AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.3.1 CHANGES OF STATE AND THE PARTICLE MODEL (PACK 2)

SCORE	PERCENTAGE
/131	%

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Q1.

A student wanted to determine the density of the irregular shaped object shown in **Figure 1**

Figure 1



(a) Plan an experiment that would allow the student to determine the density of the object.

(6)

(b) Another student did a similar experiment.

He determined the density of five common plastic materials.

Table 1 shows the results.

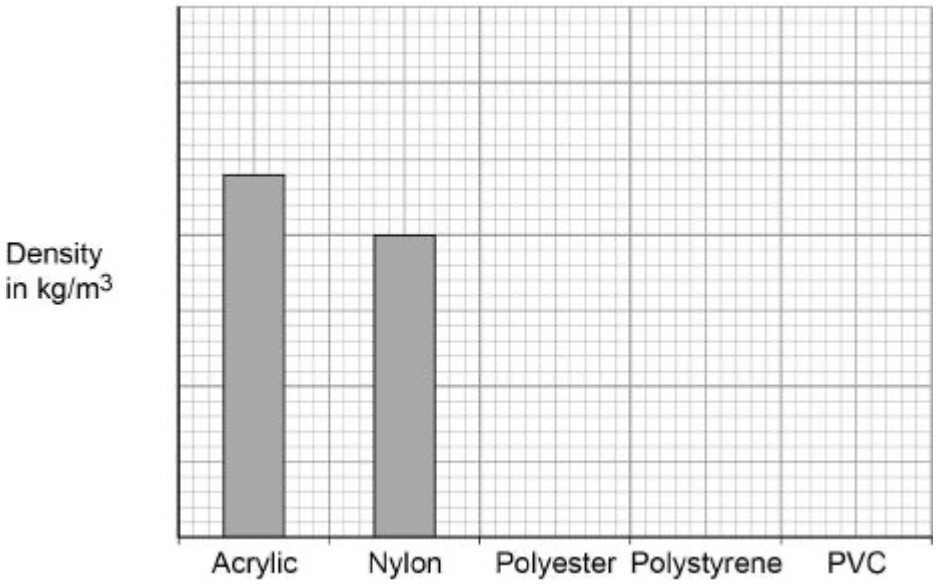
Table 1

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Plastic material	Density in kg/m^3
Acrylic	1200
Nylon	1000
Polyester	1380
Polystyrene	1040
PVC	1100

Figure 2 shows the results plotted in a bar chart.

Figure 2



Complete **Figure 2**

You should:

- Write the correct scale on the y-axis.
- Draw the bars for polyester, polystyrene and PVC.

(4)

(c) The student is given a piece of a different plastic material.

The student determined the density of the material three times.

Table 2 shows the results.

Table 2

	Density in kg/m^3
1	960
2	1120
3	1040

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Determine the uncertainty in the student's results.

_____

_____

Uncertainty = _____ kg/m^3

(2)

(Total 12 marks)

Q2.

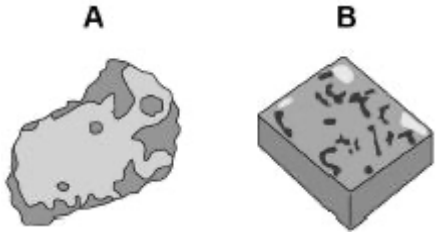
Two large semi-precious stones are discovered.

A student is asked to find out what material each of the two stones is made of.

The student does this by determining the density of the material of each stone.

Figure 1 shows the two stones.

Figure 1



(a) The student wants to measure the volume of stone **A**. Stone **A** cannot be measured using a metre rule as the stone is an irregular shape.

Describe how the student could determine the volume of stone **A** by putting it into water.

