

# 1 · Number

AQA · GCSE · Mathematics

## Number: the foundations everything else stands on

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- Order and calculate with positives, negatives, decimals and fractions; the four operations with formal written methods.
- Primes, factors, HCF/LCM by prime decomposition; indices, roots, surds (H) and standard form.
- Fractions  $\leftrightarrow$  decimals  $\leftrightarrow$  percentages as operators; rounding, estimation and bounds (H).

## Arithmetic, factors, multiples and primes (N1–N5)

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**Ordering and symbols:** order positive and negative integers, decimals and fractions on a number line; use  $=$ ,  $\neq$ ,  $<$ ,  $>$ ,  $\leq$ ,  $\geq$ .

**The four operations (N2):** formal written methods for integers, decimals, **proper and improper fractions and mixed numbers**, all signs – set in context including household finance: **profit, loss, cost price, selling price, debit, credit, balance, income tax, VAT, interest rate.**

**Inverse operations and priority (N3):** cancellation to simplify; **BIDMAS** – brackets, indices/powers, roots, division/multiplication, addition/subtraction.

**Primes and structure (N4):** prime numbers, **factors, multiples, common factors, common multiples, HCF, LCM; prime factorisation** in index form (product notation; unique factorisation). Worked pattern:

- $200 = 2^3 \times 5^2$
- HCF = product of the **lowest** powers of common primes; LCM = product of the **highest** powers of all primes.

**Worked example.**  $84 = 2^2 \times 3 \times 7$  and  $120 = 2^3 \times 3 \times 5$ , so  $\text{HCF} = 2^2 \times 3 = 12$  (lowest powers of the shared primes) and  $\text{LCM} = 2^3 \times 3 \times 5 \times 7 = 840$  (highest powers of all primes). Check:  $12 \times 840 = 10080 = 84 \times 120$  – the HCF-LCM product identity confirms both.

(N5) systematic listing and the **product rule for counting** (H).

## Indices, surds, standard form and bounds (N7–N9, N14–N16)

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**Indices (N7):** laws –  $a^m \times a^n = a^{(m+n)}$ ,  $a^m \div a^n = a^{(m-n)}$ ,  $(a^m)^n = a^{(mn)}$ ,  $a^{(-n)} = 1/a^n$ ,  $a^{(1/2)} = \sqrt{a}$ ; (H) fractional indices  $a^{(m/n)}$  = the  $n$ -th root of  $a^m$ .

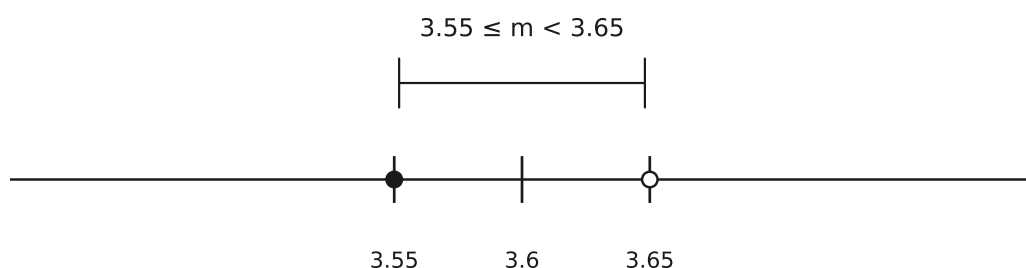
**Surds (N8, H):**  $\sqrt{12} = \sqrt{(4 \times 3)} = 2\sqrt{3}$  – simplify; **rationalise denominators** (multiply

by the conjugate:  $1/(3+\sqrt{2}) \times (3-\sqrt{2})/(3-\sqrt{2}) = (3-\sqrt{2})/7$ .

**Standard form** (N9):  $A \times 10^n$ ,  $1 \leq A < 10$ ,  $n$  an integer – add/subtract (match powers), multiply (multiply coefficients and add exponents), or divide (divide coefficients and subtract exponents); interpret calculator displays.

**Worked example.**  $(3 \times 10^7) \times (4 \times 10^{-3}) = 12 \times 10^4 = 1.2 \times 10^5$  (coefficient multiplied, exponents added, then renormalised);  $(3 \times 10^7) + (4 \times 10^{-3})$  cannot combine until the powers match, so convert first:  $30\,000\,000 + 0.004 = 30\,000\,000.004 = 3.0000000004 \times 10^7$  – the tiny term barely moves the large one.

