

MAP4C1 Unit 2: Geometry

2.4 Working with Composite Objects

Learning Goals: I am learning to...

- Determine the volume and surface area of composite objects by breaking them down into simpler objects



In lesson 2.2 we defined a **composite figure** to be a figure made up of two or more simple geometric shapes. This can also be applied to 3D objects, where the object can be broken up into two or more simpler objects. These are known as **composite objects**.

Steps to Determine the Volume of a Composite Figure

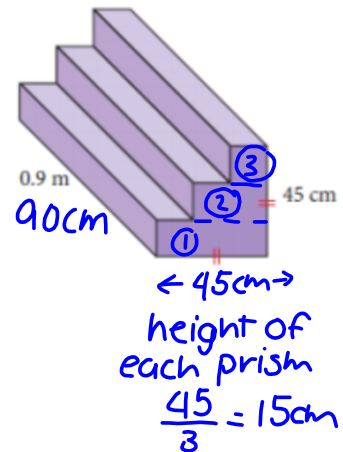
1. Break the composite object into simpler composite objects which you already know how to determine the volume for.
Note: There is often more than one way to break the object down!
2. Calculate the volume of each simpler composite object separately.
3. Combine all the volumes by adding.
4. Subtract any volumes that have been removed from the total composite object.

Example 1: You want to construct a concrete staircase with the dimensions shown.

- a) Determine the amount of concrete needed to construct the staircase. Round to **two decimal places**.

breaks down into 3 rectangular prisms.

| ① | ② | ③ |
|---|---|---|
| | | |
| $V_1 = Lwh$ $= (90)(45)(15)$ $= 60750 \text{ cm}^3$ | $V_2 = Lwh$ $= (90)(30)(15)$ $= 40500 \text{ cm}^3$ | $V_3 = Lwh$ $= (90)(15)(15)$ $= 20250 \text{ cm}^3$ |



$$V_T = V_1 + V_2 + V_3$$

$$= 60750 + 40500 + 20250$$

$$= 121500 \text{ cm}^3$$

\therefore The staircase has a volume of 121500 cm^3

- b) If concrete costs $\$0.02 / \text{cm}^3$, how much will it cost to build the stairs.

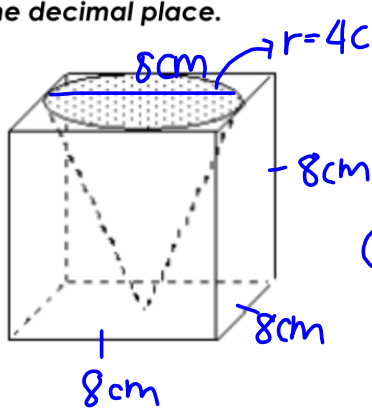
$$\text{Cost} = 121500(0.02)$$

$$= 2430$$

\therefore It will cost $\$2430$ to build the stairs

MAP4C1 Unit 2: Geometry

Example 2: A machinist drilled a conical hole into a cube, as shown in the diagram below. If the cube has sides of 8 cm, what is the volume of the metal **after** the hole is drilled? Round to **one decimal place**.



① Volume of cube
 $V_1 = LWh$
 $= 8(8)(8)$
 $= 512 \text{ cm}^3$

③ $V_{\text{total}} = V_1 - V_2$
 $= 512 - 134.04$
 $= 377.96$
 (378.0)

② Volume of cone
 $V_2 = \frac{\pi r^2 h}{3}$
 $= \frac{\pi(4)^2(8)}{3}$
 $= 134.04 \text{ cm}^3$

