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GCSE MATHEMATICS AND NUMERACY DOUBLE AWARD

FOUNDATION

COMPREHENSIVE LESSON NOTEBOOK

UNIT 3: GEOMETRY AND MEASURE

Mapped independently to WJEC qualification 3320QD • 18 detailed chapters

concept teaching • worked methods • reasoning • guided practice • independent practice • worked answers

Student: _____

Class: _____ Target grade: _____ Start date: _____

EXAM-BOARD INDEPENDENCE

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COMPREHENSIVE LESSON NOTEBOOK

How to learn from this notebook

Meaning first. Method second. Reasoning throughout.

1 • UNDERSTAND

Read the definition and big idea. Redraw or annotate the representation, then answer the checkpoint without looking back.

2 • BUILD THE METHOD

Cover each next line of the example. Predict it, reveal it and explain why the transformation or calculation is permitted.

3 • CONNECT AND REASON

Use the misconception analysis and guided task to decide which method fits, not merely how to execute it.

4 • PRACTISE INDEPENDENTLY

Show the decisive setup, accurate progress and a supported conclusion. Do not replace mathematical communication with a calculator display.

5 • DIAGNOSE AND REVISIT

Mark from the worked answer. Record whether an error came from interpretation, structure, arithmetic, accuracy, unit or communication.

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COMPREHENSIVE LESSON NOTEBOOK

Geometry and Measure unit map

18 chapters mapped to current WJEC content headings.

CH 01	3.1	Geometric terms and properties of shape: core concepts and methods
CH 02	3.1	Geometric terms and properties of shape: applications and reasoning
CH 03	3.2	Measurement and accurate drawing: core concepts and methods
CH 04	3.2	Measurement and accurate drawing: applications and reasoning
CH 05	3.3	Maps, scale drawings, bearings and views: core concepts and methods
CH 06	3.3	Maps, scale drawings, bearings and views: applications and reasoning
CH 07	3.4	Angle facts and geometrical reasoning: core concepts and methods
CH 08	3.4	Angle facts and geometrical reasoning: applications and reasoning
CH 09	3.5	Units and measure: core concepts and methods
CH 10	3.5	Units and measure: applications and reasoning
CH 11	3.6	Perimeter, area, surface area and volume: core concepts and methods
CH 12	3.6	Perimeter, area, surface area and volume: applications and reasoning
CH 13	3.7	Pythagoras and trigonometry: core concepts and methods
CH 14	3.7	Pythagoras and trigonometry: applications and reasoning
CH 15	3.8	Position, symmetry and transformations: core concepts and methods
CH 16	3.8	Position, symmetry and transformations: applications and reasoning
CH 17	3.9	Similarity and congruence: core concepts and methods
CH 18	3.9	Similarity and congruence: applications and reasoning

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COMPREHENSIVE LESSON NOTEBOOK

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Geometric terms and properties of shape: core concepts and methods

Use precise vocabulary, notation and defining properties of 2D and 3D shapes.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.1. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use precise vocabulary, notation and defining properties of 2D and 3D shapes. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

vertex, edge, face, parallel, perpendicular, tangent, chord, sector, cyclic

Three controlling ideas

- Classify a shape from stated properties, not appearance.
- Use conventional markings for equal lengths, parallel lines and right angles.
- Distinguish faces, curved surfaces, edges and vertices in solids.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A quadrilateral has four equal sides but angles are not necessarily 90 degrees. Name it.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Build the method

Geometric terms and properties of shape: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

A quadrilateral has four equal sides but angles are not necessarily 90 degrees. Name it.

WORKED REASONING

1. Four equal sides define a rhombus.

Conclusion: Rhombus

WORKED EXAMPLE 2

State the order of rotational symmetry of a regular hexagon.

WORKED REASONING

1. It maps onto itself six times in a full turn.

Conclusion: 6

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Connect and reason

Geometric terms and properties of shape: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.1, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

How many faces, edges and vertices has a triangular prism? Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding geometric terms and properties of shape: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.1 • Geometric terms and properties of shape: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **A quadrilateral has four equal sides but angles are not necessarily 90 degrees. Name it.** **[4]**

2. **State the order of rotational symmetry of a regular hexagon.** **[4]**

3. **How many faces, edges and vertices has a triangular prism?** **[4]**

4. **Name the line touching a circle at exactly one point.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.1 • Geometric terms and properties of shape: core concepts and methods

1. WORKED ANSWER

Method: Four equal sides define a rhombus. Answer: Rhombus Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: It maps onto itself six times in a full turn. Answer: 6 Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Count each feature once. Answer: 5 faces, 9 edges, 6 vertices Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: This is the definition of a tangent. Answer: Tangent Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Geometric terms and properties of shape: applications and reasoning

Use precise vocabulary, notation and defining properties of 2D and 3D shapes.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.1. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use precise vocabulary, notation and defining properties of 2D and 3D shapes. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

vertex, edge, face, parallel, perpendicular, tangent, chord, sector, cyclic

Three controlling ideas

- Classify a shape from stated properties, not appearance.
- Use conventional markings for equal lengths, parallel lines and right angles.
- Distinguish faces, curved surfaces, edges and vertices in solids.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Explain why every square is a rectangle but not every rectangle is a square.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Build the method

Geometric terms and properties of shape: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Explain why every square is a rectangle but not every rectangle is a square.

