# Internal Energy

## Question Paper 1

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|---|---|
| **Level** | GCSE (9-1) |
| **Subject** | Combined Science: Trilogy - Physics |
| **Exam Board** | AQA |
| **Topic** | 6.3 Particle Model of Matter |
| **Sub-Topic** | Internal Energy |
| **Difficulty Level** | Silver Level |
| **Booklet** | Question Paper 1 |

**Time Allowed:** **54 minutes**

**Score:** **/54**

**Percentage:** **/100**

**Grade Boundaries:**

**Q1.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.

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|---|
| Solids:<br>• have a fixed shape<br>• are difficult to compress (to squash).<br>Gases:<br>• will spread and fill the entire container<br>• 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.

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Extra space .....

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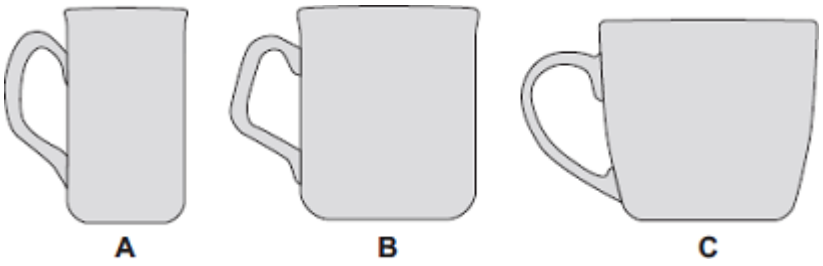
**(Total 6 marks)**

**Q2.**The diagram shows three cups **A**, **B** and **C**.




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

(a) Use the correct answer from the box to complete each sentence.

| | | |
|---|---|---|
| **condensation** | **conduction** | **convection** |

Energy is transferred through the walls of the cup by ..... .

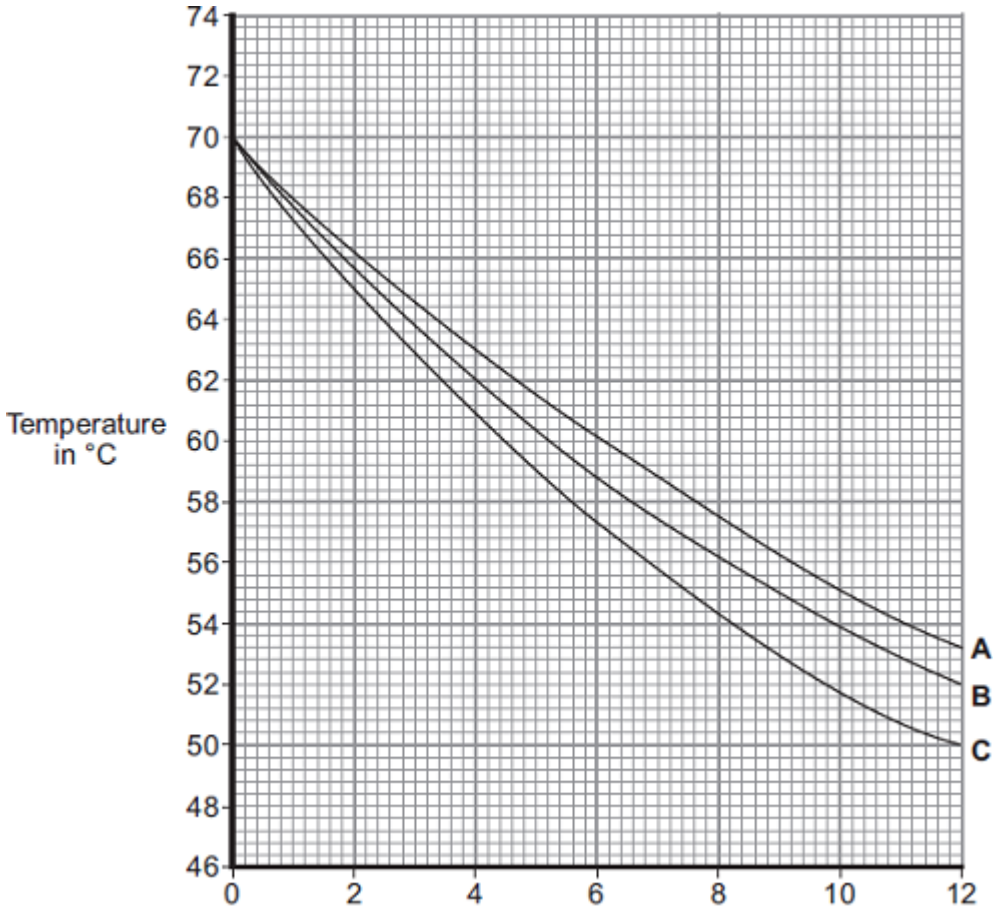
In the air around the cup, energy is transferred by ..... .

