Chapter 6 2D representations of 3D objects

Specification

FS coverage and range	Recognise and use 2D representations of 3D objects
FS exemplification	Sketch 3D solids Nets Plans, elevations Draw 3D shapes on isometric grids

GCSE

GCSE specification	**GM k** Use 2-D representations of 3-D shapes
Edexcel GCSE course	**Specification A:** **Foundation** 20.1–20.3 **Higher** 10.4–10.7 **Specification B:** **Foundation Unit 2:** 19.1–19.2; **Unit 3:** 9.1–9.2 **Higher Unit 2:** 14.3–14.6

Resources

General resources	3D objects (including a cube) Linking cubes Isometric paper Squared paper Metre rulers, trundle wheels (optional)
Resource sheets	6.1 (enlarged to A3 if required), 6.2, 6.3
Links	http://www.ikea.com/gb/en/catalog/allproducts (choose Bedroom)
ActiveTeach resources	Video ResultsPlus Knowledge Check ResultsPlus Problem Solving Question Audio Animations

Lesson 1

Objectives

- Recognise and use common 2D representations of 3D objects

Starter

- Show a variety of common 3D objects to the class and ask them to name them. As a class, sketch and label them.

Main teaching and learning

- Using the Know Zone (pp58–9), ensure that students can name common 3D shapes (have solid examples available) and that they are aware of key words such as face, edge and vertex/vertices.
- Using *Take a look*: Packaging problem (p60), discuss the idea of packing multiple objects into larger containers. Ask:
  - *Does the sketch need to be accurate? If not, why not?*
  - *When objects are placed in rows and columns, what can we do to avoid counting them one by one?*
  - *If the cans do not need to be packed in an upright position, could we fit more in?*

  Encourage students to consider divisibility.
- Ask students to complete *Have a go* Q1 and Q2.
- Demonstrate how to construct an isometric drawing of a cube. During the demonstration hold up a cube in the correct orientation.
- Ask students to complete Q3.
- Using the Know Zone, discuss the definition of a net. Give students the selection of correct and incorrect nets of cubes on Resource sheet 6.1 and get them to investigate which ones work.
- Ask students to complete Q4.

Issues and misconceptions

- When drawing cubes on isometric paper, students may draw faces as squares.

Support

- Allow students to cut out the nets on Resource sheet 6.1 when identifying which are correct and which incorrect.

Extension

- Pose the following question:

  A box is 30 cm × 20 cm × 40 cm and contains triangular prisms. Each prism is 15 cm long. The cross-section of the prism is an isosceles triangle with a base of 5 cm and a perpendicular height of 6 cm. How many prisms will fit inside the box?

Plenary

- Show students a net of a small cuboid and the net of a large cuboid (Resource sheet 6.2) and ask them to investigate how many of the small cuboids will fit inside the large cuboid.

Formative assessment

- Ask students to sketch a labelled cuboid on isometric paper. They should swap their sketch with a partner and construct a net for each other's cuboid. Students should then peer-assess their partner's work, giving constructive feedback.

Homework

- Ask students to design, draw the net of and create a 3D container that can be used to package a 3D object for retail.

Lesson 2

Objectives

- Solve problems involving 2D shapes and parallel lines

Starter

- Display a series of 2D shapes (Resource sheet 6.3) and ask students for 3D shapes that could create these 2D shadows. Encourage students to think of more than one 3D shape for each (for example, a triangle could be a triangular prism or a pyramid).

Main teaching and learning

- Use the Know Zone (pp58–9) to introduce the concept of plans and elevations. Ask: *Why are plans and elevations so important for people in the construction industry? What does the long rectangle represent in the top plan on page 59? If the 3D shape is triangular, why is it a rectangle rather than a triangle?*
- Ask students to construct an object from five linking cubes of varying colours. Then ask them to draw a plan and side and front elevations of their object. They should then disassemble the cubes and pass them to a partner along with the diagrams. Their partner should use the diagrams to reconstruct the object and swap back for peer assessment.
- Discuss *Take a look*: Paving a patio (pp61–2). Ask: *Is it quicker to break the area into three rectangles or to subtract the square from the rectangle? How could a sketch help you solve the problem? Is it easier to do 10 ÷ 0.5 or to calculate that 2 tiles are needed per metre?*
- Ask students to complete *Have a go* Q5.
- Introduce the idea of scale diagrams. Emphasise the importance of including a key for the scale. If needed, recap work on ratio and proportion from Chapter 3.
- Ask students to construct a scale diagram of their desk top.
- Discuss Q6. Ask: *Is there more than one way you can lay the carpet? What is the key information in the question? Could a sketch help? Why is it important to estimate the size of your page before deciding on a scale?*
- Ask students to complete Q6 and Q7.

Issues and misconceptions

- Ensure that students convert all measurements into the same units when necessary.
- Encourage students to plan ahead and measure their page first when constructing scale drawings, to help them choose an appropriate scale.
- Emphasise the importance of giving a key on a scale drawing.

Support

- For Q6 and Q7, discuss the use of different scale factors. Ask students to estimate the size of the scale drawing based on different scale factors.

Extension

- Ask students to investigate the number of rolls needed if the wallpaper in Q7 has a pattern that repeats every 36 cm.

Plenary

- Ask students to estimate the number of A4 sheets needed to cover the walls of the classroom, excluding doors and windows.

Formative assessment

- Students peer-assess work in the linking cube activity.

Homework

- Pose the following question: A carpet must be purchased in 4 metre widths and costs £25 per square metre. Estimate the cost of carpeting one room in your home.

Lesson 3

Objectives

- Apply 2D representations of 3D objects in more practical situations

Starter

- Pose the following question:

  A company produces matches. Each matchbox is 1 cm × 2 cm × 3 cm. They sell the matches to retailers in packets of 100. Sketch a cardboard box that can hold the 100 boxes, using the least amount of card possible.

Main teaching and learning

- Discuss *Take a look*: Moving house (pp63–4). Ask: *What is the key information in the question? Is there more than one possible orientation of the boxes? How many boxes could you fit on the base if they are turned around?*
- Discuss *Have a go* Q8. Explain that exam questions often contain many embedded parts. Encourage students to break the question into its component parts.
  - Consider the size and shape of the lawn area.
  - Consider the size and shape of the paved area.
  - Sketch a garden that meets the conditions.
  - Convert the sketch into a scale drawing.
  - Calculate the total cost.

  Ask students to complete Q8.
- Discuss Q9. Encourage students to spend time considering various layouts before committing to one, and to produce rough sketches of the various options. Ask students to complete Q9.
- Ask students to complete Q10 and Q11.

Issues and misconceptions

- In Q9, students may lack planning and start drawing before checking all their units fit. They may put cupboards in the corners that cannot be accessed.

Support

- For Q9, encourage students to consider which units offer the best value for money. The larger the units they use, the lower the overall cost.

Extension

- Ask students to design their own kitchen. They should draw a series of scale diagrams that detail their exact design.

Plenary

- Give students three points to remember when completing exam-style questions on 2D representations of 3D objects. For example:
  - Convert all measurements into the same units before calculating
  - Decide on a scale factor that is easy to use and produces a sensibly sized diagram
  - Always include a key on a scale drawing
  - Making a rough sketch first can help you plan ahead.

Formative assessment

- Ask students to peer-assess answers to Q8–10.

Homework

- Ask students to use product information from catalogues and/or the internet to design a nursery room with the same dimensions as their bedroom. They should create a scale plan and front and side elevations along with full costing. Product information can be found at, for example, www.ikea.com/gb/en/catalog/allproducts.

