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

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

Commentary: 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.

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

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

Commentary: 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: $P = \dfrac{W}{t} = \dfrac{29\,400}{8.0} = 3675 = 3.7$ kW (2 s.f.).

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

Commentary: 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]

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

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

Commentary: 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.

Commentary: 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.

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

Commentary: 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.

Commentary: 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.

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