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MATHEMATICS

NATIONAL 5

NATIONAL 5

COMPREHENSIVE LESSON NOTEBOOK

UNIT 1: NUMBER

Mapped independently to Qualifications Scotland National 5 Mathematics C847 75 • 13 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.

COMPREHENSIVE LESSON NOTEBOOK

Number unit map

13 chapters mapped independently to the current course specification.

CH 01 **N5-N1** Exact and approximate number

CH 02 **N5-N2** Simplifying surds

CH 03 **N5-N3** Rationalising denominators

CH 04 **N5-N4** Index laws

CH 05 **N5-N5** Zero, negative and fractional indices

CH 06 **N5-N6** Scientific notation

CH 07 **N5-N7** Significant figures and checking

CH 08 **N5-N8** Fractions and mixed numbers

CH 09 **N5-N9** Reverse percentages

CH 10 **N5-N10** Appreciation and compound interest

CH 11 **N5-N11** Depreciation

CH 12 **N5-N12** Non-calculator numerical fluency

CH 13 **N5-N13** Integrated numerical reasoning

COMPREHENSIVE LESSON NOTEBOOK

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COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Exact and approximate number

Distinguish exact values from approximations; choose a sensible degree of accuracy.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N1. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Distinguish exact values from approximations; choose a sensible degree of accuracy. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “State whether each value is exact or approximate: 18 pupils; a mass of 2.4 kg measured to the nearest 0.1 kg.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Build the method

Exact and approximate number

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

State whether each value is exact or approximate: 18 pupils; a mass of 2.4 kg measured to the nearest 0.1 kg.

WORKED REASONING

1. A count has no measurement uncertainty.
2. A rounded measurement represents an interval.

Conclusion: 18 pupils is exact; 2.4 kg is approximate.

WORKED EXAMPLE 2

Round 0.007864 to three significant figures.

WORKED REASONING

1. The first significant digit is 7.
2. The next digit after 6 is 4, so 6 stays unchanged.

Conclusion: 0.00786.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 1: Connect and reason

Exact and approximate number

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 N5-N1, 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

Estimate $(19.7 \times 3.04)/0.598$. 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 exact and approximate number.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N1 • Exact and approximate number

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. State whether each value is exact or approximate: 18 pupils; a mass of 2.4 kg measured to the nearest 0.1 kg.

[4]

2. Round 0.007864 to three significant figures.

[4]

3. Estimate $(19.7 \times 3.04)/0.598$.

[4]

4. A calculator gives 12.4987 for a length. Give a suitable answer to the nearest millimetre when the unit is centimetres.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N1 • Exact and approximate number

1. WORKED ANSWER

Method: A count has no measurement uncertainty. A rounded measurement represents an interval. Answer: 18 pupils is exact; 2.4 kg is approximate. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: The first significant digit is 7. The next digit after 6 is 4, so 6 stays unchanged. Answer: 0.00786. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Use $20 \times 3 / 0.6$. $60 / 0.6 = 100$. Answer: About 100. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: One millimetre is 0.1 cm. 12.4987 rounds to 12.5 cm. Answer: 12.5 cm. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Simplifying surds

Extract square factors and combine like surds while keeping exact values.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N2. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Extract square factors and combine like surds while keeping exact values. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Simplify $\sqrt{72}$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Build the method

Simplifying surds

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

Simplify $\sqrt{72}$.

WORKED REASONING

1. $72 = 36 \times 2$.
2. $\sqrt{72} = \sqrt{36} \sqrt{2} = 6\sqrt{2}$.

Conclusion: $6\sqrt{2}$.

WORKED EXAMPLE 2

Simplify $3\sqrt{8} + \sqrt{18}$.

WORKED REASONING

1. $\sqrt{8} = 2\sqrt{2}$ and $\sqrt{18} = 3\sqrt{2}$.
2. $3(2\sqrt{2}) + 3\sqrt{2} = 9\sqrt{2}$.

Conclusion: $9\sqrt{2}$.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 2: Connect and reason

Simplifying surds

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 N5-N2, 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

Simplify $\sqrt{45}-\sqrt{5}$. 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 simplifying surds.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N2 • Simplifying surds

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Simplify $\sqrt{72}$.

