

GCSE MATHEMATICS

FOUNDATION TIER

COMPREHENSIVE LESSON NOTEBOOK

UNIT 1 | NUMBER

TEACH-FROM-SCRATCH • PUBLICATION EDITION

12 detailed chapters • original diagrams • worked examples • guided practice • answers

INDEPENDENT PUBLICATION NOTICE

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COMPREHENSIVE LESSON NOTEBOOK

How to learn from this notebook

Meaning first. Method second. Practice third.

FIVE-PASS ROUTINE

1 Read the key idea without a calculator. 2 Cover each worked solution and reproduce it. 3 Complete practice independently. 4 Mark in a different colour and repair errors. 5 Retest after 2-7 days.

What a complete mathematics answer contains

- A clear model or calculation, not only a calculator display.
- Enough working for another person to follow the reasoning.
- Exact values until approximation is requested.
- Units and sensible rounding in context.
- A final statement when interpretation is required.

Error loop

REPAIR, DO NOT MERELY CORRECT

Label each error: concept, operation, arithmetic, calculator entry, accuracy, unit or interpretation. Write the corrected step and one sentence explaining the change.

Foundation does not mean superficial

Eduqas Foundation questions can combine familiar skills in unfamiliar contexts. Grade 4-5 success depends on selecting a method, connecting several steps and deciding whether the answer is reasonable.

COMPREHENSIVE LESSON NOTEBOOK

Unit 1 coverage map

EDUQAS C300 Number content organised into a teachable sequence.

CH 01	FN1	Ordering and comparing numbers
CH 02	FN2	Place value and the four operations
CH 03	FN3	Order of operations and inverse checks
CH 04	FN4-FN5	Prime factors, HCF, LCM and listing
CH 05	FN6-FN7	Powers, roots and integer indices
CH 06	FN8	Exact fractions and multiples of pi
CH 07	FN9	Standard form
CH 08	FN10	Terminating decimals and fractions
CH 09	FN11-FN12	Fractions in ratio and percentage operators
CH 10	FN13	Standard and compound measures
CH 11	FN14-FN15	Estimation and appropriate rounding
CH 12	FN16	Bounds and limits of accuracy

IMPORTANT TIER NOTE

This notebook covers Eduqas C300 references FN1-FN16 at Foundation Tier. Ratio, proportion and rates of change are developed separately in Unit 2. Specification references are identifiers, not copied specification wording.

COMPREHENSIVE LESSON NOTEBOOK

Fast-reference method bank

Understand each relationship before memorising it.

Percentage of amount

percentage $\div$ 100 $\times$ amount

Percentage change

change $\div$ original $\times$ 100%

Reverse percentage

known amount $\div$ known multiplier

Fraction of amount

fraction $\times$ amount

Standard form

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

HCF

common primes with smallest powers

LCM

all required primes with greatest powers

Index product

$a^m \times a^n = a^{m+n}$

Index quotient

$a^m \div a^n = a^{m-n}$

Error interval

rounded value $\pm$ half-unit

CURRENT ASSESSMENT NOTE

Eduqas states that an additional formula sheet is integrated into examination papers from Summer 2026. Check the official Eduqas qualification page for the arrangement applying to your examination series.

COMPREHENSIVE LESSON NOTEBOOK

Ordering and comparing numbers

Order positive and negative integers, decimals and fractions and use comparison symbols.

SPECIFICATION FOCUS

Eduqas reference FN1. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

Comparing numbers means deciding their position on one shared scale. Positive numbers lie to the right of zero and negative numbers to the left. Among negative values, the number closer to zero is greater. Fractions, decimals and percentages can only be compared reliably after they are expressed in a common form.

KEY VOCABULARY

integer • decimal • fraction • inequality • ascending • descending • number line



Why the method works

- Equivalent representations occupy the same point on a number line.
- Adding trailing zeros does not change a decimal value but makes place values easier to compare.
- An inequality symbol points towards the smaller quantity.

CHECK BEFORE MOVING ON

Answer mentally: Order -7, 3, -2, 0 and -11 from smallest to largest. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Ordering and comparing numbers - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Convert values to a common form before comparing.
- On a number line, values increase from left to right.

WORKED EXAMPLE 1

Order -7, 3, -2, 0 and -11 from smallest to largest.

SOLUTION

1. Place the integers on a number line.
2. Read from left to right.

ANSWER: -11, -7, -2, 0, 3

WORKED EXAMPLE 2

Insert $<$, $>$ or $=$ between -3.8 and -3.08.

SOLUTION

1. -3.80 lies farther left than -3.08.

ANSWER: $-3.8 < -3.08$

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Ordering and comparing numbers - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Temperatures, debt, altitude and profit all require ordered signed values. Rankings and thresholds also rely on reading $<$, $>$, $<=$ and $>=$ precisely.

Common misconceptions

- Comparing only the digits and ignoring the negative sign.
- Treating 0.7 as smaller than 0.65 because 7 is smaller than 65.
- Changing a fraction to an inaccurate rounded decimal too early.

GUIDED TRY

Order 0.42, $\frac{2}{5}$, 41% and 0.405. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why $-12 < -5$ even though $12 > 5$. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Ordering and comparing numbers

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Order -7, 3, -2, 0 and -11 from smallest to largest.

[2]

2. Insert <, > or = between -3.8 and -3.08.

[1]

3. Order 0.42, $\frac{2}{5}$, 41% and 0.405.

[3]

4. Write an integer n satisfying $-4 < n \leq -1$.

[1]

5. Which is greater, $-\frac{5}{6}$ or -0.82? Explain.

[2]

6. Arrange $\frac{7}{8}$, 0.86 and 87% in descending order.

[3]

7. A lift is at floor -4. Another is at floor -7. Which lift is higher and by how many floors?

[2]

8. Explain why $-12 < -5$ even though $12 > 5$.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Place value and the four operations

Use place value and formal methods with positive and negative integers, decimals and simple fractions.

SPECIFICATION FOCUS

Eduqas reference FN2. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

Our base-ten system gives each digit a value determined by its column. The four operations describe combining, separating, scaling and grouping. Formal written methods preserve place value, while negative numbers represent directed quantities below a chosen zero. A sensible estimate should be made before exact work so misplaced digits are noticed.

KEY VOCABULARY

place value • integer • operation • sum • difference • product • quotient • magnitude

factor**multiple****prime****square**

Why the method works

- Column methods work because each column contains equal units.
- Subtracting a negative reverses direction and is equivalent to addition.
- Multiplication and division are inverse scaling operations.

CHECK BEFORE MOVING ON

Answer mentally: State the value of 6 in 4,063,218. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Place value and the four operations - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Align equal place values in column work.
- Estimate sign and size before calculating exactly.

WORKED EXAMPLE 1

State the value of 6 in 4,063,218.

