

Thermal Properties and Temperature

Mark Scheme 1

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 1

Time Allowed: 56 minutes

Score: /46

Percentage: /100

- 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 =) $72 - 20 = 52 (^{\circ}\text{C})$
(Q =) $mc\Delta\theta$ OR $0.019 \times 4200 \times 52$ C1
4100 J A1
- (iii) Efficiency = (power) output / (power) input ($\times 100$)
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 $420 \times 95 (= 39900)$ C1
 $\Delta\theta = [40.5 - 19.5]$ OR 21 C1
 $(c = 39900 \div 42 =) 950 \text{ J/(kg }^{\circ}\text{C)}$ 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) $c = Q/(m\Delta\theta)$ 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 5.1×10^5 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 $\Delta\theta = P / (\text{mass per second} \times c)$ (C1)
 = $8500 / [(0.0036/60) \times 4200]$ (C1)
 = 34 (°C) (A1)
- outflow temp = $15 + 33.73 = 49^\circ\text{C}$ B

[Total: 7]