Mark schemes compress a solution to "C1 A1" and leave the reasoning to you. These are written the way you should write them in the exam: formula, substitution, answer, unit – in that order, because that order is what earns the method marks even when the arithmetic slips. 官方答案只写 *C1 A1;* 这里按 " 公式 – 代入 – 结果 – 单位 " 的顺序完整写出。

Motion, forces and energy

A car travelling at 8.0 m/s accelerates uniformly to 20 m/s in 6.0 s. Calculate the acceleration and the distance travelled. [5]

Acceleration: $a = \frac{v-u}{t} = \frac{20-8.0}{6.0} = 2.0\ \mathrm{m/s^2}$. Distance: the area under a speed-time graph is the distance, so $s = \frac{(u+v)}{2} \times t = \frac{(8.0+20)}{2} \times 6.0 = 14 \times 6.0 = 84$ m.

Writing the formula before substituting earns the method mark even if the arithmetic then goes wrong.

The area under a speed-time graph is the standard route to distance here. Using $s = vt$ with the final speed gives 120 m and is wrong.

Units on both answers – m/s^2 and m. A missing unit is the most-lost mark in the paper.

A 1200 kg car is brought to rest from 15 m/s in 3.0 s. Calculate the braking force. [4]

First the acceleration: $a = \frac{v-u}{t} = \frac{0-15}{3.0} = -5.0\ \mathrm{m/s^2}$. Then $F = ma = 1200 \times (-5.0) = -6000$ N, so the braking force is 6000 N acting opposite to the motion.

The negative sign means the force opposes motion; stating that is worth the final mark, and quoting a negative 'force' without explanation is not.

Work in SI units throughout: kg and m/s give newtons directly.

A crane lifts a 250 kg load 12 m in 8.0 s. Calculate the useful power output. Take g = 9.8 N/kg. [4]

Work done against gravity: $W = mgh = 250 \times 9.8 \times 12 = 29\,400$ J. Power: $P = \frac{W}{t} = \frac{29\,400}{8.0} = 3675 =$ 3.7 kW (2 s.f.).

Use the value of g printed on the paper; using 10 here gives 3.75 kW and can lose the accuracy mark.

Two significant figures matches the least precise data (8.0 s and 12 m).

Thermal physics and waves

Calculate the energy needed to raise the temperature of 0.50 kg of water from 20 °C to 100 °C. The specific heat capacity of water is 4200 J/(kg · °C). [3]

$E = mc\Delta\theta = 0.50 \times 4200 \times (100-20) = 0.50 \times 4200 \times 80 = 168\,000\ \mathrm{J} = 168\ \mathrm{kJ}$.

$\Delta\theta$ is the CHANGE in temperature, not the final temperature. Substituting 100 is the commonest error and gives 210 kJ.

A temperature change is the same in °C and K, so no conversion is needed – but a temperature VALUE would need one.

A wave has frequency 250 Hz and wavelength 1.4 m. Calculate its speed, and state what happens to the wavelength if the frequency doubles in the same medium. [4]

$v = f\lambda = 250 \times 1.4 = 350$ m/s. In the same medium the speed is unchanged, so if f doubles then λ must halve, to 0.70 m.

The second part is testing whether you know that speed depends on the MEDIUM, not on the source. Saying 'the speed doubles' loses both marks.

Electricity

Two resistors, 6.0 Ω and 3.0 Ω, are connected in parallel across a 12 V supply. Calculate the total resistance and the total current. [5]

$\frac{1}{R} = \frac{1}{6.0} + \frac{1}{3.0} = \frac{1}{6.0} + \frac{2}{6.0} = \frac{3}{6.0}$, so $R = 2.0\ \Omega$. Then $I = \frac{V}{R} = \frac{12}{2.0} = 6.0$ A.

Remember to INVERT at the end. Stopping at $1/R = 0.5$ and writing $R = 0.5\ \Omega$ is the standard slip.

Check for sense: the parallel total (2.0 Ω) is smaller than the smaller resistor (3.0 Ω). If it is not, the answer is wrong.

A 2.0 kW heater is used for 30 minutes. Calculate the energy transferred in kWh and in joules. [4]

In kWh: $E = P \times t = 2.0 \times 0.5 = 1.0$ kWh. In joules: $E = Pt = 2000 \times 1800 = 3.6 \times 10^6$ J.

For kWh the power must be in kW and the time in HOURS; for joules, watts and seconds. Mixing the two is where the marks go.

30 minutes is 0.5 h or 1800 s – convert before substituting, not after.