New Document 1

Name: _____

Class: _____

Date: _____

Time: **83 minutes**

Marks: **82 marks**

Comments:

Q1.

Solid, liquid and gas are three different states of matter.

(a) Describe the difference between the solid and gas states, in terms of the arrangement and movement of their particles.

(4)

(b) What is meant by 'specific latent heat of vaporisation'?

(2)

(c) While a kettle boils, 0.018 kg of water changes to steam.

Calculate the amount of energy required for this change.

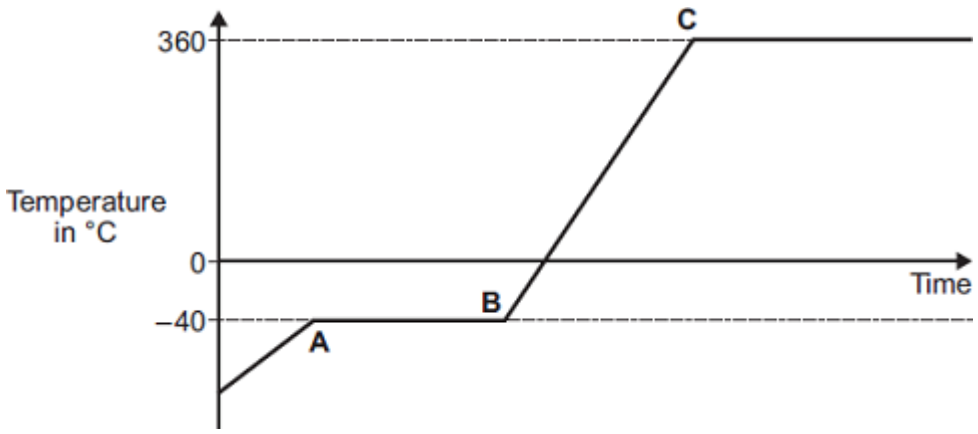
Specific latent heat of vaporisation of water = 2.3×10^6 J / kg.

Energy required = _____ J

(2)

(d) The graph shows how temperature varies with time for a substance as it is heated.

The graph is **not** drawn to scale.



Explain what is happening to the substance in sections **AB** and **BC** of the graph.

Section **AB** _____

_____

_____

_____

_____

Section **BC** _____

_____

_____

_____

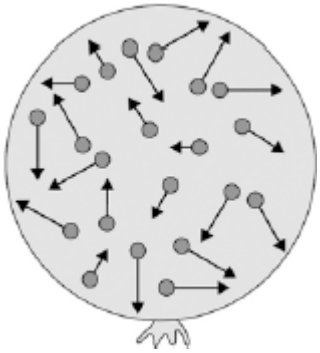
_____

(4)

(Total 12 marks)

Q2.

The figure below shows a balloon filled with helium gas.



(a) Describe the movement of the particles of helium gas inside the balloon.

_____

_____

_____

_____

(2)

(b) What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

Tick **one** box.

External energy ☐

Internal energy ☐

Movement energy ☐

(1)

(c) Write down the equation which links density, mass and volume.

_____

(1)

(d) The helium in the balloon has a mass of 0.00254 kg.

The balloon has a volume of 0.0141 m^3.

Calculate the density of helium. Choose the correct unit from the box.

m^3 / kg	**kg / m^3**	**kg m^3**

_____

_____

_____

_____

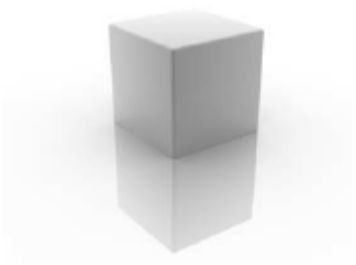
Density = _____ Unit _____

(3)

(Total 7 marks)

Q3.

A student wants to calculate the density of the two objects shown in the figure below.



Metal cube

Small statue

Describe the methods that the student should use to calculate the densities of the two objects.

