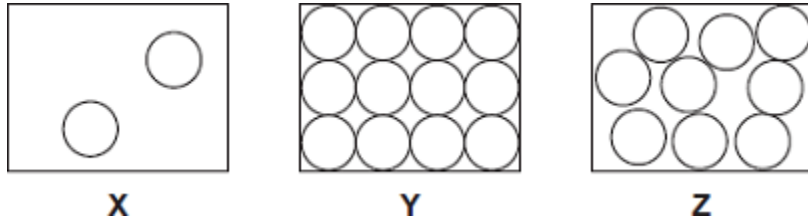


1

(a) The diagrams, **X**, **Y** and **Z**, show how the particles are arranged in the three states of matter.



(i) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a liquid?

Write the correct answer in the box.

(1)

(ii) Which **one** of the diagrams, **X**, **Y** or **Z**, shows the arrangement of particles in a gas?

Write the correct answer in the box.

(1)

(b) Draw a ring around the correct answer in each box to complete each sentence.

(i) In a gas, the particles are

- vibrating in fixed positions.
- moving randomly.
- not moving.

(1)

(ii) In a solid, the forces between the particles are

- stronger than
- equal to
- weaker than

the

forces between the particles in a liquid.

(1)

(c) The picture shows a puddle of water in a road, after a rain shower.



(i) During the day, the puddle of water dries up and disappears. This happens because the water particles move from the puddle into the air.

What process causes water particles to move from the puddle into the air?

Draw a ring around the correct answer.

**condensation**

**evaporation**

**radiation**

(1)

(ii) Describe **one** change in the weather which would cause the puddle of water to dry up faster.

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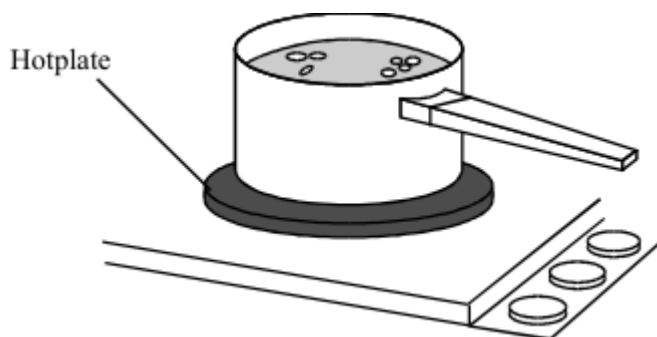
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(1)

(Total 6 marks)

2

The drawing shows water being heated in a metal saucepan.



- (a) Explain, in terms of the particles in the metal, how heat energy is transferred through the base of the saucepan.

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(2)

- (b) Energy is transferred through the water by convection currents. Explain what happens to cause a convection current in the water. The answer has been started for you.

As heat energy is transferred through the saucepan, the water particles at the bottom

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(3)

- (c) Some energy is transferred from the hotplate to the air by *thermal radiation*. What is meant by *thermal radiation*?

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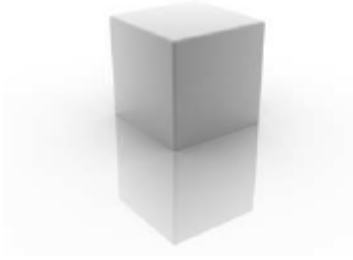
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(1)

(Total 6 marks)

3

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



**Metal cube**

© Whitehouse/iStock/Thinkstock,



**Small statue**

© Marc Dietrich/Hemera/Thinkstock

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

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**(Total 6 marks)**

4

**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.

<p>Solids:</p> <ul style="list-style-type: none"><li>• have a fixed shape</li><li>• are difficult to compress (to squash).</li></ul> <p>Gases:</p> <ul style="list-style-type: none"><li>• will spread and fill the entire container</li><li>• are easy to compress (to squash).</li></ul>
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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.

