



**Internal energy and energy transfers**

Questions

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **66 minutes**

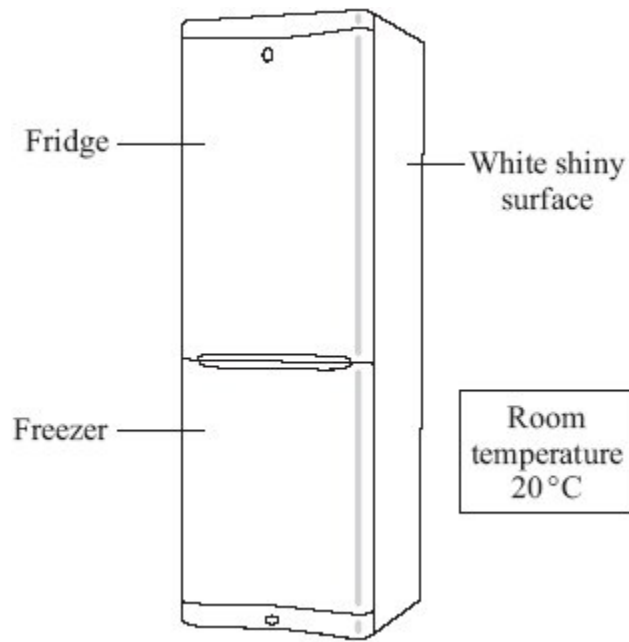
Marks: **66 marks**

Comments:

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1

The diagram shows a fridge-freezer.



(a) By which method is heat transferred through the walls of the fridge-freezer?

\_\_\_\_\_

(1)

(b) The inside of the fridge is at 4 °C. The inside of the freezer is at -18 °C.

Into which part of the fridge-freezer will the rate of heat transfer be greater?

Draw a ring around your answer.

**the fridge**

**the freezer**

Give a reason for your answer.

\_\_\_\_\_

\_\_\_\_\_

(1)

(c) The outside surface of the fridge-freezer is white and shiny.

Give **two** reasons why this type of surface is suitable for a fridge-freezer.

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

\_\_\_\_\_

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

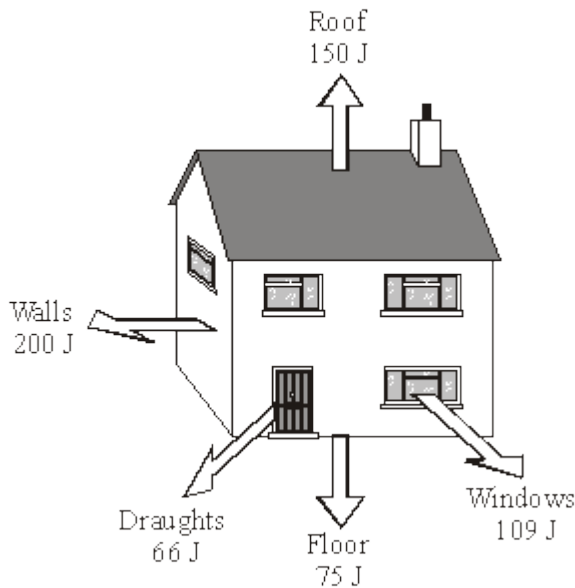
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(2)

(Total 4 marks)

**2**

(a) The diagram shows how much heat is lost each second from different parts of an uninsulated house.



(i) Each year, the house costs £760 to heat.

How much money is being wasted because of heat lost through the roof?

Show clearly how you work out your answer.

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**(2)**

(ii) Insulating the loft would cut the heat lost through the roof by 50 %.

The loft insulation has a payback time of  $1\frac{1}{2}$  years.

How much did the loft insulation cost to buy?

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Cost of loft insulation = £ \_\_\_\_\_

**(1)**

(b) What happens to the wasted energy?

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**(1)**

**(Total 4 marks)**

**3**

The table gives information about some methods of conserving energy in a house.

Conservation method	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	500	60
Hot water tank jacket	10	15
Loft insulation	110	60
Thermostatic radiator valves	75	20

- (a) Explain which of the methods in the table is the most cost effective way of saving energy over a 10 year period. To obtain full marks you must support your answer with calculations.

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**(3)**

- (b) Describe what happens to the energy which is 'wasted' in a house.