WORKED REASONING

1. Compare necessary properties.

Conclusion: Both have four right angles; a rectangle need not have four equal sides.

WORKED EXAMPLE 2

A regular polygon has 8 sides. State its name and number of symmetry lines.

WORKED REASONING

1. A regular n-gon has n reflection axes.

Conclusion: Octagon; 8 lines

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Connect and reason

Geometric terms and properties of shape: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.1, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Name the region between two radii and an arc. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding geometric terms and properties of shape: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.1 • Geometric terms and properties of shape: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Explain why every square is a rectangle but not every rectangle is a square.** **[4]**

2. **A regular polygon has 8 sides. State its name and number of symmetry lines.** **[4]**

3. **Name the region between two radii and an arc.** **[4]**

4. **State one difference between a prism and a pyramid.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.1 • Geometric terms and properties of shape: applications and reasoning

1. WORKED ANSWER

Method: Compare necessary properties. Answer: Both have four right angles; a rectangle need not have four equal sides. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: A regular n-gon has n reflection axes. Answer: Octagon; 8 lines Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Use precise circle vocabulary. Answer: Sector Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Use defining solid properties. Answer: A prism has a constant cross-section; a pyramid tapers to an apex. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Measurement and accurate drawing: core concepts and methods

Measure, construct and draw geometric objects using appropriate equipment.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.2. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Measure, construct and draw geometric objects using appropriate equipment. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

construct, bisector, locus, equidistant, arc, precision, region

Three controlling ideas

- Measure from the correct zero mark and quote suitable precision.
- Keep construction arcs visible as evidence.
- A locus is the complete set of points satisfying a condition.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Construct the perpendicular bisector of an 8 cm segment. State its locus property.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Build the method

Measurement and accurate drawing: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Construct the perpendicular bisector of an 8 cm segment. State its locus property.

WORKED REASONING

1. Use equal-radius arcs from both endpoints.

Conclusion: Every point is equidistant from the endpoints.

WORKED EXAMPLE 2

Bisect an angle of 74 degrees. State the resulting angles.

WORKED REASONING

1. An angle bisector divides the angle equally.

Conclusion: 37 degrees each

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Connect and reason

Measurement and accurate drawing: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.2, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Describe the locus 5 cm from point P. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding measurement and accurate drawing: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.2 • Measurement and accurate drawing: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Construct the perpendicular bisector of an 8 cm segment. State its locus property.** **[4]**

2. **Bisect an angle of 74 degrees. State the resulting angles.** **[4]**

3. **Describe the locus 5 cm from point P.** **[4]**

4. **Describe points equidistant from two intersecting lines.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.2 • Measurement and accurate drawing: core concepts and methods

1. WORKED ANSWER

Method: Use equal-radius arcs from both endpoints. Answer: Every point is equidistant from the endpoints. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: An angle bisector divides the angle equally. Answer: 37 degrees each Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Fixed distance from one point forms a circle. Answer: A circle centred at P with radius 5 cm Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Each bisector contains points equally distant from both lines. Answer: The two angle bisectors Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Measurement and accurate drawing: applications and reasoning

Measure, construct and draw geometric objects using appropriate equipment.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.2. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Measure, construct and draw geometric objects using appropriate equipment. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

construct, bisector, locus, equidistant, arc, precision, region

Three controlling ideas

- Measure from the correct zero mark and quote suitable precision.
- Keep construction arcs visible as evidence.
- A locus is the complete set of points satisfying a condition.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Draw a 7 cm line to the nearest millimetre. State the maximum measurement error.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Build the method

Measurement and accurate drawing: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Draw a 7 cm line to the nearest millimetre. State the maximum measurement error.

WORKED REASONING

1. Half the smallest unit is the maximum rounding error.

Conclusion: 0.5 mm

WORKED EXAMPLE 2

Which instrument should draw an arc of fixed radius?