**(2)**

(b) 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

**(1)**

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

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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.

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**(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.

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**(1)**

(c) (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.

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Energy transferred = ..... J

**(3)**

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

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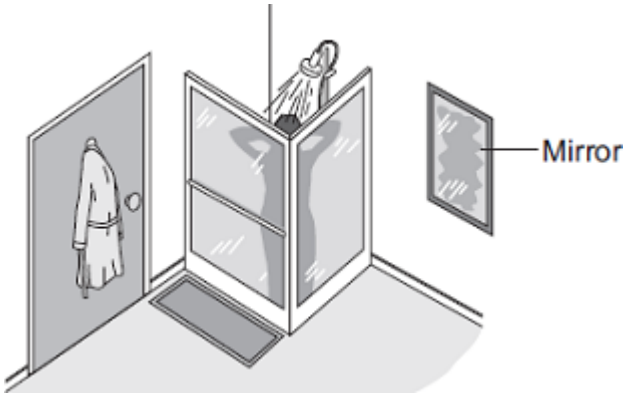
**(4)**
**(Total 16 marks)**

**Q3.**The picture shows a person taking a hot shower.




(a) When a person uses the shower the mirror gets misty.

Why?

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**(3)**

(b) The homeowner installs an electrically heated mirror into the shower room.

When a person has a shower, the heated mirror does **not** become misty but stays clear.

Why does the mirror stay clear?

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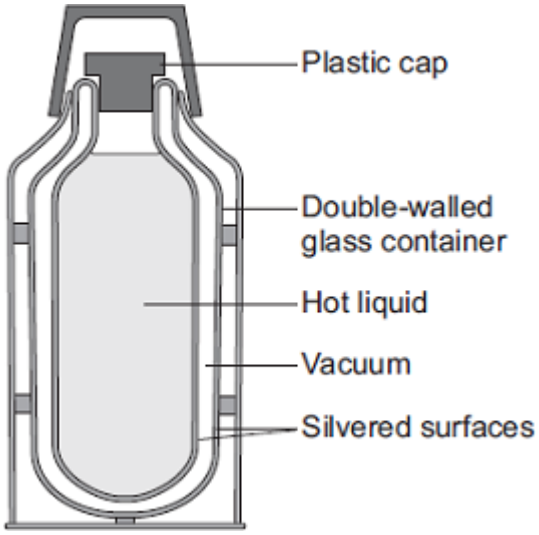
**(2)**
**(Total 5 marks)**

**Q4.**(a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The diagram shows the structure of a vacuum flask.




A vacuum flask is designed to reduce the rate of energy transfer by heating processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

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**(6)**

(b) Arctic foxes live in a very cold environment.

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Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

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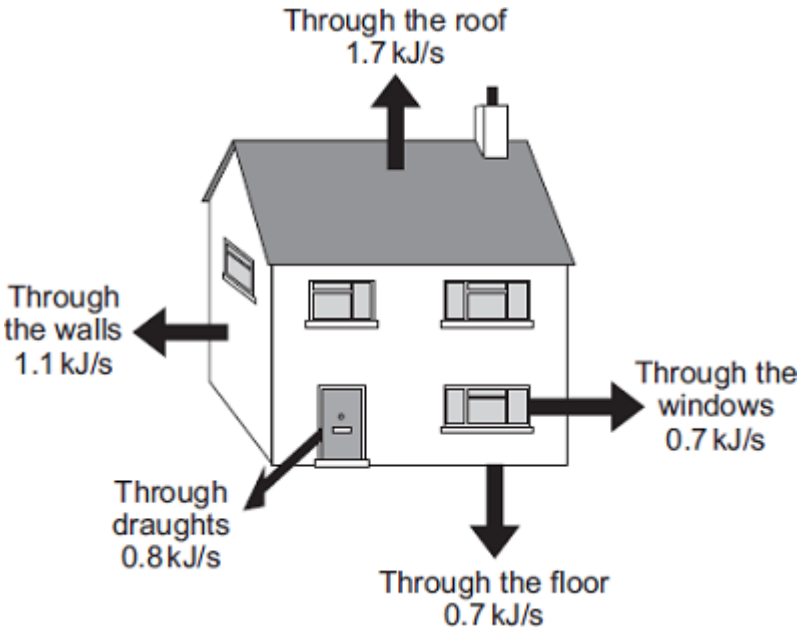
**(2)**
**(Total 8 marks)**

**Q5.Diagram 1** shows the energy transferred per second from a badly insulated house on a cold day in winter.

**Diagram 1**




(a) (i) When the inside of the house is at a constant temperature, the energy transferred from the heating system to the inside of the house equals the energy transferred from the house to the outside.