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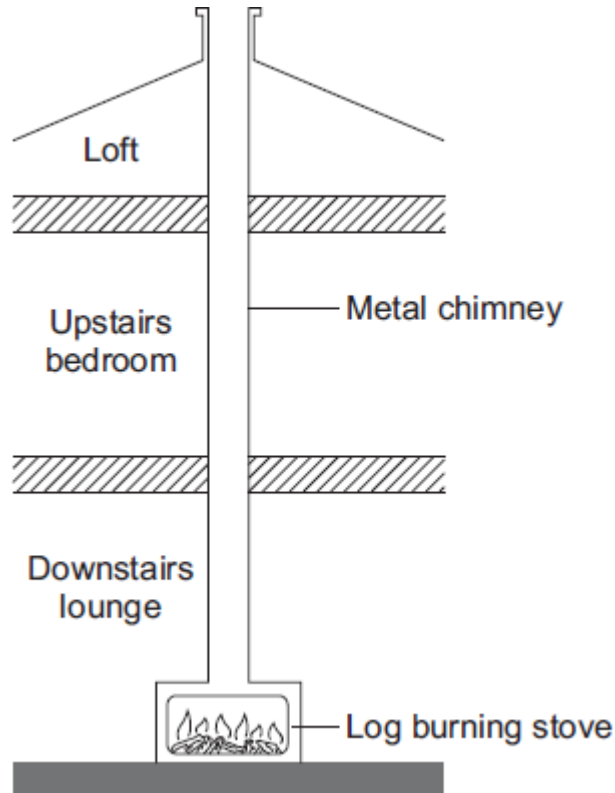
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**(2)****(Total 5 marks)**

4

The diagram shows how the metal chimney from a log-burning stove passes through the inside of a house.



(a) Explain how heat is transferred by the process of convection from the inside of the stove to the top of the chimney.

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(2)

(b) Although the outside of the chimney becomes very hot, there is no insulating material around the chimney.

(i) Explain, in terms of the particles in a metal, how heat is transferred by conduction from the inside to the outside of the metal chimney.

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(2)

(ii) Suggest **one** advantage of having no insulation around the chimney.

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(1)

(Total 5 marks)

**5**

- (a) The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Fit a new hot water boiler	1800	200
Fit a solar water heater	2400	100
Fit under floor heating	600	50
Fit thermostatic radiator valves	75	20

Which way of reducing energy consumption is most cost effective over a 10-year period?

To obtain full marks you must support your answer with calculations.

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**(3)**

- (b) Explain why using an energy-efficient light bulb instead of an ordinary light bulb reduces the amount of carbon dioxide emitted into the atmosphere.

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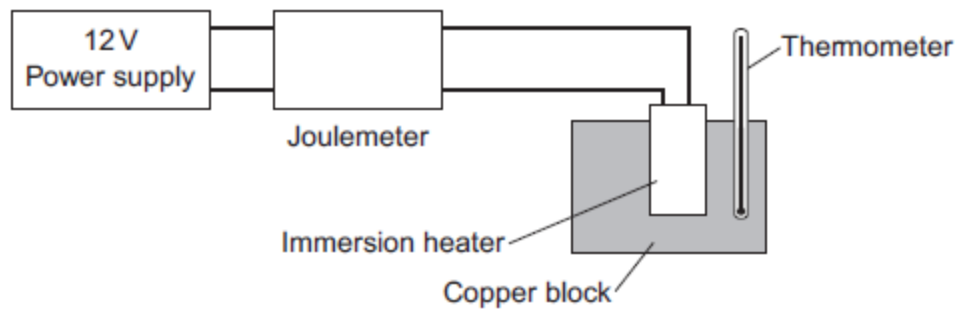
**(2)**

**(Total 5 marks)**

6

A student used the apparatus in **Figure 1** to obtain the data needed to calculate the specific heat capacity of copper.

**Figure 1**



The initial temperature of the copper block was measured.

The power supply was switched on.

