COMPREHENSIVE LESSON NOTEBOOK

AQA GCSE Mathematics

FOUNDATION TIER • 8300

UNIT 1 | NUMBER

STRUCTURE	REPRESENTATION	ACCURACY
$-12 \bullet 3.75 \bullet 10^6$	$3/8 = 0.375 = 37.5\%$	$3.35 \leq x < 3.45$

WHAT THIS BOOK DOES

This is a teach-from-scratch lesson book. Every chapter builds meaning first, models a method carefully, then moves through guided practice, independent fluency, reasoning and contextual problem solving. All explanations, examples, diagrams and questions are independently authored.

How to learn from this notebook

- Read the key vocabulary before the explanation.
- Cover each worked solution and try to reproduce every step.
- Say why each step is valid, not only what was done.
- Complete guided practice using the hint only if needed.
- Attempt independent questions without notes.
- Mark in a different colour and write a correction beside every error.
- Return after several days and complete the retrieval check again.

AQA ASSESSMENT OBJECTIVES

AO1 tests accurate methods and notation. AO2 tests reasoning, interpretation and communication. AO3 tests problem solving in mathematical and real-world contexts. Foundation papers are approximately 50% AO1, 25% AO2 and 25% AO3 overall.

Specification map

Chapter	AQA code	Detailed coverage
1	N1-N2	Place value, ordering and directed number
2	N2-N3	The four operations, written methods and BIDMAS
3	N4	Factors, multiples, primes, HCF and LCM
4	N5-N7	Systematic listing, powers, roots and indices
5	N8,N10-N12	Fractions, decimals and percentages
6	N9	Standard form and calculator notation
7	N13-N14	Units, compound measures and estimation
8	N15-N16	Rounding, error intervals and bounds

Number facts and formulas

PERCENTAGE OF AN AMOUNT

percentage ÷ 100 × amount

PERCENTAGE CHANGE

change ÷ original × 100%

NEW AMOUNT AFTER PERCENTAGE CHANGE

original × percentage multiplier

AVERAGE SPEED

distance ÷ time

DENSITY

mass ÷ volume

PRESSURE

force ÷ area

STANDARD FORM

$A \times 10^n$, where $1 \leq A < 10$

ROUNDING INTERVAL

rounded value ± half the rounding unit

IMPORTANT

A formula is useful only when the quantities and units are understood. Convert units before substitution and interpret the final answer in context.

CHAPTER 01 • N1-N2

Place value, ordering and directed number

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N1-N2. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.

Key vocabulary

Term	Student definition
digit	Write your own definition after studying the chapter.
place value	Write your own definition after studying the chapter.
integer	Write your own definition after studying the chapter.
decimal	Write your own definition after studying the chapter.
negative number	Write your own definition after studying the chapter.
ascending	Write your own definition after studying the chapter.
descending	Write your own definition after studying the chapter.
inequality	Write your own definition after studying the chapter.

Build the idea

Place value gives a digit its value

In 52,407.36 the digit 5 means fifty thousand, while the digit 5 in 0.052 means five hundredths. Moving one column left multiplies a value by 10; moving one column right divides it by 10. Zeros are placeholders: 4.07 is not the same as 4.7.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam

questions easier to decode.

A number line turns order into position

Numbers farther to the right are greater. This remains true below zero: -2 is greater than -7 because -2 lies to the right. The distance from zero is the absolute value, so |-7| = 7; absolute value describes distance, not direction.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Decimals are compared column by column

Write trailing zeros so the place-value columns line up. For example, compare 3.5, 3.47 and 3.405 as 3.500, 3.470 and 3.405. The first differing column decides the order.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Fractions need a common basis

To compare fractions, use a common denominator, convert to decimals, or compare each with a useful benchmark such as 1/2. The method must preserve the value of each fraction.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Reading a large decimal

QUESTION

Explain the value of 7 in 407,235.18.

1 **Step 1:** Locate the digit: it is in the thousands column.

2 **Step 2:** Multiply the digit by its column value: 7 × 1,000 = 7,000.

ANSWER

The digit 7 has value 7,000.

Ordering mixed forms

QUESTION

Put -1.4, -3/2, 0.2 and -1.05 in ascending order.

1 **Step 1:** Convert -3/2 to -1.5.

2 **Step 2:** Place the values on a number line: -1.5 is leftmost, followed by -1.4, -1.05 and 0.2.

ANSWER

-3/2, -1.4, -1.05, 0.2

Temperature change

QUESTION

The temperature changes from -6°C to 4°C. Find the increase.

1 **Step 1:** Move from -6 to 0: 6 degrees.

2 **Step 2:** Move from 0 to 4: 4 degrees.

3 **Step 3:** Total increase = 6 + 4 = 10.

ANSWER

The increase is 10°C.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Insert <, > or =: -4.2 ___ -4.02

HINT

Write both to hundredths: -4.20 and -4.02; use a number line if unsure.

GUIDED QUESTION 2

Write 3,050,607 in words

HINT

Split it into millions, thousands and units.

GUIDED QUESTION 3

Order 0.38, 3/8 and 39%

HINT

Convert all three to decimals or percentages.

