

29 GEOMETRY AND MEASURE: AREA AND VOLUME

LEARNING OBJECTIVES

- Recognise units of measurement used for length, area and volume
- Know and apply formulae to calculate area of triangles, circles, parallelograms and trapezia
- Calculate the surface area of cubes, cuboids and prisms (including cylinders)
- Know and apply formulae to calculate the volume of cubes, cuboids and prisms (including cylinders)

SPECIFICATION LINKS

- G16, G17

STARTER ACTIVITY

- **Units of measure; 5 minutes; page 186**

If necessary, discuss how to easily identify which units are used to measure length, area and volume.

MAIN ACTIVITIES

- **Calculating area; 25 minutes; page 187**

Work through the table, completing the formula for the area of each of the shapes and marking the dimensions the formulae refer to on the relevant diagrams. Students are no longer given any of these formulae in the exam so they must learn them. Move on to calculating compound and surface areas. Remind the student of the formulae for finding the surface area of pyramids, cones and spheres.

- **Calculating volume; 15 minutes; page 188**

Discuss the formula for calculating the volume of any prism. Look at the worked example, calculating the volume of the cylinder; explain that the exact cross-sectional area written in terms of π and the solution is not rounded until the final stage. Remind the student of the formulae for working out the volumes of pyramids, cones and spheres.

PLENARY ACTIVITY

- **Pop quiz; 5 minutes**

Test the student on their memory of the formulae for areas, surface areas and volumes. Name a shape and property and ask the student to identify the formula, or give a formula and ask the student to say what shape and property it is for.

HOMEWORK ACTIVITY

- **Spider diagram; 60 minutes; page 189**

Full instructions are given on the activity sheet.

SUPPORT IDEA

- **Calculating area** When calculating surface area, encourage the student to sketch a net of each shape before attempting to find the surface area. You could provide the student with actual 3D shapes to help them visualise the shapes of the different faces they need to calculate the area of. When finding the surface area of a cylinder, show that the curved side is a rectangle by peeling the label from a tin of soup or similar.

EXTENSION IDEAS

- **Calculating area** Challenge the student to find the surface area of a triangular prism whose cross-section is an equilateral triangle with sides of length 10 cm. They will need to use Pythagoras' theorem to find the height of the triangle before finding the surface area.
- **Calculating volume** Extend finding the volume of the shapes in cm^3 to working out how many litres each shape will hold.