Calculate, in kilowatts, the power of the heating system used to keep the inside of the house in **Diagram 1** at a constant temperature.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)

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Power of the heating system = ..... kW

**(1)**

(ii) In the winter, the heating system is switched on for a total of 7 hours each day.

Calculate, in kilowatt-hours, the energy transferred each day from the heating system to the inside of the house.

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Energy transferred each day = ..... kWh

**(2)**

(iii) Energy costs 15 p per kilowatt-hour.

Calculate the cost of heating the house for one day.

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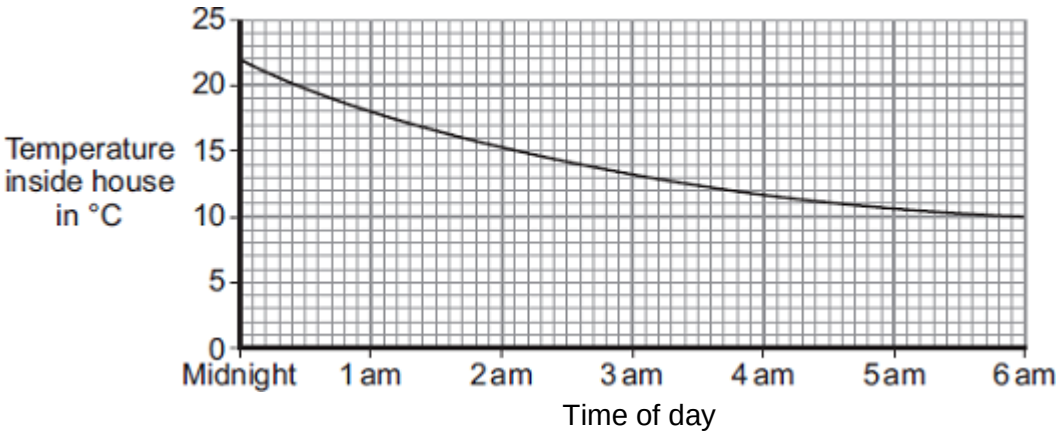
Cost = .....

**(1)**

(iv) The heating system is switched off at midnight.

The graph shows how the temperature inside the house changes after the heating system has been switched off.




Draw a ring around the correct answer in the box to complete the sentence.

Between midnight and 6 am the rate of energy transfer from

the house

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|---|
| decreases. |
| decreases then stays constant. |
| increases. |

Give the reason for your answer.

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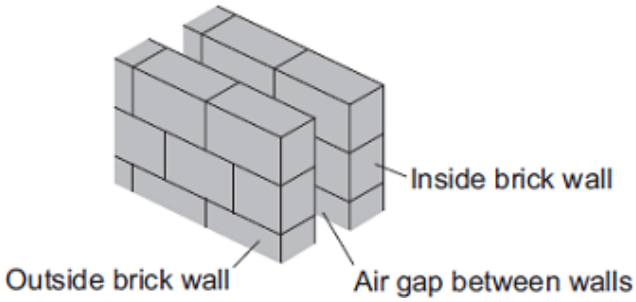
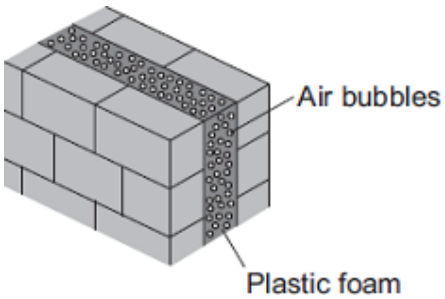
**(2)**

(b) **Diagram 2** shows how the walls of the house are constructed.
**Diagram 3** shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

**Diagram 2** **Diagram 3**




U-value of the wall = 0.7




U-value of the wall = 0.3

The plastic foam reduces energy transfer by convection.

Explain why.

