Thermal Process

Mark Scheme 3

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Process
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 3

Time Allowed: **88 minutes**

Score: **/73**

Percentage: **/100**

Question	Answer	Mark
1(a)	Gas molecules (very) far apart OR empty space between gas molecules Molecules of liquid (very) close together / compact OR are touching (each other)	**B1** **B1**
(b)(i)	Faster / more energetic water molecules evaporate / escape / leave Slower / less energetic molecules remain (so temperature is lower)	**B1** **B1**
(b)(ii)	Water in wide container AND has water with larger surface (area) Rate of evaporation higher / faster / quicker OR higher chance of evaporation	**B1** **B1**
		Total: 6

2 **(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 =) $mc\Delta\theta$ 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]

3 **(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]

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 (i)** reduces (rate of evaporation) NOT zero (rate of evaporation) M1

no / fewer evaporated molecules removed by wind
OR greater humidity / vapour pressure
NOT fewer molecules in liquid / puddle blown away A1

(ii) increases (rate of evaporation) M1

molecules move faster / have more energy OR more molecules have energy to escape A1

(b) greater (rate of evaporation) OR rate is less in small puddle
ignore rate of disappearance of puddle B1

surface areas correctly compared B1

(c) description of viable experiment NOT absorption expt M1

statement of measurements to be made A1

good detail e.g. thermometers in comparable positions OR pyrometer same position relative to different surfaces A1

[Total: 9]

7 **(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]

8 **(a** (nuclear) fusion B1 [1]

(b) (i) smaller (surface) area
(accept thinner, narrower(at top), ignore reference to lid) B1 [1]

(ii) apparatus: black object, white object, thermometer(s)/ball-bearing with wax/level of water in vessel B1

source of heat e.g. Sun/radiant heater (condone light bulb/Bunsen burner) B1

action: (fill cans with water and) measure temperature rise **or** wax melts **or** compare volumes of water B1

observation: water in black can (better absorber) has greater temperature increase / wax melts first / less water
note: emission experiment gains max. 2 B1 [4]

[Total: 6]

9 **(a)** T-shirt in wind/on L dries quicker OR T-shirt out of wind/on R dries slower M1
wind removes more evaporated molecules accept quicker
NOT wind gives water molecules more KE A1 [2]

(b) T-shirt folded double/on R dries slower OR T-shirt unfolded/on L dries quicker M1
correct reference to smaller/larger surface area for molecules to evaporate
OR water trapped (in fold) OR more humid in fold A1 [2]

(c) water <u>evaporates</u> from her hair B1
heat required for evaporation OR heat flows (from body/hair) to warm up cold water
OR faster molecules escape leaving water cooler/lowering KE
ignore: there is a cooling effect B1 [2]

[Total: 6]

10

	(a)	turn on heater and wait until water starts dripping in beaker	**B1**	
		empty beaker & replace, start watch	**B1**	
		stop watch & remove beaker at same time	**B1**	
		record time	**B1**	
		find and record mass of water in beaker	**B1**	**[M4]**
	(b)	60 x t = 120 x 340	**C1**	
		t = 680 s	**A1**	**[2]**
	(c)	ice gains heat from surroundings/ice falls through funnel	**B1**	
	(ii)	lag or fit lid to funnel/place gauze in funnel bottom	**B1**	**[2]**
				Total [8]