BLACK BODY IRRADIATION

Q1.

All objects emit and absorb infrared radiation.

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

dark matt	dark shiny	light matt	light shiny

The best emitters of infrared radiation have

_____ surfaces.

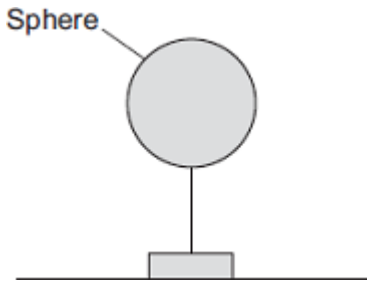
The worst emitters of infrared radiation have

_____ surfaces.

(2)

(b) **Diagram 1** shows a sphere which is at a much higher temperature than its surroundings.

Diagram 1



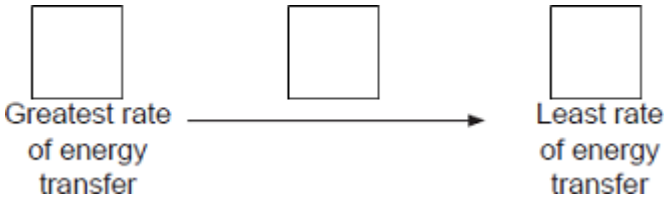
Energy is transferred from the sphere to the surroundings.

The table shows readings for the sphere in three different conditions, **A**, **B** and **C**.

Condition	Temperature of sphere in °C	Temperature of surroundings in °C
A	70	5
B	80	0
C	90	30

In each of the conditions, **A**, **B** and **C**, the sphere transfers energy to the surroundings at a different rate.

Put conditions **A**, **B** and **C** in the correct order.



Give a reason for your answer.

_____

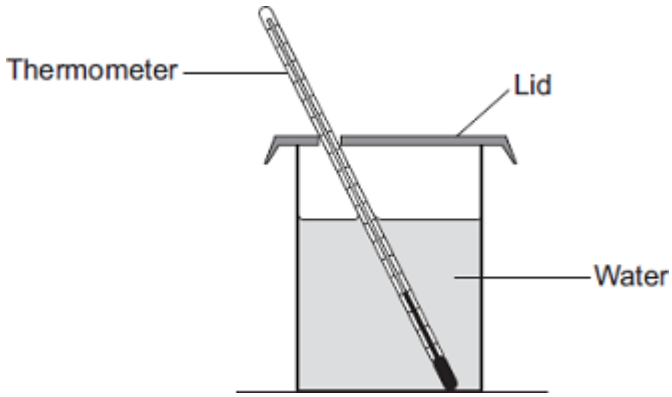
_____

(2)

(c) **Diagram 2** shows a can containing water.

A student investigates how quickly a can of water heats up when it is cooler than room temperature.

Diagram 2



The student has four cans, each made of the same material, with the following outer surfaces.

dark matt **dark shiny** **light matt** **light shiny**

The student times how long it takes the water in each can to reach room temperature.

Each can contains the same mass of water at the same starting temperature.

(i) Which can of water will reach room temperature the quickest?

Give a reason for your answer.

_____

_____

_____

_____

(2)

(ii) Apart from material of the can, mass of water and starting temperature,

suggest **three** control variables for the student's investigation.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(d) The photographs show two different foxes.

Fox A

By Algkalv (Own work) [CC-BY-3.0], via Wikimedia Commons

Fox B

© EcoPic/iStock

Which fox is better adapted to survive cold conditions?

Give reasons for your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

Q2.

(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.

_____

_____

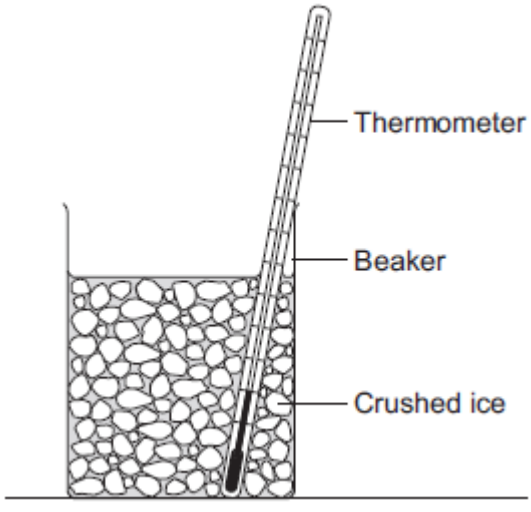
Energy = _____ J

(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)

Q3.

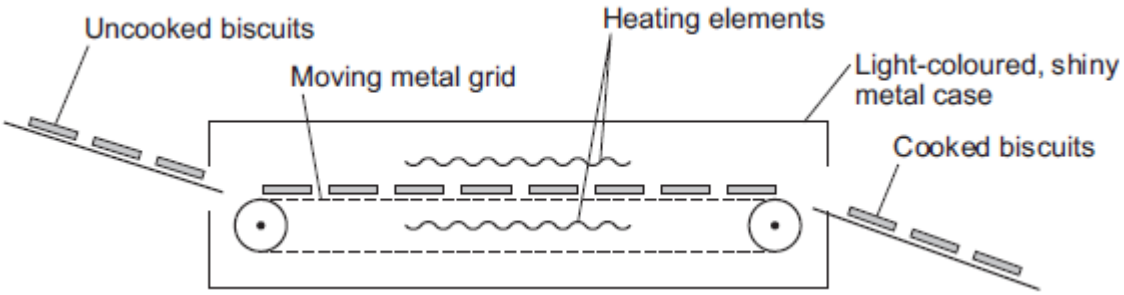
Figure 1 shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

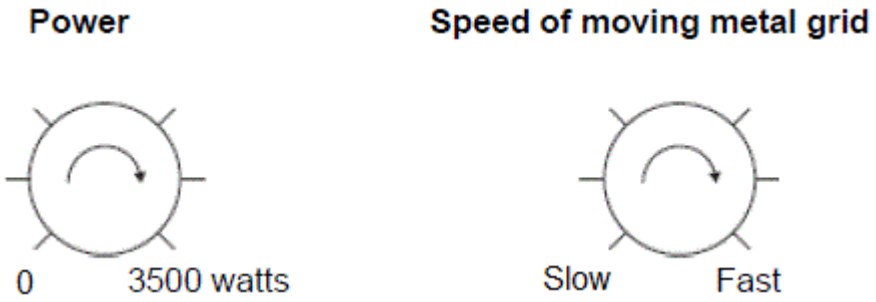
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



(a) Which type of electromagnetic radiation makes the biscuits turn brown?

_____

(1)

(b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

1. _____

_____

2. _____

_____

(2)

(c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

_____

_____

_____

_____

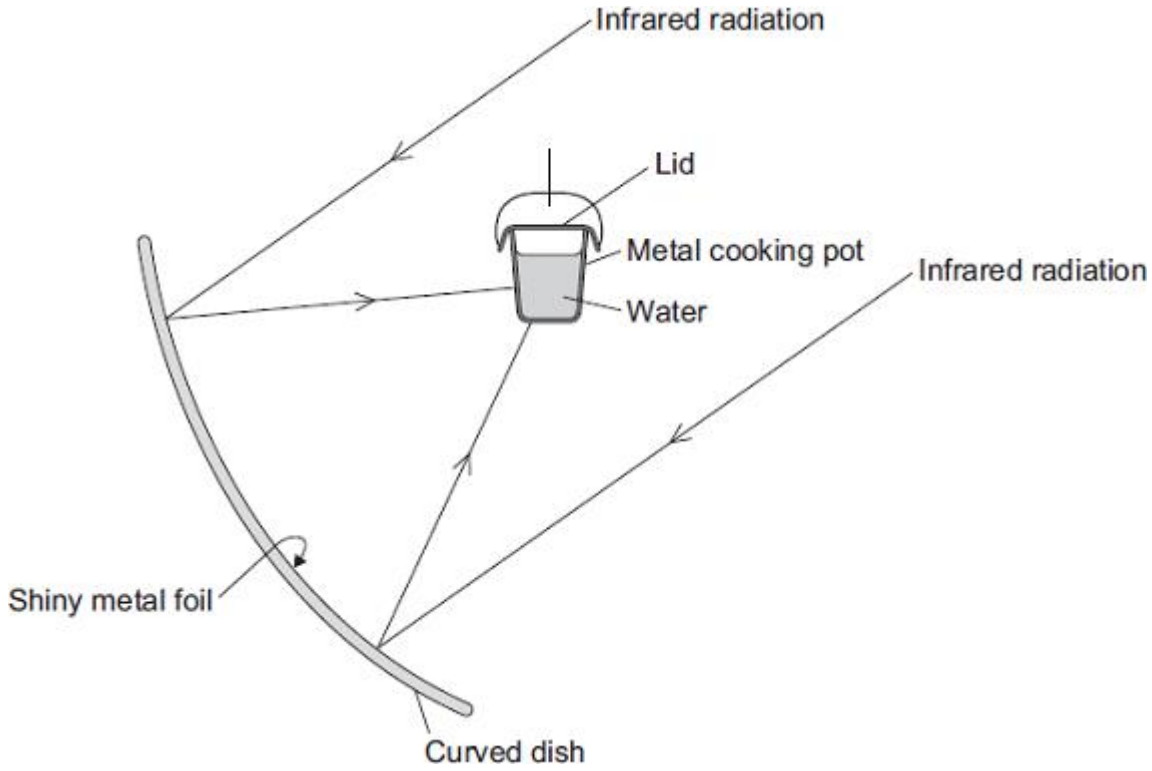
_____

(3)

(Total 6 marks)

Q4.

