**Lesson 3**

**GCSE Mathematics**
**Ratio and Similarity**

*Non Calculator*

**3.1 Start Up**

Use the table of ***Squares and Cubes from 1 to 99*** to determine;

**( i )** $\left(\frac{21}{26}\right)^2 = \frac{441}{\quad}$

**( ii )** $\left(\frac{49}{34}\right)^2 = \frac{\quad}{1156}$

**( iii )** $\left(\frac{32}{91}\right)^2 = \frac{\quad}{\quad}$

**( iv )** $\left(\frac{17}{31}\right)^3 = \frac{4913}{\quad}$

**( v )** $\left(\frac{7}{29}\right)^3 = \frac{\quad}{24389}$

**( vi )** $\left(\frac{63}{50}\right)^3 = \frac{\quad}{\quad}$

**( vii )** $\left(\frac{324}{625}\right)^{0.5} = \frac{18}{\quad}$

**( viii )** $\left(\frac{196}{4356}\right)^{0.5} = \frac{\quad}{66}$

**( ix )** $\left(\frac{6241}{9801}\right)^{0.5} = \frac{\quad}{\quad}$

**( x )** $\left(\frac{81}{25}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$

**( xi )** $\left(\frac{1}{100}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$

**( xii )** $\left(\frac{2116}{2601}\right)^{\frac{1}{2}} = \frac{\quad}{\quad}$

**( xiii )** $\left(\frac{8}{27}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$

**( xiv )** $\left(\frac{4096}{24389}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$

**( xv )** $\left(\frac{857375}{884736}\right)^{\frac{1}{3}} = \frac{\quad}{\quad}$

**[ 15 marks ]**

### 3.2 Volume Scale Factor (*vsf*)

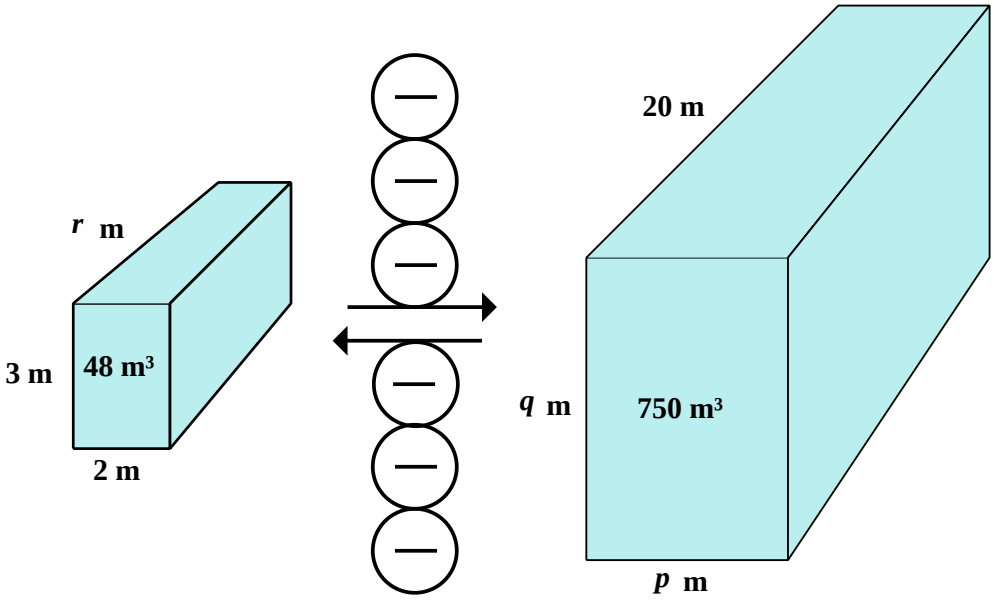
For any two similar solids:

$$volume\ scale\ factor\ =\ (\ length\ scale\ factor\ )^3$$

which can also be expressed as:

$$length\ scale\ factor\ =\ \sqrt[3]{volume\ scale\ factor}$$

### 3.3 Example




The above two similar cuboids are shown with the same orientation.

