

Solutions

2.1 Temperature change: $96 - 21 = 75\text{ }^{\circ}\text{C}$ (C1).

$$\Delta E = mc\Delta\theta = 0.030 \times 1800 \times 75 = \mathbf{4050\text{ J}}$$

(substitution C1, answer A1.)

2.2

$$c = \frac{\Delta E}{m\Delta\theta} = \frac{6300}{0.25 \times 15} = \mathbf{1700\text{ J/kg }^{\circ}\text{C}} \text{ (2 s.f.)}$$

(rearrangement 1, answer with unit 1.)

2.3 Copper rises more: for the same energy and mass, $\Delta\theta \propto 1/c$, so water's rise is about $385/4200 \approx 1/11$ of copper's – copper rises about **11 times** more.

3.1 (a) $\Delta\theta = 46 - 22 = 24\text{ }^{\circ}\text{C}$ (C1).

$$\Delta E = 0.20 \times 900 \times 24 = \mathbf{4320\text{ J}}$$

(C1, A1.) (b) The temperature rise is smaller: with a larger c , the same energy spread over more joules per degree gives fewer degrees of rise – $\Delta\theta = \Delta E/(mc)$.

3.2 (a) The gradient gives $\Delta E/\Delta\theta = 4500/9 = 500\text{ J/}^{\circ}\text{C}$ (C1); with $m = 0.50\text{ kg}$:

$$c = \frac{4500}{0.50 \times 9} = \mathbf{1000\text{ J/kg }^{\circ}\text{C}}$$

(C1, A1.) (b) Any two: the mass heated; the energy input (or power and time).

3.3 (a) Convert time: $8.0\text{ min} = 480\text{ s}$ (C1).

$$E = Pt = 36 \times 480 = \mathbf{17\,280\text{ J}}$$

(C1, A1.) (b)

$$\Delta E = mc\Delta\theta = 1.2 \times 385 \times 16 = \mathbf{7390\text{ J}} \approx 7400\text{ J}$$

(temperature change 1, answer 1.) (c) A high c means each kilogram absorbs a lot of energy for each degree of rise, so the pad's temperature rises slowly and it can store the transferred energy without becoming dangerously hot.