[4]

2. Simplify $3\sqrt{8} + \sqrt{18}$.

[4]

3. Simplify $\sqrt{45} - \sqrt{5}$.

[4]

4. Write $\sqrt{12}\sqrt{15}$ in simplest surd 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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N2 • Simplifying surds

1. WORKED ANSWER

Method: $72 = 36 \times 2$. $\sqrt{72} = \sqrt{36} \sqrt{2} = 6\sqrt{2}$. Answer: $6\sqrt{2}$. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: $\sqrt{8} = 2\sqrt{2}$ and $\sqrt{18} = 3\sqrt{2}$. $3(2\sqrt{2}) + 3\sqrt{2} = 9\sqrt{2}$. Answer: $9\sqrt{2}$. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: $\sqrt{45} = 3\sqrt{5}$. Collect like surds. Answer: $2\sqrt{5}$. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: $\sqrt{180} = \sqrt{36 \times 5}$. The exact result is $6\sqrt{5}$. Answer: $6\sqrt{5}$. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Rationalising denominators

Rewrite a fraction so that its denominator is rational without changing its value.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N3. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Rewrite a fraction so that its denominator is rational without changing its value. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Rationalise $5/\sqrt{3}$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Build the method

Rationalising denominators

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

Rationalise $5/\sqrt{3}$.

WORKED REASONING

1. Multiply top and bottom by $\sqrt{3}$.
2. The denominator becomes 3.

Conclusion: $5\sqrt{3}/3$.

WORKED EXAMPLE 2

Rationalise $7/(2\sqrt{5})$.

WORKED REASONING

1. Multiply by $\sqrt{5}/\sqrt{5}$.
2. Simplify the denominator to 10.

Conclusion: $7\sqrt{5}/10$.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 3: Connect and reason

Rationalising denominators

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 N5-N3, 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

Simplify $\sqrt{12}/\sqrt{3}$. 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 rationalising denominators.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N3 • Rationalising denominators

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Rationalise $5/\sqrt{3}$.

[4]

2. Rationalise $7/(2\sqrt{5})$.

[4]

3. Simplify $\sqrt{12}/\sqrt{3}$.

[4]

4. Rationalise $3/\sqrt{12}$ and simplify.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N3 • Rationalising denominators

1. WORKED ANSWER

Method: Multiply top and bottom by $\sqrt{3}$. The denominator becomes 3. Answer: $5\sqrt{3}/3$. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Multiply by $\sqrt{5}/\sqrt{5}$. Simplify the denominator to 10. Answer: $7\sqrt{5}/10$. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Combine as $\sqrt{12/3}$. $\sqrt{4}=2$. Answer: 2. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: $\sqrt{12}=2\sqrt{3}$. $3/(2\sqrt{3}) \times \sqrt{3}/\sqrt{3}=\sqrt{3}/2$. Answer: $\sqrt{3}/2$. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Index laws

Use multiplication, division and power laws for the same base.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N4. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Use multiplication, division and power laws for the same base. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Simplify $a^7 \times a^3$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Build the method

Index laws

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

Simplify $a^7 \times a^3$.

WORKED REASONING

1. For the same base, add the indices: $7+3$.

Conclusion: a^{10} .

WORKED EXAMPLE 2

Simplify x^9/x^4 .

WORKED REASONING

1. Subtract the indices: $9-4$.
2. The original quotient requires x not equal to 0.

Conclusion: x^5 , for x not equal to 0.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 4: Connect and reason

Index laws

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 N5-N4, 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

Simplify $(p^3)^4$. 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 index laws.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N4 • Index laws

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Simplify $a^7 \times a^3$.

[4]

2. Simplify x^9/x^4 .

[4]

3. Simplify $(p^3)^4$.

[4]

4. Simplify $(6m^5n^3)/(2m^2n)$.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N4 • Index laws

1. WORKED ANSWER

Method: For the same base, add the indices: $7+3$. Answer: a^{10} . Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Subtract the indices: $9-4$. The original quotient requires x not equal to 0. Answer: x^5 , for x not equal to 0. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Multiply the indices: 3×4 . Answer: p^{12} . Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Divide coefficients. Subtract indices for each common base. Answer: $3m^3n^2$. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Zero, negative and fractional indices

Interpret roots and reciprocals through index notation.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N5. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Interpret roots and reciprocals through index notation. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Evaluate $25^{(1/2)}$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Build the method

Zero, negative and fractional indices

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

Evaluate $25^{(1/2)}$.

WORKED REASONING

1. An index of $1/2$ means square root.

Conclusion: 5.

WORKED EXAMPLE 2

Evaluate $8^{(2/3)}$.