The diagram shows the design of a solar cooker. The cooker heats water using infrared radiation from the Sun.



(a) Why is the inside of the large curved dish covered with shiny metal foil?

(1)

(b) Which would be the best colour to paint the outside of the metal cooking pot?

Draw a ring around the correct answer.

black **silver** **white**

Give a reason for your answer.

(2)

(c) Why does the cooking pot have a lid?

_____

(1)

(d) Calculate how much energy is needed to increase the temperature of 2 kg of water by 80 °C.

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

_____

_____

_____

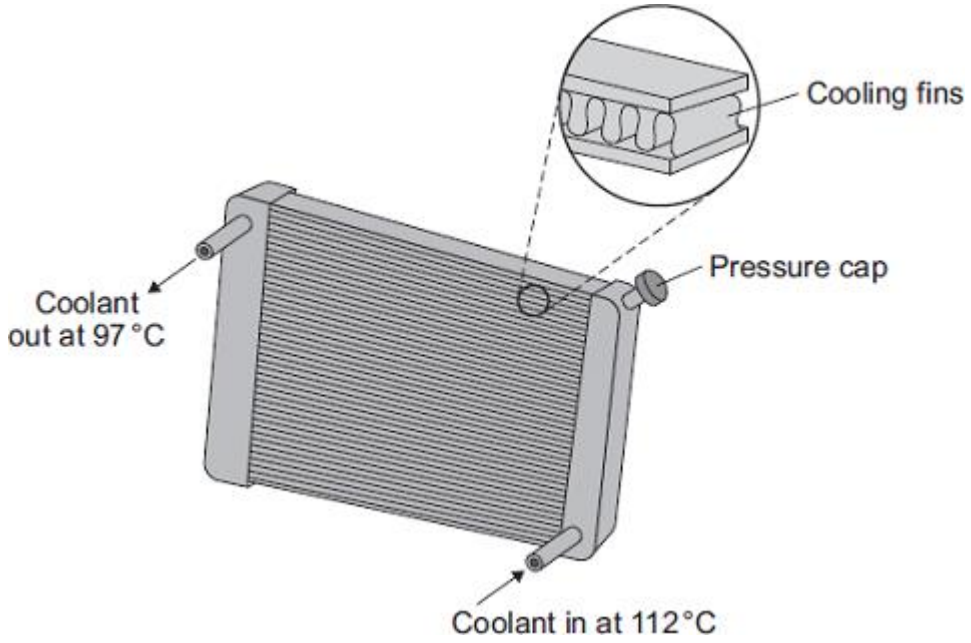
Energy = _____ J

(2)

(Total 6 marks)

Q5.

The diagram shows a car radiator. The radiator is part of the engine cooling system.



Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls.

(a) Why is the radiator painted black?

_____

_____

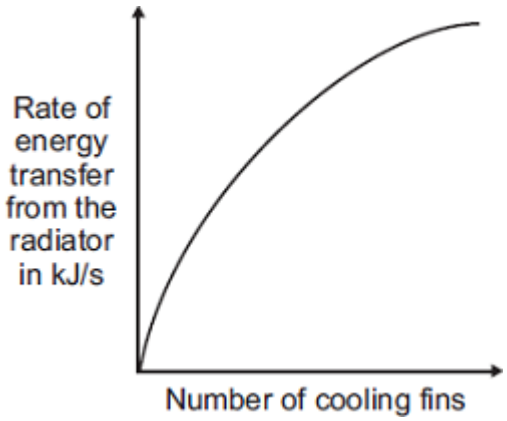
_____

_____

(2)

(b) Different radiators have different numbers of cooling fins along the length of the radiator.

The sketch graph shows how the number of cooling fins affects the rate of energy transfer from the radiator.



The number of cooling fins affects the rate of energy transfer from the radiator.

Explain how.

_____

_____

_____

_____

(2)

(c) When the car engine is working normally, 2 kg of coolant passes through the radiator each second. The temperature of the coolant falls from 112 °C to 97 °C.

Calculate the energy transferred each second from the coolant.

Specific heat capacity of the coolant = 3800 J/kg °C.

_____

_____

_____

_____

Energy transferred each second = _____ J

(3)

(d) On cold days, some of the energy transferred from a hot car engine is used to warm the air inside the car. This is a useful energy transfer.

What effect, if any, does this energy transfer have on the overall efficiency of the car engine?

Draw a ring around the correct answer.

decreases the efficiency **does not change the efficiency** **increases the efficiency**

Give a reason for your answer.

_____

_____

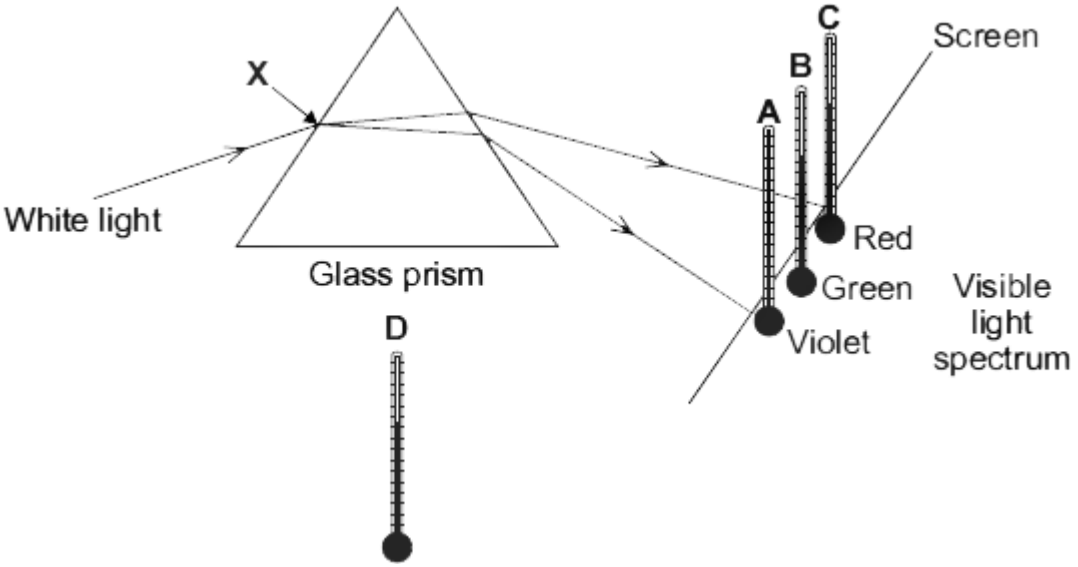
_____

(2)

(Total 9 marks)

Q6.

The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



(a) (i) The student put thermometer **D** outside of the light spectrum.

Suggest why.

_____

_____

(1)

(ii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in °C
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

_____

_____

_____

_____

(2)

(b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

_____

_____

_____

_____

(2)

(c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^{8} m/s.

Show clearly how you work out your answer.

_____

_____

_____

_____

Wavelength = _____ m

(2)

(d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q7.

A wood burning stove is used to heat a room.

Photograph supplied by iStockphoto/Thinkstock

The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

(a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

_____

_____

_____

_____

(2)

(b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Show clearly how you work out your answer.

_____

_____

_____

Efficiency = _____

(2)

(c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

_____

(1)

(d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1. _____

_____

2. _____

_____

(2)

(e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Show clearly how you work out your answer and give the unit.