(Total 6 marks)

Q4.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The information in the box is about the properties of solids and gases.

Solids:
- have a fixed shape
- are difficult to compress (to squash).

Gases:
- will spread and fill the entire container
- are easy to compress (to squash).

Use your knowledge of kinetic theory to explain the information given in the box.

You should consider:
- the spacing between the particles
- the movement of individual particles
- the forces between the particles.

Extra space _____

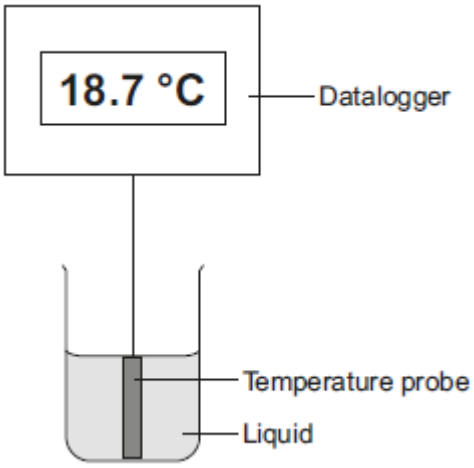
(Total 6 marks)

Q5.

A student investigated the cooling effect of evaporation.

She used the equipment (datalogger and probe) shown in **Figure 1** to measure how the temperature of a liquid changed as the liquid evaporated.

Figure 1



(a) Which type of variable was the temperature in this investigation?

Tick (✓) **one** box.

	Tick (✓)
control	
dependent	
independent	

(1)

(b) Before the investigation started, the student checked the accuracy of three different temperature probes. The student put the probes in a beaker of boiling water that had a temperature of 100.0 °C.
The readings from the three temperature probes are shown in **Figure 2**.

Figure 2

Probe A	Probe B	Probe C
99.8	100.1	103.2

Which **one** of the temperature probes, **A**, **B** or **C**, was **least** accurate?

Write the correct answer in the box.

Give a reason for your answer.

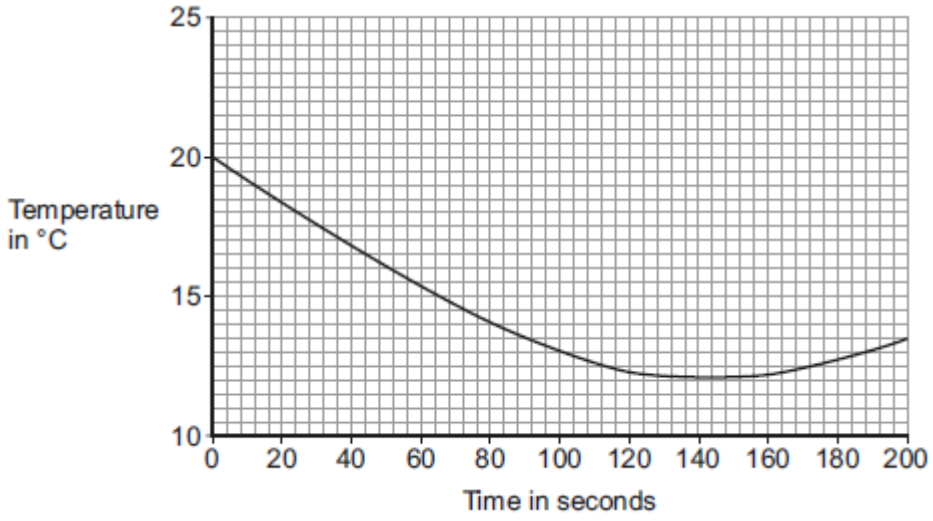
_____

_____

(2)

(c) **Figure 3** shows how the temperature recorded changed during the investigation.

Figure 3



(i) Use **Figure 3** to determine the lowest temperature recorded as the liquid evaporated.