WORKED REASONING

1. Take the cube root of 8 to get 2.
2. Then square: $2^2=4$.

Conclusion: 4.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 5: Connect and reason

Zero, negative and fractional indices

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 N5-N5, 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

Write 3^{-2} as a fraction. 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 zero, negative and fractional indices.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N5 • Zero, negative and fractional indices

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Evaluate $25^{(1/2)}$.

[4]

2. Evaluate $8^{(2/3)}$.

[4]

3. Write 3^{-2} as a fraction.

[4]

4. Evaluate $16^{(-3/4)}$.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N5 • Zero, negative and fractional indices

1. WORKED ANSWER

Method: An index of $1/2$ means square root. Answer: 5. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Take the cube root of 8 to get 2. Then square: $2^2=4$. Answer: 4. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: A negative index means reciprocal. $3^{-2}=1/3^2$. Answer: $1/9$. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: $16^{(1/4)}=2$, so $16^{(3/4)}=8$. The negative index gives the reciprocal. Answer: $1/8$. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Scientific notation

Write, compare and calculate with numbers in the form $ax10^n$.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N6. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Write, compare and calculate with numbers in the form $ax10^n$. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Write 0.0000732 in scientific notation.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Build the method

Scientific notation

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

Write 0.0000732 in scientific notation.

WORKED REASONING

1. Move the decimal five places right to make 7.32.
2. Use a negative power for a small number.

Conclusion: 7.32×10^{-5} .

WORKED EXAMPLE 2

Calculate $(4 \times 10^6)(3 \times 10^{-4})$.

WORKED REASONING

1. Multiply coefficients to get 12.
2. Add powers and normalise: $12 \times 10^2 = 1.2 \times 10^3$.

Conclusion: 1.2×10^3 .

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 6: Connect and reason

Scientific notation

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 N5-N6, 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

Calculate $(8.4 \times 10^7) / (2.1 \times 10^3)$. 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 scientific notation.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N6 • Scientific notation

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Write 0.0000732 in scientific notation.

[4]

2. Calculate $(4 \times 10^6)(3 \times 10^{-4})$.

[4]

3. Calculate $(8.4 \times 10^7)/(2.1 \times 10^3)$.

[4]

4. Order 5.9×10^{-4} , 6.1×10^{-5} and 5.2×10^{-4} from smallest.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N6 • Scientific notation

1. WORKED ANSWER

Method: Move the decimal five places right to make 7.32. Use a negative power for a small number. Answer: 7.32×10^{-5} . Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Multiply coefficients to get 12. Add powers and normalise: $12 \times 10^2 = 1.2 \times 10^3$. Answer: 1.2×10^3 . Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Divide coefficients and subtract indices. Answer: 4×10^4 . Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Compare powers first. For equal powers compare coefficients. Answer: 6.1×10^{-5} , 5.2×10^{-4} , 5.9×10^{-4} . Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Significant figures and checking

Round correctly and use estimation to test whether an answer is plausible.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N7. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Round correctly and use estimation to test whether an answer is plausible. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Round 684950 to three significant figures.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Build the method

Significant figures and checking

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

Round 684950 to three significant figures.

WORKED REASONING

1. Keep 6, 8 and 4.
2. The next digit is 9, so 684 rounds to 685.

Conclusion: 685000.

WORKED EXAMPLE 2

Round 0.009995 to three significant figures.

WORKED REASONING

1. The first three significant digits are 9, 9, 9.
2. Rounding carries to 1.00×10^{-2} .

Conclusion: 0.0100.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 7: Connect and reason

Significant figures and checking

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 N5-N7, 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

Estimate $\sqrt{82.3}$. 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 significant figures and checking.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N7 • Significant figures and checking

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Round 684950 to three significant figures.

[4]

2. Round 0.009995 to three significant figures.

[4]

3. Estimate $\sqrt{82.3}$.

[4]

4. A student reports $38.2 \times 19.7 = 75.254$. Explain the error without recalculating exactly.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N7 • Significant figures and checking

1. WORKED ANSWER

Method: Keep 6, 8 and 4. The next digit is 9, so 684 rounds to 685. Answer: 685000. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: The first three significant digits are 9, 9, 9. Rounding carries to 1.00×10^{-2} . Answer: 0.0100. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: 82.3 is close to 81. $\sqrt{81}=9$. Answer: About 9. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Use $40 \times 20 = 800$. 75.254 has the wrong order of magnitude. Answer: The decimal point is wrong; the product should be near 800. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Fractions and mixed numbers

Perform all four operations with fractions and mixed numbers.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N8. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Perform all four operations with fractions and mixed numbers. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Calculate $5/6 - 3/8$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Build the method

Fractions and mixed numbers

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

Calculate $5\frac{5}{6} - 3\frac{3}{8}$.