WORKED REASONING

1. Compasses preserve a fixed distance from a centre.

Conclusion: Compasses

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Connect and reason

Measurement and accurate drawing: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.2, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Construct a 60 degree angle without a protractor. Name the key shape. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding measurement and accurate drawing: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.2 • Measurement and accurate drawing: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Draw a 7 cm line to the nearest millimetre. State the maximum measurement error.** **[4]**

2. **Which instrument should draw an arc of fixed radius?** **[4]**

3. **Construct a 60 degree angle without a protractor. Name the key shape.** **[4]**

4. **Why should construction arcs remain visible?** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.2 • Measurement and accurate drawing: applications and reasoning

1. WORKED ANSWER

Method: Half the smallest unit is the maximum rounding error. Answer: 0.5 mm Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Compasses preserve a fixed distance from a centre. Answer: Compasses Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Equal-radius arcs create three equal sides and 60 degree angles. Answer: Equilateral triangle Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: The result alone may look measured rather than constructed. Answer: They provide evidence of the exact construction method. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Maps, scale drawings, bearings and views: core concepts and methods

Represent location and three-dimensional objects accurately in two dimensions.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.3. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Represent location and three-dimensional objects accurately in two dimensions. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

scale, bearing, north line, plan, elevation, projection, reverse bearing

Three controlling ideas

- A scale 1:n compares lengths in the same units.
- Bearings are measured clockwise from north and written with three digits.
- Align heights, widths and depths between plans and elevations.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A map scale is 1:50 000. What real distance is represented by 6 cm?”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Build the method

Maps, scale drawings, bearings and views: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

A map scale is 1:50 000. What real distance is represented by 6 cm?

WORKED REASONING

1. 6x50000=300000 cm=3 km.

Conclusion: 3 km

WORKED EXAMPLE 2

Write the bearing of east.

WORKED REASONING

1. Measure clockwise from north with three digits.

Conclusion: 090 degrees

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Connect and reason

Maps, scale drawings, bearings and views: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.3, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

A bearing from A to B is 065 degrees. Find the reverse bearing. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding maps, scale drawings, bearings and views: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.3 • Maps, scale drawings, bearings and views: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **A map scale is 1:50 000. What real distance is represented by 6 cm?** **[4]**

2. **Write the bearing of east.** **[4]**

3. **A bearing from A to B is 065 degrees. Find the reverse bearing.** **[4]**

4. **On a 1:200 plan, a wall is 4.5 cm. Find the real length.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.3 • Maps, scale drawings, bearings and views: core concepts and methods

1. WORKED ANSWER

Method: 6x50000=300000 cm=3 km. Answer: 3 km Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Measure clockwise from north with three digits. Answer: 090 degrees Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Add 180 degrees. Answer: 245 degrees Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 4.5x200=900 cm=9 m. Answer: 9 m Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Maps, scale drawings, bearings and views: applications and reasoning

Represent location and three-dimensional objects accurately in two dimensions.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.3. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Represent location and three-dimensional objects accurately in two dimensions. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

scale, bearing, north line, plan, elevation, projection, reverse bearing

Three controlling ideas

- A scale 1:n compares lengths in the same units.
- Bearings are measured clockwise from north and written with three digits.
- Align heights, widths and depths between plans and elevations.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Which view is seen from directly above a solid?”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Build the method

Maps, scale drawings, bearings and views: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Which view is seen from directly above a solid?

WORKED REASONING

1. A plan is the top view.

Conclusion: Plan

WORKED EXAMPLE 2

A front elevation is 6 cm wide and 4 cm high. What two dimensions does it show?

WORKED REASONING

1. Depth is not visible from the front.

Conclusion: Width and height

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Connect and reason

Maps, scale drawings, bearings and views: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.3, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

A scale drawing uses 2 cm for 5 m. Write the scale as 1:n. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding maps, scale drawings, bearings and views: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.3 • Maps, scale drawings, bearings and views: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Which view is seen from directly above a solid?** **[4]**

2. **A front elevation is 6 cm wide and 4 cm high. What two dimensions does it show?** **[4]**

3. **A scale drawing uses 2 cm for 5 m. Write the scale as 1:n.** **[4]**

4. **Explain why units must match before simplifying a scale.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.3 • Maps, scale drawings, bearings and views: applications and reasoning

1. WORKED ANSWER

Method: A plan is the top view. Answer: Plan Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Depth is not visible from the front. Answer: Width and height Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 2 cm:500 cm simplifies to 1:250. Answer: 1:250 Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Convert both quantities to one unit first. Answer: A numerical ratio compares like units. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Angle facts and geometrical reasoning: core concepts and methods

Use connected angle facts to calculate, justify and prove results.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.4. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use connected angle facts to calculate, justify and prove results. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

alternate, corresponding, interior, exterior, theorem, proof, deduction

Three controlling ideas

- State the angle fact before calculating.
- Use 180 degrees for a line or triangle and 360 degrees around a point.
- Parallel-line facts require the parallel lines to be identified.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Two angles on a straight line are 68 degrees and x. Find x.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Build the method

Angle facts and geometrical reasoning: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Two angles on a straight line are 68 degrees and x. Find x.

WORKED REASONING

1. Angles on a line sum to 180 degrees.

Conclusion: 112 degrees

WORKED EXAMPLE 2

Two angles of a triangle are 47 and 61 degrees. Find the third.