SOLUTION

1. The digit is in the ten-thousands column.

ANSWER: 60,000

WORKED EXAMPLE 2

Calculate $8,407 + 6,958$.

SOLUTION

1. Align place-value columns.
2. Add from right to left, carrying where required.

ANSWER: 15,365

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Place value and the four operations - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Money, stock levels, distances and temperatures combine large, small and signed quantities. Accurate place value is also essential when entering calculations into technology.

Common misconceptions

- Aligning final digits instead of decimal points.
- Losing a zero used as a place holder.
- Ignoring the sign when multiplying or dividing.

GUIDED TRY

Calculate $20,000 - 13,786$. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why $(-8) \times (-6)$ is positive. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Place value and the four operations

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. State the value of 6 in 4,063,218.

[1]

2. Calculate $8,407 + 6,958$.

[2]

3. Calculate $20,000 - 13,786$.

[2]

4. Work out $-17 + 29 - 36$.

[2]

5. Calculate 4.08×0.35 .

[3]

6. Calculate $7.56 \div 0.09$.

[2]

7. A bank balance is -£48. A payment of £125 arrives and £39 is then spent. Find the new balance.

[3]

8. Explain why $(-8) \times (-6)$ is positive.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Order of operations and inverse checks

Use brackets, powers, roots, reciprocals and inverse operations in the correct order.

SPECIFICATION FOCUS

Eduqas reference FN3. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A numerical expression has a structure. Brackets show grouped work and indices describe repeated multiplication. Multiplication and division share a priority, as do addition and subtraction, so equal-priority operations are completed from left to right. Inverse operations allow a result to be checked or an unknown to be recovered.

KEY VOCABULARY

bracket • index • root • reciprocal • inverse • priority • expression

Brackets**Indices****÷ and ×****+ and -**

Why the method works

- A shared convention gives every unambiguous expression one value.
- Inverse operations undo one another.
- A reciprocal is the multiplicative inverse because a number times its reciprocal equals 1.

CHECK BEFORE MOVING ON

Answer mentally: Work out $9 + 4 \times 7$. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Order of operations and inverse checks - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Brackets and powers are completed before multiplication, division, addition and subtraction.
- Operations of equal priority are completed from left to right.

WORKED EXAMPLE 1

Work out $9 + 4 \times 7$.

SOLUTION

1. Multiply first: $4 \times 7 = 28$.
2. Then $9 + 28 = 37$.

ANSWER: 37

WORKED EXAMPLE 2

Work out $(9 + 4) \times 7$.

SOLUTION

1. Complete the brackets: 13.
2. Then $13 \times 7 = 91$.

ANSWER: 91

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Order of operations and inverse checks - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Formulas, spreadsheets and computer programs depend on explicit operation order. A missing pair of brackets can change a financial or scientific result completely.

Common misconceptions

- Always doing multiplication before division instead of working left to right.
- Ignoring brackets around a complete expression.
- Calling the negative of a number its reciprocal.

GUIDED TRY

Calculate $96 \div 8 \times 3$. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why $48 \div 6 \times 2$ is not equal to $48 \div (6 \times 2)$. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Order of operations and inverse checks

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Work out $9 + 4 \times 7$.

[1]

2. Work out $(9 + 4) \times 7$.

[1]

3. Calculate $96 \div 8 \times 3$.

[2]

4. Calculate $5^2 - 3 \times (8 - 6)$.

[2]

5. Find the reciprocal of $2 \frac{1}{2}$.

[2]

6. Find the missing number: $6x - 11 = 43$.

[2]

7. Use an inverse operation to check that $1,344 \div 32 = 42$.

[2]

8. Explain why $48 \div 6 \times 2$ is not equal to $48 \div (6 \times 2)$.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Prime factors, HCF, LCM and listing

Use number structure for grouping, cycles and complete lists of possibilities.

SPECIFICATION FOCUS

Eduqas reference FN4-FN5. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

Every whole number greater than 1 has one prime-factor structure, apart from order. The HCF captures the largest structure shared by numbers; the LCM contains everything required by all numbers. Systematic listing applies the same discipline to combinations: fix one choice, exhaust all partners, then move to the next.

KEY VOCABULARY

prime • factor • multiple • prime factorisation • HCF • LCM • systematic list



Why the method works

- HCF uses common primes with their smallest powers.
- LCM uses all necessary primes with their greatest powers.
- A fixed listing order proves that cases have not been missed or repeated.

CHECK BEFORE MOVING ON

Answer mentally: Write 540 as a product of prime factors. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Prime factors, HCF, LCM and listing - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- HCF uses shared prime factors with the smallest powers.
- LCM uses every required prime factor with the greatest power.

WORKED EXAMPLE 1

Write 540 as a product of prime factors.

SOLUTION

1. $540 = 54 \times 10$.
2. $54 = 2 \times 3^3$ and $10 = 2 \times 5$.
3. Collect equal prime factors.

ANSWER: $2^2 \times 3^3 \times 5$

WORKED EXAMPLE 2

Find the HCF of 72 and 120.

SOLUTION

1. $72 = 2^3 \times 3^2$ and $120 = 2^3 \times 3 \times 5$.
2. Use common primes with smallest powers: $2^3 \times 3 = 24$.

ANSWER: 24

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Prime factors, HCF, LCM and listing - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Equal package sizes, tile cuts and grouping use HCF. Timetables and repeating cycles use LCM. Menus, codes and routes require systematic enumeration.

Common misconceptions

- Using HCF for events that repeat in time.
- Using only shared prime factors for an LCM.
- Writing combinations randomly and assuming the list is complete.

GUIDED TRY

Find the LCM of 45 and 84. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain how you know a systematic list is complete. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Prime factors, HCF, LCM and listing

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Write 540 as a product of prime factors.

[3]

2. Find the HCF of 72 and 120.

[2]

3. Find the LCM of 45 and 84.

[3]

4. Two lights flash every 36 seconds and 54 seconds. They flash together now. After how many seconds will they next flash together?

[3]

5. Ropes of 180 cm and 252 cm are cut into the longest equal pieces with no waste. Find each piece length.

[3]

6. List every two-digit number that can be made using 2, 5 and 8 without repetition.

[3]

7. A meal has 3 starters and 4 main courses. List systematically or draw a grid to find the number of two-course choices.

[2]

8. Explain how you know a systematic list is complete.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Powers, roots and integer indices

Recognise powers and roots and calculate using integer-index laws.

SPECIFICATION FOCUS

Eduqas reference FN6-FN7. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A power records repeated multiplication of one base. Index laws count the copies of that base that are joined, removed or repeated. Roots reverse powers: a square root recovers a side from a square area and a cube root recovers an edge from a cube volume. A negative integer index records a reciprocal power.