_____

_____

_____

_____

_____

_____

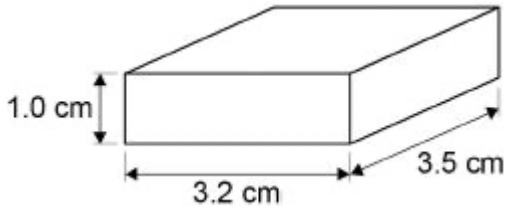
(3)

The student makes measurements of stone **B** using a metre rule.

The measurements of stone **B** are shown **in Figure 2**.

Figure 2

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(b) Which piece of equipment could the student use to get a more accurate measurement of the length of stone **B**?

Tick **one** box.

Electronic balance ☐

Microscope ☐

Newtonmeter ☐

Vernier callipers ☐

(1)

(c) Use the following equation to calculate the volume of stone **B** in cm^3

volume = length × width × height

_____

_____

Volume = _____ cm^3

(1)

(d) The mass of stone **B** is 56 grams.

Use your answer from part **(c)** to calculate the density of stone **B** in g/cm^3

Use the following equation.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

_____

_____

_____

_____

Density = _____ g/cm^3

(2)

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(e) The student calculates the density of the material stone **A** is made of as 5.2 g/cm^3

The student looks up the density of some materials in a text book.

Figure 3 shows this information.

Figure 3

Material	Density in g/cm^3
Amber	1.1 – 1.2
Cubic Zirconia	5.5 – 5.9
Garnet	3.8 – 3.9
Haematite	5.1 – 5.3

What material is stone **A** made of?

Tick **one** box.

Amber ☐

Cubic Zirconia ☐

Garnet ☐

Haematite ☐

(1)

(Total 8 marks)

Q3.

Water exists as ice, water or steam.

(a) Complete the sentences.

Choose the answers from the box.

ice	steam	water

The particles are arranged in a regular pattern in _____ .

The particles are close together but not in a pattern in _____ .

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The particles move quickly in all directions in _____ .

(2)

(b) Which will have the most internal energy?

Tick **one** box.

1 kg of ice ☐

1 kg of steam ☐

1 kg of water ☐

(1)

(c) Which will have the lowest density?

Tick **one** box.

Ice ☐

Steam ☐

Water ☐

(1)

The image shows an iceberg floating in the sea.



(d) The iceberg has a mass of 11 200 kg

The volume of the iceberg is 12.0 m^3

Calculate the density of the iceberg.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

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_____

_____

Density = _____ kg/m^3

(2)

(e) Explain why the iceberg will melt.

_____

_____

_____

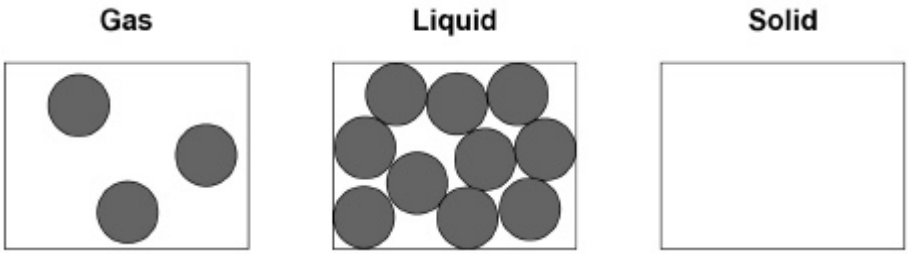
_____

(2)

(Total 8 marks)

Q4.

The diagram shows a model of the particles in a gas and in a liquid.



(a) Complete the diagram to show the arrangement of particles of the same substance as a solid.

(2)

(b) What is the name of the process when a substance changes from a gas to a liquid?

Tick **one** box.

Condensing	☐
Evaporating	☐
Freezing	☐
Melting	☐

(1)

(c) The substance in the diagram has a:

- melting point of 98 °C
- boiling point of 883 °C

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What is the state of the substance at 20 °C?

Tick **one** box.

Gas ☐ Liquid ☐ Solid ☐

(1)

(d) What type of change is a change of state?

Tick **one** box.