WORKED REASONING

1. 180-47-61=72.

Conclusion: 72 degrees

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Connect and reason

Angle facts and geometrical reasoning: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.4, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Find the sum of interior angles of a hexagon. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding angle facts and geometrical reasoning: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.4 • Angle facts and geometrical reasoning: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Two angles on a straight line are 68 degrees and x. Find x.** **[4]**

2. **Two angles of a triangle are 47 and 61 degrees. Find the third.** **[4]**

3. **Find the sum of interior angles of a hexagon.** **[4]**

4. **Find each exterior angle of a regular 15-gon.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.4 • Angle facts and geometrical reasoning: core concepts and methods

1. WORKED ANSWER

Method: Angles on a line sum to 180 degrees. Answer: 112 degrees Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: 180-47-61=72. Answer: 72 degrees Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: (6-2)x180=720. Answer: 720 degrees Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 360/15=24. Answer: 24 degrees Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Angle facts and geometrical reasoning: applications and reasoning

Use connected angle facts to calculate, justify and prove results.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.4. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use connected angle facts to calculate, justify and prove results. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

alternate, corresponding, interior, exterior, theorem, proof, deduction

Three controlling ideas

- State the angle fact before calculating.
- Use 180 degrees for a line or triangle and 360 degrees around a point.
- Parallel-line facts require the parallel lines to be identified.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Parallel lines are cut by a transversal. One angle is 126 degrees. Find its alternate angle.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Build the method

Angle facts and geometrical reasoning: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Parallel lines are cut by a transversal. One angle is 126 degrees. Find its alternate angle.

WORKED REASONING

1. Alternate angles are equal.

Conclusion: 126 degrees

WORKED EXAMPLE 2

An isosceles triangle has vertex angle 38 degrees. Find each base angle.

WORKED REASONING

1. The remaining 142 degrees is shared equally.

Conclusion: 71 degrees

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Connect and reason

Angle facts and geometrical reasoning: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.4, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Angles around a point are 90, 115, 72 and x degrees. Find x. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding angle facts and geometrical reasoning: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.4 • Angle facts and geometrical reasoning: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Parallel lines are cut by a transversal. One angle is 126 degrees. Find its alternate angle.** **[4]**

2. **An isosceles triangle has vertex angle 38 degrees. Find each base angle.** **[4]**

3. **Angles around a point are 90, 115, 72 and x degrees. Find x.** **[4]**

4. **Explain why the exterior angles of any polygon total 360 degrees.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.4 • Angle facts and geometrical reasoning: applications and reasoning

1. WORKED ANSWER

Method: Alternate angles are equal. Answer: 126 degrees Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: The remaining 142 degrees is shared equally. Answer: 71 degrees Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 360-90-115-72=83. Answer: 83 degrees Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Track the turning direction around the boundary. Answer: They form one complete turn. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Units and measure: core concepts and methods

Select, convert and calculate with units of length, area, volume, capacity and time.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.5. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Select, convert and calculate with units of length, area, volume, capacity and time. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

measure, unit, capacity, density, compound unit, conversion factor

Three controlling ideas

- Attach units to every measurement.
- Square the linear conversion factor for area and cube it for volume.
- Convert time consistently before using a compound rate.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Convert 3.7 m to centimetres.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Build the method

Units and measure: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Convert 3.7 m to centimetres.

WORKED REASONING

1. Multiply by 100.

Conclusion: 370 cm

WORKED EXAMPLE 2

Convert 2.4 m^2 to cm^2.

WORKED REASONING

1. 1 m^2=10000 cm^2.

Conclusion: 24 000 cm^2

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Connect and reason

Units and measure: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.5, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Convert 0.006 m^3 to cm^3. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding units and measure: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.5 • Units and measure: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Convert 3.7 m to centimetres.** **[4]**

2. **Convert 2.4 m^2 to cm^2.** **[4]**

3. **Convert 0.006 m^3 to cm^3.** **[4]**

4. **Convert 4.5 litres to cm^3.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.5 • Units and measure: core concepts and methods

1. WORKED ANSWER

Method: Multiply by 100. Answer: 370 cm Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: 1 m^2=10000 cm^2. Answer: 24 000 cm^2 Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 1 m^3=1000000 cm^3. Answer: 6 000 cm^3 Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 1 litre=1000 cm^3. Answer: 4 500 cm^3 Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Units and measure: applications and reasoning

Select, convert and calculate with units of length, area, volume, capacity and time.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.5. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Select, convert and calculate with units of length, area, volume, capacity and time. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

measure, unit, capacity, density, compound unit, conversion factor

Three controlling ideas

- Attach units to every measurement.
- Square the linear conversion factor for area and cube it for volume.
- Convert time consistently before using a compound rate.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A journey lasts 2 h 35 min. Write this in minutes.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Build the method

Units and measure: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

A journey lasts 2 h 35 min. Write this in minutes.