KEY VOCABULARY

base • index • power • square root • cube root • negative index • reciprocal

$$a^3 \times a^5 = a^8$$

three copies plus five copies gives eight copies of the same base

Why the method works

- Multiplying equal bases joins factors, so indices add.
- Division cancels equal factors, so indices subtract.
- Raising a power to a power repeats every factor, so indices multiply.

CHECK BEFORE MOVING ON

Answer mentally: Evaluate 7^3 . Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Powers, roots and integer indices - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- When multiplying equal bases, add indices; when dividing, subtract indices.
- A power of a power multiplies the indices.

WORKED EXAMPLE 1

Evaluate 7^3 .

SOLUTION

1. $7^3 = 7 \times 7 \times 7 = 343$.

ANSWER: 343

WORKED EXAMPLE 2

Find the square root of 1,024.

SOLUTION

1. $32 \times 32 = 1,024$.

ANSWER: 32

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Powers, roots and integer indices - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Area, volume, scientific scale and computer storage use powers. Roots recover dimensions, while index notation keeps repeated-factor calculations compact.

Common misconceptions

- Applying index laws when the bases differ.
- Multiplying indices when multiplying two powers.
- Forgetting that brackets decide whether a negative sign is part of the base.

GUIDED TRY

Find the cube root of 2,197. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

A cube has volume 729 cm^3 . Find its edge length and justify the operation. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Powers, roots and integer indices

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Evaluate 7^3 .**[1]**

2. Find the square root of 1,024.**[1]**

3. Find the cube root of 2,197.**[1]**

4. Simplify $5^4 \times 5^3$.**[1]**

5. Simplify a^{11} / a^4 .**[1]**

6. Simplify $(x^3)^5$.**[1]**

7. Write $1/2^6$ as a power of 2 with a negative index.**[2]**

8. A cube has volume 729 cm^3 . Find its edge length and justify the operation.**[2]**

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Exact fractions and multiples of pi

Calculate exactly with fractions and quantities containing pi.

SPECIFICATION FOCUS

Eduqas reference FN8. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A fraction is simultaneously a number, a division and an operator. Equivalent fractions name the same point on the number line. Addition needs equal-sized parts, multiplication scales, and division asks how many groups fit. Exact expressions containing pi preserve the full mathematical value rather than replacing it with a rounded decimal.

KEY VOCABULARY

numerator • denominator • equivalent • reciprocal • exact • pi • irrational



3 shaded equal parts out of 8 = $\frac{3}{8}$

Why the method works

- A common denominator creates pieces of equal size.
- Dividing by a fraction is multiplying by the reciprocal.
- Leaving pi symbolic prevents avoidable rounding error.

CHECK BEFORE MOVING ON

Answer mentally: Simplify $\frac{96}{144}$. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Exact fractions and multiples of pi - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Use a common denominator for fraction addition and subtraction.
- Leave pi in the answer when an exact value is requested.

WORKED EXAMPLE 1

Simplify $96/144$.

SOLUTION

1. $\text{HCF}(96, 144) = 48$.
2. Divide numerator and denominator by 48.

ANSWER: $2/3$

WORKED EXAMPLE 2

Calculate $5/6 + 7/15$.

SOLUTION

1. Use denominator 30: $25/30 + 14/30 = 39/30$.
2. Simplify to $13/10 = 1 \frac{3}{10}$.

ANSWER: $1 \frac{3}{10}$

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Exact fractions and multiples of pi - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Recipes, probability, scale and circle measurements use exact fractions. Keeping exact values until the final line protects accuracy across multi-step problems.

Common misconceptions

- Adding denominators when adding fractions.
- Cancelling terms that are joined by addition.
- Using 3.14 when an exact answer is requested.

GUIDED TRY

Calculate $7/8 - 5/12$. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why 36π is exact but 113.1 is approximate. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Exact fractions and multiples of pi

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Simplify $96/144$.

[2]

2. Calculate $5/6 + 7/15$.

[2]

3. Calculate $7/8 - 5/12$.

[2]

4. Calculate $9/14 \times 21/25$.

[2]

5. Calculate $5/9 \div 10/27$.

[2]

6. A semicircle has radius 7 cm. Find its curved edge length exactly.

[2]

7. A circle has diameter 12 cm. Find its area exactly.

[3]

8. Explain why 36π is exact but 113.1 is approximate.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Standard form

Write, interpret and calculate with numbers in the form $A \times 10^n$.

SPECIFICATION FOCUS

Eduqas reference FN9. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

Standard form separates the meaningful digits of a number from its power-of-ten scale. The coefficient is at least 1 and less than 10. Moving the decimal point changes the coefficient, so the exponent must compensate. Calculations then combine coefficients and powers separately before normalising the result.

KEY VOCABULARY

standard form • coefficient • exponent • power of ten • magnitude • ordinary number

$$4,200,000 = 4.2 \times 10^6$$

coefficient between 1 and 10 • scale recorded by the exponent

Why the method works

- Each place-value move multiplies or divides by 10.
- Multiplication joins powers of ten, so exponents add.
- Addition requires both numbers to be written with the same power of ten.

CHECK BEFORE MOVING ON

Answer mentally: Write 6,420,000 in standard form. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Standard form - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- The coefficient must satisfy $1 \leq A < 10$.
- Multiply coefficients and add exponents; divide coefficients and subtract exponents.

WORKED EXAMPLE 1

Write 6,420,000 in standard form.

SOLUTION

1. Move the decimal point six places left.
2. Record the movement with 10^6 .

ANSWER: 6.42×10^6

WORKED EXAMPLE 2

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

SOLUTION

1. A negative exponent moves the decimal point left four places.

ANSWER: 0.000408

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Standard form - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Astronomy, medicine, computing and microscopic science compare quantities with extremely different magnitudes. Standard form displays both scale and precision clearly.

Common misconceptions

- Leaving a coefficient equal to 10 or greater.
- Giving a positive exponent to a number between 0 and 1.
- Adding coefficients whose powers of ten do not match.

GUIDED TRY

Write 0.00000073 in standard form. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why 12.4×10^5 is not written in standard form and correct it. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Standard form

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Write 6,420,000 in standard form.

[1]

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

[1]

3. Write 0.00000073 in standard form.

[2]

4. Calculate $(3 \times 10^3)(4 \times 10^{-2})$. Give the answer in standard form.

[2]

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

[2]

6. Calculate $5.7 \times 10^6 + 8 \times 10^5$.

[3]

7. A cell has mass 3.2×10^{-9} g. Find the mass of 5×10^6 cells.

[3]

8. Explain why 12.4×10^5 is not written in standard form and correct it.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Terminating decimals and fractions

Move accurately between terminating decimals and fractions.

SPECIFICATION FOCUS

Eduqas reference FN10. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A terminating decimal is a fraction whose place-value expansion ends. Writing the decimal over 10, 100, 1000 and simplifying reveals its fraction form. In simplest form, a fraction terminates precisely when its denominator contains no prime factors except 2 and 5, because powers of ten are built from 2s and 5s.