Temperature = _____ °C

(1)

(ii) Use **Figure 3** to determine how long it took for all the liquid to evaporate. Give a reason for your answer.

Time = _____ seconds

Reason: _____

_____

(2)

(iii) How would increasing the starting temperature of the liquid above 20 °C affect the rate of evaporation of the liquid?

_____

_____

(1)

(Total 7 marks)

Q6.

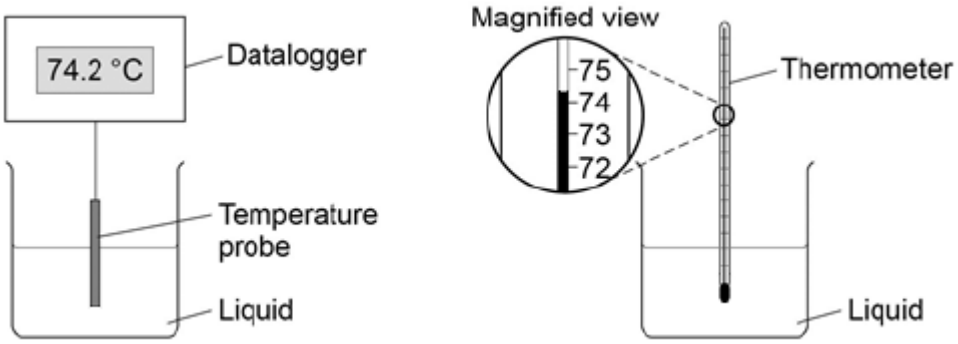
Two students investigated the change of state of stearic acid from liquid to solid.

They measured how the temperature of stearic acid changed over 5 minutes as it changed from liquid to solid.

Figure 1 shows the different apparatus the two students used.

Figure 1

Student A's apparatus **Student B's apparatus**



(a) Choose **two** advantages of using student **A**'s apparatus.

Tick **two** boxes.

Student **A**'s apparatus made sure the test was fair. ☐

Student **B**'s apparatus only measured categoric variables. ☐

Student **A**'s measurements had a higher resolution. ☐

Student **B** was more likely to misread the temperature. ☐

(2)

(b) Student **B** removed the thermometer from the liquid each time he took a temperature reading.

What type of error would this cause?

Tick **one** box.