WORKED REASONING

1. 2x60+35.

Conclusion: 155 minutes

WORKED EXAMPLE 2

A car travels 180 km in 2.4 h. Find average speed.

WORKED REASONING

1. 180/2.4=75.

Conclusion: 75 km/h

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Connect and reason

Units and measure: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.5, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Convert 8.2 kg to grams. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding units and measure: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.5 • Units and measure: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **A journey lasts 2 h 35 min. Write this in minutes.** **[4]**

2. **A car travels 180 km in 2.4 h. Find average speed.** **[4]**

3. **Convert 8.2 kg to grams.** **[4]**

4. **Explain why 1 m^2 is not 100 cm^2.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.5 • Units and measure: applications and reasoning

1. WORKED ANSWER

Method: 2x60+35. Answer: 155 minutes Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: 180/2.4=75. Answer: 75 km/h Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Multiply by 1000. Answer: 8 200 g Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 1 m^2=(100 cm)(100 cm)=10000 cm^2. Answer: Both dimensions scale by 100, so area scales by 100^2. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Perimeter, area, surface area and volume: core concepts and methods

Calculate measures of standard, circular and compound shapes and solids.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.6. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Calculate measures of standard, circular and compound shapes and solids. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

perimeter, area, surface area, cross-section, prism, sector, volume

Three controlling ideas

- Identify perpendicular height before using an area formula.
- A prism has constant cross-section, so volume is cross-sectional area times length.
- Split compound figures into non-overlapping familiar parts.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Find the area of a triangle with base 12 cm and perpendicular height 9 cm.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Build the method

Perimeter, area, surface area and volume: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Find the area of a triangle with base 12 cm and perpendicular height 9 cm.

WORKED REASONING

1. 1/2x12x9.

Conclusion: 54 cm^2

WORKED EXAMPLE 2

Find the area of a trapezium with parallel sides 7 cm and 13 cm and height 6 cm.

WORKED REASONING

1. 1/2(7+13)x6.

Conclusion: 60 cm^2

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Connect and reason

Perimeter, area, surface area and volume: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.6, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Find the circumference of a circle of radius 5 cm to 1 d.p. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding perimeter, area, surface area and volume: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.6 • Perimeter, area, surface area and volume: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Find the area of a triangle with base 12 cm and perpendicular height 9 cm.** **[4]**

2. **Find the area of a trapezium with parallel sides 7 cm and 13 cm and height 6 cm.** **[4]**

3. **Find the circumference of a circle of radius 5 cm to 1 d.p.** **[4]**

4. **Find the area of a circle of diameter 12 cm, in exact form.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.6 • Perimeter, area, surface area and volume: core concepts and methods

1. WORKED ANSWER

Method: 1/2x12x9. Answer: 54 cm^2 Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: 1/2(7+13)x6. Answer: 60 cm^2 Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 2pi(5)=31.415... Answer: 31.4 cm Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Radius is 6 cm; area=pi(6^2). Answer: 36pi cm^2 Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Perimeter, area, surface area and volume: applications and reasoning

Calculate measures of standard, circular and compound shapes and solids.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.6. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Calculate measures of standard, circular and compound shapes and solids. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

perimeter, area, surface area, cross-section, prism, sector, volume

Three controlling ideas

- Identify perpendicular height before using an area formula.
- A prism has constant cross-section, so volume is cross-sectional area times length.
- Split compound figures into non-overlapping familiar parts.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A prism has cross-sectional area 18 cm^2 and length 11 cm. Find its volume.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Build the method

Perimeter, area, surface area and volume: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

A prism has cross-sectional area 18 cm^2 and length 11 cm. Find its volume.

WORKED REASONING

1. 18x11.

Conclusion: 198 cm^3

WORKED EXAMPLE 2

Find the volume of a cylinder of radius 3 cm and height 8 cm, in exact form.

WORKED REASONING

1. pi(3^2)(8).

Conclusion: 72pi cm^3

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Connect and reason

Perimeter, area, surface area and volume: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.6, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

A rectangle 10 cm by 7 cm has a 4 cm by 3 cm rectangle removed. Find remaining area. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding perimeter, area, surface area and volume: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.6 • Perimeter, area, surface area and volume: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **A prism has cross-sectional area 18 cm^2 and length 11 cm. Find its volume.** **[4]**

2. **Find the volume of a cylinder of radius 3 cm and height 8 cm, in exact form.** **[4]**

3. **A rectangle 10 cm by 7 cm has a 4 cm by 3 cm rectangle removed. Find remaining area.** **[4]**

4. **Find the total surface area of a cuboid 4 cm by 5 cm by 7 cm.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.6 • Perimeter, area, surface area and volume: applications and reasoning