KEY VOCABULARY

terminating • recurring • equivalent fraction • place-value denominator • simplest form

$$0.3 = \frac{3}{10} = 30\%$$

three equivalent representations of one value

Why the method works

- Every finite decimal is an integer divided by a power of ten.
- Multiplying numerator and denominator by the same non-zero number preserves value.
- The denominator factor test predicts whether long division ends.

CHECK BEFORE MOVING ON

Answer mentally: Write 0.375 as a fraction in simplest form. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Terminating decimals and fractions - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Write a terminating decimal over its place-value denominator, then simplify.
- A simplified fraction terminates only when its denominator has prime factors 2 and/or 5.

WORKED EXAMPLE 1

Write 0.375 as a fraction in simplest form.

SOLUTION

1. $0.375 = 375/1000$.
2. Divide numerator and denominator by 125.

ANSWER: $3/8$

WORKED EXAMPLE 2

Write 2.45 as an improper fraction in simplest form.

SOLUTION

1. $2.45 = 245/100$.
2. Simplify by dividing by 5.

ANSWER: $49/20$

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Terminating decimals and fractions - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Money and measurement use terminating decimals, while exact proportions are often clearer as fractions. Moving between representations helps compare values and select efficient methods.

Common misconceptions

- Using the number of decimal digits as the denominator instead of a power of ten.
- Forgetting to simplify the fraction.
- Assuming every fraction has a terminating decimal.

GUIDED TRY

Write $7/20$ as a decimal. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why multiplying numerator and denominator by 10 does not change a fraction's value. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Terminating decimals and fractions

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Write 0.375 as a fraction in simplest form.

[2]

2. Write 2.45 as an improper fraction in simplest form.

[2]

3. Write $\frac{7}{20}$ as a decimal.

[1]

4. Write $\frac{13}{8}$ as a decimal.

[2]

5. Decide whether $\frac{11}{40}$ has a terminating decimal and explain.

[2]

6. Decide whether $\frac{7}{30}$ terminates or recurs and explain.

[2]

7. Order 0.58, $\frac{3}{5}$, 0.605 and $\frac{59}{100}$.

[3]

8. Explain why multiplying numerator and denominator by 10 does not change a fraction's value.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Fractions in ratio and percentage operators

Interpret fractions and percentages as parts, ratios and operations on amounts.

SPECIFICATION FOCUS

Eduqas reference FN11-FN12. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A fraction or percentage can act on an amount: “of” means multiplication. A part-to-part ratio must first be converted into total equal parts before it becomes a fraction of the whole. Percentage change uses the original value as its reference, and reverse percentage reasoning identifies what percentage of the original is known.

KEY VOCABULARY

operator • percentage • ratio • part • whole • multiplier • original amount



80% known amount → divide by 0.8 to recover 100%

Why the method works

- A percentage is a fraction with denominator 100.
- A ratio $a:b$ contains $a+b$ equal parts in total.
- Successive percentage changes multiply because each change acts on a new base.

CHECK BEFORE MOVING ON

Answer mentally: Find $\frac{7}{12}$ of 360. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Fractions in ratio and percentage operators - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- A fraction of an amount means multiply by that fraction.
- A percentage is a fraction with denominator 100.

WORKED EXAMPLE 1

Find $\frac{7}{12}$ of 360.

SOLUTION

1. $360/12=30$.
2. $30 \times 7=210$.

ANSWER: 210

WORKED EXAMPLE 2

Find 18% of £650.

SOLUTION

1. $10\% = £65$, $5\% = £32.50$ and $3\% = £19.50$.
2. Add to obtain £117.

ANSWER: £117

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Fractions in ratio and percentage operators - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Discounts, tax, recipes, sharing and survey results all depend on identifying the correct whole. Operator thinking connects fractions, ratios and percentages.

Common misconceptions

- Using one ratio part as the whole.
- Dividing a percentage by the amount instead of applying it as an operator.
- Assuming equal percentage increases and decreases cancel.

GUIDED TRY

A class has 18 girls and 12 boys. What fraction of the class are boys? First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why increasing by 10% and then decreasing by 10% does not return to the start. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Fractions in ratio and percentage operators

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Find $\frac{7}{12}$ of 360.

[2]

2. Find 18% of £650.

[2]

3. A class has 18 girls and 12 boys. What fraction of the class are boys?

[2]

4. Red and blue counters are in the ratio 3:5. What fraction are red?

[2]

5. A tank is $\frac{3}{5}$ full. Adding 84 litres makes it $\frac{9}{10}$ full. Find its capacity.

[4]

6. A value of £480 is increased by 12%. Find the new value.

[3]

7. A coat costs £72 after a 20% reduction. Find the original price.

[3]

8. Explain why increasing by 10% and then decreasing by 10% does not return to the start.

[3]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Standard and compound measures

Use units of mass, length, time, money and common compound measures.

SPECIFICATION FOCUS

Eduqas reference FN13. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A measurement combines a number with a unit. Converting units changes the numerical representation, not the physical quantity. Compound measures such as speed or pay rate compare two different quantities. Area and volume conversions apply the linear conversion factor twice or three times because two or three dimensions change.

KEY VOCABULARY

unit • conversion factor • compound measure • speed • rate • area unit • volume unit

Brackets**Indices****÷ and ×****+ and -**

Why the method works

- Multiplying by a conversion ratio equal to 1 preserves the quantity.
- Speed is a rate: distance divided by time.
- A square metre contains 100 by 100 square centimetres.

CHECK BEFORE MOVING ON

Answer mentally: Convert 3.75 km to metres. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Standard and compound measures - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Write quantities in compatible units before calculating.
- For squared or cubed units, square or cube the conversion factor.

WORKED EXAMPLE 1

Convert 3.75 km to metres.

SOLUTION

1. $1 \text{ km} = 1,000 \text{ m}$.
2. $3.75 \times 1,000 = 3,750$.

ANSWER: 3,750 m

WORKED EXAMPLE 2

Convert 4.2 kg to grams.

SOLUTION

1. $1 \text{ kg} = 1,000 \text{ g}$.
2. $4.2 \times 1,000 = 4,200$.

ANSWER: 4,200 g

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Standard and compound measures - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Travel, wages, recipes, construction and packaging all depend on reliable units. A correct number with the wrong unit can represent a completely different quantity.

Common misconceptions

- Converting only one dimension of an area.
- Mixing minutes and hours inside a speed calculation.
- Writing an answer without its compound unit.

GUIDED TRY

Convert 2.6 litres to millilitres. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why 1 m^2 equals $10,000 \text{ cm}^2$ rather than 100 cm^2 . Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Standard and compound measures

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Convert 3.75 km to metres.