GUIDED QUESTION 4

A lift moves from floor -3 to floor 8. How many floors?

HINT

Find the distance between the two directed numbers.

Independent practice

1. Write the value of 6 in 4,062,518.

2. Write “nine hundred and four thousand and seventy” in figures.

3. Arrange -2.08, -2.8, -1.98 and -2.18 in ascending order.

4. Insert <, > or =: 5/8 ___ 0.62.

5. Calculate -13 + 8.

6. Calculate 7 - 19.

7. A diver is at -18 m and rises to -5 m. Find the rise.

8. A bank balance moves from -£42.75 to £16.30. Find the change.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

CHAPTER 02 • N2-N3

The four operations, written methods and BIDMAS

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N2-N3. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.

Equal-priority operations are completed from left to right.

Key vocabulary

Term	Student definition
sum	Write your own definition after studying the chapter.
difference	Write your own definition after studying the chapter.
product	Write your own definition after studying the chapter.
quotient	Write your own definition after studying the chapter.
inverse	Write your own definition after studying the chapter.
reciprocal	Write your own definition after studying the chapter.
BIDMAS	Write your own definition after studying the chapter.
estimate	Write your own definition after studying the chapter.

Build the idea

Operations describe different structures

Addition combines or increases; subtraction finds a remainder, difference or change; multiplication scales or repeats equal groups; division shares equally or finds how many groups fit. Context determines the operation.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Written methods depend on place value

When adding or subtracting decimals, align decimal points. In multiplication, each partial product must be shifted according to its place value. In division, record remainders as a fraction or decimal when the context requires it.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Inverse operations undo one another

Addition and subtraction are inverses; multiplication and division are inverses. An inverse check is powerful because it uses a different operation: if 702 ÷ 18 = 39, then 39 × 18 must equal 702.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

BIDMAS removes ambiguity

Work through Brackets, Indices, Division and Multiplication from left to right, then Addition and Subtraction from left to right. Multiplication does not automatically come before division; they have equal priority.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Decimal subtraction

QUESTION

Calculate 23.4 - 7.865.

1 **Step 1:** Write 23.400 so decimal places align.

2 **Step 2:** Subtract column by column, exchanging where required.

ANSWER

23.4 - 7.865 = 15.535.

Order of operations

QUESTION

Calculate 18 - 3 × (4 + 2).

1 **Step 1:** Brackets: 4 + 2 = 6.

2 **Step 2:** Multiplication: 3 × 6 = 18.

3 **Step 3:** Subtraction: 18 - 18 = 0.

ANSWER

The answer is 0.

Household finance

QUESTION

Income is £1,925. Rent is £780, bills £312 and food £86 per week for four weeks. Find the balance.

1 **Step 1:** Food: 4 × £86 = £344.

2 **Step 2:** Spending: 780 + 312 + 344 = £1,436.

3 **Step 3:** Balance: 1,925 - 1,436 = £489.

ANSWER

£489 remains.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Calculate 804 - 267

HINT

Estimate first, then use column subtraction.

GUIDED QUESTION 2

Calculate 4.08 × 2.7

HINT

First calculate 408 × 27; restore three decimal places.

GUIDED QUESTION 3

Calculate 5 + 24 ÷ 6 × 2

HINT

Division and multiplication have equal priority; work left to right.

GUIDED QUESTION 4

An item costs £48 before 20% VAT. Find the total.

HINT

VAT is 0.20 × 48; add it to the original.

Independent practice

1. Calculate 38.06 + 7.9 + 0.475.

2. Calculate 50 - 18.736.

3. Calculate 3.42 × 0.6.

4. Calculate 936 ÷ 24.

5. Work out 7 + 5 × 4 - 3.

6. Work out (7 + 5) × (4 - 3).

7. Find the reciprocal of 2.5.

8. A shop buys a bicycle for £185 and sells it for £249.99. Find the profit.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

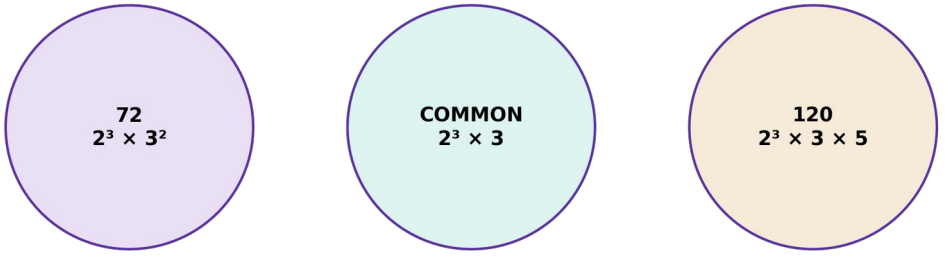
CHAPTER 03 • N4

Factors, multiples, primes, HCF and LCM

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N4. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.



Shared lowest powers give the HCF; all highest powers give the LCM.

