

## Maps and Scale Models

### Starter

1. **(Review of last lesson)** Convert these units to the ones stated:  
(a)  $0.056 \text{ m}^3$  to  $\text{cm}^3$  (b)  $290000 \text{ mm}^2$  to  $\text{m}^2$

**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  $100^3$ .  
 $\therefore 0.056 \text{ m}^3 \equiv 0.056 \times 100^3 \text{ cm}^3$   
 $= 0.056 \times 1000000 \text{ cm}^3$   
 $= 56000 \text{ cm}^3$

(b) To convert from **mm** to **cm** we **divide** by 10.  
So to convert from **mm** to **m** we **divide** by 1000.  
So to convert from **mm<sup>2</sup>** to **m<sup>2</sup>** we **divide** by  $1000^2$ .  
 $\therefore 290000 \text{ mm}^2 \equiv 290000 \div 1000^2 \text{ m}^2$   
 $= 290000 \div 1000000 \text{ m}^2$   
 $= 0.29 \text{ m}^2$

2. **(Review of previous material)** Simplify these ratios so that they are in the form 1 : n.  
(a)  $4 : 20$  (b)  $0.5 : 7$  (c)  $4 \text{ cm} : 10 \text{ m}$

**Working:** (a) Divide both numbers by 4:  $1 : 5$   
(b) Multiply both number by 2:  $1 : 14$   
(c) Convert to the same units:  $4 \text{ cm} : 1000 \text{ cm}$   
Divide both numbers by 4:  $1 : 250$

3. **(Review of previous material)** Given that the length factor is 5, write down the:  
(a) area factor (b) volume factor

**Working:** (a) Area factor = Length factor<sup>2</sup> =  $5^2 = 25$   
(b) Volume factor = Length factor<sup>3</sup> =  $5^3 = 125$

**E.g. 1** The scale of a map is 1 : 6000. What actual distance, in metres, does 3 cm represent on the map?

**Working:** Actual distance in cm =  $3 \times 6000 = 18000 \text{ cm}$   
Actual distance in m =  $18000 \div 100 = 180 \text{ m}$

**E.g. 2** The scale of a map is 1 : 50000. Calculate the distance on the map, in cm, when the actual distance between two places is 800 m?

**Hint:** convert to metres and then kilometres.

**Working:** Map distance in m =  $800 \div 50000 = 0.016 \text{ m}$   
Map distance in cm =  $0.016 \times 100 = 1.6 \text{ cm}$

**E.g. 3** The scale of a map is 1 : 250000. What actual distance (in km) does 5 cm represent on the map?

**Working:** Actual distance in cm =  $5 \times 250000 = 1250000$  cm  
Actual distance in m =  $1250000 \div 100 = 12500$  m  
Actual distance in km =  $12500 \div 1000 = 12.5$  km

**E.g. 4** Given that the length ratio is 1 : 4, write down the:

(a) area ratio (b) volume ratio

**Working:** (a) Square both numbers:  $1^2 : 4^2 \equiv 1 : 16$

(b) Cube both numbers:  $1^3 : 4^3 \equiv 1 : 64$

**E.g. 5** On a map with a scale of 1 : 200, a garden has an area of 6 cm<sup>2</sup>. Calculate the actual area of the garden in m<sup>2</sup>.

**Working:** Length ratio is 1 : 200  
Area ratio is  $1^2 : 200^2 \equiv 1 : 40000$   
Actual area of the garden in cm<sup>2</sup> =  $6 \times 40000 = 240000$  cm<sup>2</sup>  
To convert from cm to m we **divide** by 100.  
So to convert from cm<sup>2</sup> to m<sup>2</sup> we **divide** by 100<sup>2</sup>.  
 $\therefore 240000 \text{ cm}^2 \equiv 240000 \div 100^2 \text{ m}^2$   
 $= 240000 \div 10000 \text{ m}^2$   
 $= 24 \text{ m}^2$

The actual area of the garden is 24 m<sup>2</sup>.

**Alternatively:**

**Map:**  $6 \text{ cm}^2 = 6 \text{ cm} \times 1 \text{ cm}$

**Actual (multiply by map ratio):**  $(6 \times 200) \text{ cm} \times (1 \times 200) \text{ cm}$   
 $1200 \text{ cm} \times 200 \text{ cm}$

**Convert to m:**  $12 \text{ m} \times 2 \text{ m} = 24 \text{ m}^2$

The actual area of the garden is 24 m<sup>2</sup>.

**E.g. 6** A map has a scale of 1 : 500. A public playground on the map has an area of 14 cm<sup>2</sup>. Calculate the actual area, in m<sup>2</sup>, of the playground.