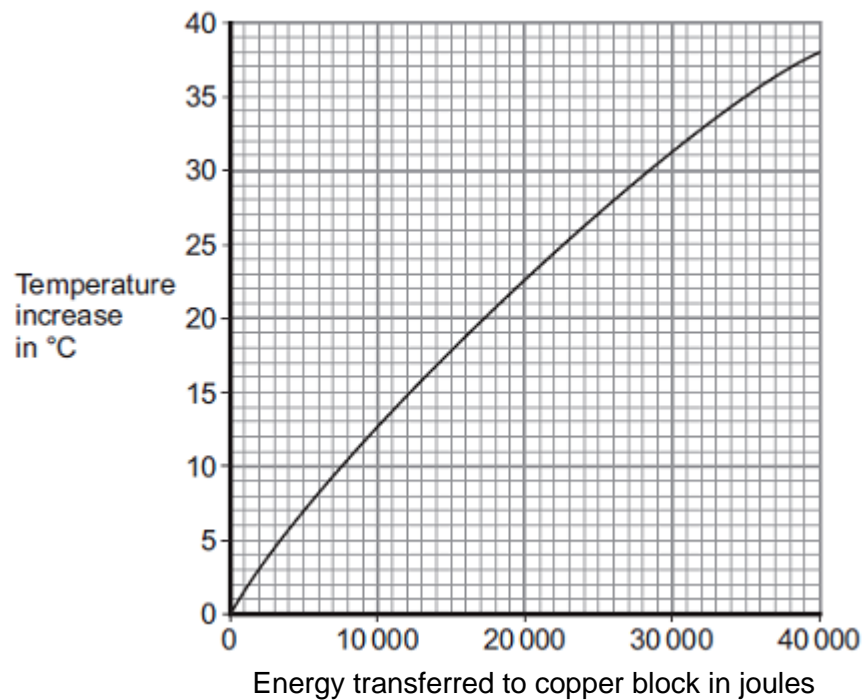
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

**Figure 2** shows the student's results.

**Figure 2**





(a) Energy is transferred through the copper block.

What is the name of the process by which the energy is transferred?

Tick (✓) **one** box.

Conduction

Convection

Radiation

(1)

(b) Use **Figure 2** to determine how much energy was needed to increase the temperature of the copper block by 35 °C.

\_\_\_\_\_ joules

(1)

(c) The copper block has a mass of 2 kg.

Use your answer to part (b) to calculate the value given by this experiment for the specific heat capacity of copper. Give the unit.

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Specific heat capacity = \_\_\_\_\_

(3)

(d) This experiment does **not** give the correct value for the specific heat of copper.

Suggest **one** reason why.

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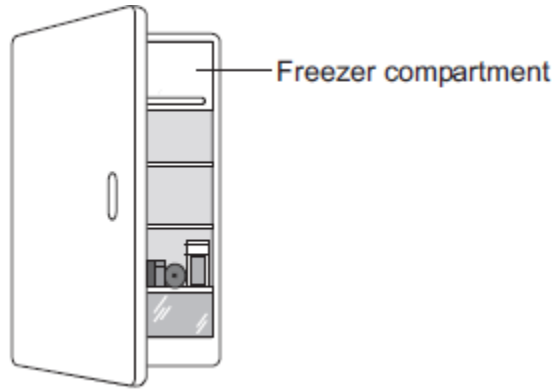
(1)

(Total 6 marks)

**7**

(a) The figure below shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is  $-5\text{ }^{\circ}\text{C}$ .



The air inside the fridge forms a convection current when the fridge door is closed.

Explain why.

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(4)

- (b) The table below shows information about four fridges.

Fridge	Volume in litres	Energy used in one year in kWh
A	250	300
B	375	480
C	500	630
D	750	750

A householder concludes that the energy used in one year is directly proportional to the volume of the fridge.

Explain why her conclusion is **not** correct.

Use data from the table in your answer.

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(2)

- (c) New fridges are more efficient than fridges made twenty years ago.

Give **one** advantage and **one** disadvantage of replacing an old fridge with a new fridge.

Ignore the cost of buying a new fridge.