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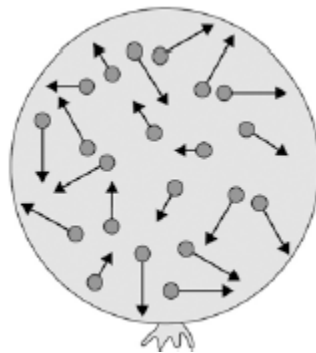
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(Total 6 marks)

**5**

The figure below shows a balloon filled with helium gas.



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

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(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.

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(1)

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

The balloon has a volume of 0.0141 m<sup>3</sup>.

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

<b>m<sup>3</sup> / kg</b>	<b>kg / m<sup>3</sup></b>	<b>kg m<sup>3</sup></b>
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Density = \_\_\_\_\_ Unit \_\_\_\_\_

(3)

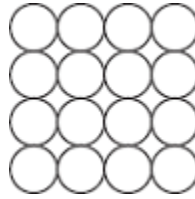
(Total 7 marks)

6

According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

**Diagram 1** shows how the particles may be arranged in a solid.

**Diagram 1**



- (a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

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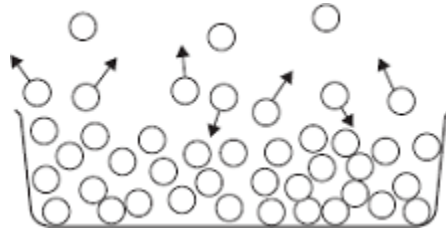
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(4)



(b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

**Diagram 2**



(i) How can you tell from **Diagram 2** that the liquid is evaporating?

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(1)

(ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

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(3)

(Total 8 marks)

**7**

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.

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**(4)**

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

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**(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 =  $2.3 \times 10^6$  J / kg.

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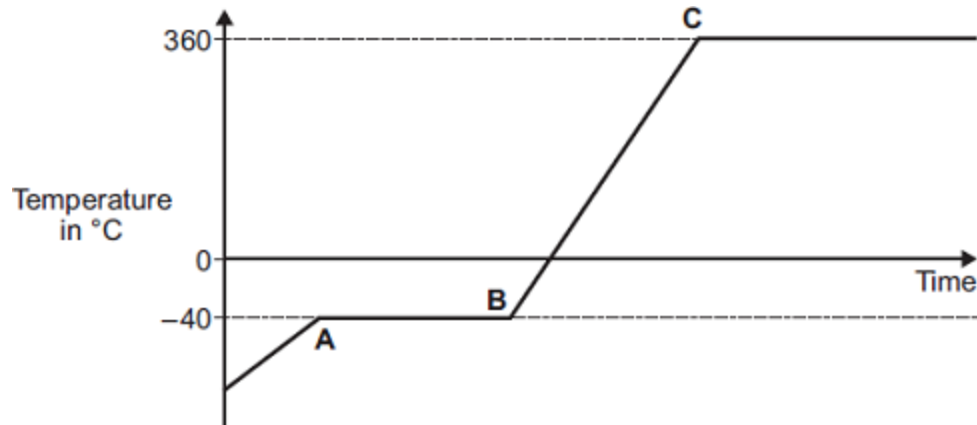
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Energy required = \_\_\_\_\_ J

**(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** \_\_\_\_\_

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Section **BC** \_\_\_\_\_

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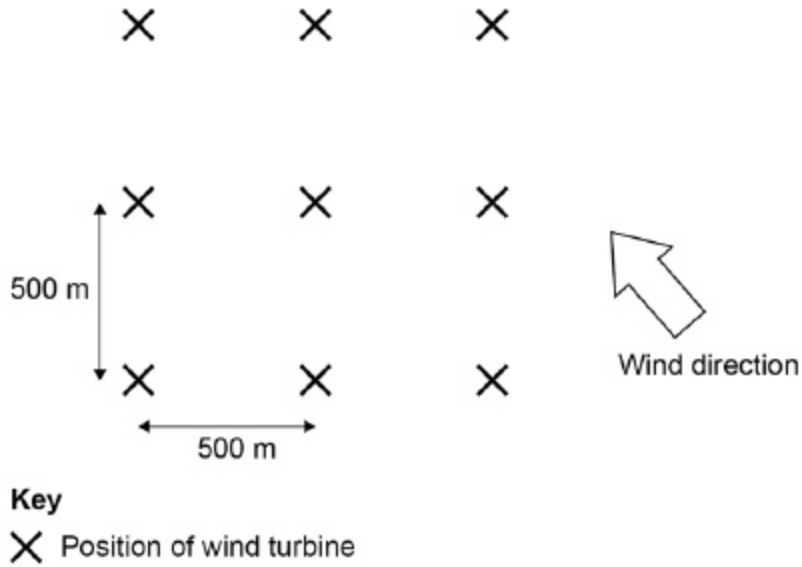
(4)