**Estimation** (N14): round each value to 1 significant figure, compute, decide over- or under-estimate; check calculations by approximation.



$m = 3.6$  to 1 decimal place: closed at the lower bound, open at the upper

*The error interval for 3.6 to one decimal place: closed at 3.55, open at 3.65.*

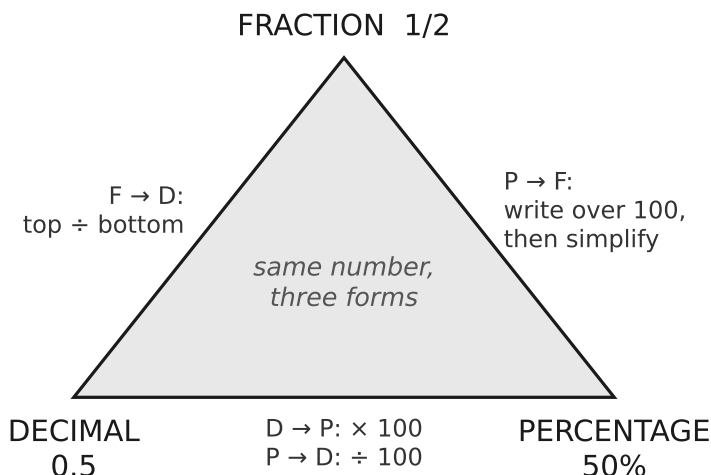
**Rounding and error intervals** (N15): to decimal places and significant figures (know not to round mid-calculation); (H) inequality notation for error intervals – 3.6 kg to 1 d.p. means  $3.55 \leq m < 3.65$ ; truncation gives  $3.6 \leq m < 3.7$ .

**Bounds** (N16, H): upper bound of a length 9 m to the nearest metre is 9.5; in calculations, for positive inputs, an upper product bound uses upper input bounds and an upper quotient bound uses upper numerator divided by lower denominator. Check signs first; these shortcuts need not hold for negative inputs. Track strict endpoints; give the answer to an appropriate degree of accuracy (often the bound width decides).

**Worked example: Higher tier.** A rectangle has sides 8 m and 5 m, each to the nearest metre: upper area =  $8.5 \times 5.5 = 46.75 \text{ m}^2$ , lower area =  $7.5 \times 4.5 = 33.75 \text{ m}^2$ . For the perimeter both OUTSIDE edges grow: upper  $P = 2 \times (8.5 + 5.5) = 28 \text{ m}$  – but a QUOTIENT like length  $\div$  width needs upper  $\div$  lower =  $8.5 \div 4.5 = 1.88 \approx 1.9$  (2 s.f.), because dividing by the smaller denominator pushes the answer up.

## Fractions, decimals and percentages (N10–N13, R9 links)

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*The FDP triangle linking fraction, decimal and percentage.*

**Conversions** (N10):  $3.5 = 7/2$ ,  $0.375 = 3/8$ ; (H) **recurring decimals** ↔ fractions:  $0.6 = 6/9 = 2/3$ ;  $0.45$  (pair) →  $45/99 = 5/11$ . Method:  $x = 0.6$ ,  $10x = 6.6$ ,  $9x = 6$ .

**Fractions as operators** (N12): “ $3/5$  of 40” =  $40 \times 3/5 = 24$ ; percentage as multiplier – increase by 15% =  $\times 1.15$ ; decrease by 20% =  $\times 0.8$ ; reverse percentage: find the original before the change by dividing by the multiplier.

**Units** (N13): metric conversions for length, area, volume, capacity; compound measures (speed, density, pressure) link to topic 3.

### Checklist before you call this topic done

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- Four operations on fractions/mixed numbers and negatives without a calculator; BIDMAS traps.
- Prime decomposition → HCF/LCM; product rule for counting (H).
- Index laws including negative and fractional; simplify and rationalise surds (H).
- Standard form arithmetic; rounding and error intervals; upper/lower bounds through a formula (H).
- FDP conversions including recurring decimals (H); percentage multipliers and reverse percentages.