Advantage \_\_\_\_\_

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Disadvantage \_\_\_\_\_

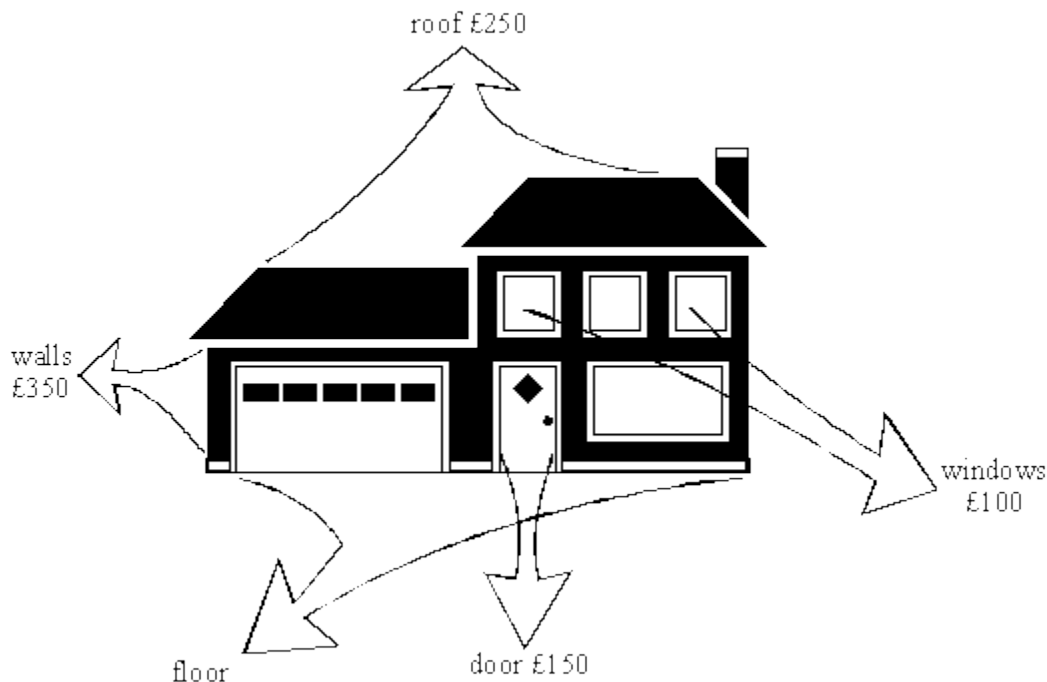
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(2)

(Total 8 marks)

8

The diagram below shows a house which has **not** been insulated. The cost of the energy lost from different parts of the house during one year is shown on the diagram.



(a) The total cost of the energy lost during one year is £1000.

(i) What is the cost of the energy lost through the floor?

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(2)

(ii) Suggest one way of reducing this loss.

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(1)

(b) The table below shows how some parts of the house may be insulated to reduce energy losses. The cost of each method of insulation is also given.

WHERE LOST	COST OF ENERGY LOST PER YEAR (£)	METHOD OF INSULATION	COST OF INSULATION (£)
roof	250	fibre-glass in loft	300
walls	350	foam filled cavity	800
windows	100	double glazing	4500
doors	150	draught proofing	5

(i) Which method of insulation would you install first? Explain why.

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(3)

(ii) Which method of insulation would you install last? Explain why.

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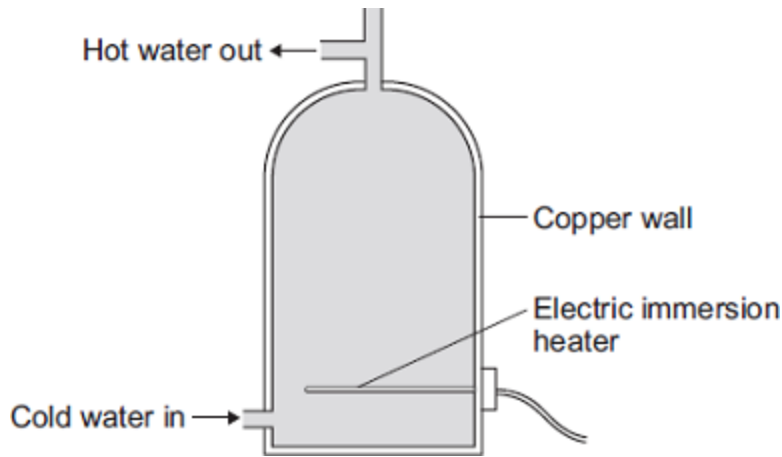
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(3)

(Total 9 marks)

9

An electric immersion heater is used to heat the water in a domestic hot water tank. When the immersion heater is switched on the water at the bottom of the tank gets hot.



(a) Complete the following sentence.

