

AQA AS SI Units, Prefixes and Unit Conversions solutions

Matching solutions and teaching prompts for the class review

Specification points covered

- 3.1.1(a) Know the fundamental SI base quantities used in AQA Physics and their associated SI units.
- 3.1.1(b) Use SI derived units correctly in calculations and written answers.
- 3.1.1(c) Use standard form and the prefixes T, G, M, k, c, m, μ , n, p and f.
- 3.1.1(d) Convert between units of the same quantity, including J and eV, and J and kW h.

Teaching focus

Require complete working, correct SI units and precision justified by the data.

Use the common-error prompt to make pupils correct the method or language, not only the final number.

1. SI foundations

1. Three telemetry values are 18.0 kg, 0.420 A and 294 K. State the fundamental quantity represented by each value. [3 marks]

Answer / mark points: 18.0 kg is mass; 0.420 A is electric current; 294 K is thermodynamic temperature. One mark for each correct quantity.

Teacher prompt / common error: The unit identifies the base quantity; do not call kelvin a measure of heat.

2. Express the newton, joule and pascal in SI base units. [3 marks]

Answer / mark points: $N = kg\ m\ s^{-2}$. $J = N\ m = kg\ m^2\ s^{-2}$. $Pa = N\ m^{-2} = kg\ m^{-1}\ s^{-2}$.

Teacher prompt / common error: Build derived units from definitions. A pascal is not a base unit.

3. Convert: (a) 4.80 GHz to Hz; (b) 725 nm to m; (c) 0.0360 μA to A; (d) 12.0 fJ to J. [4 marks]

Answer / mark points: (a) $4.80 \times 10^9\ Hz$. (b) $7.25 \times 10^{-7}\ m$. (c) $3.60 \times 10^{-8}\ A$. (d) $1.20 \times 10^{-14}\ J$.

Teacher prompt / common error: Require the prefix multiplier and the final power of ten; μ means 10^{-6} and f means 10^{-15} .



2. Diagnosing conversions

4. A nanosatellite report contains four conversions: $6.2 \times 10^{-3} \text{ m} = 6.2 \text{ mm}$; $4800 \mu\text{s} = 4.80 \text{ ms}$; $0.45 \text{ GW} = 4.5 \times 10^8 \text{ W}$; $72 \text{ pm} = 7.2 \times 10^{-10} \text{ m}$. Identify any incorrect conversion and correct it. [4 marks]

Answer / mark points: The first three conversions are correct. The picometre conversion is wrong: $72 \text{ pm} = 72 \times 10^{-12} \text{ m} = 7.2 \times 10^{-11} \text{ m}$.

Teacher prompt / common error: Pupils should test the exponent, not rely on how plausible the number looks.

5. A laser emits pulses of energy 3.20 mJ at a frequency of 25.0 Hz for 40.0 s. Calculate the total energy emitted. [2 marks]

Answer / mark points: Number of pulses = $25.0 \times 40.0 = 1000$. Total energy = $1000 \times 3.20 \times 10^{-3} = 3.20 \text{ J}$.

Teacher prompt / common error: Convert millijoules before multiplying. Frequency is pulses per second.

6. A radio signal travels $2.40 \times 10^7 \text{ m}$ at $3.00 \times 10^8 \text{ m s}^{-1}$. Calculate the travel time in seconds and milliseconds. [2 marks]

Answer / mark points: $t = d/v = 2.40 \times 10^7 / 3.00 \times 10^8 = 8.00 \times 10^{-2} \text{ s} = 80.0 \text{ ms}$.

Teacher prompt / common error: A correct answer in milliseconds must still follow from a value in seconds.

Continue your physics journey

Videos, practice and support for your next step

www.physicsuk.co.uk



3. Energy across scales

7. An ion leaves a thruster with kinetic energy 35.0 keV. Convert this energy to joules. Use $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$. [2 marks]

Answer / mark points: $E = 35.0 \times 10^3 \times 1.60 \times 10^{-19} = 5.60 \times 10^{-15} \text{ J}$.

Teacher prompt / common error: keV means 10^3 electronvolts, not 10^3 joules.

8. A station battery stores 0.840 kW h. Convert this energy to joules and calculate how long it can supply a 42.0 W instrument, assuming no losses. [3 marks]

Answer / mark points: $E = 0.840 \times 3.60 \times 10^6 = 3.024 \times 10^6 \text{ J}$. $t = E/P = 3.024 \times 10^6 / 42.0 = 7.20 \times 10^4 \text{ s} = 20.0 \text{ h}$.

Teacher prompt / common error: Use $1 \text{ kW h} = 3.60 \times 10^6 \text{ J}$. Converting the final time to hours is a useful check.

9. Only 18.0% of the battery energy in Question 8 is transferred to identical ions, each receiving 35.0 keV. Estimate the number of ions accelerated. [3 marks]

Answer / mark points: Energy given to ions $= 0.180 \times 3.024 \times 10^6 = 5.443 \times 10^5 \text{ J}$. $N = 5.443 \times 10^5 / 5.60 \times 10^{-15} = 9.72 \times 10^{19}$ ions.

Teacher prompt / common error: Apply the efficiency once, then divide energy by energy per ion.

Continue your physics journey

Videos, practice and support for your next step

www.physicsuk.co.uk



4. Units as a physics check

10. Pressure is defined by $p = F/A$. Starting from the base units of force, show that the pascal can be written as $\text{kg m}^{-1} \text{s}^{-2}$. [3 marks]

Answer / mark points: $\text{Pa} = \text{N m}^{-2}$. Since $\text{N} = \text{kg m s}^{-2}$, $\text{Pa} = \text{kg m s}^{-2} \text{m}^{-2} = \text{kg m}^{-1} \text{s}^{-2}$.

Teacher prompt / common error: Cancel powers of metre explicitly: $\text{m} \times \text{m}^{-2} = \text{m}^{-1}$.

11. The equation $v^2 = u^2 + 2as$ is proposed for linear motion. Show that every term has the same SI base units. [2 marks]

Answer / mark points: v^2 and u^2 have units $(\text{m s}^{-1})^2 = \text{m}^2 \text{s}^{-2}$. The term as has units $(\text{m s}^{-2})(\text{m}) = \text{m}^2 \text{s}^{-2}$; the number 2 has no units.

Teacher prompt / common error: This is a unit-consistency check, not a derivation of the equation.

Continue your physics journey

Videos, practice and support for your next step

www.physicsuk.co.uk



5. Unfamiliar application

12. A femtosecond system produces a light pulse lasting 85.0 fs. (a) Calculate the length of the pulse in vacuum. (b) Successive pulses enter a fibre every 12.5 ns and travel at $2.00 \times 10^8 \text{ m s}^{-1}$. Calculate their separation in the fibre. [4 marks]

Answer / mark points: (a) Length = $c\Delta t = 3.00 \times 10^8 \times 85.0 \times 10^{-15} = 2.55 \times 10^{-5} \text{ m} = 25.5 \text{ } \mu\text{m}$. (b) Separation = $v\Delta t = 2.00 \times 10^8 \times 12.5 \times 10^{-9} = 2.50 \text{ m}$.

Teacher prompt / common error: Femtoseconds and nanoseconds use different powers. The second part uses the speed in fibre, not c.

Language and method check

Award marks for independent, creditworthy physics steps rather than the amount of working shown.

Where an equivalent method is valid, accept it only when the reasoning, units and final precision remain consistent.

Continue your physics journey

Videos, practice and support for your next step

www.physicsuk.co.uk