_____

_____

_____

_____

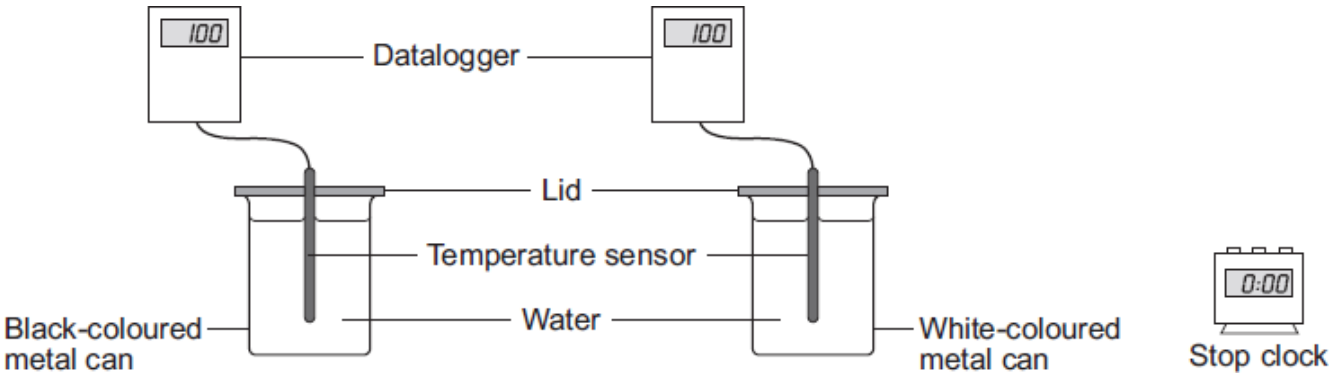
Energy required = _____

(3)

(Total 10 marks)

Q8.

The diagram shows the equipment a student used to investigate how the colour of a surface affects how fast it emits (gives out) heat.



An equal volume of boiling water was poured into each metal can. The student then recorded the temperature of the water in each can every minute for ten minutes.

(a) (i) Which of the following was a control variable in this investigation?

Put a tick (✓) in the box next to your answer.

The volume of boiling water. ☐

The decrease in temperature of the water. ☐

The outside colour of the metal can. ☐

(1)

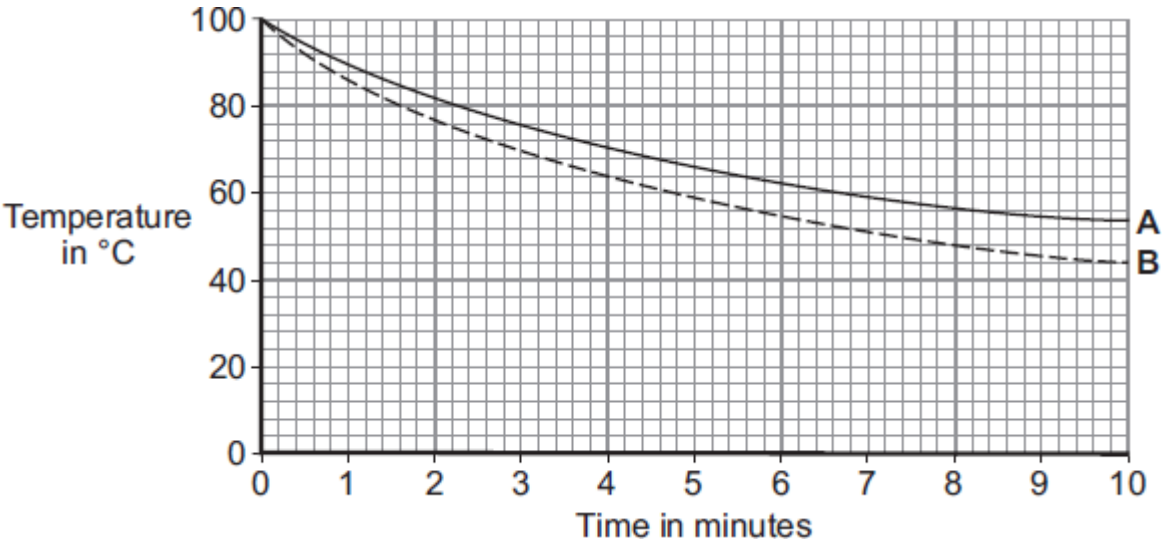
(ii) Give **one** advantage of using a temperature sensor and datalogger rather than a thermometer to measure the temperature of the water.

_____

_____

(1)

(b) The student's results for both cans are plotted on the graph.



Which line, **A** or **B**, shows how the temperature of the water inside the black-coloured metal can changed?

Draw a ring around your answer. **A** **B**

Explain the reason for your answer.

_____

_____

_____

_____

(2)

(c) Some gardeners make soil darker by digging black soot into the soil. Other gardeners use straw to protect plants from the cold.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

On a warm day, the temperature of darker coloured soil will increase

slower than
as fast as
faster than

the temperature of lighter coloured soil.

(1)

(ii) Give a reason for your answer to part (c)(i).

_____

_____

(1)

(iii) The statement in the box is **false**.

Straw keeps plants warm by trapping air. | This is because air is a good conductor.

Change **one** word in the statement to make the statement **true**.

Write down your **new** statement. The answer has been started for you.

This is because air is a _____

(1)

(Total 7 marks)

Q9.

(a) Use the words from the box to complete the following sentences.

conduction	**convection**	**radiation**

(i) The transfer of thermal energy (heat) by the movement of hot liquids

is called _____ .

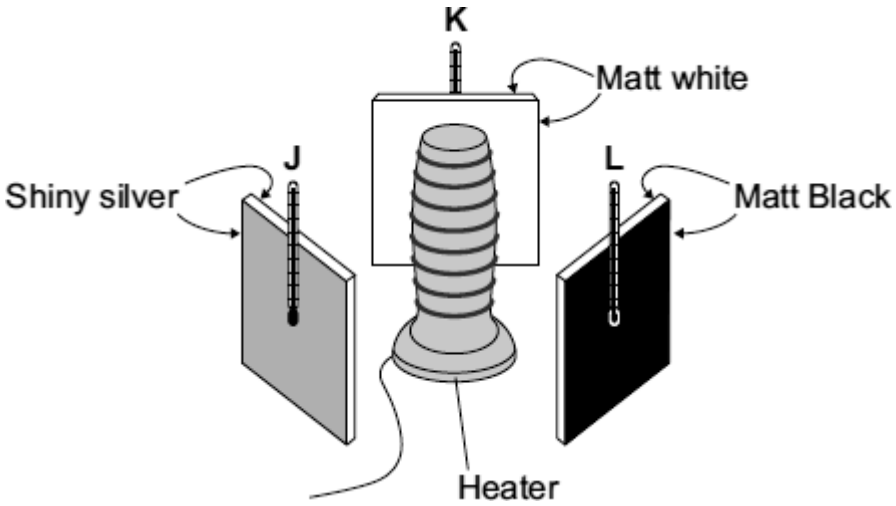
(1)

(ii) The transfer of thermal energy (heat) from one particle to another

is called _____ .

(1)

(b) A student set up the following equipment. The 3 metal plates are the same distance from the heater. The surfaces of each of the 3 metal plates are different colours.



The student switched the heater on for 10 minutes. The thermometers were read before the heater was switched on. The thermometers were read again just after the heaters were switched off.
The readings are shown in the table.

	Temperature before switching on in °C	**Temperature after switching on in °C**
1	19	21

2	19	29
3	19	23

(i) Which set of readings, **1**, **2** or **3**, is most likely to have been taken from the thermometer labelled **L**?

_____

Give a reason for your answer.

_____

_____

(2)

(ii) Which **one** of the following was **not** a control variable in this experiment?

Put a tick (✓) in the box next to your answer.

the distance between the heater and the metal plates ☐

the power of the heater ☐

the temperature before the heater was switched on ☐

the colour of the metal plates ☐

(1)

(iii) Suggest **one** advantage of using a temperature sensor, data logger and computer, rather than a thermometer to carry out this experiment.

_____

_____

(1)

(c) The picture shows a fire fighter putting out a forest fire. The fire fighter's clothing has thick thermal padding inside and a light coloured, fire proof, shiny layer outside.

(i) What is the main way that heat is transferred through the air from the fire to the fire fighter?