A systematic error ☐

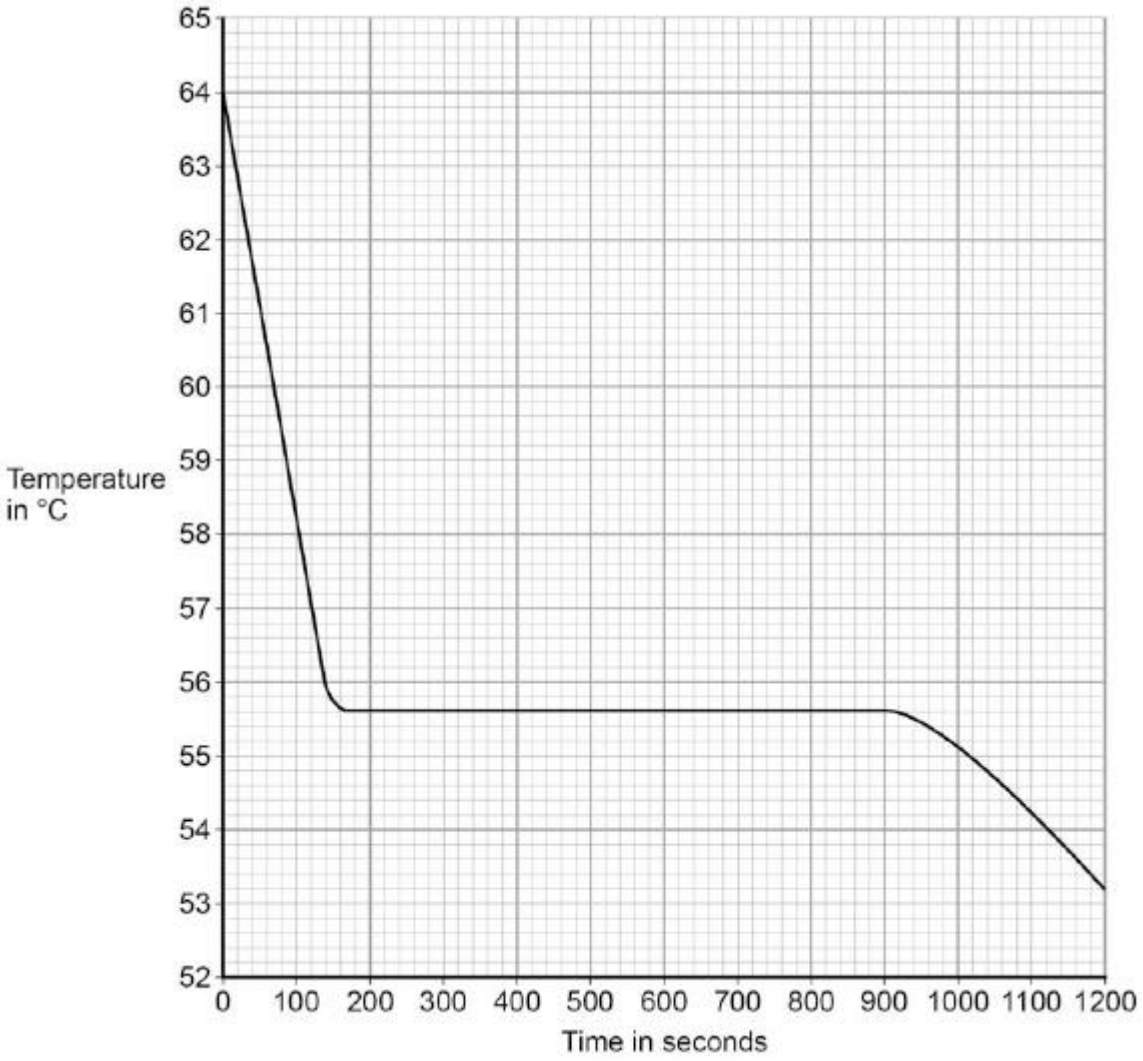
A random error ☐

A zero error ☐

(1)

(c) Student **A**'s results are shown in **Figure 2**.

Figure 2



What was the decrease in temperature between 0 and 160 seconds?

Tick **one** box.

8.2 °C ☐

8.4 °C ☐

53.2 °C ☐

55.6 °C ☐

(1)

(d) Use **Figure 2** to determine the time taken for the stearic acid to change from a liquid to a solid.

Time = _____ seconds

(1)

(e) Calculate the energy transferred to the surroundings as 0.40 kg of stearic acid changed state from liquid to solid.

The specific latent heat of fusion of stearic acid is 199 000 J / kg.

Use the correct equation from the Physics Equations Sheet.

Energy = _____ J

(2)

(f) After 1200 seconds the temperature of the stearic acid continued to decrease.

Explain why.

(2)

(Total 9 marks)

Q7.

(a) A company is developing a system which can heat up and melt ice on roads in the winter. This system is called 'energy storage'.

During the summer, the black surface of the road will heat up in the sunshine.

This energy will be stored in a large amount of soil deep under the road surface. Pipes will run through the soil. In winter, cold water entering the pipes will be warmed and brought to the surface to melt ice.

The system could work well because the road surface is black.

Suggest why.

(1)

(b) (i) What is meant by specific latent heat of fusion?

(2)

(ii) Calculate the amount of energy required to melt 15 kg of ice at 0 °C.

Specific latent heat of fusion of ice = 3.4×10^5 J/kg.