[1]

2. Convert 4.2 kg to grams.

[1]

3. Convert 2.6 litres to millilitres.

[1]

4. Convert 35,000 cm² to m².

[2]

5. A journey of 150 km takes 2.5 hours. Find the average speed.

[2]

6. A worker earns £91 for 7 hours. Find the hourly rate.

[2]

7. A car travels at 72 km/h for 25 minutes. Find the distance travelled.

[3]

8. Explain why 1 m² equals 10,000 cm² rather than 100 cm².

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Estimation and appropriate rounding

Estimate to check calculations and round numbers and measures appropriately.

SPECIFICATION FOCUS

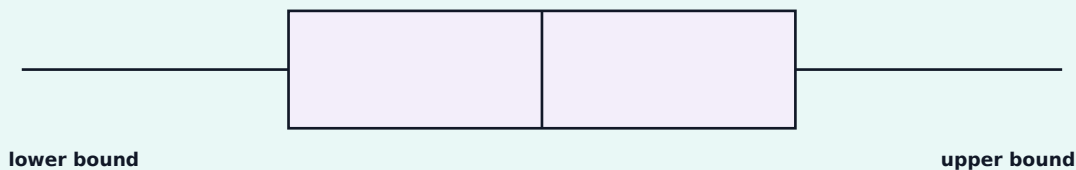
Eduqas reference FN14-FN15. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

Rounding reports a value to an appropriate precision; estimation replaces values temporarily with convenient nearby numbers to check scale and reasonableness. Decimal places count from the decimal point, while significant figures begin at the first non-zero digit. The required context decides how much accuracy is useful.

KEY VOCABULARY

rounding • decimal place • significant figure • approximation • estimate • order of magnitude



Why the method works

- The first discarded digit determines whether the retained digit changes.
- Compatible rounded values preserve a meaningful order-of-magnitude check.
- An estimate is a checking tool, not a replacement for an exact result unless requested.

CHECK BEFORE MOVING ON

Answer mentally: Round 78,462 to the nearest thousand. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Estimation and appropriate rounding - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Use compatible one-significant-figure values for an estimate.
- Significant figures begin at the first non-zero digit.

WORKED EXAMPLE 1

Round 78,462 to the nearest thousand.

SOLUTION

1. The hundreds digit is 4, so keep 78 thousand.

ANSWER: 78,000

WORKED EXAMPLE 2

Round 0.006784 to 3 significant figures.

SOLUTION

1. The first significant digits are 6, 7 and 8.
2. The next digit is 4, so do not round up.

ANSWER: 0.00678

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Estimation and appropriate rounding - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Budgets, measurements and population reports require appropriate precision. Estimation is an essential safeguard against incorrect calculator entry.

Common misconceptions

- Counting leading zeros as significant figures.
- Rounding during intermediate steps and accumulating error.
- Producing an estimate too crude to test the calculator result.

GUIDED TRY

Round 18.746 to 2 decimal places. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

Explain why an estimate should use simple values without changing the size too severely. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Estimation and appropriate rounding

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. Round 78,462 to the nearest thousand.

[1]

2. Round 0.006784 to 3 significant figures.

[2]

3. Round 18.746 to 2 decimal places.

[2]

4. Estimate $(39.6 \times 0.512)/8.08$.

[3]

5. A calculator shows $82.4 \times 19.7 = 162.328$. Explain how estimation reveals the display is wrong.

[2]

6. A measured length is 8.376 m. Give a sensible rounded value for reporting it to the nearest centimetre.

[2]

7. A theatre has 31 rows of 48 seats. Estimate the total and then calculate exactly.

[3]

8. Explain why an estimate should use simple values without changing the size too severely.

[2]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Bounds and limits of accuracy

Interpret the interval of possible values created by rounding or truncation.

SPECIFICATION FOCUS

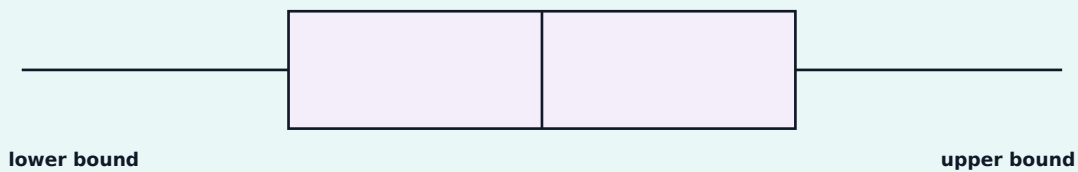
Eduqas reference FN16. This lesson develops representation, accurate calculation, reasoning and interpretation within Foundation Tier.

Understand the idea

A rounded measurement stands for a whole interval of possible original values. For rounding, the boundary lies halfway between consecutive reported values: the lower endpoint is included and the upper endpoint excluded. Truncation creates a different interval because digits are removed without examining the next digit. Bounds allow worst-case results to be calculated honestly.

KEY VOCABULARY

lower bound • upper bound • error interval • truncation • limit of accuracy • maximum • minimum



Why the method works

- Every value in the interval produces the same stated rounded value.
- The upper endpoint belongs to the next rounding interval.
- To maximise a positive quotient, use the greatest possible numerator and least possible denominator.

CHECK BEFORE MOVING ON

Answer mentally: A length is 7.4 cm correct to the nearest 0.1 cm. Write its error interval. Then define one key word from this page in your own words.

COMPREHENSIVE LESSON NOTEBOOK

Bounds and limits of accuracy - method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- A value rounded to the nearest unit u lies from half a unit below, inclusive, to half a unit above, exclusive.
- Choose bound combinations that make the required result as large or small as possible.

WORKED EXAMPLE 1

A length is 7.4 cm correct to the nearest 0.1 cm. Write its error interval.

SOLUTION

1. Half of 0.1 is 0.05.
2. Subtract and add 0.05.

ANSWER: $7.35 \leq L < 7.45$

WORKED EXAMPLE 2

A mass is 260 g correct to the nearest 10 g. State its lower and upper bounds.

SOLUTION

1. Half of 10 is 5.
2. The interval is $255 \leq m < 265$.

ANSWER: 255 g and 265 g

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes a solution easier to repair.

COMPREHENSIVE LESSON NOTEBOOK

Bounds and limits of accuracy - apply and reason

Connect the method to decisions and common errors.

Where this mathematics appears

Manufacturing tolerances, measured speed, area and density all depend on limits of accuracy. Bounds show whether a conclusion remains valid despite measurement uncertainty.

Common misconceptions

- Using the reported value as its own bound.
- Including the upper endpoint with $\leq$.
- Using two upper bounds automatically, without considering the operation being maximised.

GUIDED TRY

A population is 42,000 to the nearest thousand. State the least and greatest possible whole-number values. First predict the form or approximate size of the answer. Then show the complete method.

REASONING PROMPT

A square side is 6.8 cm to the nearest 0.1 cm. Find the upper bound for its area. Explain why each condition or operation you use is valid.

