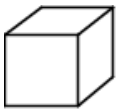
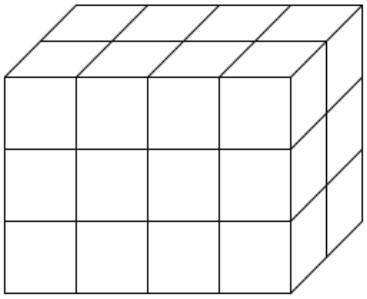
Surface Area

*Area is a measure of **flat space** (eg desk space, wall space, space on the outside of a box).*

Length is 1-dimensional	***Area is 2-dimensional***	*Volume is 3-dimensional*
*Often measured in metres (m) or **centimetres** (cm):*	***Often measured in square metres (m^2) or* square centimetres *(cm^2):***	*Often measured in cubic metres (m^3) or **cubic centimetres** (cm^3):*
		

Common units for area include:
Square centimetres (cm^2): The face of a 5p coin has an area of about $1cm^2$.
Square metres (m^2): The surface of a dining room table has an area of around $1m^2$.
Square kilometres (km^2): A small village such as Cotgrave has an area of about $1km^2$.

Bonus unit: Because a square kilometre is a million times bigger than a square metre*, a useful unit for things much bigger than tables but much smaller than villages (like the school site) is the **hectare** (ha) which is $10{,}000m^2$. $1\ ha$ is about the size of a small field ($2.5\ acres$).



Surface Area is **how many squares could cover** a shape:

We need to find the area of **all six faces**.

The **front face** has **3 rows of 4 squares**: $3 \times 4 = \mathbf{12}\boldsymbol{cm^2}$
(we include cm^2 to show the *size* of square we're using)

We also need the **back** (same as the front), the **top** and **bottom** (same as each other) and the **left** and **right** (same as each other):

$Front = Back = \mathbf{12}\boldsymbol{cm^2}$ $Top = Bottom = 2 \times 4 = \mathbf{8}\boldsymbol{cm^2}$ $Left = Right = 2 \times 3 = \mathbf{6}\boldsymbol{cm^2}$

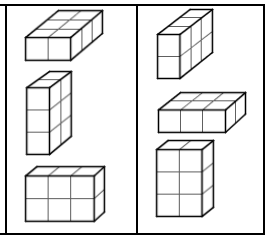
Total Surface Area: $2 \times \mathbf{12}\boldsymbol{cm^2} + 2 \times \mathbf{8}\boldsymbol{cm^2} + 2 \times \mathbf{6}\boldsymbol{cm^2} = \mathbf{52}\boldsymbol{cm^2}$

*There are a few shortcuts you can use (eg add the front, top and right first, then double), but the **most important** thing is to realise surface area is the **area of all the faces together**. You can use this even for complicated shapes.*

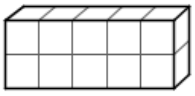
Does it matter what you call the front or top?

As long as you find the area of **every face**, it doesn't matter what you call them.

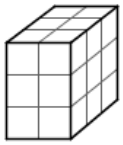
When you look at a cuboid from a different direction, or tilt it on its side or turn it upside-down, the *names* of the faces change, but the *surface area* is still the same!



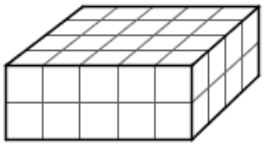
Check you understand: *Find the surface area of each of the cuboids shown below.*