Chemical ☐

Kinetic ☐

Permanent ☐

Physical ☐

(1)

(e) Which **two** statements are correct about the particles when a liquid turns into a gas?

Tick **two** boxes.

Particles are bigger ☐

Particles are lighter ☐

Particles have more chemical energy ☐

Particles have more kinetic energy ☐

Particles move faster ☐

(2)

(f) Which **two** quantities are needed to calculate the energy required to turn a liquid into a gas with no change in temperature?

Tick **two** boxes.

Mass of the liquid ☐

Specific heat capacity of the gas ☐

Specific latent heat of vaporisation ☐

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Time the liquid is heated ☐

(2)

(g) A mass of 2.0 kg of water is heated.

The temperature increase of the water is 80 °C

The specific heat capacity of water is 4200 J / kg °C

Calculate the change in thermal energy when the water is heated.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

_____

_____

_____

Change in thermal energy = _____ J

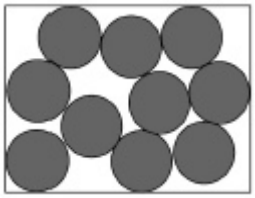
(2)

(Total 11 marks)

Q5.

Figure 1 shows a model of the particles in a liquid.

Figure 1



(a) Give **one** similarity and **one** difference you would see in **Figure 1** if it showed the same substance as a gas.

Similarity _____

_____

Difference _____

_____

(2)

(b) Describe **two** limitations of the model shown in **Figure 1**.

1. _____

_____

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2. _____

_____

(2)

(c) Explain why substances have different melting points.

_____

_____

_____

_____

(2)

(d) Some fire extinguishers contain liquid carbon dioxide.

Suggest how carbon dioxide gas can be changed to liquid carbon dioxide without reducing its temperature.

_____

_____

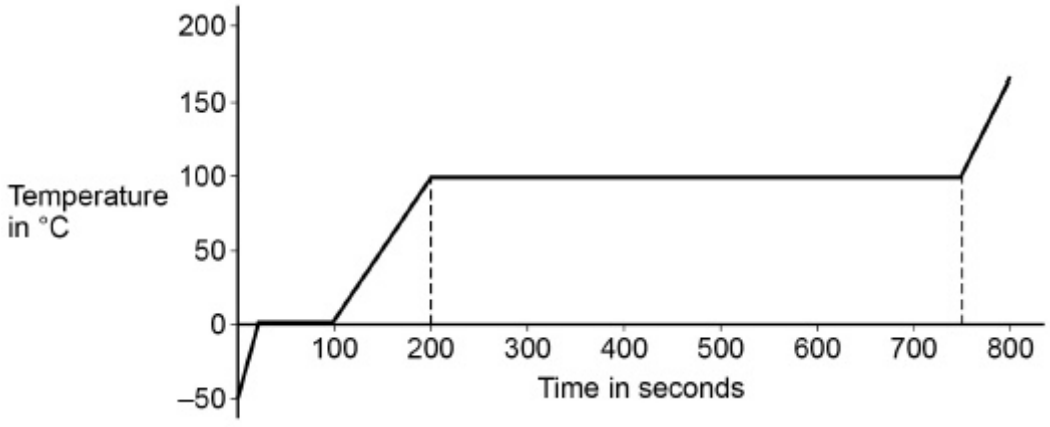
(1)

Ice was heated at a constant rate.

Eventually all the ice changed to a gas.

Figure 2 shows how the temperature changed over 800 seconds.

Figure 2



(e) What change of state occurs between 200 seconds and 750 seconds?

_____

_____

(1)

(f) Explain how **Figure 2** shows that the specific latent heat of vaporisation is greater than the specific latent heat of fusion.

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Use data from **Figure 2**.