WORKED REASONING

1. Use denominator 24: $20/24 - 9/24$.

Conclusion: $11/24$.

WORKED EXAMPLE 2

Calculate $2\frac{1}{4} \times 1\frac{2}{3}$.

WORKED REASONING

1. Convert to $9/4 \times 5/3$.
2. Cancel and multiply to get $15/4$.

Conclusion: $3\frac{3}{4}$.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 8: Connect and reason

Fractions and mixed numbers

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 N5-N8, 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

Calculate $3\frac{1}{2}$ divided by $1\frac{1}{6}$. 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 fractions and mixed numbers.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N8 • Fractions and mixed numbers

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Calculate $5/6 - 3/8$.

[4]

2. Calculate $2 \frac{1}{4} \times 1 \frac{2}{3}$.

[4]

3. Calculate $3 \frac{1}{2}$ divided by $1 \frac{1}{6}$.

[4]

4. A tank is $3/5$ full. One quarter of the water is used. What fraction of the full tank remains?

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N8 • Fractions and mixed numbers

1. WORKED ANSWER

Method: Use denominator 24: $20/24 - 9/24$. Answer: $11/24$. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Convert to $9/4 \times 5/3$. Cancel and multiply to get $15/4$. Answer: $3 \frac{3}{4}$. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Convert to $7/2$ divided by $7/6$. Multiply by the reciprocal: $7/2 \times 6/7 = 3$. Answer: 3. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Three quarters of the existing water remains. $3/4 \times 3/5 = 9/20$. Answer: $9/20$. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Reverse percentages

Recover an original amount by dividing by the appropriate multiplier.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N9. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Recover an original amount by dividing by the appropriate multiplier. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “After a 15% increase a price is GBP 276. Find the original price.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Build the method

Reverse percentages

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

After a 15% increase a price is GBP 276. Find the original price.

WORKED REASONING

1. The multiplier is 1.15.
2. $276/1.15=240$.

Conclusion: GBP 240.

WORKED EXAMPLE 2

A jacket costs GBP 68 after a 20% reduction. Find the original price.

WORKED REASONING

1. The sale price is 80% of the original.
2. $68/0.8=85$.

Conclusion: GBP 85.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 9: Connect and reason

Reverse percentages

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 N5-N9, 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 population is 12,360 after increasing by 3%. Find the earlier population. 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 reverse percentages.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N9 • Reverse percentages

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. After a 15% increase a price is GBP 276. Find the original price.

[4]

2. A jacket costs GBP 68 after a 20% reduction. Find the original price.

[4]

3. A population is 12,360 after increasing by 3%. Find the earlier population.

[4]

4. A value falls to 714 after a 16% decrease. Find the original value.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N9 • Reverse percentages

1. WORKED ANSWER

Method: The multiplier is 1.15. $276/1.15=240$. Answer: GBP 240. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: The sale price is 80% of the original. $68/0.8=85$. Answer: GBP 85. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Divide by 1.03. Answer: 12,000. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: The retained multiplier is 0.84. $714/0.84=850$. Answer: 850. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Appreciation and compound interest

Model repeated percentage growth with a power of a multiplier.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N10. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Model repeated percentage growth with a power of a multiplier. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “GBP 1800 earns 4% compound interest for 3 years. Find the final amount.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Build the method

Appreciation and compound interest

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

GBP 1800 earns 4% compound interest for 3 years. Find the final amount.

WORKED REASONING

1. Use $1800(1.04)^3$.
2. Keep full calculator accuracy until the final rounding.

Conclusion: GBP 2024.76 to the nearest penny.

WORKED EXAMPLE 2

A house valued at GBP 160000 appreciates by 2.5% each year for 4 years. Find its value.

WORKED REASONING

1. Use $160000(1.025)^4$.

Conclusion: GBP 176610.06 to the nearest penny.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 10: Connect and reason

Appreciation and compound interest

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 N5-N10, 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

Write a formula for an investment P after n years at 3.2% compound interest. 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 appreciation and compound interest.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N10 • Appreciation and compound interest

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. GBP 1800 earns 4% compound interest for 3 years. Find the final amount.