(Total 12 marks)

8

The wind turbines in a wind farm must have a minimum distance of 500 m between them for maximum efficiency.

The diagram shows the position of nine wind turbines in a wind farm.



(a) Suggest **one** way in which the layout of this wind farm ensures maximum efficiency when the wind direction changes.

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(1)

The average mass of air passing through the blades of one wind turbine is 51 000 kg per second.

The density of air is 1.2 kg / m<sup>3</sup>

(b) Write down the equation that links density, mass and volume.

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(1)

(c) Calculate the volume of air passing through the blades of one wind turbine in one second.

Give the unit.

Give your answer to 2 significant figures.

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Volume in one second = \_\_\_\_\_ Unit \_\_\_\_\_

(5)

(d) The average power output from one of the wind turbines in the diagram is  $1.6 \times 10^6$  W

The average power output of a nuclear power station is  $2.4 \times 10^9$  W

Calculate the number of wind turbines needed to generate power equal to one nuclear power station.

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Number of wind turbines = \_\_\_\_\_

(2)

(e) The UK requires a minimum electrical power of  $2.5 \times 10^{10}$  W at any time.

Give **two** reasons why wind turbines alone are unlikely to be used to meet this requirement.

1. \_\_\_\_\_

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2. \_\_\_\_\_

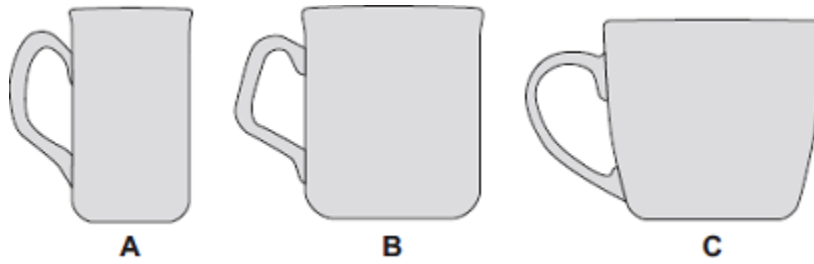
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(2)

(Total 11 marks)

9

The diagram shows three cups **A**, **B** and **C**.