**( i )** Find the lengths marked *p*, *q* and *r*.

**[ 3 marks ]**

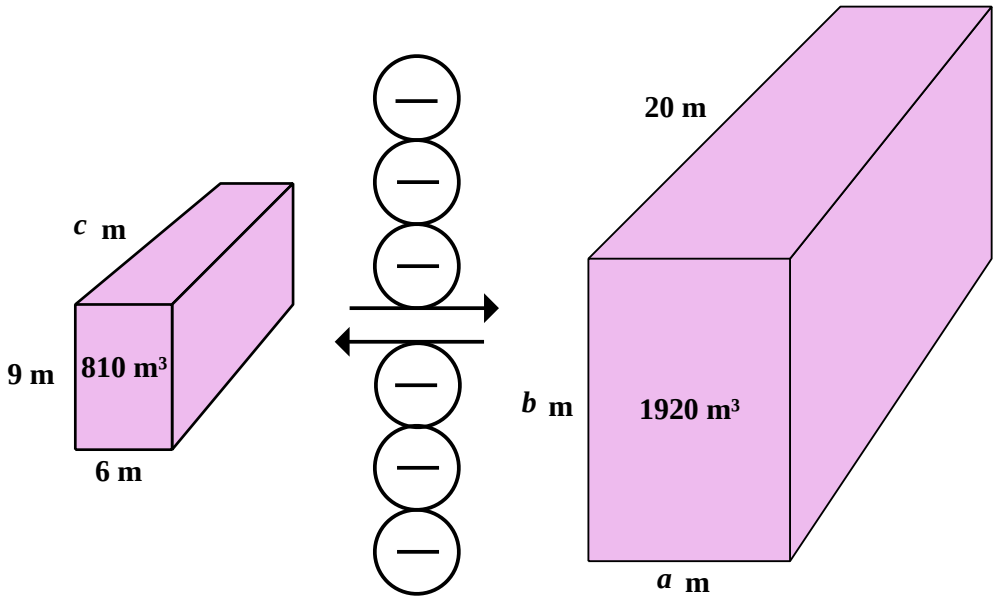
**( ii )** How many times more surface area has the larger cuboid than the smaller ?

**[ 1 mark ]**

### 3.4 Exercise

Marks Available : 56

**Question 1**




The above two similar cuboids are shown with the same orientation.

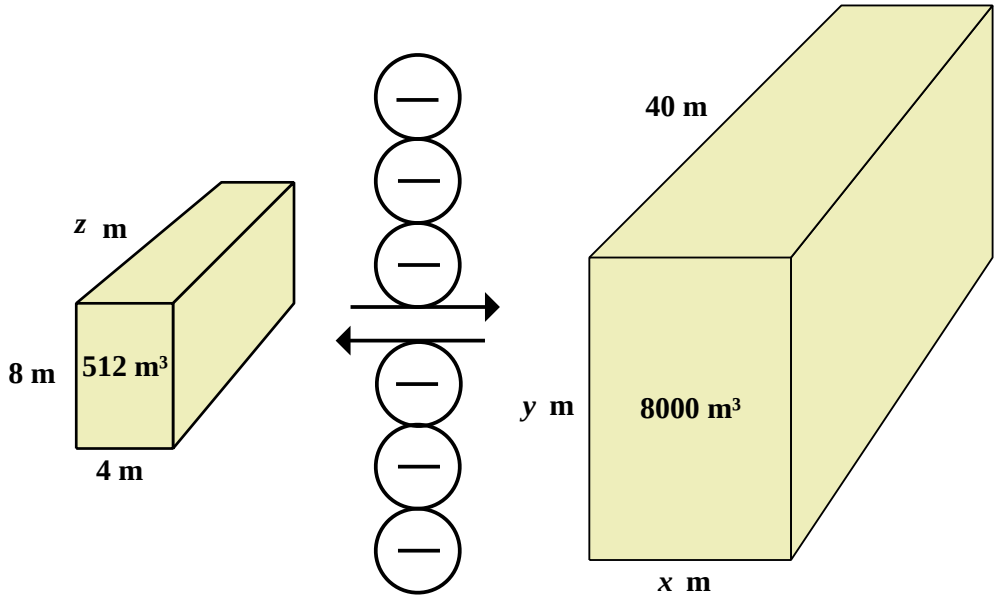
**( i )** Find the lengths marked *a*, *b* and *c*.

**[ 3 marks ]**

**( ii )** How many times more surface area has the larger cuboid than the smaller ?

**[ 2 marks ]**

**Question 2**




The above two similar cuboids are shown with the same orientation.

