

8.5 Similar Objects: Scale Models and Scale Diagrams

Learning targets:

1. Demonstrate understanding of new terminology pertaining to scale diagrams and 3-D objects.
2. Calculating a scale factor.
3. Using scale factors to solve problems.

Terminology

Similar Objects:

Two or more 3-D objects that have proportional dimensions.

*If an object has *multiple dimensions* (like length and width and height), it is important to note that **ALL of them** must be **proportional** in order for the objects to be SIMILAR.

Scale Factor

The scale factor, k , of two similar 3-D objects is the ratio of a linear measurement of an object to the corresponding linear measurement in a similar object, where both measurements are in the same units.

$$k = \frac{\textit{linear measurement of scale model}}{\textit{corresponding linear measurement of object}}$$

Scale Factor

$$k = \frac{\text{linear measurement of scale model}}{\text{corresponding linear measurement of object}}$$

Ex: **Spheres** are always similar to other spheres.

The scale factor for two spheres would be determined by the ratio of their radii.

Ex: A **cylinder** is only similar to another cylinder if the ratio of their heights is the same as the ratio of their diameters (or radii). The scale factor can be determined using **either** of these ratios.

Example #1:

Using a scale factor to determine actual measurements

A 1:18 scale model of a car has a length of 206.3 mm, a width of 94.5 mm and a height of 78.2 mm.

Find the dimensions of car.
Express your answer in m.

	L	W	H	H
$K = \frac{\text{meas m}}{\text{meas a}}$				
$\frac{1}{18} = \frac{206.3 \text{ mm}}{C}$	$C_W = 18(94.5 \text{ mm})$	$C_H = 18(78.2 \text{ mm})$		
	$C_W = 1701 \text{ mm}$	$C_H = 1407.6 \text{ mm}$		
	$C_W = 1.701 \text{ m}$	$= 1.4076 \text{ m}$		

$$C = 18(206.3 \text{ mm})$$

$$C = 3713.4 \text{ mm}$$

$$C_L = 3.7134 \text{ m}$$

Example #1:

Solution: The scale model is a reduction of the actual car.
The scale used for this reduction was 1:18

If we treat the actual car as an enlargement of the model, the scale becomes 18:1

∴ Multiply each of the model's dimensions by 18 to get the dimensions of the actual car:

Actual length: $(206.3 \text{ mm})(18) = 3713.4 \text{ mm} = 3.7 \text{ m}$

Actual width: $(94.5 \text{ mm})(18) = 1701 \text{ mm} = 1.7 \text{ m}$

Actual height: $(78.2 \text{ mm})(18) = 1407.6 \text{ mm} = 1.4 \text{ m}$

You Try:

A 1:25 scale model of a tractor trailer is 0.4 ft. tall, 0.3 ft. wide, and 1.5 ft. long.

What are the dimensions of the actual trailer?

$$\begin{aligned} &\underline{\text{Tall}} \\ \frac{1}{25} &= \frac{0.4 \text{ ft}}{t} \\ t &= 25(0.4 \text{ ft}) \\ t &= 10 \text{ ft} \end{aligned}$$

$$\begin{aligned} &\text{Width} \\ (0.3 \text{ ft})(25) &= 7.5 \text{ ft} \\ &\underline{\text{Length}} \\ (1.5 \text{ ft})(25) &= 37.5 \text{ ft} \end{aligned}$$

Example #2:

Which of the following rectangular prisms is similar to a rectangular prism that is 80 cm long, 45 cm wide, and 30 cm high?

- rectangular prism that is 20 cm long, 15 cm wide, 10 cm high
- rectangular prism that is 100 cm long, 80 cm wide, 20 cm high
- rectangular prism that is 120 cm long, 90 cm wide, 50 cm high
- rectangular prism that is 112 cm long, 63 cm wide, 42 cm high

You Try:

Which of these cylinders is similar to a cylinder **10 cm long** and **25 cm in diameter**?

- A cylinder 16 cm long and 40 cm in diameter
- A cylinder 4 cm long and 15 cm in diameter
- A cylinder 12 cm long and 35 cm in diameter

Example #3:

A sculptor wishes to reproduce a statue that is 7 ft. 4 in. tall as a scale model which is 16 in. tall.

What scale factor would the sculptor use?

$$7(12) + 4 = 88 \text{ in (actual)}$$
$$k = \frac{16}{88} = 0.\overline{18} \quad 16 \text{ in (model)}$$
$$= 18.\overline{18}\%$$

Example #3:

A sculptor wishes to reproduce a statue that is 7 ft. 4 in. tall as a scale model which is 16 in. tall.

What scale factor would the sculptor use?

Convert height to “inches” only:

$$7 \text{ ft. } 4 \text{ in.} = 7 \times 12 + 4 \text{ in.} = 88 \text{ in.}$$

$$k = \frac{\text{linear measurement of scale model}}{\text{corresponding linear measurement of object}}$$

$$k = \frac{16 \text{ in}}{88 \text{ in}} = \frac{2}{11}$$

∴ The sculptor would need to use a scale factor of $\frac{2}{11}$ to create a scale model 16 in. tall.

Assignment

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#1, 2, 3, 4, 5, 8, 9, 11

$$\begin{array}{r} 30 \\ - 5 \\ \hline 25 \\ + 3 \\ \hline 28 \\ + 2 \end{array}$$

$$\begin{array}{r} 10 \\ - 9 \\ \hline 1 \\ \hline 10 \\ - 9 \\ \hline 1 \\ \hline 10 \\ - 9 \\ \hline 1 \end{array}$$