_____

_____

_____

_____

(2)

(g) 1695 kJ of energy is transferred to water at 100 °C

The specific latent heat of vaporisation of water is 2.260×10^6 J / kg

Calculate the mass of water changed into a gas at 100 °C

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Mass of water = _____ kg

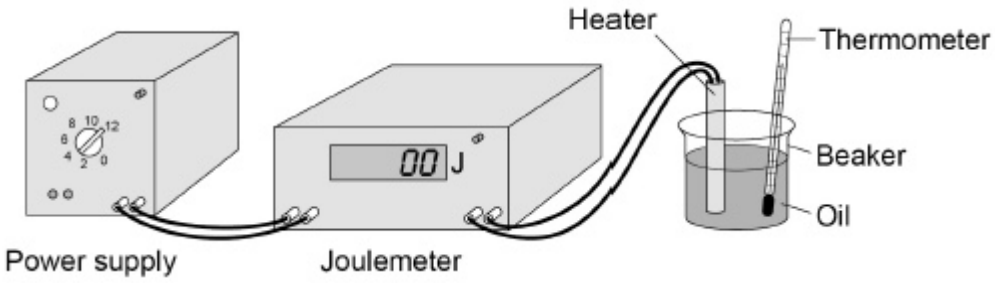
(3)

(Total 13 marks)

Q6.

Students investigated the specific heat capacity of different oils.

The diagram shows the equipment used.



This is the method used.

1. Put 200 g of an oil in a beaker.
2. Record the temperature of the oil.
3. Switch on the heater.
4. After 5 minutes, record the temperature of the oil and the reading on the joulemeter.

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5. Repeat steps 1–4 with different oils.

(a) Give **one** variable the students controlled in the investigation.

_____

(1)

The table shows the students' results for one oil.

Temperature at start in °C	**Temperature after 5 minutes in °C**
21	68

(b) What is the resolution of the thermometer used in the investigation?

Resolution = _____ °C

(1)

The students calculated the specific heat capacity of the oil as 2100 J/kg °C

The correct value for the specific heat capacity of the oil is 1630 J/kg °C

(c) Calculate the percentage difference between the two values.

_____

_____

_____

_____

Percentage difference = _____ %

(2)

(d) Suggest **two** improvements the students could make to obtain a more accurate value for the specific heat capacity.

1. _____

_____

2. _____

_____

(2)

(e) A company is considering what metal to use to make saucepans.

They use data about the:

- cost of each metal
- specific heat capacity of each metal.

Suggest **two** other properties the company needs to consider when deciding which metal to use.

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1. _____

_____

2. _____

_____

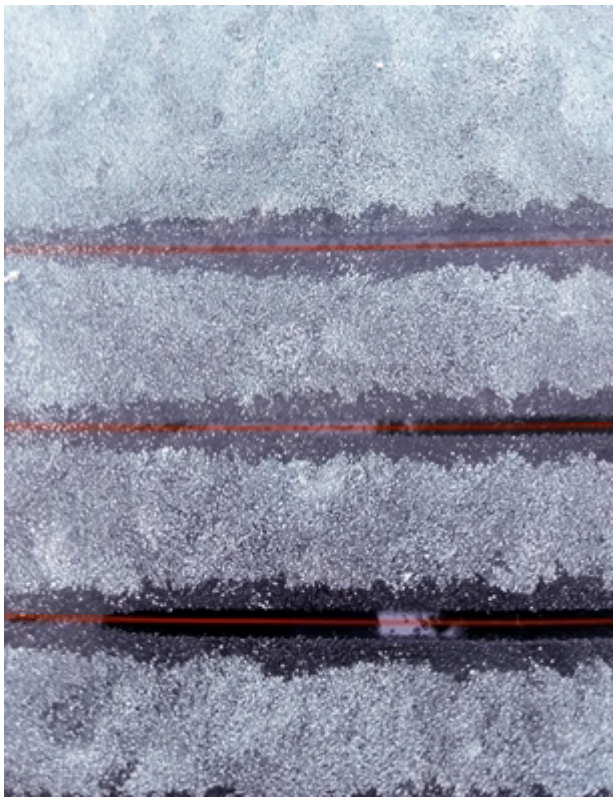
(2)

(Total 8 marks)

Q7.