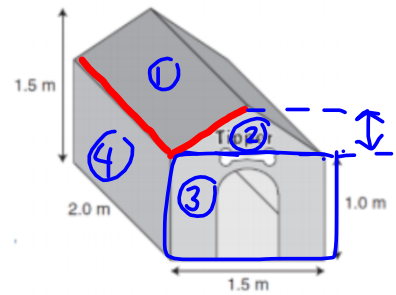
\therefore The volume is 378.0 cm^3

Steps to Determine the Surface Area of a Composite Object

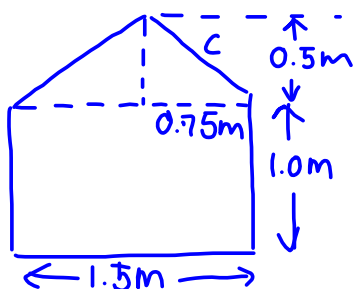
1. Determine the surface area of each "face" that makes up the composite object.
2. Combine the areas together by adding.
3. Subtract any surface areas that have been removed from the composite object.

Example 3: James is making a doghouse for his dog, Jeff.

- a) What is the surface area of the exterior of the doghouse **before the doorway is cut**? Include the floor in your calculations. Round to **one decimal place**.



| | Face | Shape | Qty | Formula | Area |
|---|-------------------|-----------|-----|---------------------|---|
| ① | Roof | Rectangle | 2 | $A = lW$ | $A = (2.0)(0.9) = 1.8 \text{ m}^2$ |
| ② | Triangular Panels | Triangle | 2 | $A = \frac{1}{2}bh$ | $A = \frac{1}{2}(1.5)(0.5) = 0.375 \text{ m}^2$ |
| ③ | Front/Back | Rectangle | 2 | $A = lW$ | $A = (1.5)(1.0) = 1.5 \text{ m}^2$ |
| ④ | Sides | Rectangle | 2 | $A = lW$ | $A = (2)(1) = 2 \text{ m}^2$ |
| ⑤ | Floor | Rectangle | 1 | $A = lW$ | $A = (2)(1.5) = 3 \text{ m}^2$ |

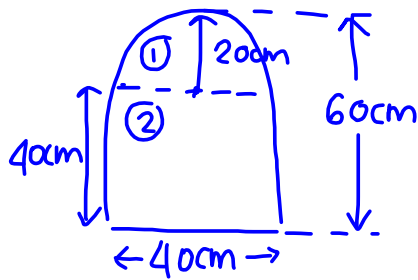


$c^2 = 0.75^2 + 0.5^2$ Total SA:
 $c^2 = 0.8125$ $2A_1 + 2A_2 + 2A_3 + 2A_4 + A_5$
 $c = 0.90 \text{ m}$ $= 2(1.8) + 2(0.375) + 2(1.5)$
 $+ 2(2) + 3$
 $= 14.4 \text{ m}^2$

\therefore The SA before the door is cut is 14.4 m^2

MAP4C1 Unit 2: Geometry

b) The exterior walls and roof of the doghouse are to be painted a different colour. A 40 cm wide doorway has been cut to allow Jeff to enter and exit his house. The doorway is 60 cm at its highest point. What area is to be painted on the doghouse? Round to one decimal place.



Semi-circle

$$A = \frac{\pi r^2}{2}$$

$$= \frac{\pi (20)^2}{2}$$

$$= 628.3 \text{ cm}^2$$

Rectangle

$$A = lw$$

$$= (40)(40)$$

$$= 1600 \text{ cm}^2$$

$$A_{\text{door}} = 628.3 + 1600$$

$$= 2228.3 \text{ cm}^2$$

↳ convert to m^2

$$1 \text{ m} = 100 \text{ cm}$$

$$1 \text{ m}^2 = 10000 \text{ cm}^2$$

$$2228.3 \text{ cm}^2 \times \frac{1 \text{ m}^2}{10000 \text{ cm}^2} = \underline{\underline{0.22283 \text{ m}^2}}$$

$$A_{\text{paint}} = A_T - A_{\text{door}} - A_{\text{floor}}$$

$$= 4.4 - 0.22283 - 3$$

$$= 1.2$$

∴ The doghouse needs to be painted with 1.2 m^2 of paint