_____

_____

(1)

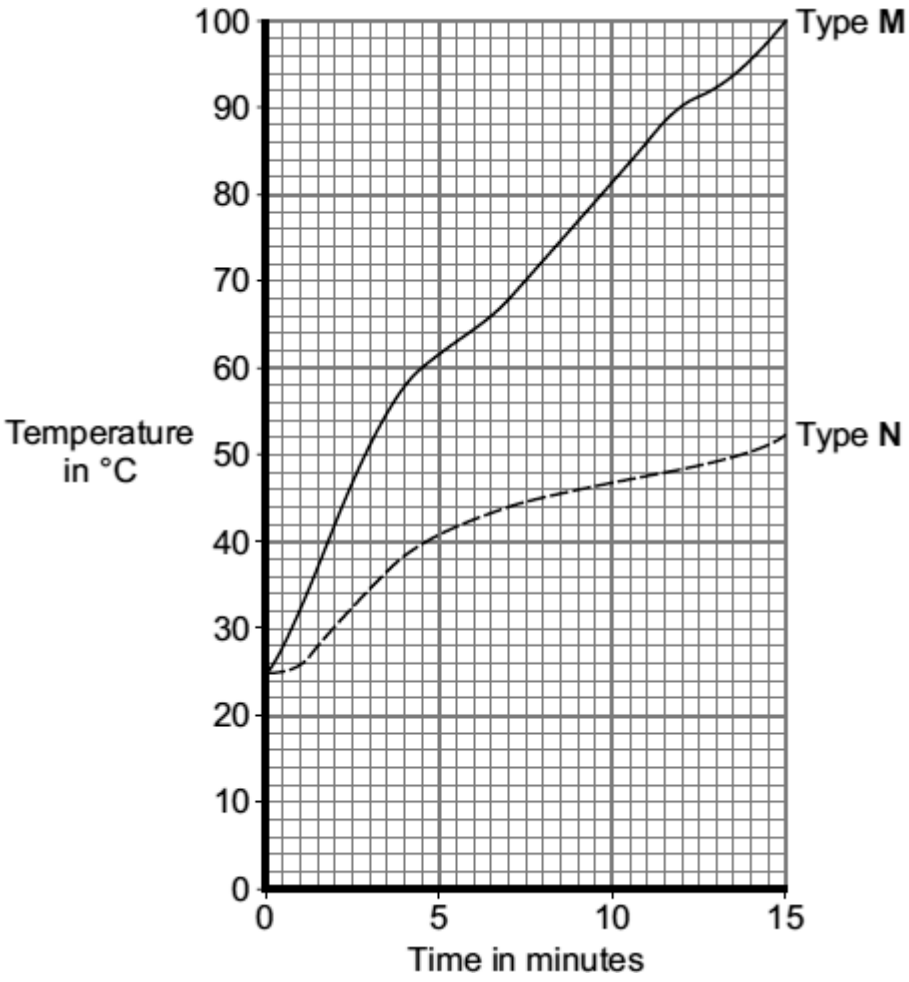
(ii) Why is the outside layer of the clothing shiny?

_____

_____

(1)

(d) The graph shows the result of a laboratory test on two types of thermal padding. Each type of padding was put onto a very hot metal surface and the temperature inside the padding was taken every minute.



Which type of padding, **M** or **N**, would it be best to use inside the fire fighter's clothing?

_____

Give a reason for your answer.

_____

_____

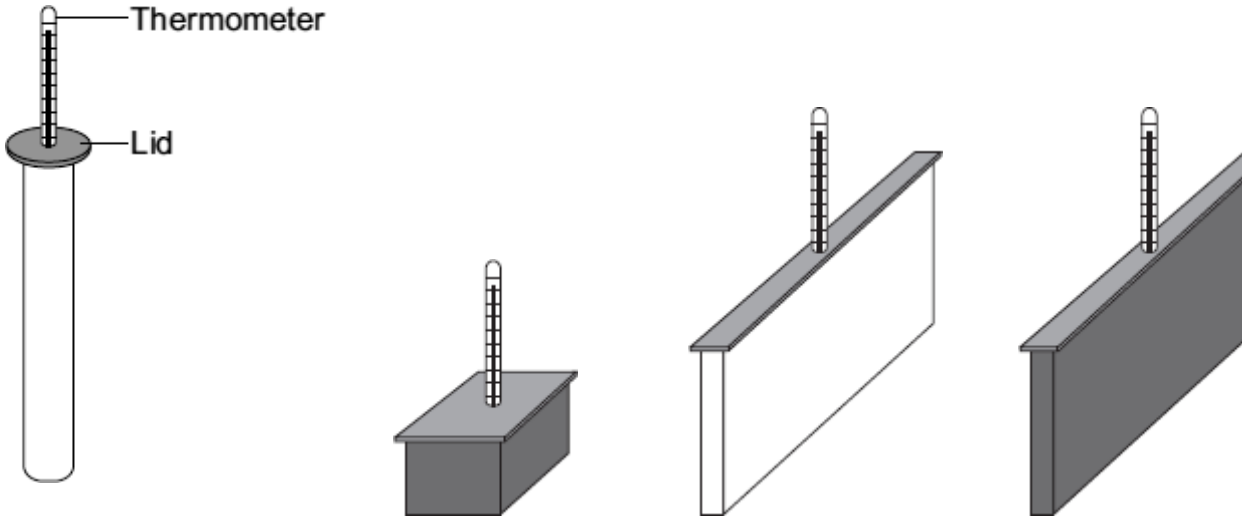
(1)

(Total 9 marks)

Q10.

A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C.
After 20 minutes the temperature of the water inside each container was measured.



The results from the investigation are given in the table.

Container	Colour	Temperature after 20 minutes in °C	Temperature fall in °C
A	White	86	14
B	Black	86	14
C	White	73	27
D	Black	60	40

(i) The student uses the results in the table to see if shape has affected heat transfer.

Which containers should the student compare to do this?

_____

Give a reason for your answer.

_____

_____

(1)

(ii) Explain why the temperature of the water in both containers **A** and **B** fell by the same amount.

_____

_____

_____

_____

(2)

(iii) A central heating system has several radiators joined together. The hot water goes

from the boiler, through each radiator in turn and then back to the boiler for reheating.

Give **one** reason, other than appearance, why it might **not** be a good idea to paint radiators black.

_____

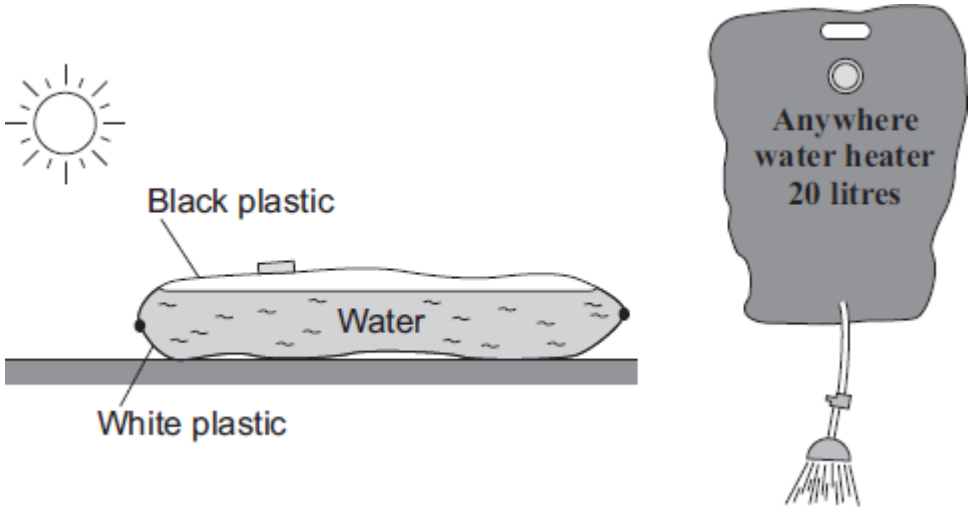
_____

(1)

(Total 4 marks)

Q11.

The diagram shows a simple type of portable shower. The water container is a strong plastic bag that is black on one side and white on the other. To warm the water, the bag is placed on the ground in direct sunlight, with the black side facing the Sun.



(a) (i) Name the process by which heat is transferred from the Sun to the outside of the bag.

_____

(1)

(ii) Explain why the black side of the bag and not the white side should face the Sun.

