

## Converting Units of Area and Volume

### Starter

1. **(Review of last lesson)** A cone has a surface area of  $250 \text{ m}^2$  and its height is  $10 \text{ m}$ . If the height of a similar cone is  $16 \text{ m}$ , calculate its surface area.
2. **(Review of last lesson)** Two spheres are such that their radii (plural of radius) are  $7 \text{ cm}$  and  $12 \text{ cm}$ . The larger sphere has a volume of  $3600 \text{ cm}^3$ . Calculate the volume of the smaller sphere. Give your answer to 1 d.p..
3. Convert  $6 \text{ m}^2$  to  $\text{cm}^2$ .

**Working:** Many people would *incorrectly* suggest that  $6 \text{ m}^2$  is equivalent to  $600 \text{ cm}^2$ . In fact, the answer is  $60000 \text{ cm}^2$ . This lesson will explain why.

### Notes

#### Converting metric units of area

Let us explain why  $6 \text{ m}^2 \equiv 60000 \text{ cm}^2$ .

Consider a rectangle whose area is  $6 \text{ m}^2$ .

Its dimensions could be  $3 \text{ m}$  by  $2 \text{ m}$  (see **diagram on the left**).

By converting the dimensions of the rectangle to  $\text{cm}$ , the rectangle stays the same size. Its dimensions would be  $300 \text{ cm}$  by  $200 \text{ cm}$  (see **diagram on the right**).



**N.B.** I chose dimensions of  $3 \text{ m}$  by  $2 \text{ m}$  but I could also have chosen  $6 \text{ m}$  by  $1 \text{ m}$  or any other numbers that multiply together to get  $6$

**E.g 1** By using a similar method to above, convert  
 (a)  $12 \text{ m}^2$  to  $\text{cm}^2$       (b)  $8 \text{ cm}^2$  to  $\text{mm}^2$       (c)  $4500 \text{ cm}^2$  to  $\text{m}^2$

**Working:** (a) Let the dimensions of the rectangle be  $4 \text{ m}$  by  $3 \text{ m}$ .

**Convert to cm:**  $400 \text{ cm}$  by  $300 \text{ m}$

**Multiply:**  $120000 \text{ cm}^2$

So  $12 \text{ cm}^2 \equiv 120000 \text{ m}^2$

**Alternatively, your working could look like this:**

$$\begin{aligned} 12 \text{ m}^2 &= 4 \text{ m} \times 3 \text{ m} && \text{two numbers multiply to get 12} \\ &= 400 \text{ cm} \times 300 \text{ cm} && \text{convert the units} \\ &= 120000 \text{ cm}^2 \end{aligned}$$

**N.B.** I could also have chosen  $6 \text{ m}$  by  $2 \text{ m}$  or  $12 \text{ m}$  by  $1 \text{ m}$  for the dimensions of the rectangle.

### Quick converting

Let's find a quicker method to convert units by considering the working of converting  $14 \text{ m}^2$  to  $\text{cm}^2$ .

$$\begin{aligned}14 \text{ m}^2 &= 7 \text{ m} \times 2 \text{ m} && \text{two numbers multiply to get 12} \\ &= (7 \times 100) \text{ cm} \times (2 \times 100) \text{ cm} && \text{convert the units} \\ &= (7 \times 2) \times (100 \times 100) \text{ cm}^2 \\ &= 14 \times 100^2 \text{ cm}^2\end{aligned}$$

So to convert from  $\text{m}^2$  to  $\text{cm}^2$  we **multiply by  $100^2$** .

To convert from **m** to **cm** we **multiply** by 100.

So to convert from **m<sup>2</sup>** to **cm<sup>2</sup>** we **multiply** by  $100^2$ .

Converting from  $\text{cm}^2$  to  $\text{m}^2$ , we would have to **divide by  $100^2$** .

