

- 1 (a) three valid features listed without explanation [1]
- any three features explained from:
- copper/metal is a good conductor (of heat)
NOT of electricity
- black is good absorber/bad reflector
ignore emitter
- insulating material will reduce heat lost/conducted away (from pipes/sheet)
NOT prevents heat loss owtte
- glass/trapping of air reduces/prevents convection/warm air being blown away
- glass produces greenhouse effect/reference to far and near I.R. [max 3]
- (b) 38 – 16 OR 22 [1]
 $mc\theta$ OR $250 \times 4200 \times$ candidate's temperature difference [1]
 2.31×10^7 (J) e.c.f. from previous line [1]
 9.24×10^7 J OR e.c.f. from previous line $\times 4$ correctly evaluated [1]
 no unit penalty if J seen anywhere in (b) clearly applied to an energy
- (c) valid explanation relating to at least one of the reasons below: [1]
 note: if no explanation, this mark is not awarded even if more than three reasons are given
- any three reasons from:
 which direction roof faces
 estimate output of panels
 household needs / whether household will use all hot water
 cost of panel / installation
 time to recoup cost
 whether roof is shaded
 relevant environmental consideration (e.g. not using wood or other fuel to heat water) [max 3]
- (d) nuclei join together, accept hydrogen for nuclei [2]
 to produce a different element / helium (and energy)

- 2 **(a) (i)** any 2 from: max. B2
- liquid molecules not in fixed positions / can move about / move past each other OR solid molecules have a fixed position
 - liquid molecules have random arrangement OR solid molecules arranged regularly / in patterns / layers / lattice
 - liquid molecules are (slightly) further apart (than solid molecules) OR reverse argument
- (ii)** energy / work / thermal energy / (latent) heat required
AND
to break bonds (between molecules) / to overcome attractive forces
(between the molecules) / to increase the potential energy of the molecules B1
- (b) (i)** $E = ml$ in any form OR ml OR $1.65 \times 330\,000$ C1
= 540 000 J OR 544 500 J A1
- (ii)** chemical (energy in body) converted to thermal / internal (energy) B1
- [Total: 6]**

- 3 **(a) (i)** X-rays B1
- (ii)** Infra-red B1
- (b) (i)** $v = f\lambda$ in any form OR $v = f\lambda$ OR $3.0 \times 10^8 \div (2.45 \times 10^9)$ C1
0.12 m A1
- (ii)** $(Q =) ml$ OR 150×330 C1
49 000 (J) OR 49 000 (J) OR 50 000 (J)
- $P = Q/t$ in any form OR $(t =) Q/P$ OR (0.65×1100) OR 715 C1
69 s A1
- [Total: 8]**

- 4 (a) diagram shows (molecules) randomly positioned M1
 diagram shows most (molecules) touching/very closely spaced A1
- (b) (i) (temperature) decreases B1
- (ii) more energetic/faster molecules escape from surface/overcome forces of attraction B1
- (iii) $E = ml$ in any form **OR** ml C1
 2900 J A1
- (iv) any two from:
 • cover/decrease surface area
 • reduce temperature
 • reduce draught owtte
 • increase humidity of air B2

[Total: 8]

- 5 (a) (i) (g.p.e. =) mgh **OR** $0.15 \times 10 \times 1.8$ C1
 2.7 J ignore minus sign A1
- (ii) (k.e. **OR** 2.7 =) $\frac{1}{2}mv^2$ **OR** $\frac{1}{2} \times 0.15v^2$ C1
 ($v^2 =$) 36 C1
 6.0 m/s A1
- (b) (i) initial temperature (of metal) **OR** final temperature (of metal)
OR temperature change (of metal) B1
- (ii) thermal energy transferred to something specific e.g. air/tube/stopper/
 thermometer/surroundings/environment
OR small spheres lost before/after weighing
OR not all the spheres fall the same distance B1
- (iii) higher temperature increase **OR** calculate mean of (100) readings M1
 small measurements less accurate owtte A1

[Total: 9]

- 6 (a) (i) and (ii) marked together to maximum of 3 marks
- (i) molecules escape/leave the liquid/form gas or vapour B1
- (ii) evaporation OR heat/(thermal) energy needed for evaporation leaves sweat cooler B1
 fast(er) molecules/high(er) energy molecules escape
 OR slow(er) molecules left behind B1
 heat flows from body to warm the sweat (so body cools) B1
- (b) (Q =) $mc\Delta\theta$ OR mcT OR $60 \times 4000 \times 0.50$ C1
 1.2×10^5 J / 120 kJ A1
- (ii) $Q = mL$ in any form OR (m =) Q/L OR either with numbers C1
 ($m = 1.2 \times 10^5 / 2.4 \times 10^6 =$) 0.05 kg e.c.f from (b)(i) A1

[Total 7]