_____

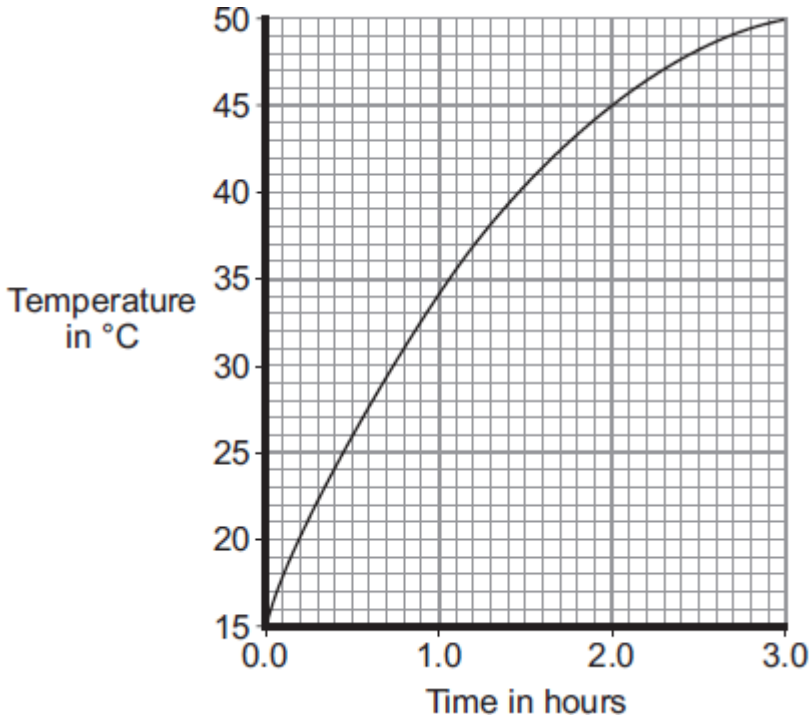
_____

_____

_____

(2)

(b) The graph shows how the temperature of the water inside a full bag increases after the bag is placed outside on a sunny day.



(i) How long does it take for the water to reach 37 °C?

_____

(1)

(ii) Describe how the temperature of the water changes during the three hours.

_____

_____

(1)

(c) A different manufacturer makes the same type of portable shower but uses a bag with a larger surface area. The bag is made from the same coloured plastics and holds the same amount of water.

(i) To compare the efficiency of the two bags at heating water, several variables need to be controlled.

Name **two** variables that need to be controlled.

1. _____

2. _____

(2)

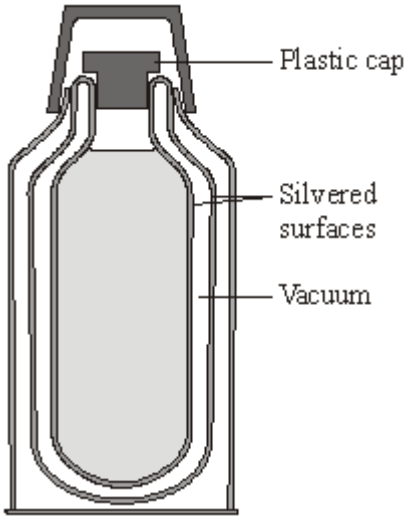
(ii) The second bag has a larger surface area.
Draw a line on the graph to show how the temperature of the water inside the second bag would change over the first hour.
Assume that the two bags are tested in exactly the same way.

(1)

(Total 8 marks)

Q12.

A vacuum flask is designed to reduce the rate of heat transfer.



(a) (i) Complete the table to show which methods of heat transfer are reduced by each of the features labelled in the diagram.

The first row has been done for you.

Feature	Conduction	Convection	Radiation
vacuum			
silveredsurfaces			
plastic cap			

(2)

(ii) Explain why the vacuum between the glass walls of the flask reduces heat transfer by conduction and convection.

_____

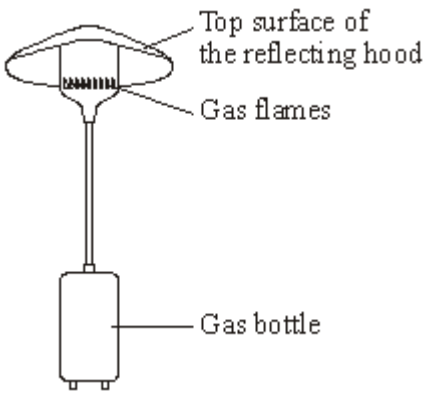
_____

_____

_____

(2)

(b) The diagram shows a gas flame patio heater.



(i) Explain why the top surface of the reflecting hood should be a light, shiny

surface rather than a dark, matt surface.

_____

_____

_____

(2)

(ii) Most of the chemical energy in the gas is transformed into heat. A **small** amount of chemical energy is transformed into light.

Draw and label a Sankey diagram for the patio heater.

(2)

(iii) State why the total energy supplied to the patio heater must always equal the total energy transferred by the patio heater.

_____

_____

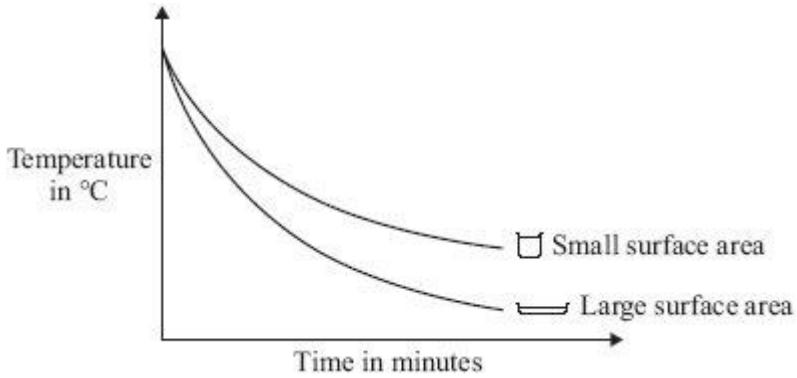
(1)

(Total 9 marks)

Q13.

(a) The graph compares how quickly hot water cooled down in two glass beakers with different surface areas.

The volume of water in each beaker was the same.



Describe how the surface area of the water affected how fast the water cooled down.

_____

_____

(1)

(b) Some foxes live in a hot desert environment.

This type of fox has very large ears.

Explain how the size of the fox's ears help it to keep cool in a hot desert.

_____

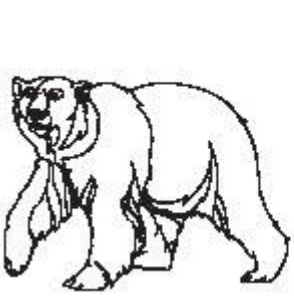
_____

_____

_____

(2)

(c) Polar bears and reindeer are adapted to live in cold environments.



Use the words in the box to complete the following sentences.

conduction	**convection**	**radiation**

(i) The white colour of a polar bear's fur helps to keep the polar bear warm by reducing the heat lost by _____ .

(1)

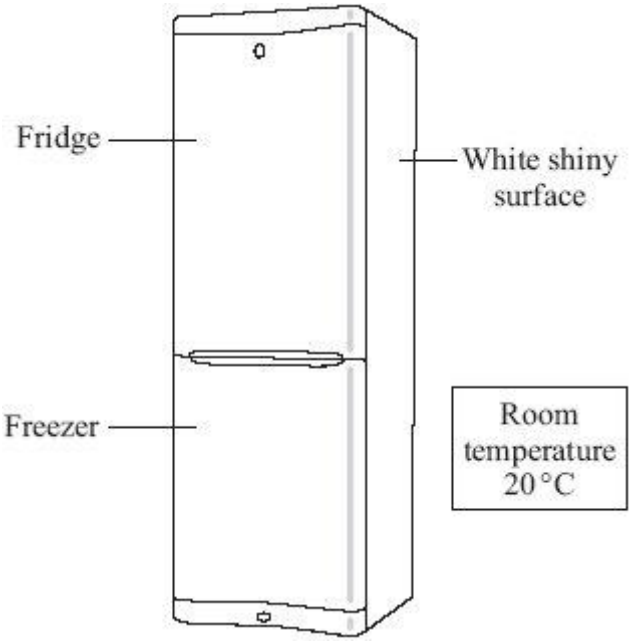
(ii) The hairs of a reindeer are hollow. The air trapped inside the hairs reduces the heat lost by _____ .

(1)

(Total 5 marks)

Q14.

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. _____

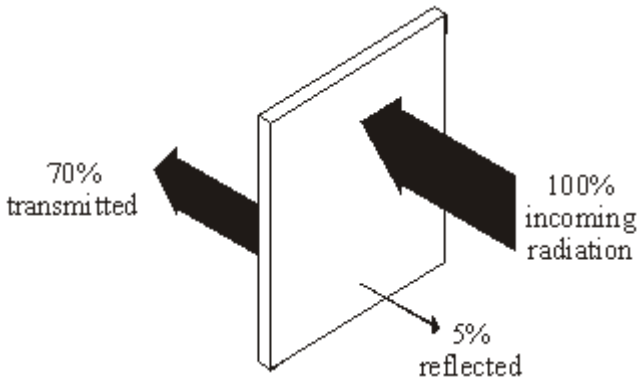
_____

(2)

(Total 4 marks)

Q15.

(a) Infra red radiation can be reflected, absorbed and transmitted by glass.



(i) What percentage of infra red is absorbed by the glass?

_____

(1)

(ii) Complete the following sentence by drawing a ring around the correct word or phrase.

Theabsorbed infra red	increases does not change decreases	the temperature of the glass.