EXAM COMMUNICATION

Use one mathematical statement per line. Label units and restrictions. If the result is approximate, show the unrounded value before the final rounded answer.

COMPREHENSIVE LESSON NOTEBOOK

Independent practice

Bounds and limits of accuracy

Complete without notes. Show all working, then use the answer section to diagnose and repair errors.

1. A length is 7.4 cm correct to the nearest 0.1 cm. Write its error interval.

[2]

2. A mass is 260 g correct to the nearest 10 g. State its lower and upper bounds.

[2]

3. A population is 42,000 to the nearest thousand. State the least and greatest possible whole-number values.

[3]

4. A rectangle measures 8.2 cm by 5.6 cm, each to the nearest 0.1 cm. Find the lower bound for its area.

[3]

5. A distance is 120 m to the nearest 10 m and time is 8 s to the nearest second. State the calculation for the upper bound of speed.

[3]

6. A number is truncated to 3.47 to two decimal places. Write its interval.

[2]

7. Explain why the upper endpoint of a rounding interval is not included.

[2]

8. A square side is 6.8 cm to the nearest 0.1 cm. Find the upper bound for its area.

[3]

REFLECTION

Circle one: secure / almost / reteach. Record the question number of your most useful error and the rule that repairs it.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Ordering and comparing numbers

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Order -7, 3, -2, 0 and -11 from smallest to largest.

ANSWER: -11, -7, -2, 0, 3

Method cue: Place the integers on a number line. Check sign, size, accuracy and units.

2. Insert $<$, $>$ or $=$ between -3.8 and -3.08.

ANSWER: $-3.8 < -3.08$

Method cue: -3.80 lies farther left than -3.08. Check sign, size, accuracy and units.

3. Order 0.42, $\frac{2}{5}$, 41% and 0.405.

ANSWER: $\frac{2}{5}$, 0.405, 41%, 0.42

Method cue: Convert to decimals: 0.42, 0.40, 0.41, 0.405. Check sign, size, accuracy and units.

4. Write an integer n satisfying $-4 < n \leq -1$.

ANSWER: For example -3

Method cue: Integers -3, -2 and -1 satisfy both inequalities. Check sign, size, accuracy and units.

5. Which is greater, $-\frac{5}{6}$ or -0.82? Explain.

ANSWER: -0.82

Method cue: $-\frac{5}{6} = -0.833\dots$ Check sign, size, accuracy and units.

6. Arrange $\frac{7}{8}$, 0.86 and 87% in descending order.

ANSWER: $\frac{7}{8}$, 87%, 0.86

Method cue: Convert: $\frac{7}{8} = 0.875$ and $87\% = 0.87$. Check sign, size, accuracy and units.

7. A lift is at floor -4. Another is at floor -7. Which lift is higher and by how many floors?

ANSWER: The lift at -4; 3 floors

Method cue: -4 is greater than -7. Check sign, size, accuracy and units.

8. Explain why $-12 < -5$ even though $12 > 5$.

ANSWER: -12 is farther left on the number line

Method cue: Negative values reverse the order of their positive magnitudes. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Place value and the four operations

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. State the value of 6 in 4,063,218.

ANSWER: 60,000

Method cue: The digit is in the ten-thousands column. Check sign, size, accuracy and units.

2. Calculate $8,407 + 6,958$.

ANSWER: 15,365

Method cue: Align place-value columns. Check sign, size, accuracy and units.

3. Calculate $20,000 - 13,786$.

ANSWER: 6,214

Method cue: Use column subtraction or count up. Check sign, size, accuracy and units.

4. Work out $-17 + 29 - 36$.

ANSWER: -24

Method cue: $-17+29=12$. Check sign, size, accuracy and units.

5. Calculate 4.08×0.35 .

ANSWER: 1.428

Method cue: Calculate $408 \times 35 = 14,280$. Check sign, size, accuracy and units.

6. Calculate $7.56 \div 0.09$.

ANSWER: 84

Method cue: Multiply both numbers by 100. Check sign, size, accuracy and units.

7. A bank balance is -£48. A payment of £125 arrives and £39 is then spent. Find the new ba...

ANSWER: £38

Method cue: $-48+125=77$. Check sign, size, accuracy and units.

8. Explain why $(-8) \times (-6)$ is positive.

ANSWER: Reversing direction twice gives a positive product

Method cue: The sign rules follow from preserving the distributive law and inverse relationships. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Order of operations and inverse checks

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Work out $9 + 4 \times 7$.

ANSWER: 37

Method cue: Multiply first: $4 \times 7 = 28$. Check sign, size, accuracy and units.

2. Work out $(9 + 4) \times 7$.

ANSWER: 91

Method cue: Complete the brackets: 13. Check sign, size, accuracy and units.

3. Calculate $96 \div 8 \times 3$.

ANSWER: 36

Method cue: Division and multiplication have equal priority. Check sign, size, accuracy and units.

4. Calculate $5^2 - 3 \times (8 - 6)$.

ANSWER: 19

Method cue: $5^2 = 25$ and $8 - 6 = 2$. Check sign, size, accuracy and units.

5. Find the reciprocal of $2 \frac{1}{2}$.

ANSWER: $\frac{2}{5}$

Method cue: $2 \frac{1}{2} = \frac{5}{2}$. Check sign, size, accuracy and units.

6. Find the missing number: $6x - 11 = 43$.

ANSWER: 9

Method cue: Add 11 to obtain $6x = 54$. Check sign, size, accuracy and units.

7. Use an inverse operation to check that $1,344 \div 32 = 42$.

ANSWER: $32 \times 42 = 1,344$

Method cue: $32 \times (40 + 2) = 1,280 + 64 = 1,344$. Check sign, size, accuracy and units.

8. Explain why $48 \div 6 \times 2$ is not equal to $48 \div (6 \times 2)$.

ANSWER: The values are 16 and 4

Method cue: Without brackets work left to right: $48 \div 6 \times 2 = 8 \times 2$. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Prime factors, HCF, LCM and listing

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Write 540 as a product of prime factors.

ANSWER: $2^2 \times 3^3 \times 5$

Method cue: $540 = 54 \times 10$. Check sign, size, accuracy and units.

2. Find the HCF of 72 and 120.

ANSWER: 24

Method cue: $72 = 2^3 \times 3^2$ and $120 = 2^3 \times 3 \times 5$. Check sign, size, accuracy and units.

3. Find the LCM of 45 and 84.

ANSWER: 1,260

Method cue: $45 = 3^2 \times 5$ and $84 = 2^2 \times 3 \times 7$. Check sign, size, accuracy and units.

4. Two lights flash every 36 seconds and 54 seconds. They flash together now. After how man...

ANSWER: 108 seconds

Method cue: This is a repeating-cycle problem, so find $\text{LCM}(36, 54)$. Check sign, size, accuracy and units.

