1 **(a** Coal, hydroelectric and wind boxes ticked B2

**(b) (i)** Copper is a good conductor of thermal energy / heat
Black surface is a good / the best absorber <u>of radiation</u> / <u>infra red</u> B1

**(ii)** (Temp rise = ) 72 – 20 = 52 (°C)
(Q =) mcΔθ OR $0.019 \times 4200 \times 52$ C1
4100 J A1

**(iii)** Efficiency = (power) output / (power) input (× 100)
OR 70 $\frac{(4100/5)\times 100}{\text{power input}}$ OR $\frac{(4100\times 100)}{\text{power input}}$ OR rearranged C1
Power input = 1200 W A1

**[Total: 9]**

2 **(a** energy/heat required to increase temperature
- of 1 kg / 1 g / unit mass (of the substance) B1
- by 1 °C / 1 K / unit temperature B1

**(b)** $E = mc\Delta\theta$ in any form OR ($c$ =) $E \div m\Delta\theta$ C1
$E = Pt$ in any form OR 420 × 95 (= 39 900) C1
$\Delta\theta$ = [40.5 – 19.5] OR 21 C1
($c$ = 39 900 ÷ 42 =) 950 J / (kg °C) A1

**(c)** any two separate points from: max. B2
- lagging / insulation (around block) OR insulate (the block)
- raise temperature of block by a smaller amount OR heat for a shorter time OR use lower power heater <u>for same time</u> OR higher power <u>for same temperature rise / shorter time</u>
- polish the surface of the block OR wrap the block in shiny material OR paint (shiny) white
- reduce initial temperature of block (to below room temperature) OR raise temperature of room
- reduce draughts

**[Total: 8]**

3 **(a** box 2: Z measures p. d. B1

box 4: X and Y are different materials. B1

box 6: X and Y are electrical conductors. B1

**(b)** more sensitive OR thread moves more M1

more (greater volume of) expansion A1

**(c)** not linear OR linearity worse/less B1

correctly relates movement of thread to diameter of capillary B1

4 **(a** same distance moved (by thread) for same temperature change B1

**(b)** – 10 °C B1

**(c)** any two from: max. B2

- longer stem
- bigger bulb OR more liquid
- narrower bore OR thinner thread
- liquid with greater expansivity

**(d) (i)** falls from 100 °C with a decreasing gradient AND at a faster rate B1

finishes horizontal along 20 °C line B1

**(ii)** **only** bottom box ticked B1

**[Total: 7]**

5 **(a** energy/heat needed to change state of substance/melt B1

(from solid to liquid at constant temperature / melting point) per kg / per unit mass B1

**(b) (i)** ($l_f$=) $Q \div m$ in any form: words, symbols, numbers C1

340 J / kg OR 336 J / g OR equivalent in J / kg A1

**(ii)** ($c$ =) $Q \div [m \Delta T]$ in any form: words, symbols, numbers C1
4.1 J / (g °C) OR 4100 J / (kg °C)

**(iii)** cold water denser AND sinks B1
convection (current) OR circulation OR warmer water rises B1

**[Total: 8]**

6 **(a** $c = Q / (m\Delta\theta)$ B1

**(b)** d = m / V in any form OR (m =) Vd OR 0.0036 × 1000 C1
3.6 kg A1

**(ii)** (E =) Pt OR 8500 × 60 OR 510 000 J OR $5.1 \times 10^5$ J C1
$\Delta\theta = Q / mc$ OR $\Delta\theta = Pt / mc$ in any form OR $5.1 \times 10^5 / (3.6 \times 4200)$ C1
= 34 (°C) A1

OR $\Delta\theta$ = P / (mass per second × c) (C1)
= 8500 / [(0.0036 / 60) × 4200 (C1)
= 34 (°C) (A1)

outflow temp = 15 + 33.73 = 49 °C B

**[Total: 7]**