(1)

(b) **Two** of the following statements are true. **One** of the statements is false.

Tick (✓) the boxes next to the **two** true statements.

All objectsabsorb infra red radiation.	
Blacksurfaces are poor emitters of infra red radiation.	
A hot objectemits more infra red than a cooler object.	

(1)

(c) The following statement is false.

Blacksurfaces are good reflectors of infra red radiation.

Change **one** word in this statement to make it true.

Write down your **new** statement.

_____

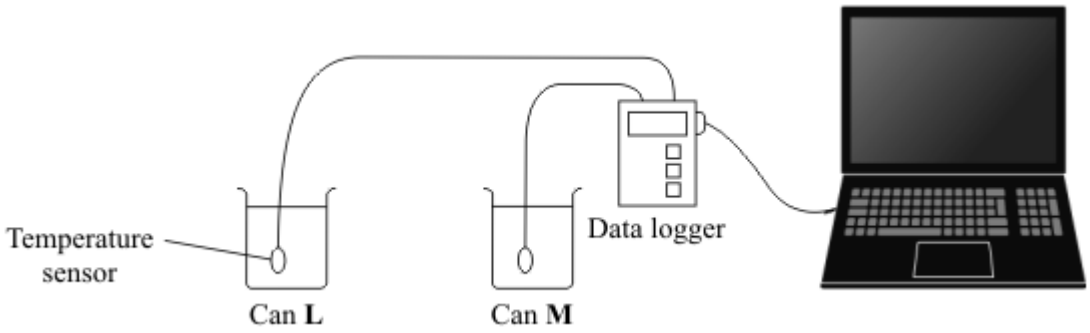
_____

(1)

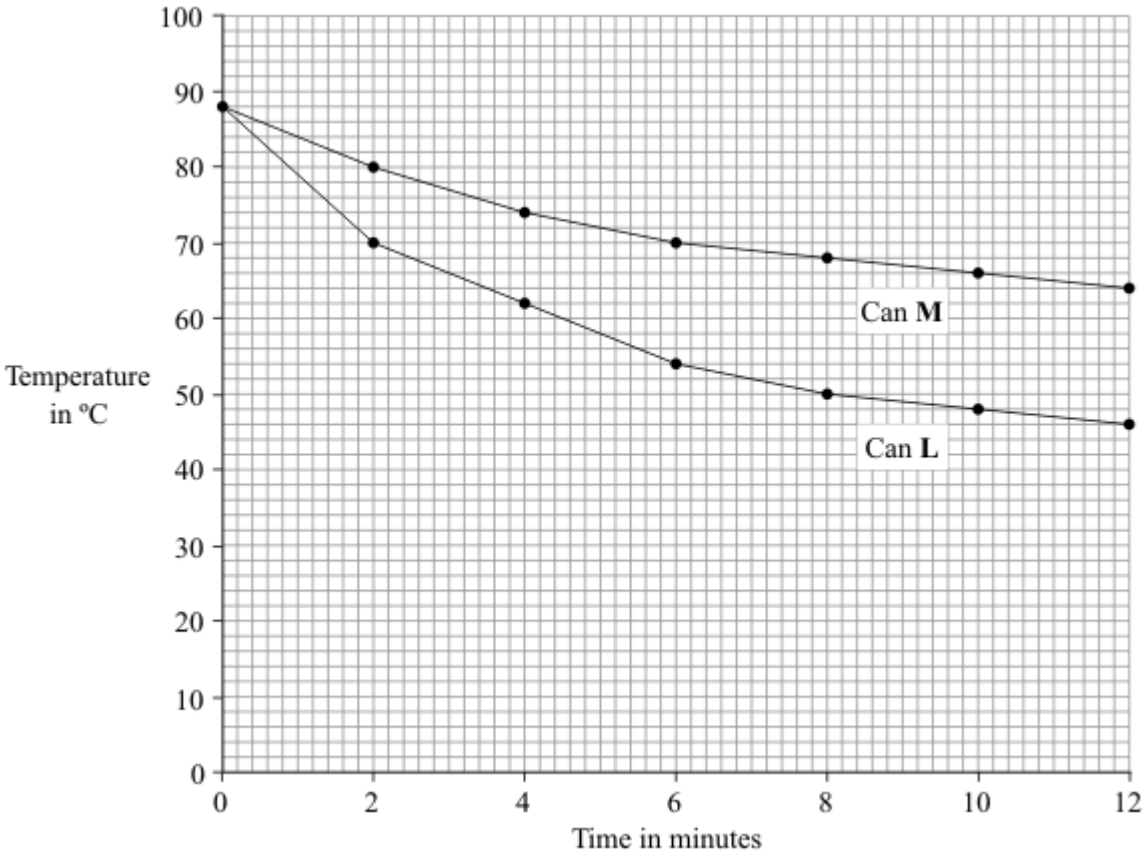
(Total 4 marks)

Q16.

A student was asked to investigate the heat loss from two metal cans, L and M. The cans were identical except for the outside colour.



The student filled the two cans with equal volumes of hot water. He then placed the temperature sensors in the water and started the data logger. The computer used the data to draw the graph below.



(a) Which **one** of the following is a categoric variable?

Put a tick (✓) in the box next to your answer.

the outside colour of the cans ☐

the starting temperature of the hot water ☐

the time ☐

the volume of hot water ☐

(1)

(b) For can **L**, state the temperature drop of the water:

(i) in the **first** two-minute interval

_____

(1)

(ii) in the **second** two-minute interval.

_____

(1)

(c) In both cans the water cooled faster at the start of the investigation than at the end of the investigation. Why?

_____

_____

(1)

(d) One can was black on the outside and the other can was white on the outside.

What colour was can **L**? _____

Explain the reason for your answer.

_____

_____

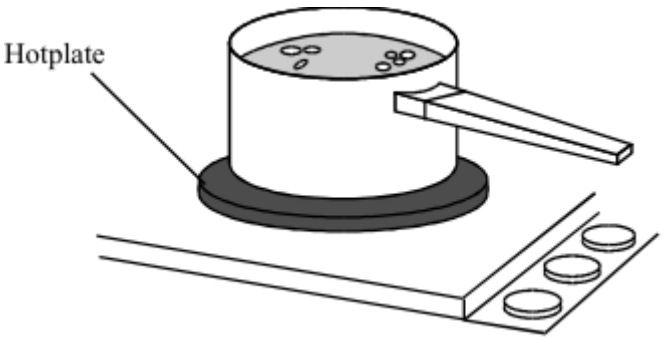
_____

(3)

(Total 7 marks)

Q17.

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.

_____

_____

_____

_____

(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

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

_____

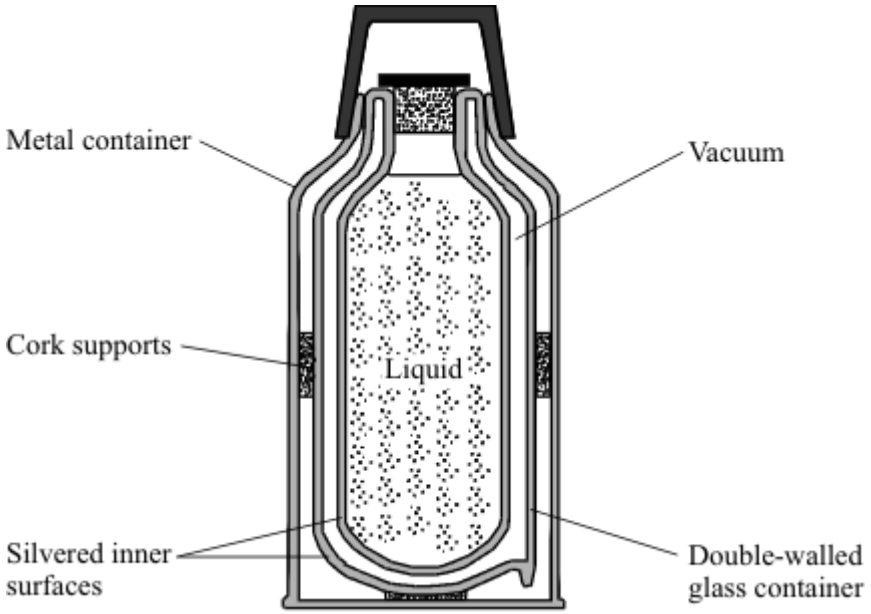
_____

(1)

(Total 6 marks)

Q18.

The vacuum flask shown has five features labelled, each one designed to reduce heat transfer.



(a) (i) Which labelled feature of the vacuum flask reduces heat transfer by both conduction and convection?