Key vocabulary

Term	Student definition
factor	Write your own definition after studying the chapter.
multiple	Write your own definition after studying the chapter.
prime	Write your own definition after studying the chapter.
composite	Write your own definition after studying the chapter.
prime factorisation	Write your own definition after studying the chapter.
HCF	Write your own definition after studying the chapter.
LCM	Write your own definition after studying the chapter.
index form	Write your own definition after studying the chapter.

Build the idea

Factors divide exactly

A factor of a whole number divides it with no remainder. Factors come in pairs: for 36, 1×36, 2×18, 3×12, 4×9 and 6×6. Listing pairs prevents omissions.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Prime numbers have exactly two factors

A prime has factors 1 and itself. The number 1 is not prime because it has only one factor. Every integer greater than 1 can be written uniquely as a product of primes, apart from the order.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

HCF means the largest shared factor

Use the lowest shared power of each prime. HCF is useful for making the greatest possible number of identical groups or finding the largest equal size.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

LCM means the first shared multiple

Use the highest required power of every prime present. LCM is useful when repeating cycles must coincide or when equivalent fractions need a common denominator.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Prime factorisation

QUESTION

Write 360 as a product of prime factors.

1 **Step 1:** Divide by primes: $360 = 36 \times 10$.

2 **Step 2:** $36 = 2^2 \times 3^2$ and $10 = 2 \times 5$.

3 **Step 3:** Collect equal primes.

ANSWER

$360 = 2^3 \times 3^2 \times 5$.

Finding HCF and LCM

QUESTION

Find the HCF and LCM of 72 and 120.

1 **Step 1:** $72 = 2^3 \times 3^2$; $120 = 2^3 \times 3 \times 5$.

2 **Step 2:** HCF uses lowest common powers: $2^3 \times 3 = 24$.

3 **Step 3:** LCM uses highest powers: $2^3 \times 3^2 \times 5 = 360$.

ANSWER

HCF = 24 and LCM = 360.

Identical packs

QUESTION

84 apples and 126 oranges are divided into the greatest number of identical packs.

1 **Step 1:** The number of packs must divide both totals.

2 **Step 2:** HCF(84,126) = 42.

3 **Step 3:** Each pack has 84÷42=2 apples and 126÷42=3 oranges.

ANSWER

42 packs, each with 2 apples and 3 oranges.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

List every factor of 48

HINT

Use factor pairs in increasing order.

GUIDED QUESTION 2

Write 294 as a product of primes

HINT

Start by dividing by 2, then continue until every factor is prime.

GUIDED QUESTION 3

Find HCF(90,150)

HINT

Use prime factors and select shared primes with lowest powers.

GUIDED QUESTION 4

Two alarms sound every 28 and 42 minutes. When next together?

HINT

This is a repeating-cycle problem, so use LCM.

Independent practice

1. List all factors of 60.

2. State all prime numbers between 20 and 40.

3. Write 540 as a product of prime factors in index form.

4. Find HCF(84,126).

5. Find LCM(18,30).

6. 96 red and 144 blue cards form the greatest number of identical sets. How many sets?

7. Buses leave every 24 and 36 minutes. They leave together at 08:00. When next together?

8. Explain why 51 is not prime.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

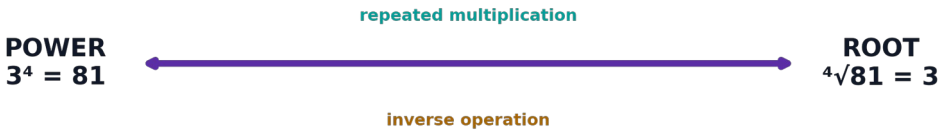
CHAPTER 04 • N5-N7

Systematic listing, powers, roots and indices

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N5-N7. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.



Key vocabulary

Term	Student definition
combination	Write your own definition after studying the chapter.
systematic	Write your own definition after studying the chapter.
power	Write your own definition after studying the chapter.
base	Write your own definition after studying the chapter.
index	Write your own definition after studying the chapter.
square root	Write your own definition after studying the chapter.
cube root	Write your own definition after studying the chapter.
index law	Write your own definition after studying the chapter.

Build the idea

Systematic listing proves completeness

Choose a fixed order and change one feature at a time. A table, tree diagram or ordered list makes omissions and repetitions visible. At Foundation tier, the method matters as much as the total.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

A power is repeated multiplication

In 5^3, 5 is the base and 3 is the index: $5^3 = 5×5×5$. Squaring and cubing are special powers. A root reverses a power, so $\sqrt{81} = 9$ because $9^2 = 81$.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Index laws follow repeated multiplication

When multiplying powers with the same base, add indices. When dividing, subtract indices. Raising a power to a power multiplies indices. These laws require the same base.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Zero and negative indices have meaning

For non-zero a, $a^0=1$ because $a^3÷a^3=a^0$ and also equals 1. A negative index means a reciprocal: $a^{-2}=1/a^2$. Foundation students calculate with integer indices.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Complete outcomes

QUESTION

A café offers 3 breads and 2 fillings. List all sandwiches.

1 **Step 1:** Fix bread 1 and pair it with both fillings.

2 **Step 2:** Repeat for breads 2 and 3.

3 **Step 3:** Check: 3 groups of 2 gives 6 outcomes.

ANSWER

There are 6 sandwiches.

