Thermal Properties and Temperature

Mark Scheme 10

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 10

Time Allowed: **69 minutes**

Score: **/57**

Percentage: **/100**

1 **(a** any two from:
at surface / not within liquid (if other way round must be explicit) B1
at any temperature / not at boiling point (if other way round must be explicit) B1 [2]
(evaporation) causes cooling
boiling requires a heat source
bubbles rising

(b) (i) viable heat source clearly described e.g. electrical/immersion heater B1
appropriate readings e.g. V, I, t or P & t or joulemeter readings B1 [2]
OR
combustion heater but only with some mention of amount of fuel used B1
correct measurement of amount of fuel used B1

(ii) viable mass measuring device clearly described B1
e.g. (top pan) balance/scal
appropriate readings B1 [2]
e.g. mass of water before and after / change of mass of wat
OR
measuring cylinder B1
volume of water before and after / change of volume of water B1

[Total: 6]

2 **(a)** any two of:
boiling throughout liquid (evaporation at surface),
boiling at one temperature (evaporation at any / all temperature / below boiling point),
boiling not affected by draught/area (evaporation is),
boiling produces bubbles (evaporation does not). B2

(b) (thermal energy) does work against intermolecular forces / breaks bonds B1
molecules separated/moved apart OR becomes PE B1

(c) apparatus: e.g. kettle AND balance / scales OR steam condensing in water with
measuring cylinder / scales AND thermometer B1
two masses determined OR volume/mass condensed B1
determine energy input: e.g. VIt **or** Pt **or** $mc\Delta T$ B1
(l_e =)Q/m B1 [8]

3	**(a)**	**(i)**	(gravitational) potential energy to kinetic energy	B1	
		(ii)	chemical energy to (gravitational) potential energy	B1	
			reference in **(i)** or **(ii)** to heat / thermal / internal energy produced OR work done against air resistance or friction	B1	
	(b)	**(i)**	(K.E. =) $\frac{1}{2}mv^2$ OR $0.5 \times 940 \times 16^2$	C1	
			1.2×10^5 J	A	
		(ii)	in words or symbols $Q = mc\theta$ OR $\theta = Q/mc$	C1	
			$1.203 \times 10^5 = 4.5 \times 520 \times \theta$ OR $\theta = 1.203 \times 10^5 / (4.5 \times 520)$	C1	
			51 °C or K	A1	
					[Total: 8]

4	**(a)**		matt black	B1	
	(b)	**(i)**	L down and R up, equal amounts (by eye)	B1	
		(ii)	on black side or on left (more) energy / heat absorbed OR greater temp rise OR heats up quicker	B1	
			on black side or on left greater expansion of air / greater pressure of air	B1	[4]

5 **(a (i)** good conductor (of heat) B1
(ignore electricity)

(ii) black is good absorber/bad reflector B1
(ignore emitter)

(iii) reduce heat lost/conducted away (from pipes/sheet) B1
NOT prevents heat loss o.w.t.t.e.

(iv) air heated OR glass reduces/prevents convection
OR greenhouse effect OR reference to far and near I.R.
OR glass prevents warm air being blown away OR traps air B1
Ignore traps heat

(b) 38 – 16 OR 22 C1
$mc\theta$ OR 250 × 4200 × his 22 C1
2.31×10^7 (J) e.c.f from previous line C1
9.24×10^7 J OR e.c.f from previous line × 4 correctly evaluated A1
No unit penalty if J seen anywhere in **(b)** clearly applied to an energy

[Total: 8]

6 **(a** Total penalty for use of 'particles' rather than 'molecules' is 1 mark.

(i) idea of some molecules gaining more KE B1
mols overcome attractive forces OR mols break free of surface B1

(ii) greater area B1
more mols escape (in given time) B1

(iii) increase temperature / supply more heat / make hotter)
blow air across surface, or equiv.) any 2 B1 + B1
reduce humidity)
decrease pressure)

(b) water evaporates from cloth / water OR faster / more energetic molecules evaporate)
less energetic mols left behind)
energy to evaporate taken from milk) any 3 B1 × 3
evaporation produces cooling)
idea of cloth always being damp by soaking up water) [9]

7 **(a) (i)** random B1
high speed (between collisions) B1

(ii) hit walls B1
many hits/unit area OR hit hard OR large force OR high energy OR many hits/s OR hit very often B1

(b) particles vibrate (more) OR electrons gain energy B1
particle to particle transfer OR flow of free electrons B1

(c) 75 × 3200 OR ml C1
240 000 J OR 240 kJ OR 2.4×10^5J A

[Total: 8]

8. **(a)** Water molecules at higher temps. have higher (av) k.e. / energy **B1**
Higher energy molecules (have greater chance to) escape the surface **B1**
Higher energy molecules have energy to break liquid "bonds" or separate liquid molecules or more evaporation at 85°C (lowers level) **B1** **3**

(b) Heat for evaporation = 34 500 – 600 = (33 900) **C1**
Sp. latent heat of evaporation = heat/mass evap. or 33 900 / 15 **C1**
2260 J/g (method and working correct, but no heat loss used, 2/3) **A1**

(600 added or 34 500 used can score **2 max**) **3**

[Total: 6**]**