1. WORKED ANSWER

Method: 18x11. Answer: 198 cm^3 Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: pi(3^2)(8). Answer: 72pi cm^3 Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 70-12=58. Answer: 58 cm^2 Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 2(4x5+4x7+5x7)=166. Answer: 166 cm^2 Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Pythagoras and trigonometry: core concepts and methods

Solve problems involving lengths and angles in triangles.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.7. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Solve problems involving lengths and angles in triangles. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

hypotenuse, sine, cosine, tangent, inverse, elevation, depression

Three controlling ideas

- Use Pythagoras only in a right-angled triangle.
- Choose sine, cosine or tangent from the known and required sides.
- Keep full calculator accuracy until the final rounding.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A right triangle has legs 6 cm and 8 cm. Find the hypotenuse.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Build the method

Pythagoras and trigonometry: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

A right triangle has legs 6 cm and 8 cm. Find the hypotenuse.

WORKED REASONING

1. sqrt(6^2+8^2)=10.

Conclusion: 10 cm

WORKED EXAMPLE 2

A right triangle has hypotenuse 13 cm and one leg 5 cm. Find the other leg.

WORKED REASONING

1. sqrt(13^2-5^2)=12.

Conclusion: 12 cm

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Connect and reason

Pythagoras and trigonometry: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.7, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

In a right triangle, opposite=7 and hypotenuse=12. Find the angle to 1 d.p. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding pythagoras and trigonometry: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.7 • Pythagoras and trigonometry: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **A right triangle has legs 6 cm and 8 cm. Find the hypotenuse.** **[4]**

2. **A right triangle has hypotenuse 13 cm and one leg 5 cm. Find the other leg.** **[4]**

3. **In a right triangle, opposite=7 and hypotenuse=12. Find the angle to 1 d.p.** **[4]**

4. **A ladder 5 m long reaches 4.2 m up a wall. Find its base distance to 2 d.p.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.7 • Pythagoras and trigonometry: core concepts and methods

1. WORKED ANSWER

Method: sqrt(6^2+8^2)=10. Answer: 10 cm Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: sqrt(13^2-5^2)=12. Answer: 12 cm Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: sin angle=7/12; use inverse sine. Answer: 35.7 degrees Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: sqrt(5^2-4.2^2)=2.712... Answer: 2.71 m Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 14: Pythagoras and trigonometry: applications and reasoning

Solve problems involving lengths and angles in triangles.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.7. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Solve problems involving lengths and angles in triangles. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

hypotenuse, sine, cosine, tangent, inverse, elevation, depression

Three controlling ideas

- Use Pythagoras only in a right-angled triangle.
- Choose sine, cosine or tangent from the known and required sides.
- Keep full calculator accuracy until the final rounding.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “In a right triangle, angle=38 degrees and adjacent=9 cm. Find the opposite side.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 14: Build the method

Pythagoras and trigonometry: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

In a right triangle, angle=38 degrees and adjacent=9 cm. Find the opposite side.

WORKED REASONING

1. tan38=opposite/9.

Conclusion: 7.03 cm

WORKED EXAMPLE 2

Which ratio links adjacent and hypotenuse?

WORKED REASONING

1. cos=adjacent/hypotenuse.

Conclusion: Cosine

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 14: Connect and reason

Pythagoras and trigonometry: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.7, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Explain why Pythagoras cannot be used directly in a non-right triangle. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding pythagoras and trigonometry: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.7 • Pythagoras and trigonometry: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **In a right triangle, angle=38 degrees and adjacent=9 cm. Find the opposite side.** **[4]**

2. **Which ratio links adjacent and hypotenuse?** **[4]**

3. **Explain why Pythagoras cannot be used directly in a non-right triangle.** **[4]**

4. **A square has side 11 cm. Find its diagonal.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.7 • Pythagoras and trigonometry: applications and reasoning

1. WORKED ANSWER

Method: tan38=opposite/9. Answer: 7.03 cm Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: cos=adjacent/hypotenuse. Answer: Cosine Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Check the conditions before selecting a method. Answer: Its theorem requires a right angle. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Use Pythagoras: sqrt(11^2+11^2). Answer: 11sqrt(2) cm, about 15.56 cm Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 15: Position, symmetry and transformations: core concepts and methods

Describe and perform transformations using coordinates and geometric information.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.8. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Describe and perform transformations using coordinates and geometric information. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

translation, reflection, rotation, enlargement, centre, vector, invariant

Three controlling ideas

- A complete transformation description includes every required parameter.
- A translation vector records horizontal movement before vertical movement.
- Enlargement preserves angles and multiplies lengths by one scale factor.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Translate (3,-2) by vector (5,4).”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 15: Build the method

Position, symmetry and transformations: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Translate (3,-2) by vector (5,4).

WORKED REASONING

1. Add corresponding components.

Conclusion: (8,2)

WORKED EXAMPLE 2

Reflect (-4,6) in the y-axis.