Index laws

QUESTION

Simplify $3^5 \times 3^2 \div 3^4$.

1 **Step 1:** Same base: add indices for multiplication, giving 3^7.

2 **Step 2:** Subtract the divisor index: $3^7 \div 3^4 = 3^3$.

3 **Step 3:** Evaluate if required: $3^3 = 27$.

ANSWER

The simplified result is $3^3 = 27$.

Finding a root

QUESTION

A square has area 196 cm^2. Find its side length.

1 **Step 1:** For a square, area = $side^2$.

2 **Step 2:** Reverse squaring by taking the positive square root.

3 **Step 3:** $\sqrt{196} = 14$.

ANSWER

The side length is 14 cm.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

List two-digit numbers made from 1, 4 and 7 without repetition

HINT

Fix the tens digit, then vary the units digit.

GUIDED QUESTION 2

Evaluate 2^6

HINT

Write repeated multiplication if needed.

GUIDED QUESTION 3

Simplify $5^3 \times 5^4$

HINT

The base is the same, so add indices.

GUIDED QUESTION 4

Evaluate 10^{-3}

HINT

A negative index means reciprocal.

Independent practice

1. List all two-digit numbers using 3, 6 and 9 without repetition.

2. A code uses one letter from A,B,C and one digit from 1,2,3,4. How many codes?

3. Evaluate 12^2.

4. Evaluate $\sqrt[3]{343}$.

5. Simplify $2^5 \times 2^3$.

6. Simplify $7^9 \div 7^4$.

7. Simplify $(3^2)^4$.

8. Evaluate 4^{-2}.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

CHAPTER 05 • N8,N10-N12

Fractions, decimals and percentages

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N8,N10-N12. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.

Key vocabulary

Term	Student definition
numerator	Write your own definition after studying the chapter.
denominator	Write your own definition after studying the chapter.
equivalent	Write your own definition after studying the chapter.
improper fraction	Write your own definition after studying the chapter.
mixed number	Write your own definition after studying the chapter.
percentage	Write your own definition after studying the chapter.
operator	Write your own definition after studying the chapter.
multiplier	Write your own definition after studying the chapter.

Build the idea

Equivalent forms describe the same amount

A fraction, decimal and percentage can name the same point on a number line. Divide numerator by denominator for a decimal; multiply a decimal by 100 for a percentage. Simplifying changes the name, not the value.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam

questions easier to decode.

Fraction operations depend on meaning

For addition and subtraction, equal-sized parts are needed, so use a common denominator. For multiplication, multiply numerators and denominators, cancelling first when possible. For division, multiply by the reciprocal.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

A percentage is an operator

“Find 35% of 240” means multiply 240 by 0.35. A 12% increase uses multiplier 1.12; a 12% decrease uses 0.88. The multiplier combines the original 100% and the change.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Percentage change compares with the original

Percentage change = change ÷ original × 100%. The denominator is the starting value, not the final value. State whether the result is an increase or decrease.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Adding fractions

QUESTION

Calculate 3/4 + 5/6.

1 **Step 1:** LCM(4,6)=12.

2 **Step 2:** 3/4=9/12 and 5/6=10/12.

3 **Step 3:** Add numerators: 19/12 = 1 7/12.

ANSWER

1 7/12.

Percentage decrease

QUESTION

A £240 phone is reduced by 17.5%. Find the sale price.

1 **Step 1:** Remaining percentage = 82.5%.

2 **Step 2:** Multiplier = 0.825.

3 **Step 3:** 240 × 0.825 = 198.

ANSWER

The sale price is £198.

Reverse percentage

QUESTION

After a 20% increase, a bill is £156. Find the original.

1 **Step 1:** £156 represents 120% of the original.

2 **Step 2:** 120% multiplier = 1.2.

3 **Step 3:** Original = 156 ÷ 1.2 = 130.

ANSWER

The original bill was £130.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Convert 0.625 to a fraction and percentage

HINT

Write 625/1000, simplify, then multiply decimal by 100.

GUIDED QUESTION 2

Calculate 2/3 - 3/10

HINT

Use denominator 30.

GUIDED QUESTION 3

Find 42% of £350

HINT

Use multiplier 0.42.

GUIDED QUESTION 4

A value falls from 80 to 68. Find percentage decrease

HINT

Find the change, then divide by the original 80.

Independent practice

1. Convert 7/16 to a decimal and percentage.

2. Write 0.072 as a fraction in simplest form.

3. Calculate 5/8 + 7/12.

4. Calculate 3/5 ÷ 9/10.

5. Find 18% of £650.

6. Increase £480 by 7.5%.

7. A population falls from 2,400 to 2,052. Find the percentage decrease.

8. After a 25% reduction, a price is £54. Find the original price.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

CHAPTER 06 • N9

Standard form and calculator notation

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N9. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.

Move 5 places right to form the coefficient; record -5 as the index.

Key vocabulary

Term	Student definition
standard form	Write your own definition after studying the chapter.
coefficient	Write your own definition after studying the chapter.
power of ten	Write your own definition after studying the chapter.
positive index	Write your own definition after studying the chapter.
negative index	Write your own definition after studying the chapter.
calculator display	Write your own definition after studying the chapter.