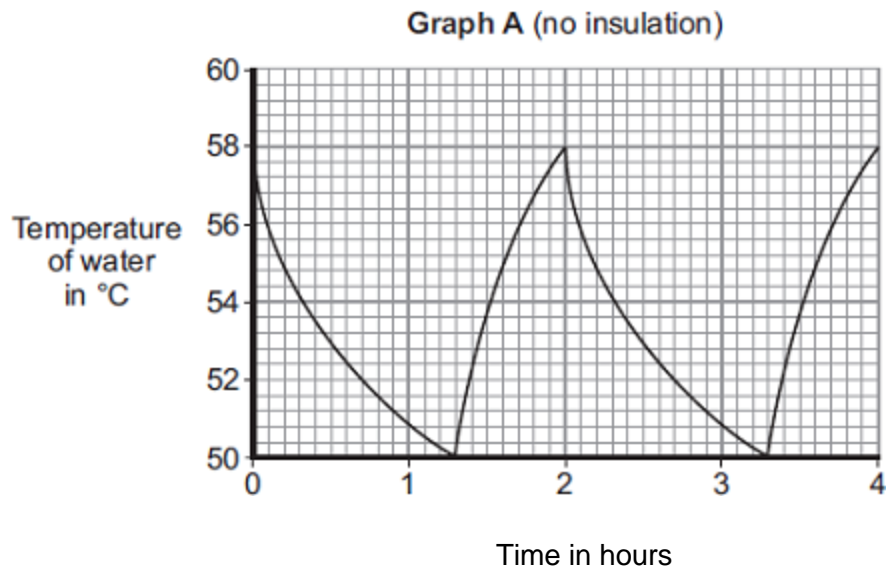
The main way the energy is transferred through the copper wall of the water tank is by the process of \_\_\_\_\_ .

(1)

- (b) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches 58°C the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to 50°C.

**Graph A** shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.



- (i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

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(2)

- (ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

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

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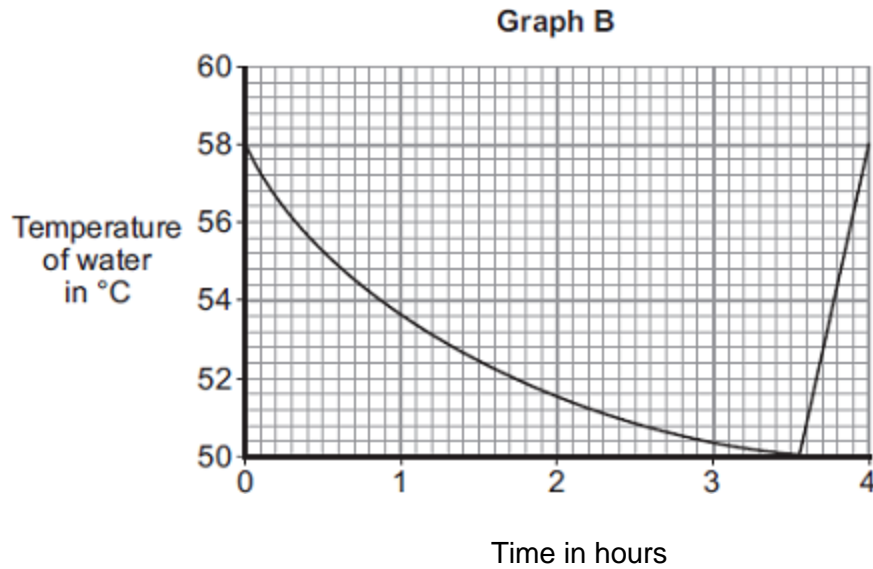
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Mass = \_\_\_\_\_ kg

(3)

(iii) An insulating jacket is fitted to the hot water tank.

**Graph B** shows how the temperature of the water inside the insulated hot water tank changes with time.



An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

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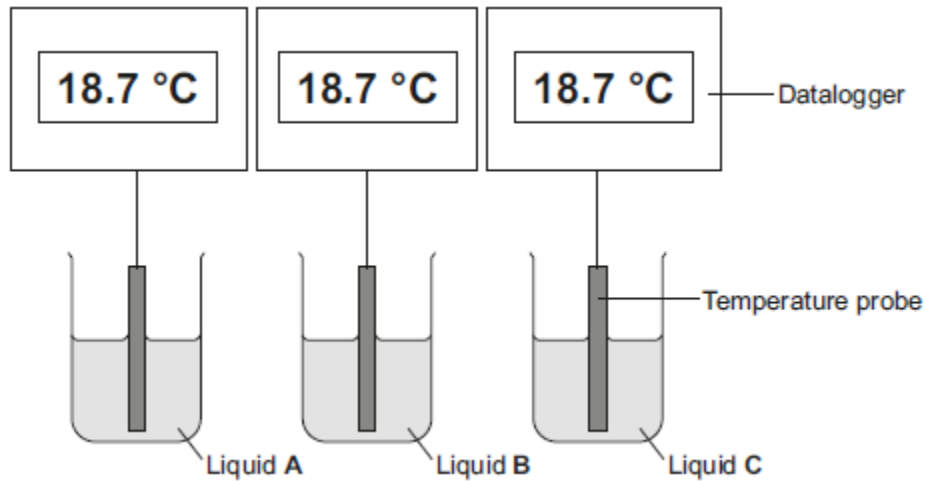
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(3)  
(Total 9 marks)

10

A student investigated the cooling effect of evaporation. She used the equipment in **Figure 1** to measure how the temperature of three different liquids changed as the liquids evaporated.