PROGRESS AND OBSERVATIONS

STARTER ACTIVITY: UNITS OF MEASURE

TIMING: 5 MINS

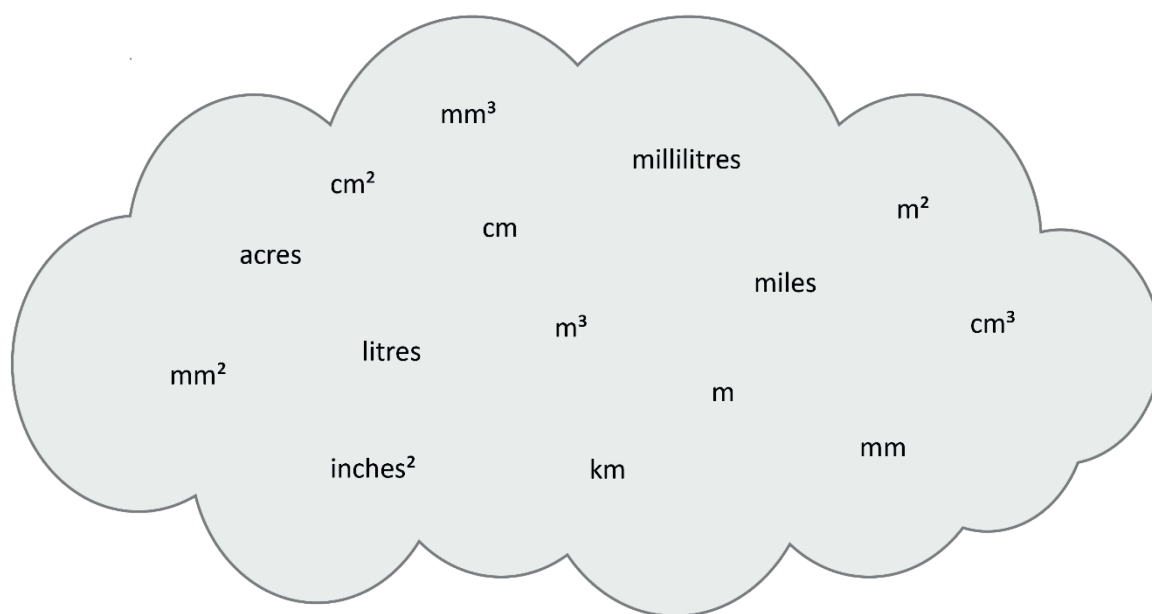
LEARNING OBJECTIVES

- Recognise units of measurement used for length, area and volume

EQUIPMENT

none

1. Each of these units is a measure of length, area or volume. Sort them into the correct columns of the table.



Length	Area	Volume

MAIN ACTIVITY: CALCULATING AREA

TIMING: 25 MINS

LEARNING OBJECTIVES

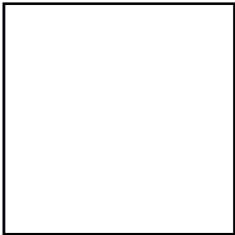
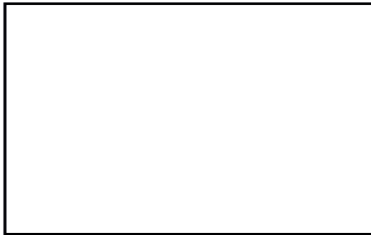
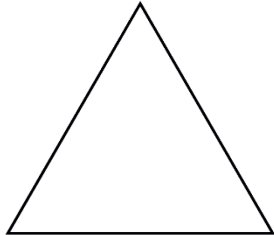
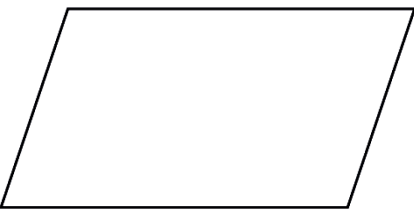
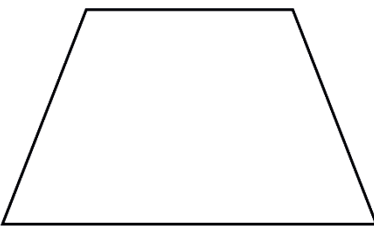
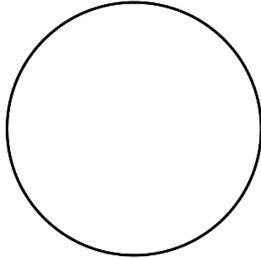
- Know and apply formulae to calculate area of triangles, circles, parallelograms and trapezia
- Calculate the surface area of cubes, cuboids and prisms (including cylinders)

EQUIPMENT

- scissors



1. Write down the formula for calculating the area of each of these shapes. Mark the dimensions you use onto the diagrams. Cut out each card and fold back the formula. Use the cards to test yourself.

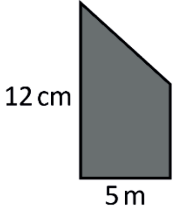
		
area =	area =	area =
		
area =	area =	area =

To work out the surface area of a 3D shape, try sketching the net. This will help you see how many faces there are and what shape each face is.