Build the idea

Standard form has a strict structure

Write a number as $A \times 10^n$ where $1 \leq A < 10$ and n is an integer. The first factor contains exactly one non-zero digit before the decimal point.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

The index records movement, not zero counting alone

For a large number, move the decimal left and use a positive index. For a small positive number, move it right and use a negative index. The index equals the number of places moved.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Multiplication and division use index laws

Multiply or divide the coefficients, then apply the index law to the powers of ten. Finally adjust the coefficient so it lies between 1 and 10.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Addition needs a common power of ten

Indices cannot simply be added during addition. Rewrite terms using the same power of ten, then add the coefficients. Calculator displays such as 4.7E-6 mean 4.7×10^{-6}.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Small number

QUESTION

Write 0.0000582 in standard form.

1 **Step 1:** Move the decimal 5 places right to make 5.82.

2 **Step 2:** Moving right gives a negative index.

ANSWER

5.82×10^{-5}.

Multiplication

QUESTION

Calculate $(4\times10^{6})(7\times10^{3})$.

1 **Step 1:** Coefficients: $4\times7=28$.

2 **Step 2:** Powers: $10^{6}\times10^{3}=10^{9}$.

3 **Step 3:** 28×10^{9} is not standard form; rewrite as 2.8×10^{10}.

ANSWER

2.8×10^{10}.

Addition

QUESTION

Calculate $3.2\times10^{5} + 7.5\times10^{4}$.

1 **Step 1:** Rewrite 7.5×10^{4} as 0.75×10^{5}.

2 **Step 2:** Add coefficients: $3.2+0.75=3.95$.

ANSWER

3.95×10^{5}.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Write 6,730,000 in standard form

HINT

Move the decimal until one non-zero digit remains before it.

GUIDED QUESTION 2

Write 8.04×10^{-4} as an ordinary number

HINT

A negative index moves the decimal left.

GUIDED QUESTION 3

Calculate $(9\times10^{7})\div(3\times10^{2})$

HINT

Divide coefficients and subtract indices.

GUIDED QUESTION 4

Interpret 1.26E8

HINT

Replace E8 by $\times10^{8}$.

Independent practice

1. Write 54,900,000 in standard form.

2. Write 0.000000306 in standard form.

3. Write 7.21×10^{5} as an ordinary number.

4. Write 4.08×10^{-3} as an ordinary number.

5. Calculate $(6\times10^{4})(3\times10^{7})$.

6. Calculate $(8.4\times10^{9})\div(2.1\times10^{3})$.

7. Calculate $5.7\times10^{6} + 8\times10^{5}$.

8. A cell is 7.5×10^{-6} m wide. Find the width of 400 cells in a row.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

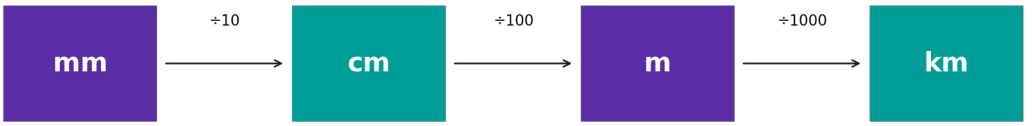
CHAPTER 07 • N13-N14

Units, compound measures and estimation

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N13-N14. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.



Square the conversion factor for area; cube it for volume.

Key vocabulary

Term	Student definition
metric unit	Write your own definition after studying the chapter.
conversion factor	Write your own definition after studying the chapter.
compound measure	Write your own definition after studying the chapter.
estimate	Write your own definition after studying the chapter.
approximation	Write your own definition after studying the chapter.
significant figure	Write your own definition after studying the chapter.
unit rate	Write your own definition after studying the chapter.

Build the idea

Units are part of the answer

A measurement without a unit is incomplete. Choose units suited to scale: millimetres for thickness, metres for room length, kilometres for journeys. Convert before combining quantities.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Area and volume conversions are powered

Because 1 m=100 cm, 1 m^2=100^2=10,000 cm^2 and 1 m^3=100^3=1,000,000 cm^3. A common error is using the linear factor for area or volume.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Compound measures combine units

Speed is distance÷time, density is mass÷volume and pressure is force÷area. Units such as km/h show the calculation: kilometres divided by hours.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Estimation checks magnitude

Round values, usually to one significant figure, then calculate mentally. An estimate is deliberately approximate; it helps detect mistyped calculator entries and decide whether a result is realistic.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Area conversion

QUESTION

Convert 2.4 m^2 to cm^2.

1 **Step 1:** 1 m = 100 cm.

2 **Step 2:** Therefore 1 m^2 = 100×100 = 10,000 cm^2.

3 **Step 3:** 2.4×10,000 = 24,000.

ANSWER

2.4 m^2 = 24,000 cm^2.

Average speed

QUESTION

A van travels 168 km in 2 hours 24 minutes. Find average speed.

1 **Step 1:** Convert 24 minutes to 24/60=0.4 hours.

2 **Step 2:** Total time=2.4 hours.