**Working:** Length ratio is 1 : 500  
Area ratio is  $1^2 : 500^2 \equiv 1 : 250000$   
Actual area of the playground in cm<sup>2</sup> =  $14 \times 250000 = 3500000$  cm<sup>2</sup>  
To convert from cm to m we **divide** by 100.  
So to convert from cm<sup>2</sup> to m<sup>2</sup> we **divide** by 100<sup>2</sup>.  
 $\therefore 3500000 \text{ cm}^2 \equiv 3500000 \div 100^2 \text{ m}^2$   
 $= 3500000 \div 10000 \text{ m}^2$   
 $= 350 \text{ m}^2$

The actual area of the garden is 350 m<sup>2</sup>.

**Alternatively:**

**Map:**  $14 \text{ cm}^2 = 14 \text{ cm} \times 1 \text{ cm}$

**Actual (multiply by map ratio):**  $(14 \times 500) \text{ cm} \times (1 \times 500) \text{ cm}$   
 $7000 \text{ cm} \times 500 \text{ cm}$

**Convert to m:**  $70 \text{ m} \times 5 \text{ m} = 350 \text{ m}^2$

The actual area of the garden is 350 m<sup>2</sup>.

**E.g. 7** A standard football pitch has area  $7140 \text{ m}^2$ . What would the area of the pitch be, in cm, on a scale drawing whose scale is  $1 : 90$ ? Give your answer to 3 s.f..

**Working:** Length ratio is  $1 : 90$   
Area ratio is  $1^2 : 90^2 \equiv 1 : 8100$   
Area of scale drawing of the pitch in  $\text{m}^2 = 7140 \div 8100 \approx 0.881 \text{ m}^2$   
To convert from **m** to **cm** we **times** by 100.  
So to convert from  $\text{m}^2$  to  $\text{cm}^2$  we **times** by  $100^2$ .  
 $\therefore 0.881 \text{ cm}^2 \equiv 0.881 \times 100^2 \text{ cm}^2$   
 $= 0.881 \times 10000 \text{ cm}^2$   
 $= 8810 \text{ cm}^2 \quad (3 \text{ s.f.})$   
The area of scale drawing of the pitch is  $8810 \text{ cm}^2$ .

**Alternatively:**

**Actual:**  $7140 \text{ m}^2 = 7140 \text{ m} \times 1 \text{ m}$

**Drawing (divide by map ratio):**  $(7140 \div 90) \text{ m} \times (1 \div 90) \text{ m}$

**Convert to cm:**  $(7140 \div 90 \times 100) \text{ cm} \times (1 \div 90 \times 100) \text{ cm}$   
 $7933.\bar{3} \text{ cm} \times 1.\bar{1} \text{ cm} \approx 8814.8 \text{ cm}^2$

The area of scale drawing of the pitch is  $8810 \text{ cm}^2$  (3 s.f.).

**E.g. 8** A diagram of a cuboid has lengths 2 cm, 3 cm and 5 cm. It is scaled up using the ratio  $1 : 80$ . Calculate the actual volume of the cube in  $\text{m}^3$ .

**Working:** Length ratio is  $1 : 80$   
Volume ratio is  $1^3 : 80^3 \equiv 1 : 512000$   
Volume of model  $= 2 \times 3 \times 5 = 30 \text{ cm}^3$   
Actual area of the playground in  $\text{cm}^2 = 30 \times 512000 = 15360000 \text{ cm}^2$   
To convert from **cm** to **m** we **divide** by 100.  
So to convert from  $\text{cm}^3$  to  $\text{m}^3$  we **divide** by  $100^3$ .  
 $\therefore 15360000 \text{ cm}^3 \equiv 15360000 \div 100^3 \text{ m}^3$   
 $= 15360000 \div 1000000 \text{ m}^3$   
 $= 15.36 \text{ m}^3$

The actual area of the garden is  $15.36 \text{ m}^3$ .

**Alternatively:**

**Model:**  $2 \text{ cm} \times 3 \text{ cm} \times 5 \text{ cm}$

**Actual (multiply by model ratio):**

$(2 \times 80) \text{ cm} \times (3 \times 80) \text{ cm} \times (5 \times 80) \text{ cm}$   
 $160 \text{ cm} \times 240 \text{ cm} \times 400 \text{ cm}$

**Convert to m:**  $1.6 \text{ m} \times 2.4 \text{ m} \times 4 \text{ m} = 15.36 \text{ m}^3$

The actual area of the garden is  $15.36 \text{ m}^3$ .

**Video:** [Maps scales](#)

[Solutions to Starter and E.g.s](#)

## Exercise

p149 Ex 19.4 Qu 1-10