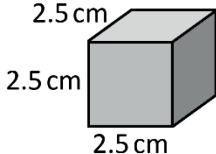
2. Find the area or surface area of each of these shapes. Explain your method to your tutor.

a)



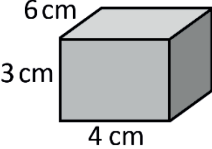
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b)



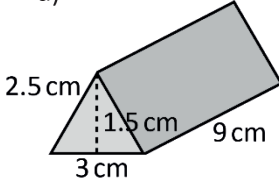
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c)



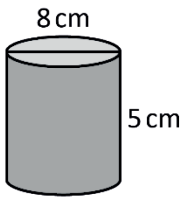
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d)



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e)



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MAIN ACTIVITY: CALCULATING VOLUME

TIMING: 15 MINS

LEARNING OBJECTIVES

- Know and apply formulae to calculate the volume of cubes, cuboids and prisms (including cylinders)

EQUIPMENT

- calculator

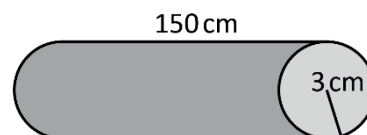
volume of a prism = cross-sectional area \times length

Example:

Calculate the volume of this cylinder to the nearest cm^3 .

$$\begin{aligned}\text{cross-sectional area} &= \pi \times 3^2 \\ &= 9\pi\end{aligned}$$

$$\begin{aligned}\text{volume} &= 150 \times 9\pi \\ &= 4241 \text{ cm}^3\end{aligned}$$



- Eric says *to work out the volume of a cuboid, you multiply the length by the width by the height.* Eric is correct. Explain why.



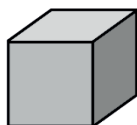
- A cuboid has a volume of 280 cm^3 . Its cross-sectional area is 56 cm^2 . Work out the depth of the cuboid.



- Explain how you would calculate the volume of these shapes.



a)



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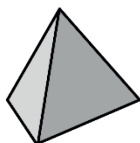
b)



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c)



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HOMEWORK ACTIVITY: SPIDER DIAGRAM**TIMING: 60 MINS****LEARNING OBJECTIVES**

- Know and apply formulae to calculate area of triangles, circles, parallelograms and trapezia
- Know and apply the formula to calculate the area of a circle
- Calculate the surface area of cubes, cuboids and prisms (including cylinders)
- Know and apply formulae to calculate the volume of cubes, cuboids and prisms

EQUIPMENT

- large piece of paper



1. Draw a spider diagram to display all the information you have learnt about calculating area and volume.

Ensure you include:

- how to calculate the area of squares, rectangles, circles, triangles, parallelograms and trapezia
- how to calculate the volume of cubes, cuboids, cylinders and prisms
- how to calculate the surface area of cubes, cuboids, cylinders and triangular prisms
- which unit should be used for each measurement.

You should try to show where concepts link to one another. You may wish to include some examples.

29 ANSWERS

STARTER ACTIVITY: UNITS OF MEASURE

1.

Length	Area	Volume
cm	m ²	mm ³
miles	cm ²	millilitres
m	acres	cm ³
km	mm ²	m ³
mm	inches ²	litres

MAIN ACTIVITY: CALCULATING AREA

1. Check the student has labelled the correct dimensions on their diagrams.

square: area = b^2	rectangle: area = bh	triangle: area = $\frac{1}{2}bh$
parallelogram: area = bh	trapezium: area = $\frac{1}{2}(a+b)h$	circle: area = πr^2

2. a) 47.5 cm² b) 37.5 cm² c) 108 cm² d) 76.5 cm² e) 226.2 cm²

MAIN ACTIVITY: CALCULATING VOLUME

1. The cross-sectional area is $b \times h$, and this is multiplied by the length.

2. 5 cm

3. a) $b \times b \times b$ b) $\pi r^2 h$ c) $\frac{1}{3} \times \text{area of base} \times \text{height}$

HOMEWORK ACTIVITY: SPIDER DIAGRAM

1. Student's own work

GLOSSARY

Cross-sectional area

The shape made when a 3D shape is cut through by a plane