3 **Step 3:** Speed=168÷2.4=70.

ANSWER

Average speed = 70 km/h.

Estimate

QUESTION

Estimate (19.8×4.12)/0.198.

1 **Step 1:** Round to 20, 4 and 0.2.

2 **Step 2:** Calculate (20×4)÷0.2 = 80÷0.2.

ANSWER

The estimate is 400.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Convert 3.65 kg to g

HINT

Multiply by 1000.

GUIDED QUESTION 2

Convert 45,000 cm^2 to m^2

HINT

Divide by 10,000, not 100.

GUIDED QUESTION 3

A car travels 150 miles in 2.5 h. Find speed

HINT

Use distance÷time.

GUIDED QUESTION 4

Estimate 598×0.203

HINT

Round each value to one significant figure.

Independent practice

1. Convert 0.84 km to metres.

2. Convert 3,750 ml to litres.

3. Convert 2.7 m^2 to cm^2.

4. Convert 0.006 m^3 to cm^3.

5. A cyclist travels 52.5 km in 2.1 h. Find average speed.

6. A block has mass 540 g and volume 200 cm^3. Find density.

7. Estimate 31.2×0.487.

8. Estimate 799÷0.039.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

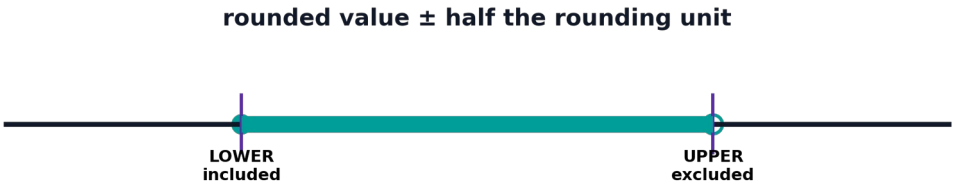
CHAPTER 08 • N15-N16

Rounding, error intervals and bounds

What does the method mean, why does it work, and when should it be used?

Specification focus

AQA references N15-N16. This chapter teaches the Foundation-tier knowledge, accurate methods, notation, reasoning and contextual application associated with these statements.



Key vocabulary

Term	Student definition
decimal place	Write your own definition after studying the chapter.
significant figure	Write your own definition after studying the chapter.
degree of accuracy	Write your own definition after studying the chapter.
lower bound	Write your own definition after studying the chapter.
upper bound	Write your own definition after studying the chapter.
error interval	Write your own definition after studying the chapter.
truncation	Write your own definition after studying the chapter.

Build the idea

Decimal places count from the decimal point

For 3 decimal places, keep three digits after the point and inspect the next digit. Significant figures begin at the first non-zero digit, so leading zeros do not count.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Context decides appropriate rounding

People, buses and packets often require whole numbers. Money normally uses two decimal places. Do not round intermediate calculator values unless instructed; early rounding can change the final answer.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

A rounded value represents an interval

A measurement of 8.2 cm to the nearest 0.1 cm represents values from 8.15 inclusive to 8.25 exclusive: $8.15 \leq x < 8.25$. The half-unit of rounding is 0.05.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Bounds answer worst-case questions

For positive lengths, the maximum product uses upper bounds and the minimum product uses lower bounds. For a quotient, the largest result uses a large numerator and small denominator. Keep bound values unrounded during the calculation.

WHY IT MATTERS

Do not memorise a rule in isolation. Connect the rule to place value, repeated multiplication, equal parts or the measurement context. This makes unfamiliar exam questions easier to decode.

Worked examples: follow the reasoning

Significant figures

QUESTION

Round 0.004786 to 3 significant figures.

1 **Step 1:** Ignore leading zeros; significant digits are 4,7,8.

2 **Step 2:** The next digit is 6, so round 8 upward.

ANSWER

0.00479.

Error interval

QUESTION

A mass is 3.4 kg to the nearest 0.1 kg.

1 **Step 1:** Half of 0.1 is 0.05.

2 **Step 2:** Lower bound=3.4-0.05=3.35; upper=3.45.

3 **Step 3:** Lower included, upper excluded.

ANSWER

$3.35 \leq m < 3.45$.

Upper bound area

QUESTION

Lengths 8.2 cm and 5.6 cm are nearest 0.1 cm.

1 **Step 1:** Upper bounds are 8.25 and 5.65.

2 **Step 2:** Maximum area uses both upper bounds.

3 **Step 3:** $8.25 \times 5.65 = 46.6125$.

ANSWER

Upper bound area = 46.6125 cm^2.

Guided practice

Attempt each question before opening the hint. Write a complete mathematical statement, including units where necessary.

GUIDED QUESTION 1

Round 68,749 to 2 significant figures

HINT

Keep 6 and 8; inspect the 7.

GUIDED QUESTION 2

Write interval for 12 cm nearest cm

HINT

Half the rounding unit is 0.5 cm.

GUIDED QUESTION 3

Find lower bound of 7.2×4.8, nearest 0.1

HINT

Use 7.15 and 4.75.

GUIDED QUESTION 4

Explain why the upper endpoint is excluded

HINT

Ask which value it would round to.