Figure 1 shows solid ice on a car's rear window.

Figure 1

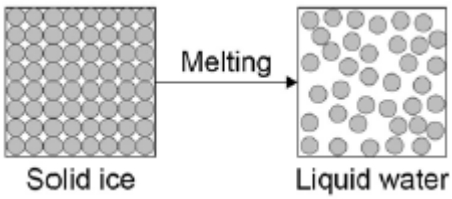


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The glass window contains an electrical heating element.

(a) Use the particle model in **Figure 2** to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 2



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You should include a description of how the particles are arranged in the solid ice and in the water.

(6)

(b) A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify **two** control variables in the car manufacturer's test.

Tick **two** boxes.

- The colour of the car ☐
- The current in the heating element ☐
- The mass of ice ☐
- The size of the car ☐
- The time taken for the ice to melt ☐

(2)

(c) Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

What is the name given to this energy supplied by the heater?

Tick **one** box.

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Latent heat of freezing ☐

Latent heat of fusion ☐

Latent heat of vaporisation ☐

(1)

(d) When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

$$\text{Efficiency} = \frac{\text{Output energy transfer}}{\text{input energy transfer}}$$

Give your answer to two decimal places.

_____

_____

_____

Efficiency = _____

(2)

(Total 11 marks)

Q8.

The particle model can be used to explain the properties of gases.

(a) Describe the direction of motion of the particles in a gas.

_____

_____

(1)

(b) Explain why heating a gas increases the average speed of the gas particles.

_____

_____

_____

_____

_____

_____

(3)

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(c) Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

(2)

(d) Water vapour is a gas. Gases change state when they cool.

The figure below shows condensation on a cold bathroom mirror.



© Dwight Eschliman/Getty Images

A volume of 2.5×10^{-5} m^3 of condensation forms on the mirror.

Density of water = 1000 kg / m^3

Specific latent heat of vaporisation of water = 2.26×10^6 J / kg.

Calculate the energy released when the condensation forms.

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_____

Energy released = _____ J

(5)

(e) Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

_____

_____

_____

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_____

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_____

_____

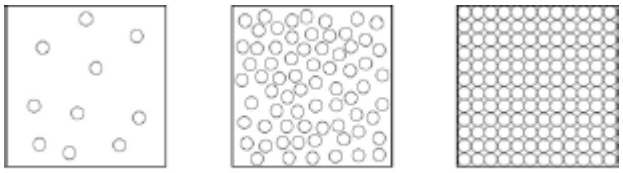
_____

(4)

(Total 15 marks)

Q9.

The figure below shows a simple model of the three states of matter.



(a) What is the correct equation to work out the density of a material?

_____

(1)

(b) A student explains density to his teacher using the particle model in the figure above.

His teacher says there are limitations to the model.

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Give **two** limitations of the particle model in the figure above.

1. _____

_____

2. _____

_____

(2)

(c) When the gas in a container with a fixed volume is heated, the pressure increases as the temperature increases.

Explain why the pressure increases.

Use the model in the figure above to help you.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

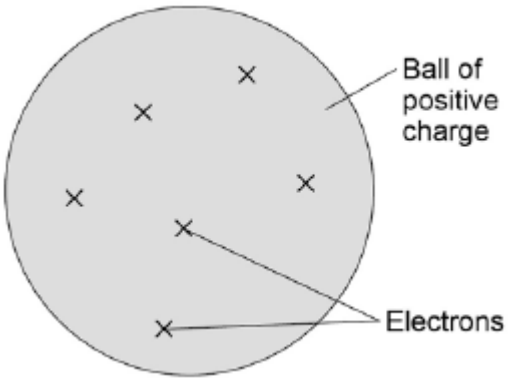
Q10.

Figure 1 shows the plum pudding model of the atom.

This model was used by some scientists after the discovery of electrons in 1897.