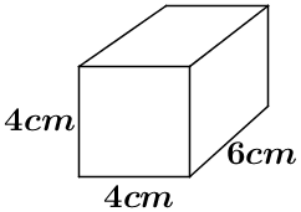
Surface Area = _____ cm^2



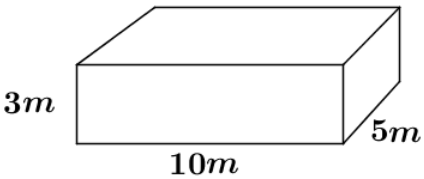
Surface Area = _____ cm^2



Surface Area = _____ cm^2



Surface Area = _____ cm^2



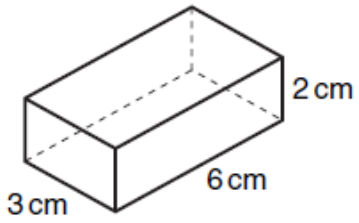
Surface Area = _____ m^2

Surface Area = _____ mm^2

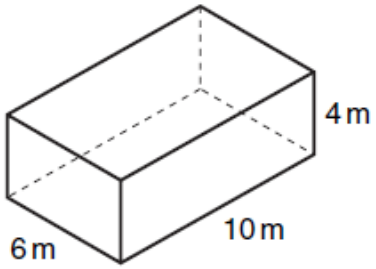
Surface Area Problems

1. Work out the surface areas of the cuboids shown. Give units with your answers.

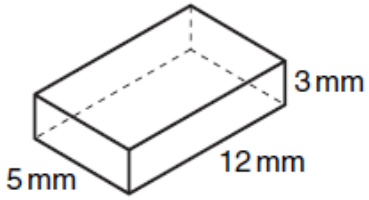
a



b

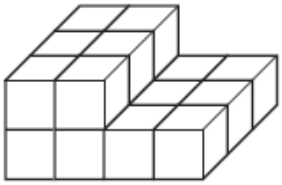


c

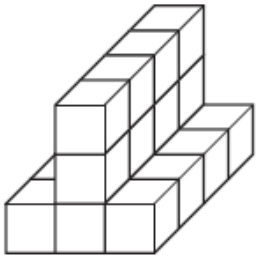


2. The shapes below are **prisms** made from **centimetre cubes.**
Find the surface area of each shape. Give units with your answers.

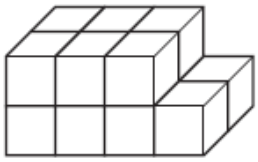
a



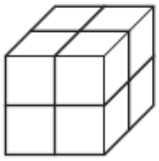
b



c

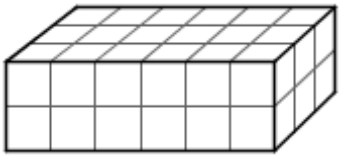


d



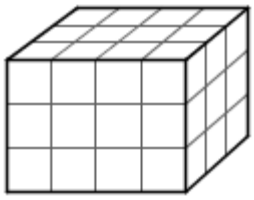
Extension Section

Compare the two cuboids below. Work out their **volume** and their **surface area**.



Volume = _____ cm^3

Surface Area = _____ cm^2



Volume = _____ cm^3

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Use your answers to the question above to complete the following sentence:

The cuboid which looks most like a cube has the **smallest / largest** surface area.

Do you think this is always true? Why?

Surface Area SOLUTIONS

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Length is 1-dimensional	***Area is 2-dimensional***	*Volume is 3-dimensional*
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		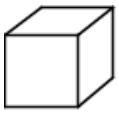

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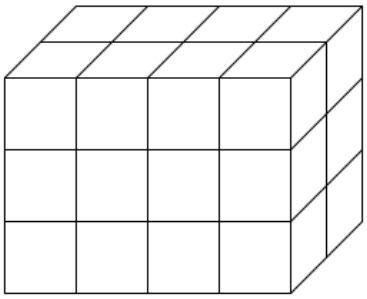

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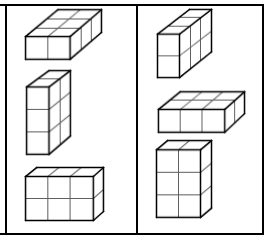

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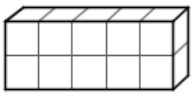
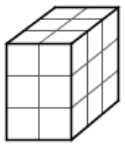
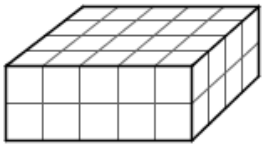