Independent practice

1. Round 47.386 to 2 decimal places.

2. Round 0.006954 to 2 significant figures.

3. A length is 70 cm to the nearest 10 cm. Write its error interval.

4. A time is 8.6 s to the nearest 0.1 s. State both bounds.

5. Find the lower bound of 6.4×3.7 when both are nearest 0.1.

6. Find the upper bound of $45 \div 8$ when both values are nearest whole numbers.

7. A box is 12 cm by 8 cm, each nearest cm. Find the upper bound for area.

8. Explain why rounding every intermediate result can be unsafe.

Reason, explain and connect

AO2 REASONING

Choose one answer above. Explain how you know it is reasonable and identify one mistake a student might make.

AO3 APPLICATION

Create a realistic problem that uses this chapter's main idea. Solve it and state what the answer means in context.

CHAPTER SUMMARY

Complete from memory: three facts I must remember; one diagram or model that helps; one error I will avoid; one real-life use.

Fully explained answers

These solutions model a clear written method. Equivalent correct methods are acceptable when the reasoning is valid and notation is accurate.

Chapter 1: Place value, ordering and directed number

1. 60,000

The 6 is in the ten-thousands column, so its value is 6 × 10,000 = 60,000.

2. 904,070

Split the words into 904 thousand and 70: 904,000 + 70 = 904,070.

3. -2.8, -2.18, -2.08, -1.98

For negative numbers, the value with greater magnitude lies farther left. Therefore -2.8 < -2.18 < -2.08 < -1.98.

4. 5/8 > 0.62 because 5/8 = 0.625

5/8 = 5 ÷ 8 = 0.625. Since 0.625 > 0.620, 5/8 > 0.62.

5. -5

Starting at -13 and moving 8 places right gives -5.

6. -12

Subtracting 19 from 7 crosses zero: 7 - 19 = -(19 - 7) = -12.

7. 13 m

Rise = final depth - starting depth = -5 - (-18) = -5 + 18 = 13 m.

8. £59.05 increase

Change = 16.30 - (-42.75) = 16.30 + 42.75 = £59.05, an increase.

Chapter 2: The four operations, written methods and BIDMAS

1. 46.435

Align decimal points: 38.060 + 7.900 + 0.475 = 46.435.

2. 31.264

Write 50 as 50.000, then 50.000 - 18.736 = 31.264.

3. 2.052

Calculate 342 × 6 = 2052. The factors contain three decimal places altogether, so the result is 2.052.

4. 39

936 ÷ 24 = 39 because 24 × 39 = 936.

5. 24

Multiplication first: 5 × 4 = 20. Then 7 + 20 - 3 = 24.

6. 12

Brackets first: 7 + 5 = 12 and 4 - 3 = 1. Then 12 × 1 = 12.

7. 0.4 or 2/5

2.5 = 5/2. Its reciprocal is 2/5 = 0.4.

8. £64.99

Profit = selling price - cost price = £249.99 - £185.00 = £64.99.

Chapter 3: Factors, multiples, primes, HCF and LCM

1. 1,2,3,4,5,6,10,12,15,20,30,60

Use factor pairs: 1×60, 2×30, 3×20, 4×15, 5×12 and 6×10. This gives 1,2,3,4,5,6,10,12,15,20,30,60.

2. 23,29,31,37

Test divisibility by primes up to each square root. The primes are 23, 29, 31 and 37.

3. $2^2 \times 3^3 \times 5$

540 = 54×10 = $(2\times3^3)(2\times5) = 2^2\times3^3\times5$.

4. 42

84 = $2^2\times3\times7$ and 126 = $2\times3^2\times7$. Lowest shared powers give HCF = 2×3×7 = 42.

5. 90

18 = 2×3^2 and 30 = 2×3×5. Highest powers give LCM = $2\times3^2\times5$ = 90.

6. 48 sets

HCF(96,144)=48, so the greatest possible number is 48 identical sets.

7. LCM=72 minutes, so 09:12

LCM(24,36)=72 minutes. 72 minutes after 08:00 is 09:12.

8. 51 = 3 × 17, so it has factors other than 1 and itself

51 is divisible by 3 because 5+1=6. Since 51=3×17, it has more than two factors and is not prime.

Chapter 4: Systematic listing, powers, roots and indices

1. 36,39,63,69,93,96

Fix the tens digit and vary the units: 36,39; 63,69; 93,96.

2. 3 × 4 = 12

There are 3 independent letter choices and 4 digit choices, so 3×4=12 codes.

3. 144

12^2 means 12×12 = 144.

4. 7

$7^3=343$, so $\sqrt[3]{343}=7$.

5. 2^8 = 256

Same base: add indices, $2^5\times2^3=2^8=256$.

6. 7^5

Same base: subtract indices, $7^9\div7^4=7^5$.

7. 3^8

Power of a power: multiply indices, $(3^2)^4=3^8$.

8. 1/16

A negative index gives a reciprocal: $4^{-2}=1/4^2=1/16$.

Chapter 5: Fractions, decimals and percentages

1. 0.4375 and 43.75%

7÷16=0.4375. Multiplying by 100 gives 43.75%.