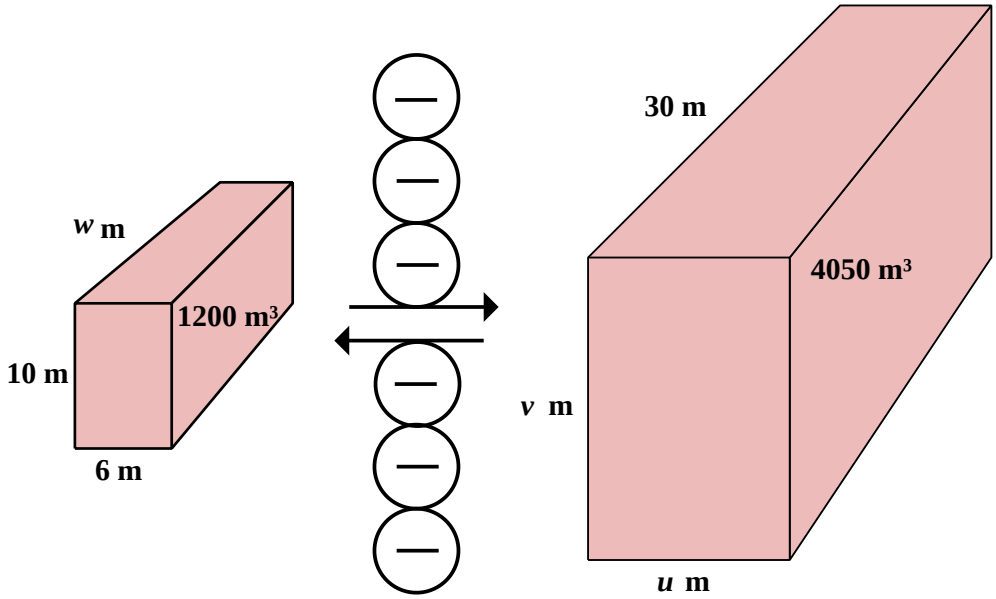
**( i )** Find the lengths marked *x*, *y* and *z*.

**[ 3 marks ]**

**( ii )** How many times more surface area has the larger cuboid than the smaller ?

**[ 2 marks ]**

**Question 3**




The above two similar cuboids are shown with the same orientation.

**( i )** Find the lengths marked *u*, *v* and *w*.

**[ 3 marks ]**

**( ii )** How many times more surface area has the larger cuboid than the smaller ?

**[ 2 marks ]**

**Question 4**

**( i )** Are all squares similar ? YES / NO

In other words, *Are all squares the same shape* ?

**[ 1 mark ]**

**( ii )** A smaller square has an area of $27cm^3$.

A larger square has a side $\frac{5}{3}$ times greater than the small square.

What is the area of the larger square ?

Hint : $lsf = \frac{5}{3}$ $asf = (lsf)^2$ $A_{BIG} = A_{SMALL} \times asf$

**[ 3 marks ]**

**Question 5**

Cuboid *G* measures 14cm by 21cm by 28cm.

Cuboid *H* measures 4cm by 6cm by 8cm.

**( i )** Complete the following to show that the two cuboids similar.

$\frac{14}{\quad} = \frac{\quad}{6} = \frac{\quad}{\quad}$ All cancel down to $\frac{\quad}{\quad}$

**[ 2 marks ]**

**( ii )** What is the ***length scale factor***, greater than 1, of the similarity ?

$lsf =$ ———

**[ 1 mark ]**

**( iii )** What is the ***area scale factor*** of, greater than 1, of the similarity ?

$asf =$ ———

**[ 1 mark ]**

**( iv )** What is the ***volume scale factor***, greater than 1, of the similarity ?

$vsf =$ ———

**[ 1 mark ]**

**( v )** Calculate;

**( a )** $V_{BIG}$

**[ 1 mark ]**

**( b )** $V_{SMALL}$

**[ 1 mark ]**

**( c )** $V_{SMALL} \times vsf$

**[ 1 mark ]**

**( d )** Comment

**[ 1 mark ]**

**Question 6**

Are all rectangles similar ? YES / NO

In other words, *Are all rectangles the same shape* ?

**[ 1 mark ]**

**Question 7**

**( i )** Are all spheres similar ? YES / NO

**[ 1 mark ]**

**( ii )** A smaller sphere has a volume of $32cm^3$.

A larger sphere has a radius $\frac{5}{2}$ times greater than the small sphere.

What is the volume of the larger sphere ?

Hint : $lsf = \frac{5}{2}$ $vsf = (lsf)^3$ $V_{BIG} = V_{SMALL} \times vsf$

**[ 3 marks ]**

**Question 8**

A larger cuboid has lengths that are $\frac{4}{3}$ times longer than a similar smaller cuboid.

The smaller cuboid measures 60cm by 66cm by 42cm.

What are the measurements of the larger cuboid ?

_____ by _____ by _____

**[ 2 marks ]**

**Question 9**

A larger cuboid has lengths that are $\frac{7}{4}$ times longer than a similar smaller cuboid.

The smaller cuboid measures 8 cm by 40 cm by 44 cm.

What are the measurements of the larger cuboid ?