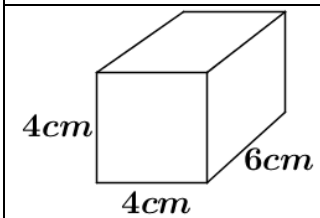
Surface Area = ___34___ cm^2



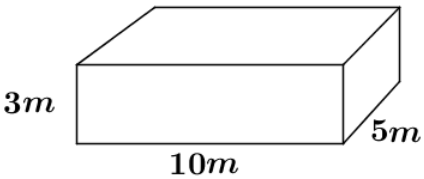
Surface Area = ___42___ cm^2



Surface Area = ___76___ cm^2



Surface Area = ___128___ cm^2



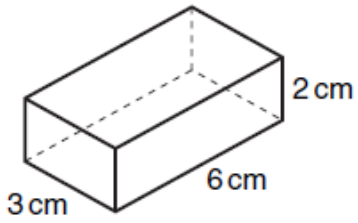
Surface Area = ___190___ m^2

Surface Area = __2800__ mm^2

Surface Area Problems SOLUTIONS

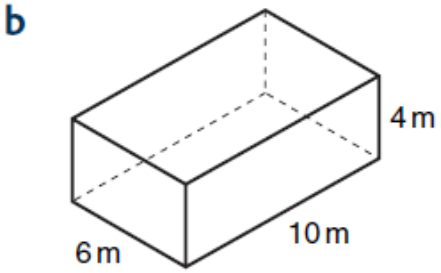
1. Work out the surface areas of the cuboids shown. Give units with your answers.

a



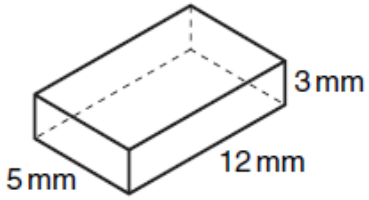
$72cm^2$

b



$248m^2$

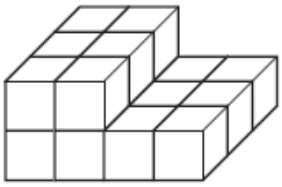
c



$222mm^2$

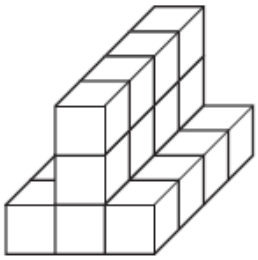
2. The shapes below are **prisms** made from **centimetre cubes.**
Find the surface area of each shape. Give units with your answers.

a



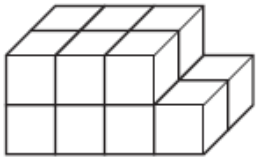
$48cm^2$

b



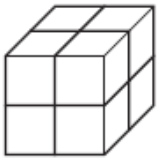
$58cm^2$

c



$38cm^2$

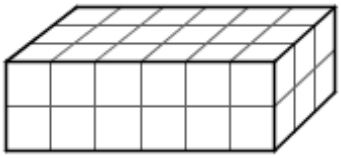
d



$24cm^2$

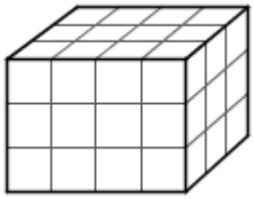
Extension Section

Compare the two cuboids below. Work out their **volume** and their **surface area**.



Volume = _____**36**_____ cm^3

Surface Area = _____**72**_____ cm^2



Volume = _____**36**_____ cm^3

Surface Area = _____**66**_____ cm^2

Use your answers to the question above to complete the following sentence:

The cuboid which looks most like a cube has the **smallest / ~~largest~~** surface area.

Do you think this is always true? Why?

It is always true. A long, thin or flat cuboid exposes more of its cubes, so a cube shape is the best way to minimise surface area for a fixed number of cubes. If you're allowed other shapes, however, the very best 3D shape for minimising surface area is a sphere (which is why planets are roughly spherical – they are pulled in as tightly as they can be into the most efficient shape by their own gravity. It's also why bubbles are spheres – they are trying to contain all the air with the least amount of liquid.