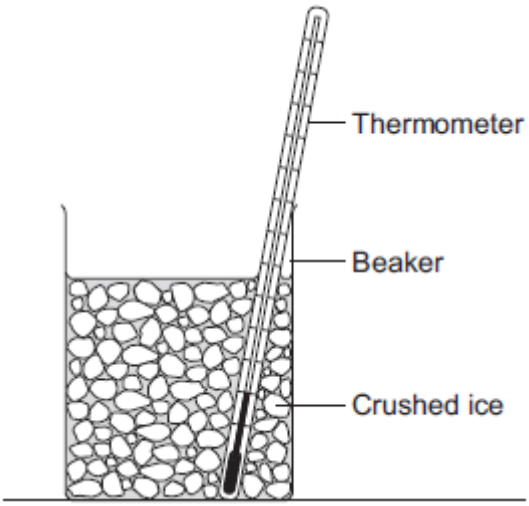
Energy = _____ J

(2)

(c) Another way to keep roads clear of ice is to spread salt on them.
When salt is added to ice, the melting point of the ice changes.

A student investigated how the melting point of ice varies with the mass of salt added.

The figure below shows the equipment that she used.



The student added salt to crushed ice and measured the temperature at which the ice melted.

(i) State **one** variable that the student should have controlled.

_____

_____

(1)

(ii) During the investigation the student stirred the crushed ice.

Suggest **two** reasons why.

Tick (✓) **two** boxes.

	Tick (✓)
To raise the melting point of the ice	
To lower the melting point of the ice	
To distribute the salt throughout the ice	
To keep all the ice at the same temperature	
To reduce energy transfer from the surroundings to the	

ice	

(2)

(iii) The table below shows the data that the student obtained.

Mass of salt added in grams	0	10	20
Melting point of ice in °C	0	-6	-16

Describe the pattern shown in the table.

_____

_____

(1)

(d) Undersoil electrical heating systems are used in greenhouses. This system could also be used under a road.

A cable just below the ground carries an electric current. One greenhouse system has a power output of 0.50 kW.

Calculate the energy transferred in 2 minutes.

_____

_____

_____

Energy transferred = _____ J

(3)

(e) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

A local council wants to keep a particular section of a road clear of ice in the winter.

Describe the advantages and disadvantages of keeping the road clear of ice using:

- energy storage
- salt
- undersoil electrical heating.

_____

_____

_____

_____

_____

_____

Extra space

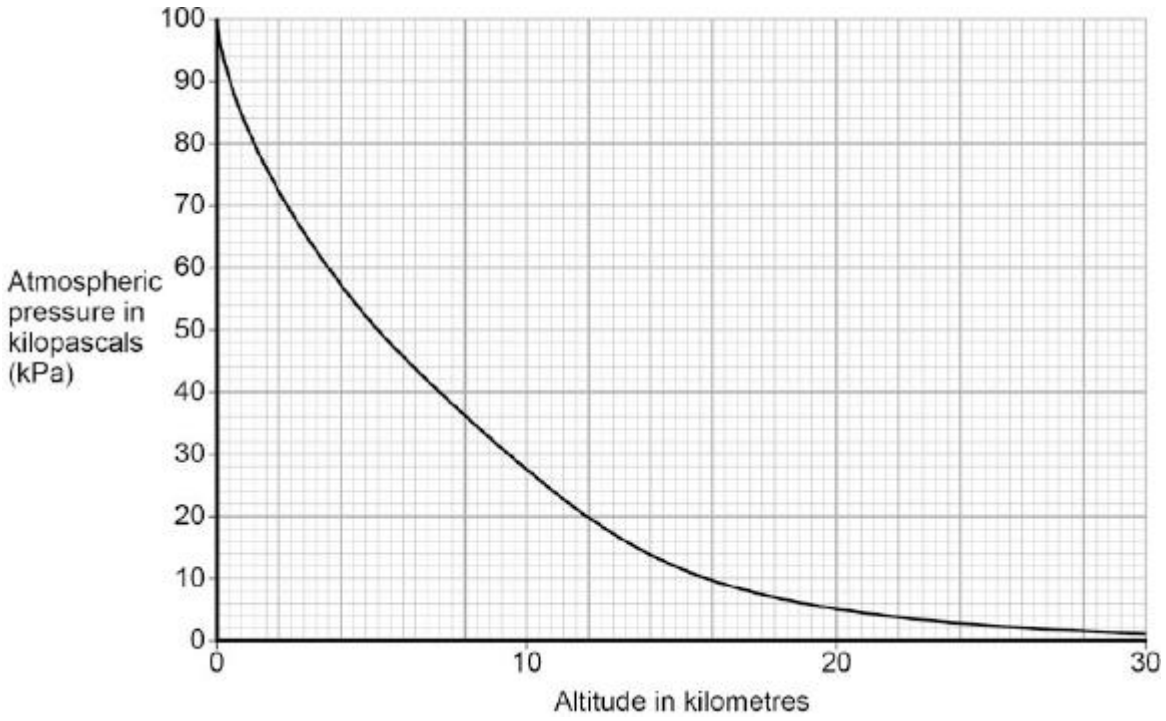
(6)