WORKED REASONING

1. Change the sign of x only.

Conclusion: (4,6)

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 15: Connect and reason

Position, symmetry and transformations: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.8, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

Rotate (2,5) 180 degrees about the origin. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding position, symmetry and transformations: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.8 • Position, symmetry and transformations: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Translate (3,-2) by vector (5,4).** **[4]**

2. **Reflect (-4,6) in the y-axis.** **[4]**

3. **Rotate (2,5) 180 degrees about the origin.** **[4]**

4. **Enlarge (4,6) from the origin by scale factor 1/2.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.8 • Position, symmetry and transformations: core concepts and methods

1. WORKED ANSWER

Method: Add corresponding components. Answer: (8,2) Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Change the sign of x only. Answer: (4,6) Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: A half-turn maps (x,y) to (-x,-y). Answer: (-2,-5) Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Multiply both coordinates by 1/2. Answer: (2,3) Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 16: Position, symmetry and transformations: applications and reasoning

Describe and perform transformations using coordinates and geometric information.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.8. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Describe and perform transformations using coordinates and geometric information. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

translation, reflection, rotation, enlargement, centre, vector, invariant

Three controlling ideas

- A complete transformation description includes every required parameter.
- A translation vector records horizontal movement before vertical movement.
- Enlargement preserves angles and multiplies lengths by one scale factor.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Describe the translation from A(1,7) to A prime (-3,10).”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 16: Build the method

Position, symmetry and transformations: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Describe the translation from A(1,7) to A prime (-3,10).

WORKED REASONING

1. Subtract original coordinates from image coordinates.

Conclusion: Vector (-4,3)

WORKED EXAMPLE 2

State one property preserved by rotation.

WORKED REASONING

1. Rotation is an isometry.

Conclusion: Lengths and angles are preserved.

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 16: Connect and reason

Position, symmetry and transformations: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.8, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

How many lines of symmetry has a regular pentagon? Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding position, symmetry and transformations: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.8 • Position, symmetry and transformations: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Describe the translation from A(1,7) to A prime (-3,10).** **[4]**

2. **State one property preserved by rotation.** **[4]**

3. **How many lines of symmetry has a regular pentagon?** **[4]**

4. **Describe reflection in the x-axis using coordinates.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.8 • Position, symmetry and transformations: applications and reasoning

1. WORKED ANSWER

Method: Subtract original coordinates from image coordinates. Answer: Vector (-4,3) Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Rotation is an isometry. Answer: Lengths and angles are preserved. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: A regular n-gon has n lines. Answer: 5 Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: The x-coordinate stays fixed. Answer: (x,y) maps to (x,-y) Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 17: Similarity and congruence: core concepts and methods

Use corresponding sides, scale factors and valid congruence criteria.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.9. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use corresponding sides, scale factors and valid congruence criteria. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this core concepts lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

corresponding, similar, congruent, scale factor, SSS, SAS, ASA, RHS

Three controlling ideas

- Match corresponding vertices before comparing sides.
- Congruence preserves size and shape; similarity preserves shape.
- Check the scale-factor direction and use it consistently.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Similar shapes have scale factor 3 from small to large. A side is 7 cm. Find the matching side.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 17: Build the method

Similarity and congruence: core concepts and methods

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Similar shapes have scale factor 3 from small to large. A side is 7 cm. Find the matching side.

WORKED REASONING

1. 7x3.

Conclusion: 21 cm

WORKED EXAMPLE 2

Two triangles have all three corresponding sides equal. State the congruence test.

WORKED REASONING

1. Three equal side pairs establish congruence.

Conclusion: SSS

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 17: Connect and reason

Similarity and congruence: core concepts and methods

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.9, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

A 4 cm side corresponds to a 10 cm side. Find the scale factor small to large. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding similarity and congruence: core concepts and methods.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.9 • Similarity and congruence: core concepts and methods

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Similar shapes have scale factor 3 from small to large. A side is 7 cm. Find the matching side.** **[4]**

2. **Two triangles have all three corresponding sides equal. State the congruence test.** **[4]**

3. **A 4 cm side corresponds to a 10 cm side. Find the scale factor small to large.** **[4]**

4. **A model is made at scale 1:40. A real length is 6 m. Find the model length.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.9 • Similarity and congruence: core concepts and methods

1. WORKED ANSWER

Method: 7x3. Answer: 21 cm Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Three equal side pairs establish congruence. Answer: SSS Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 10/4=2.5. Answer: 2.5 Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: 6 m=600 cm; 600/40=15. Answer: 15 cm Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 18: Similarity and congruence: applications and reasoning

Use corresponding sides, scale factors and valid congruence criteria.

SPECIFICATION ALIGNMENT

Independent teaching summary for current WJEC content heading 3.9. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use corresponding sides, scale factors and valid congruence criteria. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this applications and reasoning lesson, first identify the quantities, structures or events involved; then connect the words to notation, a diagram, a table or a graph. A reliable solution preserves that meaning at every step and ends with an answer that fits the original context.