Figure 1

Plum-pudding model

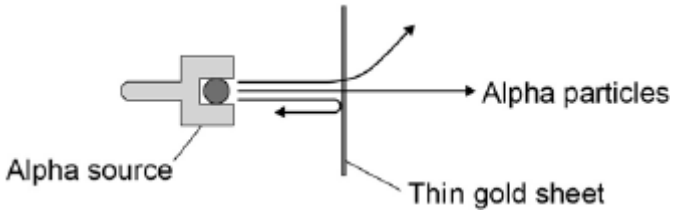


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In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.

Their experiment is shown in **Figure 2**. The arrows show the paths taken by alpha particles in the experiment.

Figure 2



(a) Explain why scientists replaced the plum pudding model of the atom with the nuclear model of the atom as a result of the experiment.

(4)

(b) According to modern measurements:

- the radius of an atom is about 1×10^{-10}m
- the radius of an atomic nucleus is about 1×10^{-14}m

Show that these values fit with the nuclear model of the atom.

(2)

(c) In 1931 a scientist discovered that there are hydrogen atoms with mass number 2 as well as hydrogen atoms with mass number 1.

A year later, another scientist discovered neutrons.

Explain why the discovery of neutrons could explain the presence of hydrogen

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atoms with different mass numbers.

_____

_____

_____

_____

_____

_____

(3)

(d) How would the results of the experiment shown in **Figure 2** change if neutrons were used instead of alpha particles to bombard a thin sheet of gold?

_____

_____

_____

_____

_____

_____

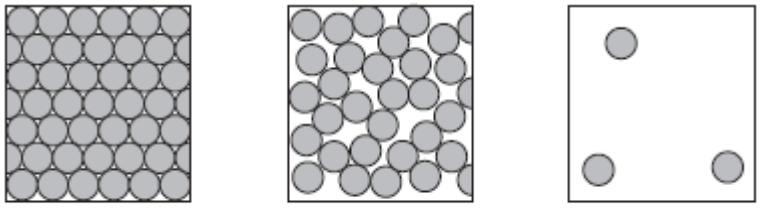
(2)

(Total 11 marks)

Q18.

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

The diagram shows the arrangement of particles in a solid, a liquid and a gas.



Use the diagram above and your own knowledge to compare solids, liquids and gases in terms of their particles.

You should include information about the arrangement, movement and energy of the particles.

_____

_____

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_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q19.

Figure 1 shows a woman filling her bathroom sink with hot water.

Figure 1



(a) The mirror changes from being dry to being covered with small drops of water.

Name the process causing this change on the mirror.

_____

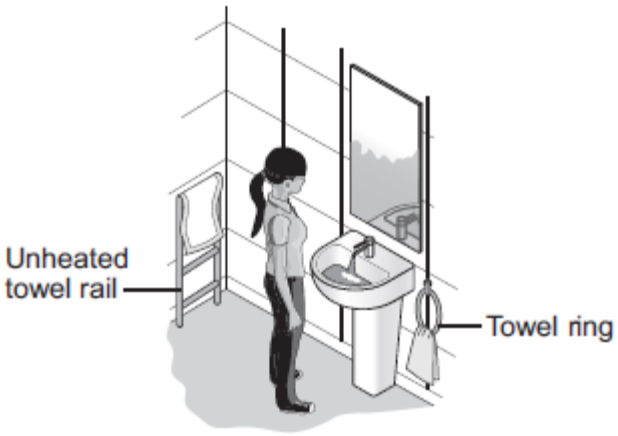
(1)

(b) The woman dries herself with a towel. She hangs the wet towel in the bathroom to dry.

Figure 2 shows two places she could hang the towel.

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Figure 2



The towel will dry faster if it is hung from the unheated towel rail instead of the towel ring.

Explain why.

