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 of radiation / infra red B1

(ii) (Temp rise =) 72 – 20 = 52 (°C)
(Q =) mcΔθ OR 0.019 × 4200 × 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 for same time OR higher power for same temperature rise / shorter time
- 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 / (mΔθ) 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 5.1×10^5 J C1
Δθ = Q / mc OR Δθ = Pt / mc in any form OR $5.1 \times 10^5 / (3.6 \times 4200)$ C1
= 34 (°C) A1

OR Δθ = 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]