_____

(1)

(ii) Explain how this feature reduces heat transfer by **both** conduction and convection.

_____

_____

_____

_____

_____

(2)

(b) (i) Which labelled feature of the vacuum flask reduces beat transfer by radiation?

_____

(1)

(ii) Explain how this feature reduces heat transfer by radiation.

_____

_____

_____

_____

_____

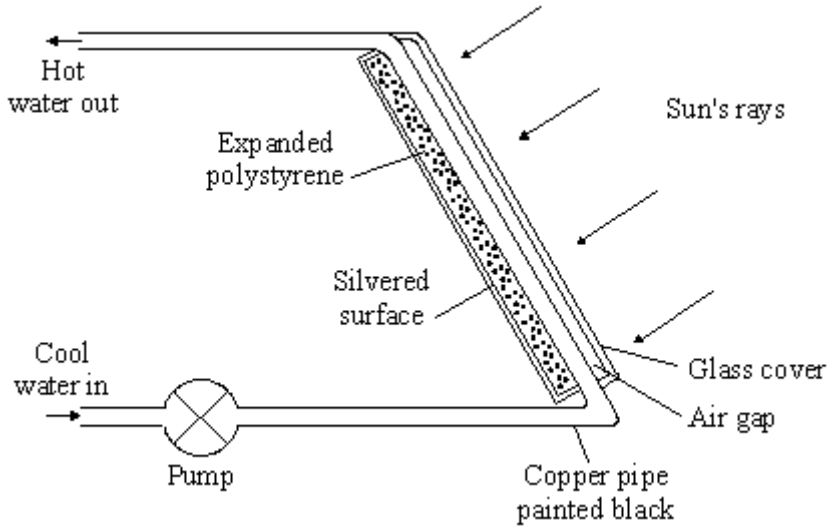
_____

(2)

(Total 6 marks)

Q19.

The diagram shows part of a solar water heater. Water circulating through the solar panel is heated by the Sun.



(i) Complete the following sentence.

Heat energy is transferred from the Sun to the solar panel by

_____ .

(1)

(ii) The pipe inside the solar panel is black. Why?

_____

_____

(1)

(iii) There is a layer of expanded polystyrene behind the black pipe. Why?

_____

_____

(1)

(iv) A silvered surface is used at the back of the solar panel. Explain why.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q20.

(a) When an electric kettle is switched on it will take a few minutes to boil the water. Once switched off it will gradually cool down.

(i) When the kettle is switched on the water heats. Explain how all of the water is heated.

_____

_____

(ii) The kettle is now switched off and begins to cool.

(1) Describe how heat energy is transferred **through** the walls of the kettle.

_____

_____

_____

(2) Describe how the heat energy is transferred **from** the walls of the kettle.

_____

_____

_____

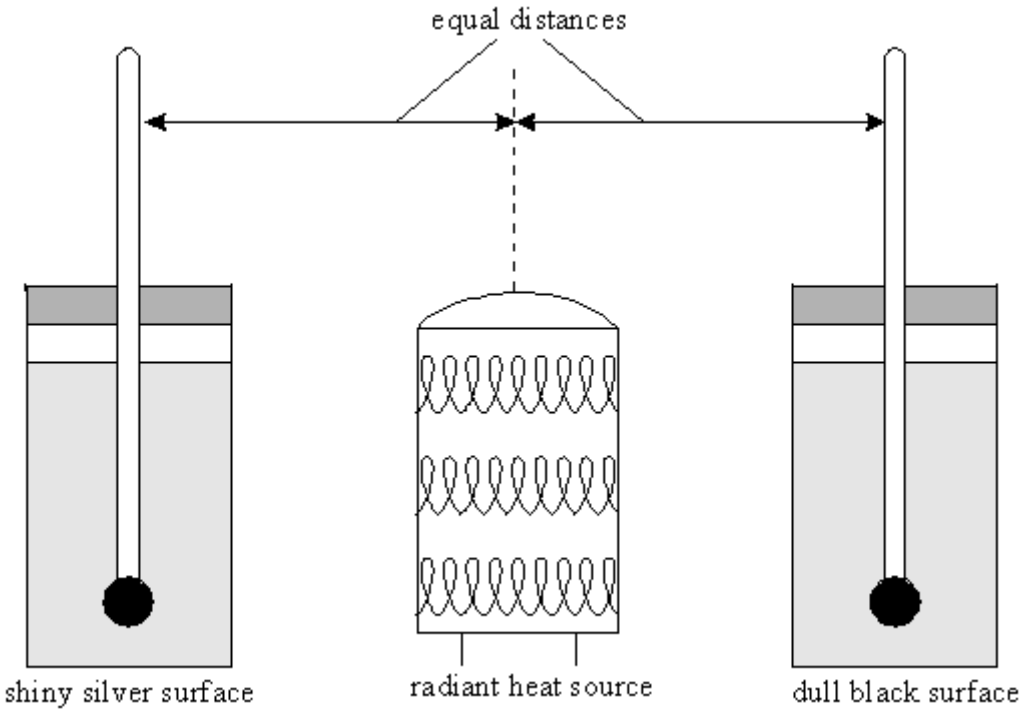
(iii) Describe how heat losses from the surface of a metal kettle may be kept small.

_____

_____

(4)

(b) A shiny metal can and a dull black can are filled with the same amounts of cold water.
A radiant heater is placed exactly half way between the cans as shown in the diagram below.



Two thermometers are used to measure the temperature of the water in each can every minute.

(i) Suggest how the temperature of the water in the dull can would be different from the temperature of the water in the shiny can after ten minutes.

_____

_____

(ii) Explain your answer to part (i).

_____

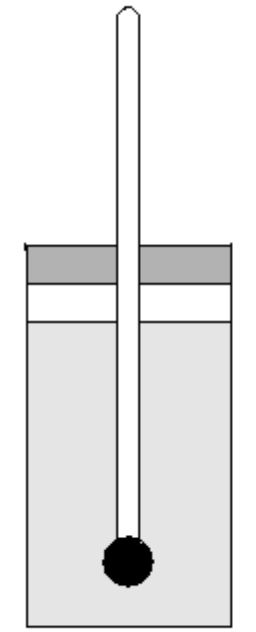
_____

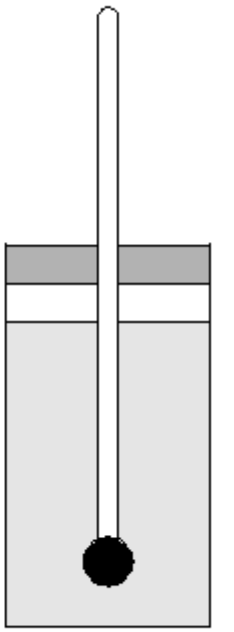
_____

_____

(3)

(c) The radiant heater was removed and both the cans were filled with the same amount of boiling water, as shown in the diagram below.





The temperature was recorded every minute for ten minutes.

(i) Suggest how the temperature of the water in the dull can would be different from the temperature of the water in the shiny can after ten minutes.

_____

_____

(ii) Explain your answer to part (i).

_____

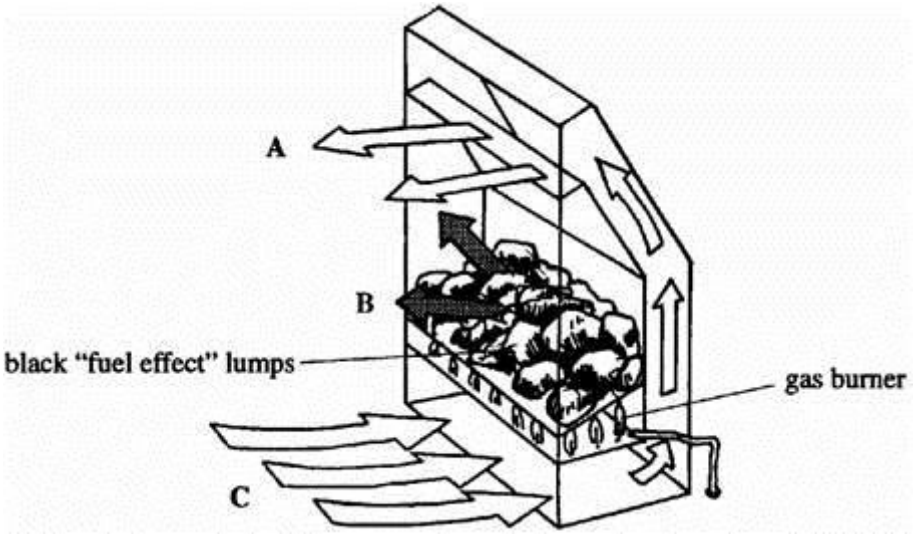
_____

(3)

(Total 10 marks)

Q21.

