

- 1 (a) in all parts accept by implication reference to X
e.g. in (i) accept "it covers a greater range of temperatur
- (i) X covers greater range of temperature OR (goes to) higher temperature OR greater range expressed numerically B1
 - (ii) liquid in X expands uniformly (with temperature rise) B1
 - (iii) (for the same temperature rise,) the liquid in X expands more B1
- (b) (i) two junctions correctly connected to each other and to meter OR one junction between wires and other junction at connection to meter M1
temperature difference between junctions A1
two wires correctly labelled as made of different materials, accept labels metal A & metal B NOT 3 different metals labelled B1
- (ii) junction (in liquid) has low mass/small heat capacity/small size B1
temperature of junction reacts quickly/quickly reaches temperature of liquid/heat or cools faster B1

[Total: 8]

- 2 (a) any **two** from:
volume (of a liquid/gas); resistance (of a metal);
voltage (of a thermocouple); other appropriate examples; B2
- (b) (i) 1 place bulb in ice and water mixture AND mark liquid level B1
2 place bulb in steam from boiling water AND mark liquid level B1
pure ice OR pure water mentioned in 1 OR at normal atmospheric pressure mentioned in 2 B1
- (ii) 1 liquid expands uniformly (as temperature rises) OR capillary/tube has uniform diameter/cross-sectional (area) B1
2 glass expands much less than the liquid **or** (also) expands linearly B1

[Total: 7]

- 3 (a) (i) (liquid) has a uniform expansion/expands at a constant rate/expands evenly/expands linearly B1
- (ii) any two from:
 larger bulb/wider/longer bulb
 more liquid
 narrower capillary/tube
 use liquid with greater expansion B2
- (iii) thermometer must be longer B1
- (b) any 2 from:
 resistance/conductance of a metal/wire/conductor/thermistor
 voltage/current of a thermocouple
 volume/pressure/expansion/contraction of a gas
 colour of a metal
 amount of radiation OR frequency OR wavelength of radiation from a metal/furnace
 colour/arrangement of liquid crystals
 expansion of a solid/any dimension of a solid
 bending of a bimetallic strip B2

[Total: 6]

- 4 (a) (a liquid evaporates) at any temperature/below the boiling point/over a range of temperatures/below 100°C/at different temperatures/not at a fixed temperature B1
- (during evaporation) vapour forms at/escapes from the surface of the liquid B1
- (without a supply of thermal energy,) evaporation continues/occurs/doesn't stop
 OR causes liquid to cool/is slower/reduces
- (b) (i) $(Q =) mL$ C1
 OR $0.075 \times 2.25 \times 10^6$
 $1.7 \times 10^5 \text{ J}$ A1
- (ii) $(E =) VI t$ OR $240 \times 0.65 \times (20 \times 60)$ C1
 OR $P = IV$ and $P = E/t$ OR energy/time
 $1.9 \times 10^5 \text{ J}$ A1
- (iii) energy is transferred to the surroundings
 OR in heating the surroundings/air/atmosphere/hot-plate

[Total: 8]

- 5 (a) (thermal) energy/heat to heat unit mass/1 kg/1 g B1
 by unit temperature/1 °C/1 K B1
- (b) SHC= $Q/(m\Delta T)$ in any form or $Q/(m\Delta T)$ words, symbols or numbers C1
 (SHC = $8700/800 \times 12 = 0.91 \text{ J}/(\text{g } ^\circ\text{C})$ or $910 \text{ J}/(\text{kg } ^\circ\text{C})$) A1
- (ii) th. cap. = $Q/\Delta T$ in any form or $Q/\Delta T$ or $m \times \text{SHC}$ words, symbols or numbers C1
 (th. cap. = $8700/12$ or 0.906×800 or $906 \times 0.8 = 730 \text{ J}/^\circ\text{C}$ or $725 \text{ J}/^\circ\text{C}$) A1
- (c) lag (cylinder)/wait after heating until temperature stable/at max. value M1
 prevents/reduces heat losses or heat (energy) takes time to flow throughout block A1
 throughout **4(c)**, reward correct alternative physics which answers the question
 e.g. use greater power to reduce expt time and hence energy lo
 ignore: repeats or use thermometer with low thermal capacity

[Total: 8]

- 6 (a) (m =) Pt/l OR $460 \times 180/2.3 \times 10^6$ OR $82\,800/2.3 \times 10^6$ C1
 0.036 kg OR 36 g A1
- (b) (i) any two from:
 (surface) area
 draught
 temperature (of water/room)
 humidity of air B2
- (ii) any two from:
 evaporation at any temperature/below boiling point
 evaporation (only) at the surface
 evaporation influenced by surface area/draught/temperature/humidity (not
 if given in **(b)(i)**) B2

[Total: 6]

- 7 (a) (i) A **OR** left hand thermometer B1
- (ii) E **AND** longest length and smallest range/more length per degree/liquid moves more per degree/increases the most per degree B1
- (b) any two from:
narrow bore/tube
large amount of liquid/mercury/ethanol/alcohol/bulb
liquid with large expansivity **OR** ethanol instead of mercury B2
- (c) 80 (°C) **OR** 80/120 **OR** 18/120
- 12 cm A1

[Total: 6]