

Mark schemes

- 1** (a) Student A's measurements had a higher resolution 1
- Student B was more likely to misread the temperature 1
- (b) a random error 1
- (c) 8.4 °C 1
- (d) 740 (seconds)
allow answers in the range 730 – 780 1
- (e) $0.40 \times 199\,000$ 1
- 79 600 (J) 1
- accept 79 600 (J) with no working shown for 2 marks*
- (f) stearic acid has a higher temperature than the surroundings 1
- accept stearic acid is hotter than the surroundings*
- temperature will decrease until stearic acid is the same as the room temperature / surroundings 1
- [9]**
- 2** (a) range of speeds 1
- moving in different directions
accept random motion 1
- (b) internal energy 1
- (c) density = mass / volume 1
- (d) 0.00254 / 0.0141 1
- 0.18 1

accept 0.18 with no working shown for the 2 calculation marks

kg / m³

1

[7]

3

Level 3 (5–6 marks):

Clear and coherent description of both methods including equation needed to calculate density. Steps are logically ordered and could be followed by someone else to obtain valid results.

Level 2 (3–4 marks):

Clear description of one method to measure density **or** partial description of both methods. Steps may not be logically ordered.

Level 1 (1–2 marks):

Basic description of measurements needed with no indication of how to use them.

0 marks:

No relevant content.

Indicative content

For both:

- measure mass using a balance
- calculate density using $\rho = m / V$

Metal cube:

- measure length of cube's sides using a ruler
- calculate volume

Small statue:

- immerse in water
- measure volume / mass of water displaced
- volume of water displaced = volume of small statue

[6]

4	<p>(a) dependent</p>	1
	<p>(b) (probe) C <i>allow 103.2</i></p>	1
	<p>largest difference between reading and actual temperature <i>reason only scores if C chosen</i> <i>accept larger</i> <i>it is 3.2 greater is insufficient</i> <i>comparing C with only one other probe is insufficient</i></p>	1
	<p>(c) (i) 12(°C) <i>accept a value between 12.0 and 12.2 inclusive</i></p>	1
	<p>(ii) 140 (seconds) <i>accept an answer between 130 and 150 inclusive</i></p>	1
	<p><u>temperature</u> starts to rise <i>only scores if time mark awarded</i> <i>accept the <u>temperature</u> was lowest (at this time)</i></p>	1
	<p>(iii) increase <i>accept faster (rate)</i></p>	1
		[7]
5	<p>(a) solid <u>particles</u> vibrate about fixed positions</p>	1
	<p>closely packed <i>accept regular</i></p>	1
	<p>gas <u>particles</u> move randomly <i>accept particles move faster</i> <i>accept freely for randomly</i></p>	1
	<p>far apart</p>	1
	<p>(b) amount of energy required to change the state of a substance from liquid to gas (vapour)</p>	1

unit mass / 1 kg
dependent on first marking point

1

- (c) 41000 or 4.1×10^4 (J)
accept
41400 or 4.14×10^4
correct substitution of
 $0.018 \times 2.3 \times 10^6$ gains 1 mark

2

- (d) **AB**
changing state from solid to liquid / melting

1

at steady temperature
*dependent on first **AB** mark*

1

BC
temperature of liquid rises

1

until it reaches boiling point
*dependent on first **BC** mark*

1

[12]

6

- (a) (black) is a good absorber of (infrared) radiation

1

- (b) (i) amount of energy required to change (the state of a substance) from solid to liquid (with no change in temperature)
melt is insufficient

1

unit mass / 1kg

1

- (ii) 5.1×10^6 (J)
accept 5×10^6
allow 1 mark for correct substitution ie $E = 15 \times 3.4 \times 10^5$

2

- (c) (i) mass of ice
allow volume / weight / amount / quantity of ice

1

- (ii) to distribute the salt throughout the ice

1

to keep all the ice at the same temperature

1

(iii) melting point decreases as the mass of salt is increased

allow concentration for mass

accept negative correlation

*do **not** accept inversely proportional*

1

(d) 60 000 (J)

accept 60 KJ

*allow **2** marks for correct substitution ie $E = 500 \times 2.0 \times 60$*

*allow **2** marks for an answer of 1000 **or** 60*

*allow **1** mark for correct substitution ie*

*$E = 500 \times 2.0$ **or** $0.50 \times 2.0 \times 60$*

*allow **1** mark for an answer of 1*

3

- (e) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

There is *an attempt at a description of some advantages or disadvantages.*

Level 2 (3–4 marks)

*There is a basic description of some advantages **and / or** disadvantages for some of the methods*

Level 3 (5–6 marks)

There is a clear description of the advantages and disadvantages of all the methods.

examples of the points made in the response

extra information

energy storage

advantages:

- no fuel costs
- no environmental effects

disadvantages:

- expensive to set up and maintain
- need to dig deep under road
- dependent on (summer) weather
- digging up earth and disrupting habitats

salt spreading

advantages:

- easily available
- cheap

disadvantages:

- can damage trees / plants / drinking water / cars
- needs to be cleaned away

undersoil heating

advantages:

- not dependent on weather
- can be switched on and off

disadvantages:

- costly
- bad for environment

6
[18]

7

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1–2 marks)

Considers either solid or gas and describes at least one aspect of the particles.

or

Considers both solids and gases and describes an aspect of each.