5. Ropes of 180 cm and 252 cm are cut into the longest equal pieces with no waste. Find eac...

ANSWER: 36 cm

Method cue: The longest equal divisor is $\text{HCF}(180, 252)$. Check sign, size, accuracy and units.

6. List every two-digit number that can be made using 2, 5 and 8 without repetition.

ANSWER: 25, 28, 52, 58, 82, 85

Method cue: Choose each possible tens digit in turn. Check sign, size, accuracy and units.

7. A meal has 3 starters and 4 main courses. List systematically or draw a grid to find the...

ANSWER: 12

Method cue: Each starter pairs with four mains. Check sign, size, accuracy and units.

8. Explain how you know a systematic list is complete.

ANSWER: Use a fixed order and exhaust every allowed choice before moving to the next

Method cue: A consistent structure prevents omissions and repetitions. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Powers, roots and integer indices

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Evaluate 7^3 .

ANSWER: 343

Method cue: $7^3 = 7 \times 7 \times 7 = 343$. Check sign, size, accuracy and units.

2. Find the square root of 1,024.

ANSWER: 32

Method cue: $32 \times 32 = 1,024$. Check sign, size, accuracy and units.

3. Find the cube root of 2,197.

ANSWER: 13

Method cue: $13 \times 13 \times 13 = 2,197$. Check sign, size, accuracy and units.

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

ANSWER: 5^7

Method cue: The base is unchanged and indices add: $4 + 3 = 7$. Check sign, size, accuracy and units.

5. Simplify a^{11} / a^4 .

ANSWER: a^7

Method cue: Cancel four copies of a , so $11 - 4 = 7$. Check sign, size, accuracy and units.

6. Simplify $(x^3)^5$.

ANSWER: x^{15}

Method cue: Multiply the indices: $3 \times 5 = 15$. Check sign, size, accuracy and units.

7. Write $1/2^6$ as a power of 2 with a negative index.

ANSWER: 2^{-6}

Method cue: A negative index represents a reciprocal. Check sign, size, accuracy and units.

8. A cube has volume 729 cm^3 . Find its edge length and justify the operation.

ANSWER: 9 cm

Method cue: Edge length is the cube root of volume. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Exact fractions and multiples of pi

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Simplify $96/144$.

ANSWER: $2/3$

Method cue: $\text{HCF}(96,144)=48$. Check sign, size, accuracy and units.

2. Calculate $5/6 + 7/15$.

ANSWER: $1 \frac{3}{10}$

Method cue: Use denominator 30: $25/30+14/30=39/30$. Check sign, size, accuracy and units.

3. Calculate $7/8 - 5/12$.

ANSWER: $11/24$

Method cue: Use denominator 24. Check sign, size, accuracy and units.

4. Calculate $9/14 \times 21/25$.

ANSWER: $27/50$

Method cue: Cancel common factors before multiplying. Check sign, size, accuracy and units.

5. Calculate $5/9 \div 10/27$.

ANSWER: $3/2$

Method cue: Multiply by the reciprocal: $5/9 \times 27/10$. Check sign, size, accuracy and units.

6. A semicircle has radius 7 cm. Find its curved edge length exactly.

ANSWER: 7π cm

Method cue: Half a circumference is πr . Check sign, size, accuracy and units.

7. A circle has diameter 12 cm. Find its area exactly.

ANSWER: 36π cm²

Method cue: Radius=6 cm. Check sign, size, accuracy and units.

8. Explain why 36π is exact but 113.1 is approximate.

ANSWER: π has not been rounded in 36π

Method cue: Replacing π with a decimal introduces rounding. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Standard form

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Write 6,420,000 in standard form.

ANSWER: 6.42×10^6

Method cue: Move the decimal point six places left. Check sign, size, accuracy and units.

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

ANSWER: 0.000408

Method cue: A negative exponent moves the decimal point left four places. Check sign, size, accuracy and units.

3. Write 0.00000073 in standard form.

ANSWER: 7.3×10^{-7}

Method cue: Move the decimal point seven places right to make 7.3. Check sign, size, accuracy and units.

4. Calculate $(3 \times 10^3)(4 \times 10^{-2})$. Give the answer in standard form.

ANSWER: 1.2×10^4

Method cue: $3 \times 4 = 12$ and $10^3 \times 10^{-2} = 10^1$. Check sign, size, accuracy and units.

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

ANSWER: 4×10^4

Method cue: $8.4/2.1 = 4$. Check sign, size, accuracy and units.

6. Calculate $5.7 \times 10^6 + 8 \times 10^5$.

ANSWER: 6.5×10^6

Method cue: Write 8×10^5 as 0.8×10^6 . Check sign, size, accuracy and units.

7. A cell has mass 3.2×10^{-9} g. Find the mass of 5×10^6 cells.

ANSWER: 1.6×10^{-2} g

Method cue: Multiply coefficients and powers: $3.2 \times 5 \times 10^{-9+6} = 16 \times 10^{-3}$. Check sign, size, accuracy and units.

8. Explain why 12.4×10^5 is not written in standard form and correct it.

ANSWER: 1.24×10^6

Method cue: The coefficient 12.4 is not less than 10. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Terminating decimals and fractions

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Write 0.375 as a fraction in simplest form.

ANSWER: $\frac{3}{8}$

Method cue: $0.375 = \frac{375}{1000}$. Check sign, size, accuracy and units.

2. Write 2.45 as an improper fraction in simplest form.

ANSWER: $\frac{49}{20}$

Method cue: $2.45 = \frac{245}{100}$. Check sign, size, accuracy and units.

3. Write $\frac{7}{20}$ as a decimal.

ANSWER: 0.35

Method cue: Make denominator 100: $\frac{7}{20} = \frac{35}{100}$. Check sign, size, accuracy and units.

4. Write $\frac{13}{8}$ as a decimal.

ANSWER: 1.625

Method cue: $\frac{13}{8} = 1$ remainder 5. Check sign, size, accuracy and units.

5. Decide whether $\frac{11}{40}$ has a terminating decimal and explain.

ANSWER: Yes

Method cue: $40 = 2^3 \times 5$. Check sign, size, accuracy and units.

6. Decide whether $\frac{7}{30}$ terminates or recurs and explain.

ANSWER: Recurring

Method cue: $30 = 2 \times 3 \times 5$ includes a factor 3. Check sign, size, accuracy and units.

7. Order 0.58, $\frac{3}{5}$, 0.605 and $\frac{59}{100}$.

ANSWER: 0.58, $\frac{59}{100}$, $\frac{3}{5}$, 0.605

Method cue: Convert to 0.58, 0.60, 0.605 and 0.59. Check sign, size, accuracy and units.