KEY VOCABULARY

corresponding, similar, congruent, scale factor, SSS, SAS, ASA, RHS

Three controlling ideas

- Match corresponding vertices before comparing sides.
- Congruence preserves size and shape; similarity preserves shape.
- Check the scale-factor direction and use it consistently.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Explain why AAA establishes similarity but not congruence.”, and predict the form or approximate size of the answer? Repair any weakness before continuing.

CHECKPOINT

Explain one method condition in a complete sentence. Give a simple valid example and one non-example that breaks the condition.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 18: Build the method

Similarity and congruence: applications and reasoning

Reliable routine

- Interpret: name the target, given information, conditions and units.
- Represent: write an equation, diagram, table, graph or exact numerical structure.
- Execute: show valid transformations or calculations in a readable order.
- Verify: test size, sign, units, domain, accuracy and contextual meaning.

WORKED EXAMPLE 1

Explain why AAA establishes similarity but not congruence.

WORKED REASONING

1. Different scale factors can give the same angles.

Conclusion: Equal angles fix shape but not size.

WORKED EXAMPLE 2

Congruent triangles have corresponding angles 52, 61 and x degrees. Find x.

WORKED REASONING

1. 180-52-61=67.

Conclusion: 67 degrees

SELF-EXPLANATION PROMPT

Which line contains the main mathematical decision? Which line checks interpretation, reasonableness or accuracy? Explain how the method would change if one condition changed.

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 18: Connect and reason

Similarity and congruence: applications and reasoning

Why the method works

The method works because each stage preserves the defining relationship in the problem. A calculation is not merely a sequence of button presses: it is a chain in which every symbol, operation and representation has a stated meaning. An independent check uses a different feature - such as an inverse operation, an alternative representation, a bound, a unit or a limiting case - so it can reveal an error rather than repeat it.

COMMON MISCONCEPTION

A common error is to use a familiar rule before checking its conditions. For 3.9, this can produce a plausible-looking answer with the wrong structure, scale, sign, unit or interpretation. State the condition first, then apply the rule.

GUIDED REASONING TASK

A photo 8 cm by 12 cm is enlarged to width 18 cm. Find the new height. Before calculating, write: (a) what is known, (b) what is required, (c) the controlling relationship, and (d) one check. Then complete the solution.

COMMUNICATION STANDARD

Use one mathematical statement per line. Define symbols, label units and diagrams, retain exact values until approximation is requested, and close with a sentence that answers the actual question.

EXTENSION OR REPAIR

Change one value or condition in the guided task. Predict which steps remain valid and which must change. This is the difference between memorising a routine and understanding similarity and congruence: applications and reasoning.

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COMPREHENSIVE LESSON NOTEBOOK

Independent practice

3.9 • Similarity and congruence: applications and reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official WJEC marks.

1. **Explain why AAA establishes similarity but not congruence.** **[4]**

2. **Congruent triangles have corresponding angles 52, 61 and x degrees. Find x.** **[4]**

3. **A photo 8 cm by 12 cm is enlarged to width 18 cm. Find the new height.** **[4]**

4. **State the RHS congruence conditions.** **[4]**

REFLECTION

Record the question number of your least secure answer. Name the error type and write the first corrected line that would repair it.

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COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

3.9 • Similarity and congruence: applications and reasoning

1. WORKED ANSWER

Method: Different scale factors can give the same angles. Answer: Equal angles fix shape but not size. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: 180-52-61=67. Answer: 67 degrees Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Scale factor=18/8=2.25; 12x2.25=27. Answer: 27 cm Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: All three conditions are required. Answer: Right angle, equal hypotenuse and one equal corresponding side. Check: confirm the result against the original conditions, units and expected scale.

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COMPREHENSIVE LESSON NOTEBOOK

Geometry and Measure mastery review

Explain, demonstrate, connect and revisit.

I can...

- 3.1 Geometric terms and properties of shape: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.1 Geometric terms and properties of shape: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.2 Measurement and accurate drawing: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.2 Measurement and accurate drawing: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.3 Maps, scale drawings, bearings and views: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.3 Maps, scale drawings, bearings and views: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.4 Angle facts and geometrical reasoning: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.4 Angle facts and geometrical reasoning: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.5 Units and measure: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.5 Units and measure: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.6 Perimeter, area, surface area and volume: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.6 Perimeter, area, surface area and volume: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.7 Pythagoras and trigonometry: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.7 Pythagoras and trigonometry: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.8 Position, symmetry and transformations: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.8 Position, symmetry and transformations: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.9 Similarity and congruence: core concepts and methods: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- 3.9 Similarity and congruence: applications and reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.

INDEPENDENT PUBLICATION NOTICE

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