22 \times 3)$
$\quad = 4 \times 66$
$\quad = 264$

Calculate the circumference of the edge around the window.
$C = 2\pi r$
$\quad = 2 \times \pi \times 4$
$\quad = 25.132\ldots$

Calculate the area of the edges around the window.
$SA = C \times$ depth
$\quad \doteq 25.132 \times 3$
$\quad \doteq 75.40$

Calculate the total surface area of the washing machine door.
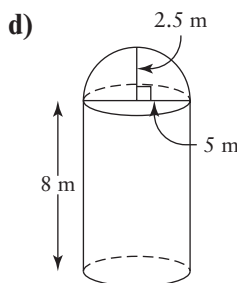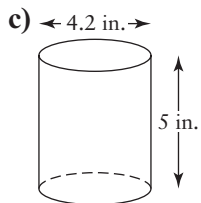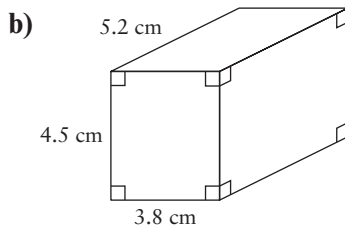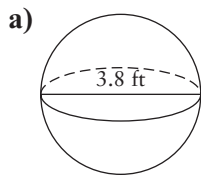$A = A_{\text{front and back of door}} - 2A_{\text{window}} + A_{\text{around four edges}} + A_{\text{around window}}$

$\quad \doteq 968 - 2(50.27) + 264 + 75.40$
$\quad \doteq 1206.86$
The total surface area of the washing machine door is approximately 1206.9 in.^{2}.

A

Unless otherwise specified, round all measures to the nearest tenth of a unit.

1. Calculate the surface area of each shape.

    a)

    3.8 ft

    b)

    5.2 cm
    4.5 cm
    3.8 cm

    c)

    4.2 in.
    5 in.

    d)

    2.5 m
    5 m
    8 m

2. A box has length 15 cm, width 12 cm, and height 7 cm.

    a) Draw and label a net for the box.

    b) Calculate the surface area of the box.

3. A closed cylindrical storage container has diameter 7.5 cm and height 11 cm.

    a) Calculate the surface area of the container.

    b) The material used to make the container costs $0.44 per square inch. What is the cost of material needed to make 10 containers?

    c) How would the formula to calculate the surface area change if the storage container did not have a lid?

4. A cabinet is in the shape of a cube. It has surface area 6144 in.^{2}. Determine the area of one face, and then the length of one edge of the cabinet.

B
5. A candle is in the shape of a cylinder. It has diameter 3 in. and surface area 70.7 in.^{2}.

    a) Determine the height of the candle.

    b) If the candle has burned down to half its height, will the surface area be halved? Explain your reasoning.

⭐ **6.** The surface area of a beach ball is 2827 cm². Calculate the diameter of the beach ball.

7. A storage box is in the shape of a square-based rectangular prism. The side lengths of the base are 2.5 ft and the height of the prism is 3.5 ft.

   a) Draw a diagram of the storage box.

   b) Determine the surface area of the storage box.

   c) If the dimensions of the storage box are doubled, determine the surface area of the storage box. By what factor did the surface area increase? Explain.

   d) If the dimensions of the storage box are tripled, determine the surface area of the storage box. By what factor did the surface area increase? Explain.

8. **a)** Determine the surface area of Sphere A with diameter 7 in.

   b) The diameter of Sphere B is double that of Sphere A. Calculate the surface area of Sphere B.

   c) How do the surface areas of Spheres A and B compare?

   d) The diameter of Sphere C is half that of Sphere A. Predict the relationship between the surface areas of Sphere C and Sphere A. Explain your prediction.

   **e)** Calculate the surface area of Sphere C. Compare the result to your answer to part d).

9. A rectangular piece of insulation is 40 cm long by 25.5 cm wide. It is to fit over a section of cylindrical pipe that is 40 cm long and 8 cm in diameter. Will the piece of insulation cover the section of pipe? Explain.

