

The trap question field guide

The short answer

A trap is not a secret topic. It is a familiar method with one fragile condition. Before calculating, write three things: **the requested quantity, its unit, and the constraint**. That ten-second habit catches most of the damage below.

Unit conversions: the exponent travels too

Prefixes are easy when a quantity is linear. They become dangerous when the converted length is squared or cubed. Convert the measurement first, then apply the geometry.

Worked example Current density in a thin wire

A wire carries a current of 2.4 A and has diameter 0.40 mm. Estimate the current density $J = I/A$. The radius is half the diameter, expressed in metres:

$$r = 0.20 \text{ mm} = 2.0 \times 10^{-4} \text{ m.}$$

Hence

$$A = \pi r^2 \approx 3.14(2.0 \times 10^{-4})^2 = 1.26 \times 10^{-7} \text{ m}^2,$$

so

$$J = \frac{2.4}{1.26 \times 10^{-7}} \approx \boxed{1.9 \times 10^7 \text{ A m}^{-2}}.$$

Correct: the factor 10^{-3} was squared, and the diameter was halved before the area was found.

Trap: 1.9×10^4 treats square millimetres as though the conversion were linear. Using 0.40 mm as the radius creates a separate factor-of-four error.

1 The tell

The stem contains a prefix and the formula contains x^2 , x^3 , an area or a volume. Write the base-unit conversion on its own line. If the options differ by 10^3 , 10^6 or 4, the distractors represent these errors.

Boundary conditions: test the equality case

Words such as *positive*, *distinct*, *inside*, *at least* and *no real roots* decide whether an endpoint belongs. Solve the inequality, then put the boundary back into the original sentence.

Worked example Two distinct positive roots

For which real values of m does

$$x^2 - (m + 1)x + m = 0$$

have two distinct positive roots? Factorise before reaching for the discriminant:

$$x^2 - (m+1)x + m = (x-1)(x-m).$$

The roots are 1 and m . Both are positive when $m > 0$, but they are distinct only when $m \neq 1$. Therefore

$$m > 0 \text{ and } m \neq 1.$$

Correct: $m = 0$ is excluded because zero is not positive; $m = 1$ is excluded because the roots coincide.

Trap: $m \geq 0$ checks neither the strict word “positive” nor the word “distinct”.

2 The tell

The final step produces $<$, $>$, $\leq$, $\geq$, a square root or a denominator. Test every endpoint for domain, physical meaning and whether equality changes the number of solutions.

Subtle wording: answer the quantity asked for

The arithmetic can be flawless and still answer the wrong question. Percentage *increase* is not the final percentage. Momentum is not kinetic energy. A statement about one fixed variable does not survive if that variable changes.

Worked example A ten per cent change that becomes twenty-one

A particle’s momentum increases by 10% while its mass stays constant. By what percentage does its kinetic energy increase?

Use $K = p^2 / (2m)$. If $p' = 1.10p$ and m is fixed, then

$$\frac{K'}{K} = \frac{(1.10p)^2 / (2m)}{p^2 / (2m)} = (1.10)^2 = 1.21.$$

The final kinetic energy is 121% of the original, so the *increase* is

$$21\%.$$

Correct: translate the wording into a multiplier first, then convert the final multiplier back into a change.

Trap: 121% answers “what percentage of the original?”; 10% assumes kinetic energy is proportional to momentum.

3 The tell

The options contain both a final value and a change, or both an absolute and a percentage change. Box the noun phrase after “find”: *new value, increase, ratio, magnitude or component*.

Sign traps: predict the direction before the algebra

A minus sign can mean a negative charge, an opposite direction, a fall in a scalar, or simply the coordinate convention you chose. Give each sign a job before multiplying them.

Worked example An electron crosses a potential difference

An electron moves from a point at 120 V to one at 20 V. Only the electric force does work. What happens to its kinetic energy?

$$\Delta V = 20 - 120 = -100 \text{ V}.$$

For an electron $q = -e$, so

$$\Delta U = q\Delta V = (-e)(-100 \text{ V}) = +100 \text{ eV}.$$

Conservation of energy gives $\Delta K = -\Delta U$, hence

$$\Delta K = -100 \text{ eV}.$$

Its kinetic energy decreases by 100 eV.

Correct: the negative charge reverses the usual positive-charge intuition. The energy check confirms the direction.

Trap: saying “potential fell, so kinetic energy rose” forgets that electric potential and electric potential energy are different quantities.

4 The tell

The stem says *change in*, supplies a direction, uses an electron, or asks for a vector component. Predict *positive, negative or zero* in words before substituting. If the algebra disagrees, inspect the convention rather than deleting the sign.

The 12-second trap scan

Before line one of working, run **A-U-B-S**:

1. **Ask:** underline exactly what the question wants.
2. **Units:** convert prefixes before powers, areas or volumes.
3. **Boundary:** test equality, zero, domain and limiting cases.
4. **Sign:** predict direction or change before calculation.

Most questions are direct. The scan stops one silent assumption turning a right method into a wrong answer.

5 Try it

Take eight mixed questions. Spend the first 12 seconds of each writing only A, U, B and S, with a dash beside anything irrelevant. Mark the set twice: once for the answer and once for whether you spotted the fragile condition before calculating.