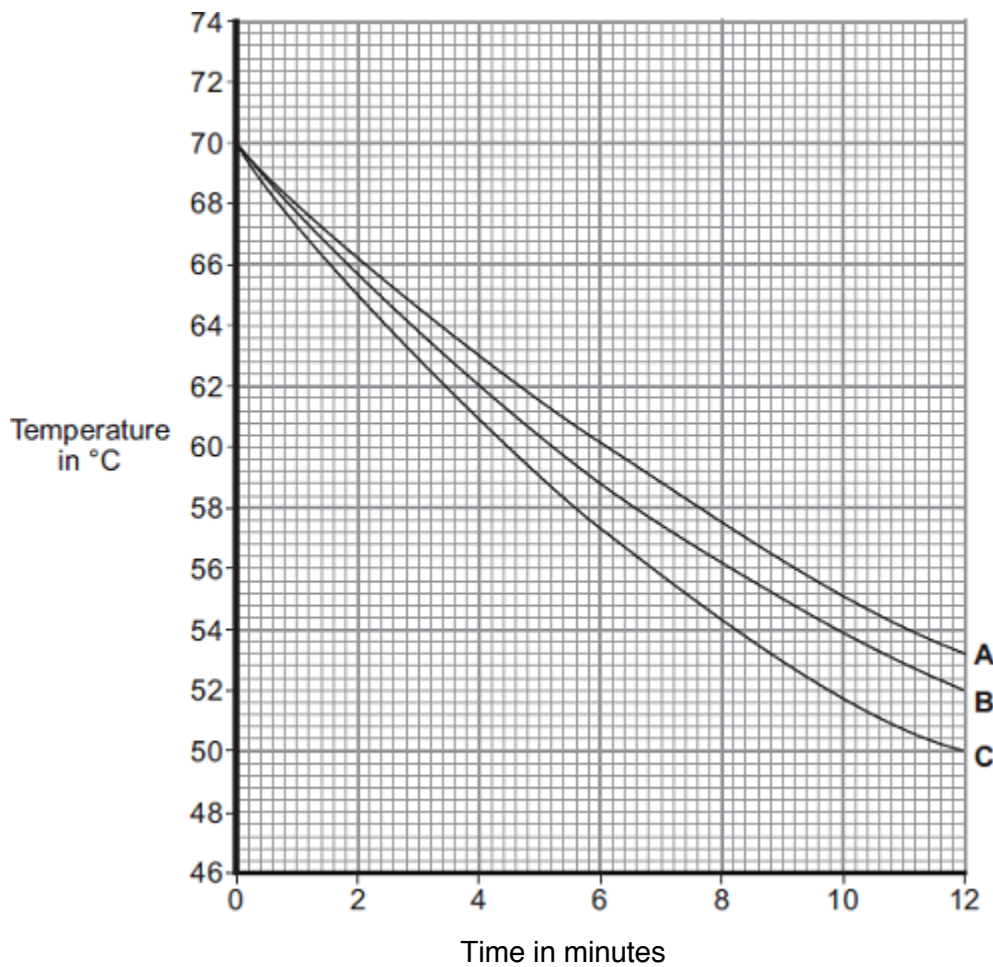


Energy is transferred from hot water in the cups to the surroundings.

- (a) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups **A**, **B** and **C**. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.



- (i) What was the starting temperature of the water for each cup?

Starting temperature = \_\_\_\_\_ °C

- (ii) Calculate the temperature fall of the water in cup **B** in the first 9 minutes.

\_\_\_\_\_

Temperature fall = \_\_\_\_\_ °C

(2)

- (iii) Which cup, **A**, **B** or **C**, has the greatest rate of cooling?



Using the graph, give a reason for your answer.

\_\_\_\_\_

\_\_\_\_\_

(2)

- (iv) The investigation was repeated using the bowl shown in the diagram.

The same starting temperature and volume of water were used.



Draw on the graph in part (b) another line to show the expected result.

(1)

- (v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20°C.

Suggest why the temperature does **not** fall below 20°C.

\_\_\_\_\_

(1)

- (b) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

Specific heat capacity of water = 4200 J / kg°C.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Energy transferred = \_\_\_\_\_ J

(3)

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

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(4)

(Total 14 marks)

10

(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.

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(1)

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

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(2)



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

Specific latent heat of fusion of ice =  $3.4 \times 10^5$  J/kg.

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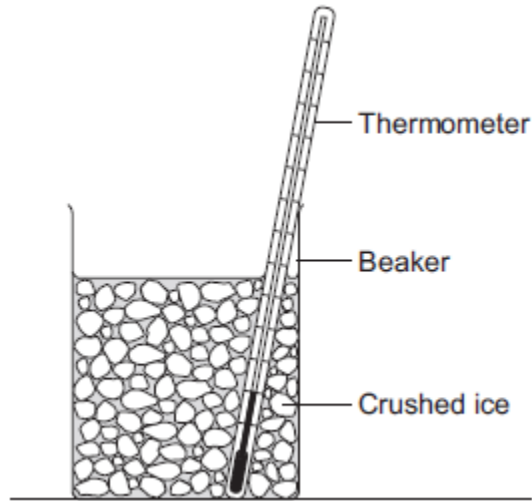
Energy = \_\_\_\_\_ J

(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.

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(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.

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

Describe the pattern shown in the table.

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(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.

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Energy transferred = \_\_\_\_\_ J

(3)