**Figure 1**



(a) The temperature and volume of each liquid was the same at the start of the investigation.

State **one** further control variable in this investigation.

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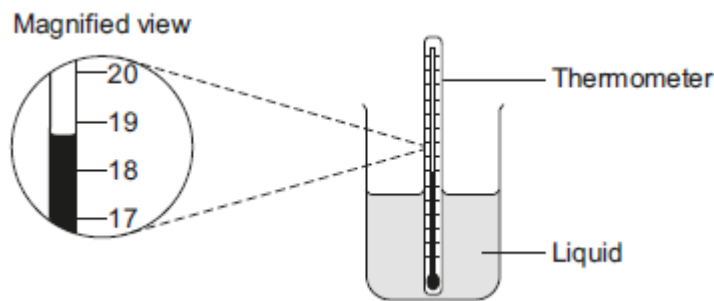


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(1)

(b) Give **two** advantages of using dataloggers and temperature probes compared to using the thermometer shown in **Figure 2**.

**Figure 2**



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

\_\_\_\_\_

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

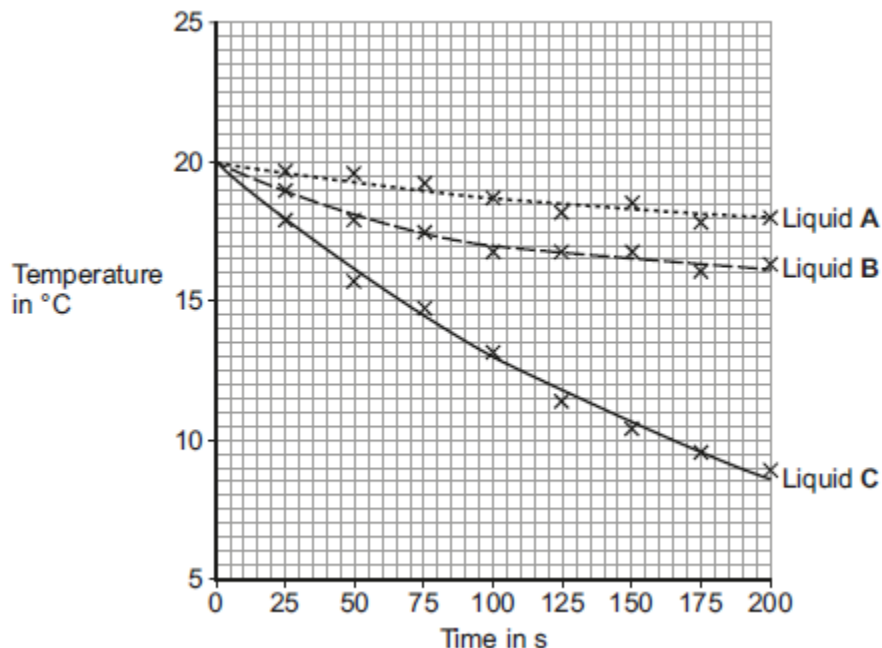
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(2)



(c) The student's results are shown in **Figure 3**.

**Figure 3**



(i) Calculate the average rate of temperature decrease of liquid **C** between 0 and 100 seconds.

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Average rate of temperature decrease = \_\_\_\_\_ °C / s

(2)

(ii) Give **one** conclusion that can be made about the rate of temperature decrease of **all three** liquids from the results in **Figure 3**.

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(1)

(iii) Which liquid had the lowest rate of evaporation? Give a reason for your answer.

Liquid \_\_\_\_\_

Reason \_\_\_\_\_

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(1)

- (iv) A second student did the same investigation but using a smaller volume of liquid than the first student.

All other variables were kept the same.

What effect would this have on the results of the second student's investigation?

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(1)

- (d) Explain how the evaporation of a liquid causes the temperature of the remaining liquid to decrease.

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(3)

(Total 11 marks)