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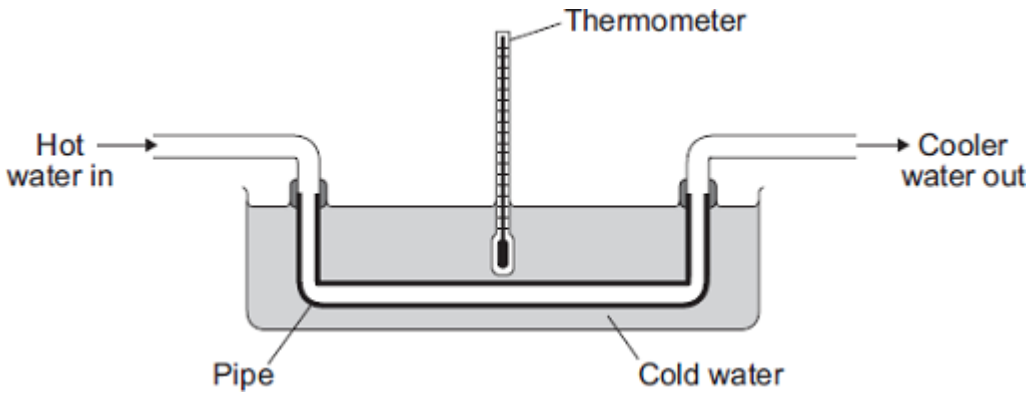
**(2)**
**(Total 8 marks)**

**Q6.**Heat exchangers are devices used to transfer heat from one place to another.

The diagram shows a pipe being used as a simple heat exchanger by a student in an investigation.

Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.




(a) Complete the following sentence by drawing a ring around the correct word in the

box.

Heat is transferred from the hot water inside the pipe

to the cold water outside the pipe by

| |
|---|
| conduction. |
| convection. |
| radiation. |

**(1)**

(b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

The student's results are recorded in the table.

| **Material** | **Temperature of the cold water at the start in °C** | **Temperature of the cold water after 10 minutes in °C** |
|---|---|---|
| Copper | 20 | 36 |
| Glass | 20 | 23 |
| Plastic | 20 | 21 |

(i) The rate of flow of hot water through the pipe was one of the control variables in the investigation.

Give **one** other control variable in the investigation.

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**(1)**

(ii) Which **one** of the three materials made the best heat exchanger?

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Give a reason for your answer.

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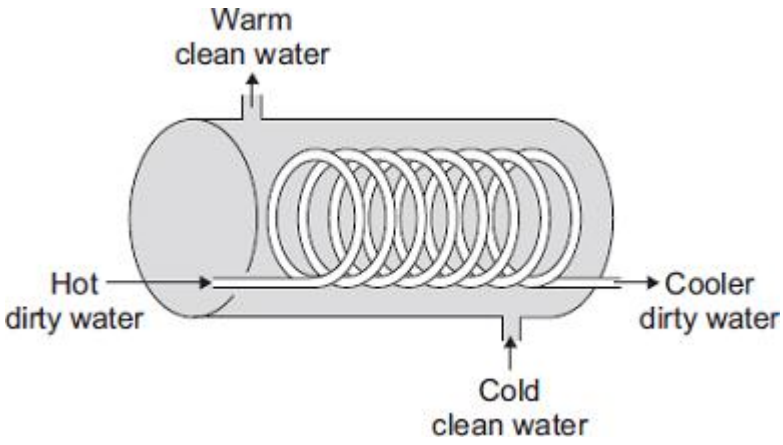
**(2)**

(c) The student finds a picture of a heat exchanger used in an industrial laundry. The heat exchanger uses hot, dirty water to heat cold, clean water.




This heat exchanger transfers heat faster than the heat exchanger the student used in the investigation.

Explain why.