(Total 18 marks)

Q8.

Figure 1 shows how atmospheric pressure varies with altitude.

Figure 1



(a) Explain why atmospheric pressure decreases with increasing altitude.

(3)

(b) When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 810 cm^2.

Use data from **Figure 1** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

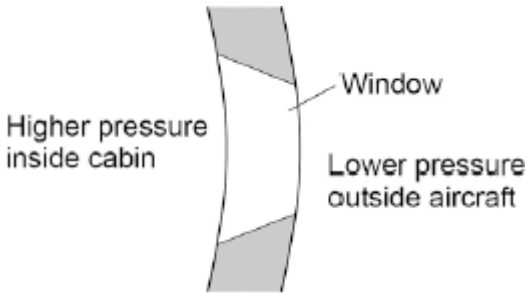
Give your answer to two significant figures

Resultant force = _____ N

(5)

(c) **Figure 2** shows the cross-section of one type of aircraft window.

Figure 2



Explain why the window has been designed to have this shape.

(2)

(Total 10 marks)

Q9.

Some students fill an empty plastic bottle with water.
The weight of the water in the bottle is 24 N and the cross-sectional area of the bottom of the bottle is 0.008 m^2.

(a) Calculate the pressure of the water on the bottom of the bottle and give the unit.

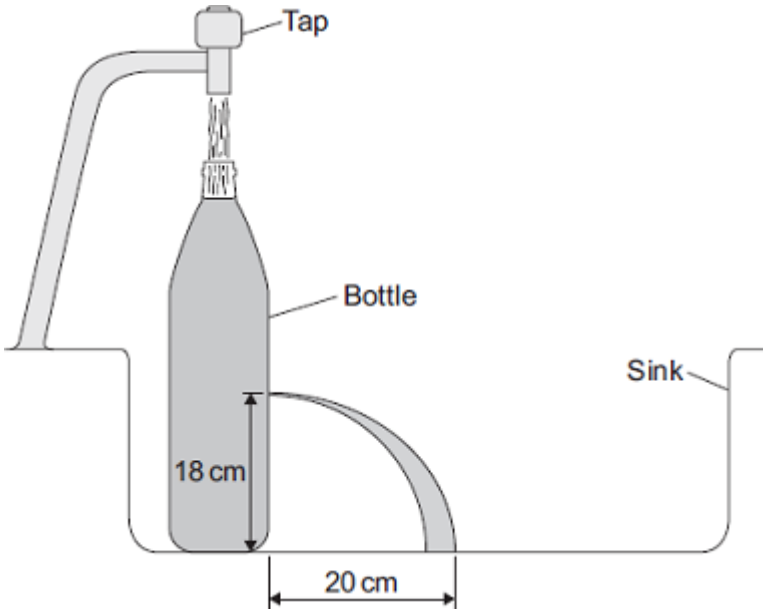
_____

_____

Pressure = _____

(3)

(b) The students made four holes in the bottle along a vertical line.
They put the bottle in a sink. They used water from a tap to keep the bottle filled to the top.