_____ by _____ by _____

**[ 2 marks ]**

**Question 10**

**( i )** Are all triangles similar ? YES / NO

**[ 1 mark ]**

**( ii )** Are all right angled triangles similar ? YES / NO

**[ 1 mark ]**

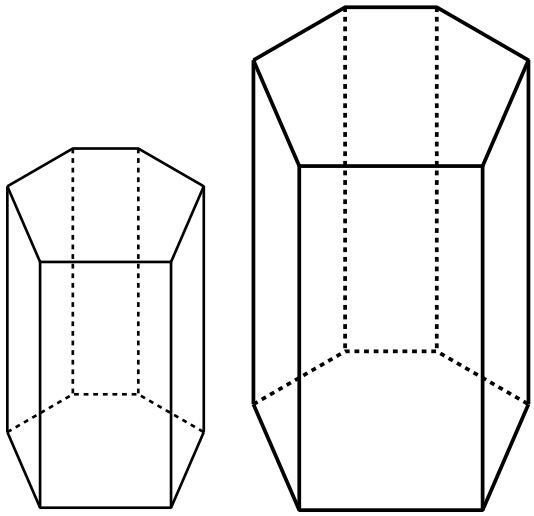
**( iii )** Are all equilateral triangles similar ? YES / NO

**[ 1 mark ]**

**Question 11**

Two similar hexagonal prisms are shown below.

An edge of 14cm on the smaller corresponds to an edge of length 21cm on the larger.




**( i )** What is the ***length scale factor***, greater than 1, of the similarity ?

*lsf* = ———

**[ 1 mark ]**

**( ii )** What is the ***area scale factor***, greater than 1, of the similarity ?

*asf* = ———

**[ 1 mark ]**

**( iii )** What is the ***volume scale factor***, greater than 1, of the similarity ?

*vsf* = ———

**[ 1 mark ]**

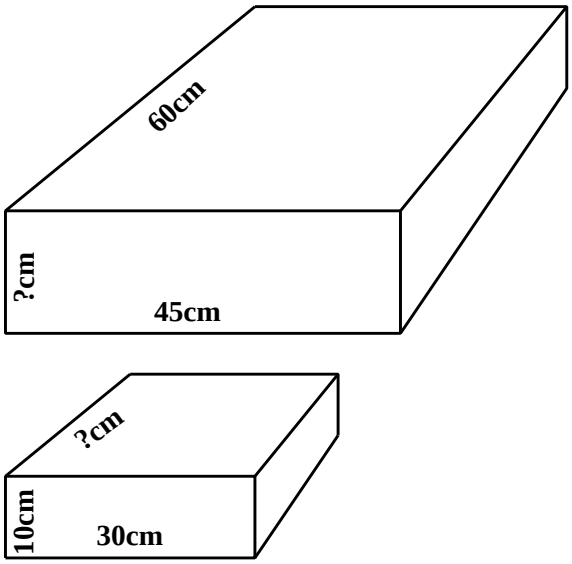
**( iv )** The volume of the smaller hexagonal prism is 40 $cm^3$.

Calculate the volume of the larger hexagonal prism.

**[ 2 marks ]**

**Question 12**

The two cuboids shown below are similar.




**( i )** What is the ***length scale factor***, greater than 1, of the similarity ?

*lsf* = ———

**[ 1 mark ]**

**( ii )** Find the height of the upper cuboid, marked with a question mark.

**[ 1 mark ]**

**( iii )** Find the missing length on the lower cuboid, marked with a question mark.

**[ 1 mark ]**

**Question 13**

Each face of a smaller cube has an area of 36 $cm^2$

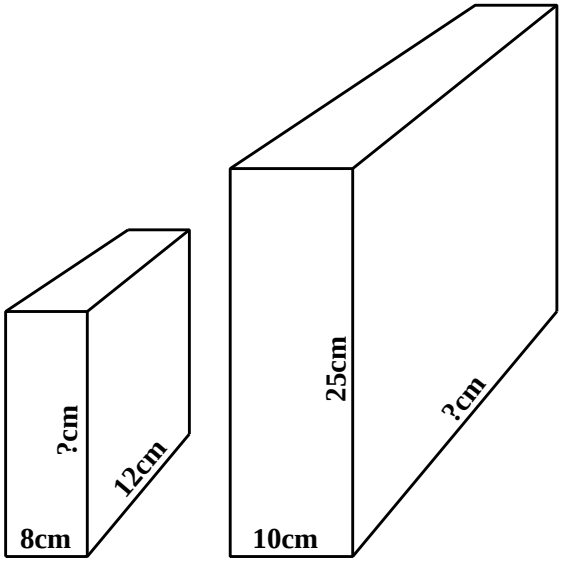
A larger cube has edges that are 10 times longer.

What is the volume of the larger cube ?

**[ 3 marks ]**

**Question 14**

The two cuboids shown below are similar.




**( i )** What is the ***length scale factor***, greater than 1, of the similarity ?

*lsf* = ———

**[ 1 mark ]**

**( ii )** Find the unknown length of the right cuboid, marked with a question mark.

**[ 1 mark ]**

**( iii )** Find the unknown height of the left cuboid, marked with a question mark.

**[ 1 mark ]**

**Question 15**

A 250 ml can of coke is similar to a 500 ml can of coke.
Explain why radius of the larger can is NOT double that of the smaller.

**[ 3 marks ]**