8. Explain why multiplying numerator and denominator by 10 does not change a fraction's value.

ANSWER: It multiplies the fraction by $\frac{10}{10} = 1$

Method cue: Multiplying by 1 preserves the value. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Fractions in ratio and percentage operators

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Find $\frac{7}{12}$ of 360.

ANSWER: 210

Method cue: $360/12=30$. Check sign, size, accuracy and units.

2. Find 18% of £650.

ANSWER: £117

Method cue: $10\%=£65$, $5\%=£32.50$ and $3\%=£19.50$. Check sign, size, accuracy and units.

3. A class has 18 girls and 12 boys. What fraction of the class are boys?

ANSWER: $\frac{2}{5}$

Method cue: Total=30. Check sign, size, accuracy and units.

4. Red and blue counters are in the ratio 3:5. What fraction are red?

ANSWER: $\frac{3}{8}$

Method cue: There are $3+5=8$ equal parts. Check sign, size, accuracy and units.

5. A tank is $\frac{3}{5}$ full. Adding 84 litres makes it $\frac{9}{10}$ full. Find its capacity.

ANSWER: 280 litres

Method cue: $\frac{3}{5}=\frac{6}{10}$, so the added fraction is $\frac{3}{10}$. Check sign, size, accuracy and units.

6. A value of £480 is increased by 12%. Find the new value.

ANSWER: £537.60

Method cue: 12% of $480=57.60$. Check sign, size, accuracy and units.

7. A coat costs £72 after a 20% reduction. Find the original price.

ANSWER: £90

Method cue: The sale price is 80% of the original. Check sign, size, accuracy and units.

8. Explain why increasing by 10% and then decreasing by 10% does not return to the start.

ANSWER: The second change uses a different base; overall multiplier $1.10 \times 0.90=0.99$

Method cue: The result is 99% of the original, a 1% decrease. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Standard and compound measures

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Convert 3.75 km to metres.

ANSWER: 3,750 m

Method cue: 1 km=1,000 m. Check sign, size, accuracy and units.

2. Convert 4.2 kg to grams.

ANSWER: 4,200 g

Method cue: 1 kg=1,000 g. Check sign, size, accuracy and units.

3. Convert 2.6 litres to millilitres.

ANSWER: 2,600 ml

Method cue: 1 litre=1,000 ml. Check sign, size, accuracy and units.

4. Convert 35,000 cm² to m².

ANSWER: 3.5 m²

Method cue: 1 m²=10,000 cm². Check sign, size, accuracy and units.

5. A journey of 150 km takes 2.5 hours. Find the average speed.

ANSWER: 60 km/h

Method cue: Speed=distance/time. Check sign, size, accuracy and units.

6. A worker earns £91 for 7 hours. Find the hourly rate.

ANSWER: £13 per hour

Method cue: Rate=total pay/time. Check sign, size, accuracy and units.

7. A car travels at 72 km/h for 25 minutes. Find the distance travelled.

ANSWER: 30 km

Method cue: 25 minutes=25/60 hour. Check sign, size, accuracy and units.

8. Explain why 1 m² equals 10,000 cm² rather than 100 cm².

ANSWER: Both dimensions are multiplied by 100, so area is multiplied by 100²

Method cue: A 1 m by 1 m square is 100 cm by 100 cm. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Estimation and appropriate rounding

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. Round 78,462 to the nearest thousand.

ANSWER: 78,000

Method cue: The hundreds digit is 4, so keep 78 thousand. Check sign, size, accuracy and units.

2. Round 0.006784 to 3 significant figures.

ANSWER: 0.00678

Method cue: The first significant digits are 6, 7 and 8. Check sign, size, accuracy and units.

3. Round 18.746 to 2 decimal places.

ANSWER: 18.75

Method cue: The third decimal digit is 6. Check sign, size, accuracy and units.

4. Estimate $(39.6 \times 0.512)/8.08$.

ANSWER: About 2.5

Method cue: Use $40 \times 0.5/8$. Check sign, size, accuracy and units.

5. A calculator shows $82.4 \times 19.7 = 162.328$. Explain how estimation reveals the display is ...

ANSWER: 80×20 is about 1,600, not about 160

Method cue: The calculator entry or decimal point must be incorrect. Check sign, size, accuracy and units.

6. A measured length is 8.376 m. Give a sensible rounded value for reporting it to the near...

ANSWER: 8.38 m

Method cue: One centimetre is 0.01 m. Check sign, size, accuracy and units.

7. A theatre has 31 rows of 48 seats. Estimate the total and then calculate exactly.

ANSWER: Estimate 1,500; exact 1,488

Method cue: Use $30 \times 50 = 1,500$. Check sign, size, accuracy and units.

8. Explain why an estimate should use simple values without changing the size too severely.

ANSWER: The aim is a quick but meaningful check of order of magnitude

Method cue: Over-rounding can make the check too crude to detect an error. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

Practice answers and repair notes

Bounds and limits of accuracy

Use only after a genuine attempt. Rework incorrect questions from a blank line rather than copying the final value.

1. A length is 7.4 cm correct to the nearest 0.1 cm. Write its error interval.

ANSWER: $7.35 \leq L < 7.45$

Method cue: Half of 0.1 is 0.05. Check sign, size, accuracy and units.

2. A mass is 260 g correct to the nearest 10 g. State its lower and upper bounds.

ANSWER: 255 g and 265 g

Method cue: Half of 10 is 5. Check sign, size, accuracy and units.

3. A population is 42,000 to the nearest thousand. State the least and greatest possible wh...

ANSWER: 41,500 and 42,499

Method cue: The interval is $41,500 \leq P < 42,500$. Check sign, size, accuracy and units.

4. A rectangle measures 8.2 cm by 5.6 cm, each to the nearest 0.1 cm. Find the lower bound ...

ANSWER: 45.2325 cm^2

Method cue: Lower lengths are 8.15 cm and 5.55 cm. Check sign, size, accuracy and units.

5. A distance is 120 m to the nearest 10 m and time is 8 s to the nearest second. State the...

ANSWER: $125/7.5 \text{ m/s}$

Method cue: Use the greatest possible distance and least possible time. Check sign, size, accuracy and units.

6. A number is truncated to 3.47 to two decimal places. Write its interval.

ANSWER: $3.47 \leq x < 3.48$

Method cue: Truncation removes later digits without rounding. Check sign, size, accuracy and units.

7. Explain why the upper endpoint of a rounding interval is not included.

ANSWER: The upper endpoint would round to the next stated value

Method cue: Use $<$ at the upper boundary and $\leq$ at the lower boundary. Check sign, size, accuracy and units.

8. A square side is 6.8 cm to the nearest 0.1 cm. Find the upper bound for its area.

ANSWER: 46.9225 cm^2

Method cue: Side upper bound=6.85 cm. Check sign, size, accuracy and units.

COMPREHENSIVE LESSON NOTEBOOK

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