_____

_____

_____

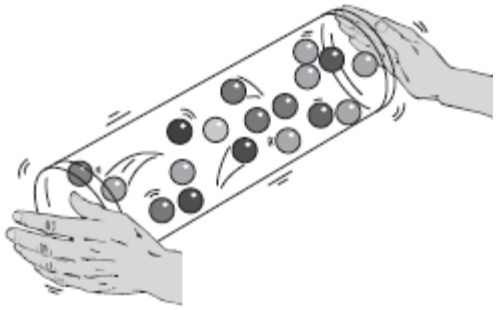
_____

(2)

(Total 3 marks)

Q20.

A student shakes a tube containing small balls to model the movement of particles in a gas.



(a) Why is this a good model for the movement of particles in a gas?

Tick (✓) **two** boxes.

The balls move slowly. ☐

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The balls are far apart from each other.	☐
The balls are different colours.	☐
The balls move randomly.	☐

(2)

(b) For a given material, in which state of matter:

are the particles in a regular arrangement?

_____

do the particles have the most kinetic energy?

_____

(2)

(Total 4 marks)

Q21.

An athlete runs in a marathon race. As he runs, his body gets hotter.

His body produces sweat to help him cool down.

(a) Explain in terms of particles, how sweating helps the athlete to cool down.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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(4)

(b) At the end of the race, the athlete is covered with a 'space blanket' made from shiny foil to prevent him from cooling too quickly.



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He wraps the space blanket around his body to reduce energy transfer to the surroundings.

How does the space blanket reduce energy transfer to the surroundings?

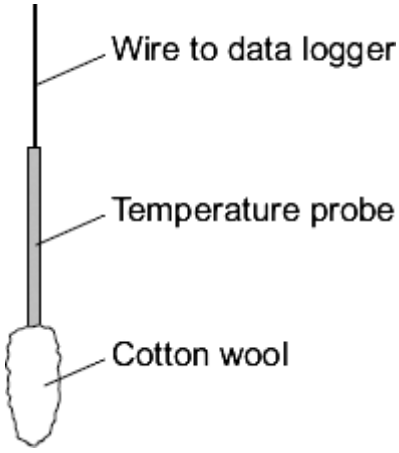
(3)

(Total 7 marks)

Q22.

A student investigated the evaporation of three different liquids using the apparatus shown.

