

1	(a) conduction	rod / target / anode copper / thickness of rod <u>good</u> conductor / increases amount of conduction (of thermal energy)	B1 B1 B1	[3]
	(b) convection	fins large surface area / number of fins / spaces between fins large contact with air / allows air to rise between fins	B1 B1 B1	[3]
	(c) radiation	fins / black surface / end of rod black surface / large surface area good emitter / large radiating surface ignore absorber	B1 B1 B1	[3]

- 2 (a) electrical method  
 lagged container + lid  
 liquid (allow) water  
 heater in liquid  
 heater connected to electrical supply (seen or stated)  
 voltmeter and ammeter appropriately connected (seen)  
 thermometer
- } 5 points 3  
 4 points 2  
 3 points 1  
 B3

OR

- mixtures method  
 lagged container  
 liquid  
 hot solid/hot liquid  
 means of heating hot solid / liquid (seen or stated)  
 means of weighing hot solid / liquid / use of known mass (seen or stated)  
 thermometer
- } 5 points 3  
 4 points 2  
 3 points 1  
 B3

- (ii) electrical method  
 initial & final temps of liquid OR temp rise  
 voltmeter reading (however expressed)  
 ammeter reading (however expressed)  
 heating time  
 mass of liquid
- } -1 e.e.o.o.  
 B3

OR

- mixtures method  
 initial and final temps of liquid OR temp rise  
 initial and final temps of added solid / liquid OR temp drop  
 mass of added solid / liquid  
 mass of liquid  
 SHC of added solid / liquid
- } -1 e.e.o.o  
 B3

- (b)  $Q = mc\theta$  in any form B1  
 100.6 – 12 OR 88.6 C1  
 $0.8 \times 3900 \times 88.6$  C1  
 276 432 J A

- (ii)  $Q = Wt$  OR ( $t =$ ) candidate's (i)/620  
 445.858 s ecf (i) A1 [12]

- 3 (a) energy / heat required to change state / phase / any example of change of state / phase M1
- with no change in temperature / at a specified temperature A1  
 OR energy to break bonds between molecules / atoms M1  
 with no change in K.E. A1
- (b) any time or range of time between 1.6 (min) and 14.0 (min) inclusive [no UP] B1
- (c) turns substance to gas / vapour OR causes evaporation OR escape from liquid C1
- energy to break bonds/separate molecules/overcome intermolecular forces A1  
 Ignore move faster / PE increases
- (d) (i)  $Pt / 2 \times 4 / 2000 \times 4 / 2 \times 240 / 2000 \times 240 / 8 / 8000 / 480 / 480000$  C1  
 $480\ 000\ J$  OR  $480\ kJ$  A1
- (ii)  $(\theta =) 43\ (^{\circ}C)$  seen anywhere C1  
 $Q = mc\theta$  OR  $480000 = m \times 1760 \times 43$  in any form ecf. from (i) C1  
 $6.34\ kg$  or  $6.3\ kg$  ecf. A1 [10]
- 4 (a) (i) change in length / distance moved (accept "how much it expands") per unit / given temp rise OR equivalent B1
- (ii) large bulb OR thin / narrow bore / tube / capillary B1  
 NOT thin / narrow thermometer
- (b) (i) difference between the highest and lowest temperatures B1  
 ignore reference to fixed points
- (ii) tube (sufficiently) long / not too short B1  
 OR bore wide/not too thin  
 OR little/not too much liquid/bulb  
 NOT change liquid
- (c) (i) idea of equal size divisions/expansion for equal temperature rises OR  $\Delta l / \Delta\theta$  constant OR reference to  $l$  against  $\theta$  graph straight line ignore 1 division =  $1^{\circ}C$
- (ii) uniform bore OR alcohol/liquid expands uniformly (with temp) B1 [6]

- 5 (a) heat/energy to raise/change temperature of 1 kg/1g/unit mass through 1°C/1K (mention of change of state scores zero) M1  
A1
- (b)  $Q = mc\theta$  (for  $\theta$  accept  $t, T, \Delta\theta, \Delta t,$  or  $\Delta T$ ) B1  
 $23800 = 0.93 \times c \times (41.3 - 13.1)$  C1  
 907.5 or 907 or 908 or 910 J/(kg °C) or J/(kg K) at least 2 sig. figs A1  
 (for unit in (b) and (c)(i) condone no brackets and extra solidus)
- (c) 1212.9 or 1200 or 1210 or 1213 or 1214 J/(kg °C) or J/(kg K) B1
- (ii) more energy lost (to surroundings) B1  
 (average) temperature is higher/initial temperature higher/no cooling  
 time allowed/temperature rise is lower/time of heating may be longer/  
 rate of heating may be lower B1
- (d) insulate block/provide lid/cover with shiny foil )  
 start & finish same amount below & above room temperature ) any 2 B1 + B1  
 get heater up to temperature before inserting )  
 put oil in gap between heater & block )

[Total: 10]