⭐ **10.** Reid made a wooden bowl of uniform thickness that is in the shape of a hemisphere. At the top of the bowl, the outer diameter is 30 cm and the inner diameter is 28 cm.

   a) Determine the area of exposed wood on the outside of the bowl.

   b) Determine the area of exposed wood on the inside of the bowl.

   c) Determine the area of exposed wood on the rim of the bowl.

   d) One bottle of finishing oil covers 1800 in.². What percent of a bottle is required to coat all the surfaces of the bowl?

11. A length of rubber hose is 150 cm long. It has outer diameter 4 cm and inner diameter 3.5 cm. Determine the area of exposed rubber (inside the hose, outside the hose, and at the ends).

12. Mary designed a riser for a concert. The side and top faces will be painted blue.
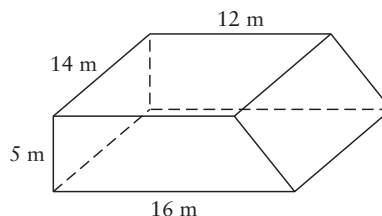
   a) Sketch a net of the riser.

   b) Determine the area of the riser to be painted blue.

13. A cylindrical container is designed to hold three stacked tennis balls. The height of the container is 20.6 cm. A tennis ball has diameter 2.7 in. Determine the amount of material required for the cylindrical container, to the nearest square inch.

14. Ed designed a birdhouse in the shape of a rectangular prism topped by half a cylinder. The rectangular prism is 40 cm long, 30 cm wide, and 20 cm high. There is a circular hole with radius 7.5 cm cut out of the front.
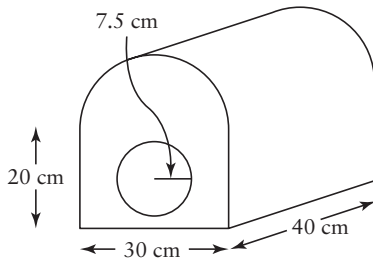
a) Determine the surface area of the birdhouse in square centimetres.

b) Determine the surface area of the birdhouse in square feet.

c) Explain how you determined the surface area of the birdhouse.

15. Erik is manufacturing umbrella stands. Each stand is in the shape of a cube with side lengths 2.5 ft. He drills a hole with diameter 1 ft through the centre of the top to hold umbrellas. Determine the surface area of one umbrella stand.
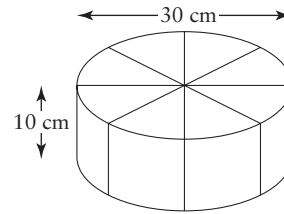
C

16. A tent is in the shape of a square-based pyramid with side lengths 8 ft and height 6 ft.
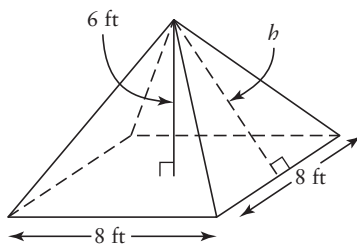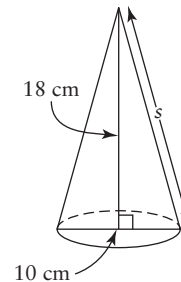

a) Consider the triangular faces. Calculate the height, h, of one face.

b) Determine the surface area of the tent.

**17.** A cylindrical wheel of cheese is cut into 8 congruent pieces.

What is the least amount of wrapping required for each wedge of cheese?

18. Rae designed a candle that is in the shape of a cone. The bottom diameter is 10 cm and the height is 18 cm.

a) Determine the slant height, s, of the side of the candle.

b) Determine the surface area of the candle.

c) Determine the surface area of the candle when it has burned to half its original height.

19. An open-top silo has cylindrical walls with outside diameter 5.2 m, thickness 52 cm, and height 12 m.
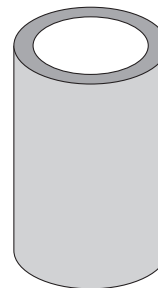
A can of paint costs $15.98 and covers 14 m². How much will it cost to paint the silo, including the inside, the outside, and the top of the walls?