[4]

2. A house valued at GBP 160000 appreciates by 2.5% each year for 4 years. Find its value.

[4]

3. Write a formula for an investment P after n years at 3.2% compound interest.

[4]

4. An account grows from GBP 5000 to GBP 5463.64 in 3 years at a fixed rate. Identify the annual rate.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N10 • Appreciation and compound interest

1. WORKED ANSWER

Method: Use $1800(1.04)^3$. Keep full calculator accuracy until the final rounding. Answer: GBP 2024.76 to the nearest penny. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Use $160000(1.025)^4$. Answer: GBP 176610.06 to the nearest penny. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Convert 3.2% to multiplier 1.032. Answer: $P(1.032)^n$. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: $5463.64/5000=1.092728$. The cube root is 1.03, so the rate is 3%. Answer: 3% per year. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Depreciation

Model repeated percentage decrease and interpret the result in context.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N11. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Model repeated percentage decrease and interpret the result in context. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A machine worth GBP 24000 loses 12% each year for 5 years. Find its value.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Build the method

Depreciation

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 machine worth GBP 24000 loses 12% each year for 5 years. Find its value.

WORKED REASONING

1. Use $24000(0.88)^5$.

Conclusion: GBP 12665.57 to the nearest penny.

WORKED EXAMPLE 2

A car retains 82% of its value each year. It starts at GBP 18500. Find its value after 3 years.

WORKED REASONING

1. Use $18500(0.82)^3$.

Conclusion: GBP 10200.31 to the nearest penny.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 11: Connect and reason

Depreciation

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 N5-N11, 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

Write a formula for value V after n years when an item initially costs 720 and depreciates by 9% yearly. 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 depreciation.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N11 • Depreciation

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. A machine worth GBP 24000 loses 12% each year for 5 years. Find its value.

[4]

2. A car retains 82% of its value each year. It starts at GBP 18500. Find its value after 3 years.

[4]

3. Write a formula for value V after n years when an item initially costs 720 and depreciates by 9% yearly.

[4]

4. A device is worth GBP 2916 after two annual decreases of 10%. Find its original value.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N11 • Depreciation

1. WORKED ANSWER

Method: Use $24000(0.88)^5$. Answer: GBP 12665.57 to the nearest penny. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Use $18500(0.82)^3$. Answer: GBP 10200.31 to the nearest penny. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: The retained multiplier is 0.91. Answer: $V=720(0.91)^n$. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Divide by 0.9^2 . Answer: GBP 3600. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Non-calculator numerical fluency

Choose efficient exact methods and show an auditable chain of reasoning.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N12. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Choose efficient exact methods and show an auditable chain of reasoning. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “Evaluate $(3/4 + 5/6)$ divided by $19/12$.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Build the method

Non-calculator numerical fluency

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

Evaluate $(3/4 + 5/6)$ divided by $19/12$.

WORKED REASONING

1. The sum is $19/12$.
2. Any non-zero number divided by itself is 1.

Conclusion: 1.

WORKED EXAMPLE 2

Evaluate $27^{(2/3)} - 16^{(1/2)}$.

WORKED REASONING

1. Cube root 27 then square gives 9.
2. Square root 16 is 4.

Conclusion: 5.

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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 12: Connect and reason

Non-calculator numerical fluency

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 N5-N12, 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

Simplify $\sqrt{50} + \sqrt{8} - \sqrt{18}$. 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 non-calculator numerical fluency.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N12 • Non-calculator numerical fluency

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. Evaluate $(3/4 + 5/6)$ divided by $19/12$.

[4]

2. Evaluate $27^{(2/3)} - 16^{(1/2)}$.

[4]

3. Simplify $\sqrt{50} + \sqrt{8} - \sqrt{18}$.

[4]

4. Without a calculator, find 17.5% of 240.

[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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N12 • Non-calculator numerical fluency

1. WORKED ANSWER

Method: The sum is $19/12$. Any non-zero number divided by itself is 1. Answer: 1. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: Cube root 27 then square gives 9. Square root 16 is 4. Answer: 5. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: Write the terms as $5\sqrt{2}+2\sqrt{2}-3\sqrt{2}$. Answer: $4\sqrt{2}$. Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: $10\%=24$, $5\%=12$ and $2.5\%=6$. Add $24+12+6$. Answer: 42. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Integrated numerical reasoning

Select and connect number skills in unfamiliar multi-step problems.