Level 2 (3–4 marks)

Considers both solids and gases and describes aspects of the particles.

or

Considers one state and describes aspects of the particles and explains at least one of the properties.

or

Considers both states and describes an aspect of the particles for both and explains a property for solids or gases.

Level 3 (5–6 marks)

Considers both states of matter and describes the spacing and movement / forces between the particles. Explains a property of both solids and gases.

examples of the points made in the response

extra information

Solids

- (particles) close together
- (so) no room for particles to move closer (so hard to compress)
- vibrate about fixed point
- strong forces of attraction (at a distance)
- the forces become repulsive if the particles get closer
- particles strongly held together / not free to move around (shape is fixed)

any explanation of a property must match with the given aspect(s) of the particles.

Gases

- (particles) far apart
- space between particles (so easy to compress)
- move randomly
- negligible / no forces of attraction
- spread out in all directions (to fill the container)

[6]

8

(a) conduction

must be in correct order

1

convection

1

(b) (i) 70

*accept \pm half a square
(69.8 to 70.2)*

1

(ii) 15

*accept 14.6 to 15.4 for 2 marks
allow for 1 mark 70 – 55
ecf from (b)(i) \pm half a square*

2

(iii) C

1

biggest drop in temperature during a given time

accept it has the steepest gradient this is a dependent

1

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

1

(v) because 20 °C is room temperature

accept same temperature as surroundings

1

(c) (i) 6720

correct answer with or without working gains 3 marks

6 720 000 gains 2 marks

correct substitution of $E = 0.2 \times 4200 \times 8$ gains 2 marks

correct substitution of $E = 200 \times 4200 \times 8$ gains 1 mark

3

(ii) the fastest particles have enough energy

accept molecules for particles

1

to escape from the surface of the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

the lower the mean energy of particles the lower the temperature (of the water)
accept speed for energy

1
[16]

9

(a) (i) Z

1

(ii) X

1

(b) (i) moving randomly

1

(ii) stronger than

1

(c) (i) evaporation

1

(ii) any **one** from:

- becomes windy
- temperature increases
accept (becomes) sunny
"the sun" alone is insufficient
- less humid

1

[6]

10

(a) there are strong forces (of attraction) between the particles in a solid

accept molecules / atoms for particles throughout
accept bonds for forces

1

(holding) the particles close together

particles in a solid are less spread out is insufficient

1

or

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

accept very small / zero for negligible
accept bonds for forces

1

so the particles spread out (to fill their container)

accept particles are not close together
gas particles are not in a fixed position is insufficient

1

- (b) (i) particles are (shown) leaving (the liquid / container)
accept molecules / atoms for particles throughout
accept particles are escaping
particles are getting further apart is insufficient 1
- (ii) *accept molecules / atoms for particles throughout*
accept speed / velocity for energy throughout
- particles with most energy leave the (surface of the) liquid
accept fastest particles leave the liquid 1
- so the mean / average energy of the remaining particles goes down 1
- and the lower the average energy (of the particles) the lower the temperature (of the liquid) 1

[8]

11

- (a) (i) random distribution of circles in the box with at least 50 % of circles touching 1
- random distribution of circles occupies more than 50 % of the space
judged by eye 1
- (ii) (large) gaps between particles
accept particles do not touch
accept particles are spread out 1
- (so) easy to push particles closer (together)
or
 forces between particles are negligible / none
an answer in terms of number of particles is insufficient 1
- (b) (i) (both are) random
accept a correct description of random eg unpredictable or move around freely or in all directions
they take up all the space is insufficient
they are spread out is insufficient
they move in straight lines is insufficient 1
- (ii) (speed also) increases 1

[6]

12

(a) ions / electrons gain (kinetic) energy

accept atom / particles / molecules for ion

accept ions vibrate faster

accept ions vibrate with a bigger amplitude

accept ions vibrate more

do not accept ions move faster

1

(free) electrons transfer energy by collision with ions

or energy transferred by collisions between vibrating ions

1

(b) move faster or take up more space

*do **not** accept start to move / vibrate*

1

(warmer) water expands **or** becomes less dense (than cooler water)

*do **not** accept answers in terms of particles expanding*

1

warm water rises (through colder water) **or** colder water falls to take its place

1

(c) transfer of energy by waves / infrared (radiation)

accept rays for waves

*do **not** accept transfer of energy by electromagnetic waves*

ignore reference to heat

1

[6]