Mark schemes give "C1 M1 A1" and leave the reasoning to you. These are written the way you should write them: state the principle, write the equation, substitute with units, then evaluate – because the method marks are awarded before the answer is reached. 官方答案只给 *C1 M1 A1;* 这里按"原理 – 公式 – 代入 – 结果"完整写出。

Mechanics

A ball of mass 0.15 kg strikes a wall horizontally at 12 m/s and rebounds at 8.0 m/s. The contact lasts 0.020 s. Calculate the average force on the ball. [4]

Taking the initial direction as positive, the change in momentum is $\Delta p = mv_{\text{final}} - mv_{\text{initial}} = 0.15(-8.0) - 0.15(12) = -1.2 - 1.8 = -3.0$ N s. The average force is $F = \dfrac{\Delta p}{\Delta t} = \dfrac{-3.0}{0.020} = -150$ N, so a force of 150 N acts on the ball away from the wall.

Momentum is a VECTOR. The rebound velocity must be negative; treating both as positive gives 30 N s and 1500 N, a factor-of-five error that looks plausible.

Defining the positive direction in words is worth doing – it is where the sign marks are won.

A satellite orbits the Earth at radius $r = 7.0 \times 10^6$ m. Given $GM = 4.0 \times 10^{14}$ m^{3}s^{-2}, calculate its orbital speed and period. [5]

For a circular orbit the gravitational force provides the centripetal force: $\dfrac{GMm}{r^2} = \dfrac{mv^2}{r}$, so $v^2 = \dfrac{GM}{r}$ and $v = \sqrt{\dfrac{4.0 \times 10^{14}}{7.0 \times 10^6}} = \sqrt{5.71 \times 10^7} = 7.6 \times 10^3$ m/s. The period is $T = \dfrac{2\pi r}{v} = \dfrac{2\pi(7.0 \times 10^6)}{7.6 \times 10^3} = 5.8 \times 10^3$ s.

The first line – equating gravitational to centripetal force – is the method mark, and it is worth writing even if the algebra then fails.

The mass of the satellite cancels. Saying so shows why the orbit is independent of it.

Fields and circuits

A capacitor of 470 µF is charged to 12 V. Calculate the energy stored, and the charge on it. [4]

Energy: $E = \frac{1}{2}CV^2 = 0.5 \times 470 \times 10^{-6} \times 12^2 = 0.5 \times 470 \times 10^{-6} \times 144 = 3.4 \times 10^{-2}$ J. Charge: $Q = CV = 470 \times 10^{-6} \times 12 = 5.6 \times 10^{-3}$ C.

Convert µF to F before substituting. Leaving 470 in the formula gives 33 840 J, which should look absurd.

Note $E = \frac{1}{2}CV^2$, not CV^2 – the factor of a half is a mark on its own.

Explain why the resistance of a metallic conductor increases with temperature. [3]

In a metal the charge carriers are delocalised electrons. As temperature rises the positive ions vibrate with greater amplitude, so electrons collide with them more frequently. Each collision transfers energy from the electron, reducing the drift velocity for a given potential difference, so the current falls and the resistance rises.

The marks are for the ions vibrating MORE, more frequent collisions, and reduced drift velocity – three linked steps, not one assertion.

Saying 'the electrons move faster so there is more resistance' reverses the mechanism and scores nothing.

Light of wavelength 450 nm falls on a metal of work function 2.0 eV. Calculate the maximum kinetic energy of the emitted electrons. ($h = 6.63\times10^{-34}$ J s, $c = 3.00\times10^{8}$ m/s, 1 eV $= 1.60\times10^{-19}$ J) [5]

Photon energy: $E = \dfrac{hc}{\lambda} = \dfrac{(6.63 \times 10^{-34})(3.00 \times 10^{8})}{450 \times 10^{-9}} = 4.42 \times 10^{-19}$ J. Work function in joules: $2.0 \times 1.60 \times 10^{-19} = 3.20 \times 10^{-19}$ J. By Einstein's photoelectric equation, $E_{k,\max} = hf - \phi = 4.42 \times 10^{-19} - 3.20 \times 10^{-19} = 1.2 \times 10^{-19}$ J, which is 0.76 eV.

Convert the wavelength to metres and the work function to joules BEFORE subtracting. Mixing eV with joules is the standard failure here.

Quoting the answer in both joules and eV costs one line and protects against a units requirement in the mark scheme.