SPECIFICATION ALIGNMENT

Independent teaching summary for Qualifications Scotland National 5 Mathematics: N5-N13. This lesson develops conceptual understanding, communication using symbols, fluency, logical reasoning and strategic competence.

Understand the mathematical object

Select and connect number skills in unfamiliar multi-step problems. The central idea is that a representation is useful only when its meaning and conditions are explicit. In this national 5 course skills 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

exact value; approximation; representation; condition; inverse operation; reasonableness; mathematical communication

Three controlling ideas

- Name the mathematical structure and all domain or accuracy conditions.
- Transform one justified step at a time; keep exact values until approximation is required.
- Verify by inverse operation, estimation, substitution, graph behaviour or units.

PRIOR-KNOWLEDGE CHECK

Can you state the meaning of the key terms, identify the operation or relationship in “A GBP 3200 investment grows by 2.8% for 4 years, then a GBP 250 fee is deducted. Find the balance.”, 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Build the method

Integrated numerical 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 GBP 3200 investment grows by 2.8% for 4 years, then a GBP 250 fee is deducted. Find the balance.

WORKED REASONING

1. Calculate $3200(1.028)^4$.
2. Subtract 250 only after the compound growth.

Conclusion: GBP 3323.74 to the nearest penny.

WORKED EXAMPLE 2

A square has exact area 72 cm^2 . Give its side in simplest surd form and to 3 significant figures.

WORKED REASONING

1. The side is $\sqrt{72} = 6\sqrt{2}$.
2. Approximate only after stating the exact form.

Conclusion: $6\sqrt{2} \text{ cm}$, approximately 8.49 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.

COMPREHENSIVE LESSON NOTEBOOK

Chapter 13: Connect and reason

Integrated numerical 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 N5-N13, 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 value in scientific notation is multiplied by 0.04: $(7.5 \times 10^6)(4 \times 10^{-2})$. Give standard form. 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 integrated numerical reasoning.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

N5-N13 • Integrated numerical reasoning

Complete without notes. Show the setup, decisive working and final conclusion. Marks are independent teaching allocations, not official Qualifications Scotland / former SQA marks.

1. A GBP 3200 investment grows by 2.8% for 4 years, then a GBP 250 fee is deducted. Find the balance. [4]

2. A square has exact area 72 cm^2 . Give its side in simplest surd form and to 3 significant figures. [4]

3. A value in scientific notation is multiplied by 0.04: $(7.5 \times 10^6)(4 \times 10^{-2})$. Give standard form. [4]

4. A phone loses 18% of its value each year. After 2 years it is worth GBP 1075.84. Find its original price. [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.

COMPREHENSIVE LESSON NOTEBOOK

Worked answers and repair notes

N5-N13 • Integrated numerical reasoning

1. WORKED ANSWER

Method: Calculate $3200(1.028)^4$. Subtract 250 only after the compound growth. Answer: GBP 3323.74 to the nearest penny. Check: confirm the result against the original conditions, units and expected scale.

2. WORKED ANSWER

Method: The side is $\sqrt{72} = 6\sqrt{2}$. Approximate only after stating the exact form. Answer: $6\sqrt{2}$ cm, approximately 8.49 cm. Check: confirm the result against the original conditions, units and expected scale.

3. WORKED ANSWER

Method: $7.5 \times 4 = 30$ and powers combine to 10^4 . Normalise 30×10^4 . Answer: 3×10^5 . Check: confirm the result against the original conditions, units and expected scale.

4. WORKED ANSWER

Method: Divide by 0.82^2 . Answer: GBP 1600. Check: confirm the result against the original conditions, units and expected scale.

COMPREHENSIVE LESSON NOTEBOOK

Number mastery review

Explain, demonstrate, connect and revisit.

I can...

- N5-N1 Exact and approximate number: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N2 Simplifying surds: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N3 Rationalising denominators: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N4 Index laws: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N5 Zero, negative and fractional indices: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N6 Scientific notation: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N7 Significant figures and checking: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N8 Fractions and mixed numbers: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N9 Reverse percentages: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N10 Appreciation and compound interest: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N11 Depreciation: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N12 Non-calculator numerical fluency: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.
- N5-N13 Integrated numerical reasoning: explain the idea, reproduce a valid method, solve an unfamiliar problem and check the result.

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