Thermal Properties and Temperature

Mark Scheme 9

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Thermal Physics
Sub-Topic	Thermal Properties and Temperature
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 9

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

1 **(a** three valid features listed without explanation [1]

any three features explained from:

copper/metal is a good conductor (of heat)
NOT of electricity

black is good absorber/bad reflector
ignore emitter

insulating material will reduce heat lost/conducted away (from pipes/sheet)
NOT prevents heat loss owtte

glass/trapping of air reduces/prevents convection/warm air being blown away

glass produces greenhouse effect/reference to far and near I.R. [max 3]

(b) 38 – 16 OR 22 [1]
$mc\theta$ OR 250 × 4200 × candidate's temperature difference [1]
2.31×10^7 (J) e.c.f. from previous line [1]
9.24×10^7 J OR e.c.f. from previous line × 4 correctly evaluated [1]
no unit penalty if J seen anywhere in **(b)** clearly applied to an energy

(c) valid explanation relating to at least one of the reasons below: [1]
note: if no explanation, this mark is not awarded even if more than three reasons are given

any three reasons from:
which direction roof faces
estimate output of panels
household needs / whether household will use all hot water
cost of panel / installation
time to recoup cost
whether roof is shaded
relevant environmental consideration (e.g. not using wood or other fuel to heat water) [max 3]

(d) nuclei join together, accept hydrogen for nuclei
to produce a different element / helium (and energy) [2]

2 **(a) (i)** any 2 from: max. B2
- liquid molecules not in fixed positions / can move about / move past each other OR solid molecules have a fixed position
- liquid molecules have random arrangement OR solid molecules arranged regularly / in patterns / layers / lattice
- liquid molecules are (slightly) further apart (than solid molecules) OR reverse argument

(ii) energy / work / thermal energy / (latent) heat required
AND
to break bonds (between molecules) / to overcome attractive forces (between the molecules) / to increase the potential energy of the molecules B1

(b) (i) $E = ml$ in any form OR ml OR $1.65 \times 330\,000$ C1
$= 540\,000$ J OR 544 500 J A1

(ii) chemical (energy in body) converted to thermal / internal (energy) B1

[Total: 6]

3 **(a) (i)** X-rays B1

(ii) Infra-red B1

(b) (i) $v = f\lambda$ in any form OR $v \div f$ OR $3.0 \times 10^8 \div (2.45 \times 10^9)$ C1
0.12 m A1

(ii) ($Q =$) ml OR 150×330 C1
49 000 (J) OR 49 000 (J) OR 50 000 (J)

$P = Q/t$ in any form OR ($t =$) Q/P OR (0.65×1100) OR 715 C1
69 s A1

[Total: 8]

4	**(a**		diagram shows (molecules) randomly positioned diagram shows <u>most</u> (molecules) touching/very closely spaced	M1 A1
	(b)	**(i)**	(temperature) decreases	B1
		(ii)	<u>more energetic</u>/faster molecules escape from surface/overcome forces of attraction	B1
		(iii)	$E = ml$ in any form **OR** ml 2900 J	C1 A1
		(iv)	any two from: • cover/decrease surface area • reduce temperature • reduce draught owtte • increase humidity of air	B2

[Total: 8]

5	**(a**	**(i)**	(g.p.e. =) mgh **OR** $0.15 \times 10 \times 1.8$ 2.7 J ignore minus sign	C1 A1
		(ii)	(k.e. **OR** 2.7 =) $\frac{1}{2}mv^2$ **OR** $\frac{1}{2} \times 0.15v^2$ (v^2 =) 36 6.0 m / s	C1 C1 A1
	(b)	**(i)**	<u>initial</u> temperature (of metal) **OR** <u>final</u> temperature (of metal) **OR** temperature change (of metal)	B1
		(ii)	thermal energy transferred to something specific e.g. air / tube / stopper / thermometer / surroundings / environment **OR** small spheres lost before / after weighing **OR** not all the spheres fall the same distance	B1
		(iii)	higher temperature increase **OR** calculate mean of (100) readings small measurements less accurate owtte	M1 A1

[Total: 9]

6 **(a)** **(i)** and **(ii)** marked together to maximum of 3 marks

(i) molecules escape/leave the liquid/form gas or vapour B1

(ii) evaporation OR heat/(thermal) energy needed for evaporation leaves sweat cooler B1

fast(er) molecules/high(er) energy molecules escape
OR slow(er) molecules left behind B1

heat flows from body to warm the sweat (so body cools) B1

(b) (Q =) $mc\Delta\theta$ OR mcT OR $60 \times 4000 \times 0.50$ C1

1.2×10^5 J / 120 kJ A1

(ii) $Q = mL$ in any form OR (m =) Q/L OR either with numbers C1

($m = 1.2 \times 10^5 / 2.4 \times 10^6$ =) 0.05 kg e.c.f from **(b)(i)** A1

[Total 7]