2. 9/125

0.072=72/1000. Divide numerator and denominator by 8 to obtain 9/125.

3. 29/24 = 1 5/24

LCM(8,12)=24. Then 5/8=15/24 and 7/12=14/24, so the sum is 29/24=1 5/24.

4. 2/3

Divide by multiplying by the reciprocal: 3/5 ÷ 9/10 = 3/5 × 10/9 = 30/45 = 2/3.

5. £117

18%=0.18, so 0.18×650 = £117.

6. £516

A 7.5% increase uses multiplier 1.075: 480×1.075 = £516.

7. 14.5%

Decrease = 2400-2052=348. Percentage decrease = 348/2400×100 = 14.5%.

8. £72

£54 represents 75% after a 25% reduction. Original = 54÷0.75 = £72.

Chapter 6: Standard form and calculator notation

1. 5.49×10^{7}

Move the decimal 7 places left: 54,900,000 = 5.49×10^{7}.

2. 3.06×10^{-7}

Move the decimal 7 places right to make 3.06, so 0.000000306 = 3.06×10^{-7}.

3. 721,000

A positive power 10^{5} moves the decimal 5 places right: 7.21×10^{5} = 721,000.

4. 0.00408

A negative power 10^{-3} moves the decimal 3 places left: 4.08×10^{-3} = 0.00408.

5. 1.8×10^{12}

Multiply coefficients and add indices: $6\times3=18$ and $10^{4}\times10^{7}=10^{11}$. Then $18\times10^{11}=1.8\times10^{12}$.

6. 4×10^{6}

Divide coefficients and subtract indices: $8.4\div2.1=4$ and $10^{9}\div10^{3}=10^{6}$, giving 4×10^{6}.

7. 6.5×10^{6}

Rewrite 8×10^{5} as 0.8×10^{6}. Then $(5.7+0.8)\times10^{6}=6.5\times10^{6}$.

8. 3×10^{-3} m

$400=4\times10^{2}$. Then $(7.5\times10^{-6})(4\times10^{2})=30\times10^{-4}=3\times10^{-3}$ m.

Chapter 7: Units, compound measures and estimation

1. 840 m

1 km=1000 m, so 0.84×1000=840 m.

2. 3.75 L

1 litre=1000 ml, so 3750÷1000=3.75 L.

3. 27,000 cm^2

1 m^2=10,000 cm^2, so 2.7×10,000=27,000 cm^2.

4. 6,000 cm^3

1 m^3=1,000,000 cm^3, so 0.006×1,000,000=6,000 cm^3.

5. 25 km/h

Average speed = distance÷time = 52.5÷2.1 = 25 km/h.

6. 2.7 g/cm^3

Density = mass÷volume = 540÷200 = 2.7 g/cm^3.

7. 30×0.5=15

To one significant figure, 31.2≈30 and 0.487≈0.5. Estimate: 30×0.5=15.

8. 800÷0.04=20,000

To one significant figure, 799≈800 and 0.039≈0.04. Estimate: 800÷0.04=20,000.

Chapter 8: Rounding, error intervals and bounds

1. 47.39

For 2 decimal places keep 47.38 and inspect the next digit, 6. Round upward to 47.39.

2. 0.0070

The first two significant digits are 6 and 9; the next digit is 5, so 0.006954 rounds to 0.0070. The final zero records two significant figures.

3. $65 \leq L < 75$

Nearest 10 has half-unit 5, so $65 \leq L < 75$.

4. $8.55 \leq t < 8.65$

Nearest 0.1 has half-unit 0.05, so $8.55 \leq t < 8.65$.

5. $6.35 \times 3.65 = 23.1775$

Lower bounds are 6.35 and 3.65. Minimum product = $6.35 \times 3.65 = 23.1775$.

6. $45.5 \div 7.5 = 6.0666\ldots$

For the largest quotient use the largest numerator and smallest denominator: $45.5 \div 7.5 = 6.0666\ldots$.

7. $12.5 \times 8.5 = 106.25\ \text{cm}^2$

Upper bounds are 12.5 cm and 8.5 cm. Maximum area = $12.5 \times 8.5 = 106.25\ \text{cm}^2$.

8. Small rounding errors can accumulate and change the final rounded answer

Each rounded intermediate value introduces an error. Several errors can accumulate, causing the final rounded answer to change; retain full calculator precision until the end.

Unit mastery record

AQA reference	I can demonstrate…	Confident?
N1-N2	Place value, ordering and directed number	☐
N2-N3	The four operations, written methods and BIDMAS	☐
N4	Factors, multiples, primes, HCF and LCM	☐
N5-N7	Systematic listing, powers, roots and indices	☐
N8,N10-N12	Fractions, decimals and percentages	☐
N9	Standard form and calculator notation	☐
N13-N14	Units, compound measures and estimation	☐
N15-N16	Rounding, error intervals and bounds	☐

Official sources used

AQA GCSE Mathematics (8300), Subject Content 3.1 Number: https://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300/specification/subject-content/3.1-number

AQA GCSE Mathematics (8300), Scheme of Assessment: https://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300/specification/scheme-of-assessment

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