**E.g. 2** State what you need to **multiply** or **divide** by to convert from:

- (a)  $\text{cm}^2$  to  $\text{m}^2$                       (b)  $\text{cm}^2$  to  $\text{mm}^2$                       (c)  $\text{m}^2$  to  $\text{km}^2$

**Working:**      (a) To convert from **cm** to **m** we **divide** by 100.  
To convert from **cm<sup>2</sup>** to **m<sup>2</sup>** we **divide** by  $100^2$ .

### Converting metric units of volume

**E.g. 3** To convert from  $\text{m}^2$  to  $\text{cm}^2$  we **multiply** by  $100^2$  — this is for areas.

What could we need to multiply by to convert from  $\text{m}^3$  to  $\text{cm}^3$  (units of volume).

**Working:**      We would multiply by  $100^3$  — **cubed** because it is a **volume**.

**E.g. 4** State what you need to **multiply** or **divide** by to convert from:

- (a)  $\text{km}^3$  to  $\text{m}^3$                       (b)  $\text{mm}^3$  to  $\text{cm}^3$                       (c)  $\text{m}^3$  to  $\text{mm}^3$

### Success criteria — converting units of area or volume

- Ignore the <sup>2</sup> or the <sup>3</sup> on the units. Write down how to convert the length units.  
**E.g.** Multiply by 10 if cm to mm                      or                      Divide by 100 if cm to m
- Now look at the <sup>2</sup> or the <sup>3</sup> on the units. Square the number from step 1 if it is an area conversion or cube the number if it involves volumes.  
**E.g.** Multiply by  $10^2$  if  $\text{cm}^2$  to  $\text{mm}^2$                       or                      Divide by  $100^3$  if  $\text{cm}^3$  to  $\text{m}^3$
- Multiply or divide the given units by the number found in step 2.

**E.g. 5** Convert these areas or volumes to the units given:

- (a)  $9 \text{ m}^3$  to  $\text{cm}^3$                       (b)  $72000 \text{ mm}^2$  to  $\text{cm}^2$   
(c)  $4.3 \text{ cm}^3$  to  $\text{mm}^3$                       (d)  $3000000 \text{ cm}^2$  to  $\text{km}^2$

**Working:**      (a) To convert from **m** to **cm** we **multiply** by 100.  
So to convert from **m<sup>3</sup>** to **cm<sup>3</sup>** we **multiply** by  $100^3$ .  
 $\therefore 9 \text{ m}^3 \equiv 9 \times 100^3 \text{ cm}^3$   
 $= 9 \times 1000000 \text{ cm}^3$   
 $= 9000000 \text{ cm}^3$

**Video:**                      [Converting between metric units of area](#)  
**Video:**                      [Converting between metric units of volume](#)

**Exercise**

1. Convert these units to the ones stated:

- |  |  |
|--|--|
| (a) $9 \text{ m}^2$ to $\text{cm}^2$       | (b) $850 \text{ mm}^2$ to $\text{cm}^2$  |
| (c) $2000000 \text{ m}^3$ to $\text{km}^3$ | (d) $3.65 \text{ cm}^3$ to $\text{mm}^3$ |
| (e) $690 \text{ cm}^3$ to $\text{m}^3$     | (f) $5300 \text{ km}^2$ to $\text{m}^2$  |
| (g) $9100 \text{ cm}^2$ to $\text{m}^2$    | (h) $793 \text{ km}^3$ to $\text{m}^3$   |
| (i) $4200 \text{ mm}^3$ to $\text{cm}^3$   | (j) $5800 \text{ m}^2$ to $\text{km}^2$  |
| (k) $6.1 \text{ m}^3$ to $\text{cm}^3$     | (l) $1.8 \text{ cm}^2$ to $\text{mm}^2$  |

2. Convert these units to the ones stated:

- |  |  |
|--|--|
| (a) $54 \text{ km}^2$ to $\text{cm}^2$ | (b) $8500000 \text{ mm}^3$ to $\text{m}^3$ |
|--|--|

For the answers to the exercise, click on the [blue link](#) above.