The students measured and recorded the vertical heights of the holes above the sink.
They also measured the horizontal distances the water landed away from the bottle.
A pair of measurements for one of the holes is shown in the diagram.

The complete data from the experiment is shown in the table.

Hole	Vertical height in cm	Horizontal distance in cm
J	24	15
K	18	20
L	12	30
M	6	40

(i) Which hole is shown in the diagram?

Draw a ring around the correct answer.

J **K** **L**

(1)

(ii) On the diagram, draw the path of the water coming out of hole **M**.

Use the information in the table to help you.

(2)

(c) Suggest **one** problem that might arise from trying to collect data from a fifth hole with a vertical height of 1 cm above the sink.

_____

_____

(1)

(Total 7 marks)

Mark schemes

Q1.

(a) **solid**
particles vibrate about fixed positions
1

closely packed
accept regular
1

gas
particles move randomly
accept particles move faster
accept freely for randomly
1

far apart
1

(b) amount of energy required to change the state of a substance from liquid to gas (vapour)
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]

Q2.

(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 / m^3

1

[7]

Q3.

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]

Q4.

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]

Q5.

(a) dependent

1

(b) (probe) C

allow 103.2

1

largest difference between reading and actual temperature

reason only scores if C chosen

accept larger

it is 3.2 greater is insufficient

comparing C with only one other probe is insufficient

1

(c) (i) 12(°C)

accept a value between 12.0 and 12.2 inclusive

1

(ii) 140 (seconds)

accept an answer between 130 and 150 inclusive

1

temperature starts to rise

only scores if time mark awarded

accept the temperature was lowest (at this time)

1

(iii) increase

accept faster (rate)

1

[7]

Q6.

(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 × 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

accept stearic acid is hotter than the surroundings

1

temperature will decrease until stearic acid is the same as the room temperature / surroundings

1

[9]

Q7.

(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 <u>*ice*</u>

allow volume / weight / amount / quantity of <u>*ice*</u>

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]

Q8.

(a) air molecules colliding with a surface create pressure

1

at increasing altitude distance between molecules increases

or

at increasing altitude fewer molecules (above a surface)

1

so number of collisions with a surface decreases

or

or so always less weight of air than below (the surface)

1

(b) atmospheric pressure = 20 kPa from graph **and** conversion of 810 cm^2 to 0.081 m^2

allow ecf for an incorrect value clearly obtained from the graph

1

$5 \times 10^4 = \frac{F}{0.081}$

1

$F = 5 \times 10^4 \times 0.081$

1

4050

1

4100 (N)

1

*allow 4100 (N) with no working shown for **5** marks*

*allow 4050 with no working shown for **4** marks*

(c) force from air pressure acting from inside to outside bigger than force acting inwards

1

so keeps the window in position

1

[10]

Q9.

(a) 3000

*correct substitution of 24 / 0.008 gains **1** mark provided no subsequent steps are shown*

2

N / m^2 or Pa

1

(b) (i) K

accept ringed K in table

1

(ii) water exiting bottle one-third of vertical height of K

allow less than half vertical height of spout shown, judged by eye

1

water landing twice the distance of the spout shown in the diagram

accept at least one and a half times further out than spout shown, judged by eye

*do **not** accept water hitting the side of the sink*

ignore trajectory

1

(c) water will land on the (vertical) side of the sink

*accept sink **not** long / wide / big enough*

or

water will dribble down very close to the bottle

or

that part of the bottle is curved

*do **not** accept goes out of the sink*

1

[7]