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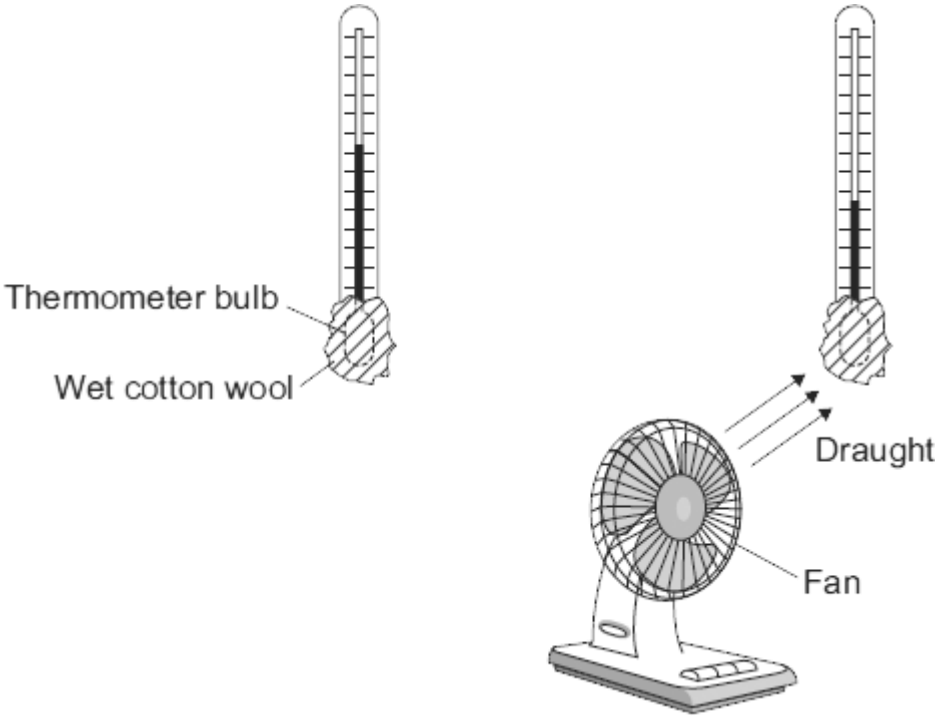
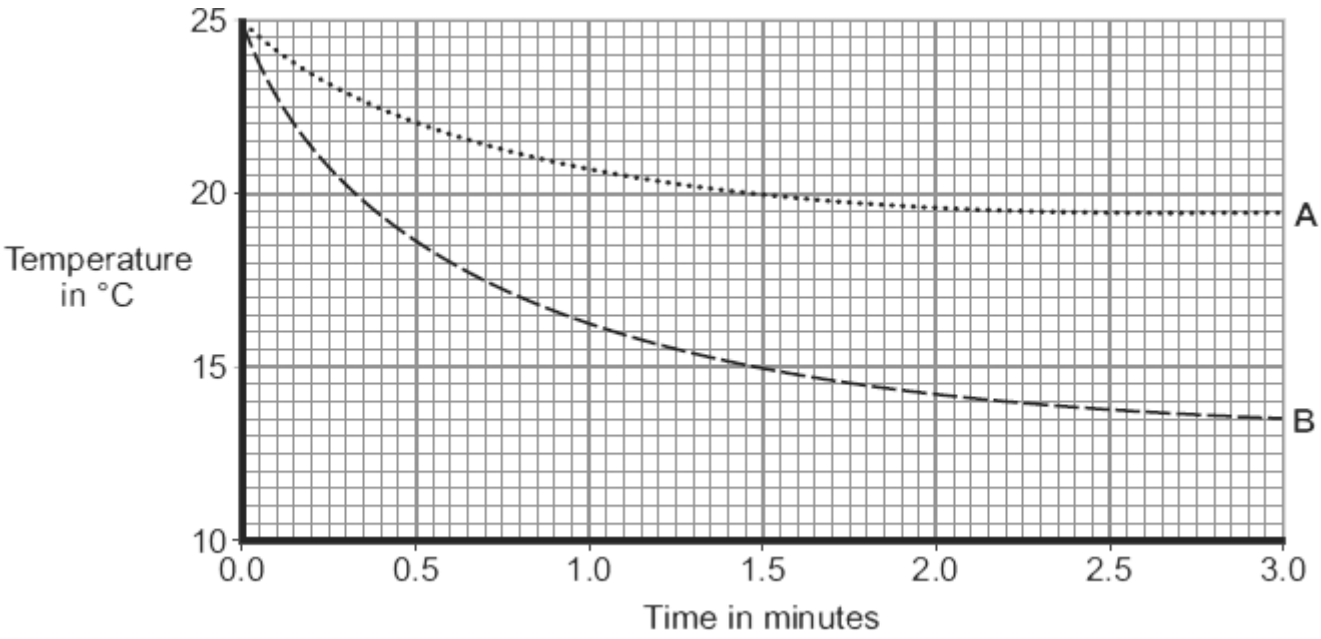
**(2)**
**(Total 6 marks)**

**Q7.** The diagram shows two thermometers. The bulb of each thermometer is covered with a piece of wet cotton wool. One of the thermometers is placed in the draught from a fan.




The graph shows how the temperature of each thermometer changes with time.




(a) Which of the graph lines, **A** or **B**, shows the temperature of the thermometer placed in the draught?

Write the correct answer in the box. ☐

Explain, in terms of evaporation, the reason for your answer.

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**(3)**

(b) A wet towel spread out and hung outside on a day without wind dries faster than an identical wet towel left rolled up in a plastic bag.

Explain why.

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**(2)**
**(Total 5 marks)**