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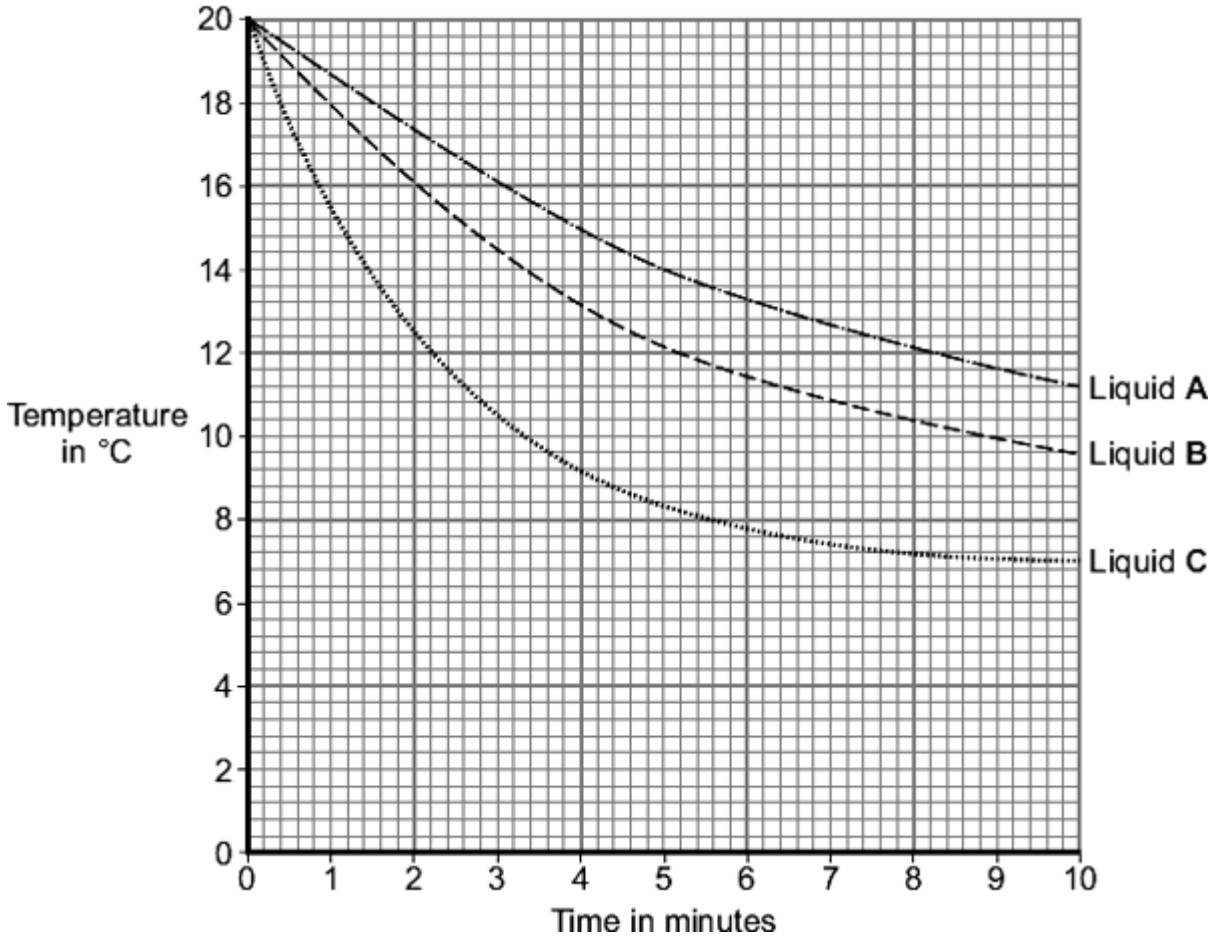


Identical pieces of cotton wool were soaked in one of three liquids, **A**, **B** or **C**, that have different boiling points. The same volume of liquid, at the same starting temperature, was used each time.

The temperature of the cotton wool was measured during a ten minute period.

The results are shown on **Graph 1**.

Graph 1



(a) Which liquid has the lowest boiling point?

Explain your choice.

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Liquid _____

Explanation _____

_____

_____

_____

(2)

(b) Room temperature is 20 °C.

The line for liquid **C** reached a lower limit of 7 °C.

Explain why the temperature did **not** fall below 7 °C.

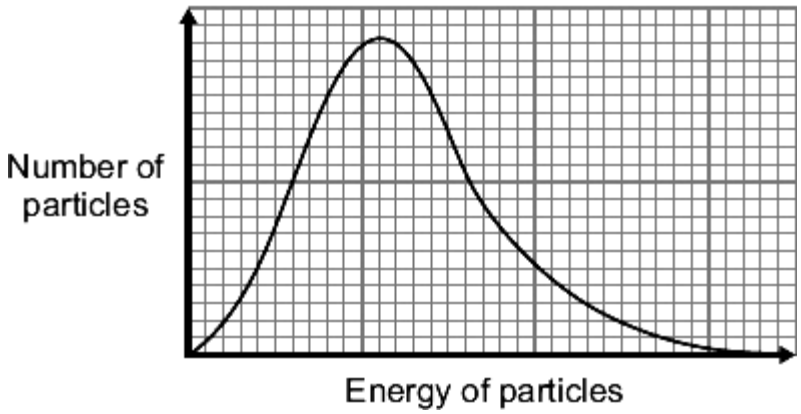
_____

_____

(1)

(c) **Graph 2** shows the distribution of energy among particles in a liquid.

Graph 2



Explain, in terms of the particles in a liquid, why evaporation causes cooling.

You may use information from **Graph 2** to help you with your answer.

_____

_____

_____

_____

_____

_____

_____

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(4)
(Total 7 marks)

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