The diagram comes from a leaflet about a “coal effect” gas fire.
It shows how air circulates through the fire.



(a) Explain in detail why the air travels from **C** to **A**.

_____

_____

_____

_____

_____

_____

(4)

(b) The black "fuel effect" lumps become very hot.

(i) Name the process by which the lumps transfer thermal energy to the room as shown at **B**.

_____

(1)

(ii) Suggest **one** feature of the black "fuel effect" lumps which make them efficient at transferring energy.

_____

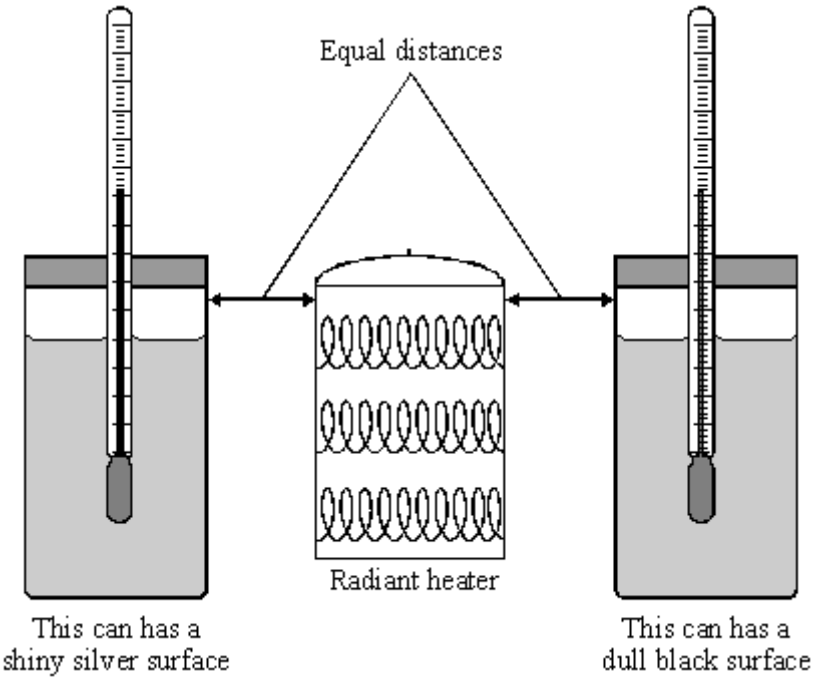
_____

(1)

(Total 6 marks)

Q22.

A student did two experiments on radiation. The apparatus he used is shown in the diagram.



Experiment 1

- The student put the same volume of cold water into the two cans.
- He then switched on the heater.
- Ten minutes later the water in the can with the dull black surface was much hotter than the water in the other can.

Experiment 2

- The student filled both cans with boiling water.
- This time he left the heater off.
- Ten minutes later the water in the can with the dull black surface was much cooler than the water in the other can.

Use words from the box to complete the sentences.

absorber	conductor	emitter	reflector

Experiment 1 shows that the dull black surface is a good _____ of radiation

and that the shiny silver surface is a good _____ of radiation.

Experiment 2 shows that the dull black surface is a good _____ of radiation.

(Total 3 marks)

Q23.

The diagram shows four identical pieces of aluminium. Each had been painted with a different type of paint. A drop of water was placed on each and they were then heated by a radiant heater held about one metre above them.

A Shiny white

B Shiny black

C Matt white

D Matt black

(i) Suggest in which order the pieces of aluminium would become dry.

first _____ _____ _____ _____ last

(1)

(ii) Explain why you chose your order.

_____

_____

_____

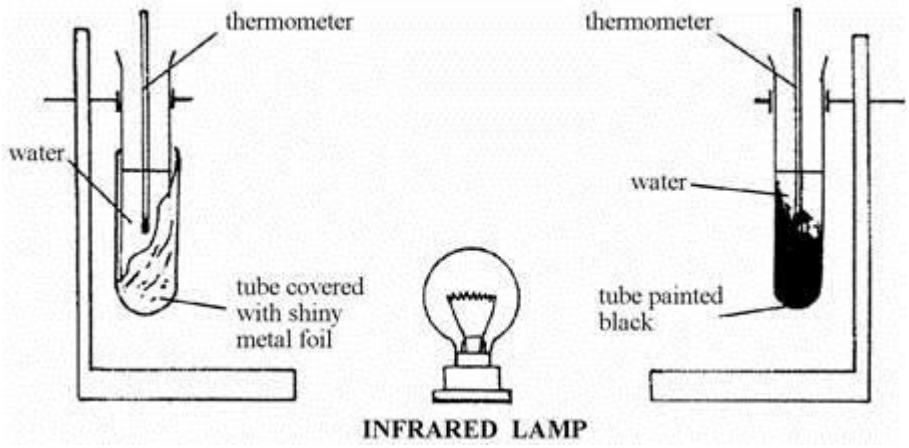
_____

(2)

(Total 3 marks)

Q24.

The diagram shows an experiment to find out what happens to infrared waves when they strike different surfaces.



(a) The water in the black tube gets hotter than the water in the shiny tube.
Choose words from the list to complete the sentences below.

absorbs **conducts** **convects** **radiates** **reflects**

The infrared lamp _____ energy to the tubes of water.

The black surface _____ most of the energy that reaches it.

The shiny surface _____ most of the energy that reaches it.

(3)

(b) Put the sentences A- E below into the correct boxes on the flow diagram so that they tell you how to do the experiment

(You may use just the letters if you want to.)

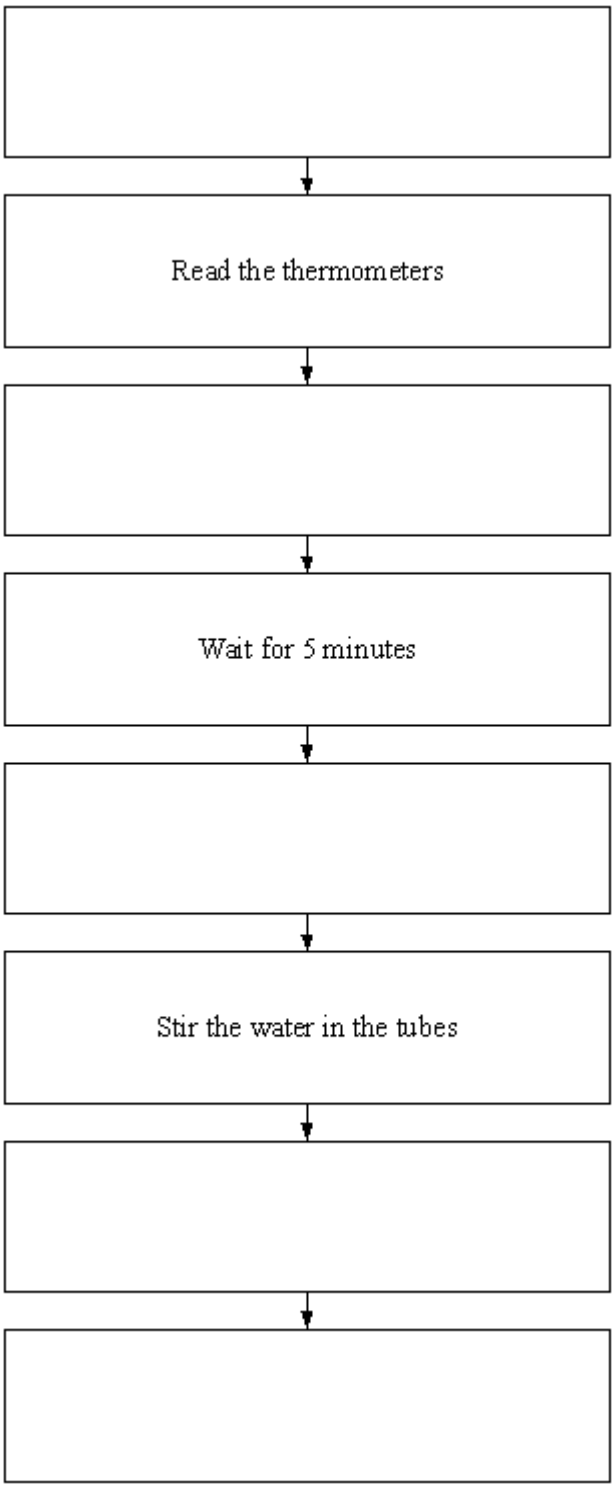
A Switch off the lamp

B Switch on the lamp

C Make sure the lamp is the same distance from both tubes

D Read the thermometers

E Wait for the temperature to stop rising



(5)

(Total 8 marks)