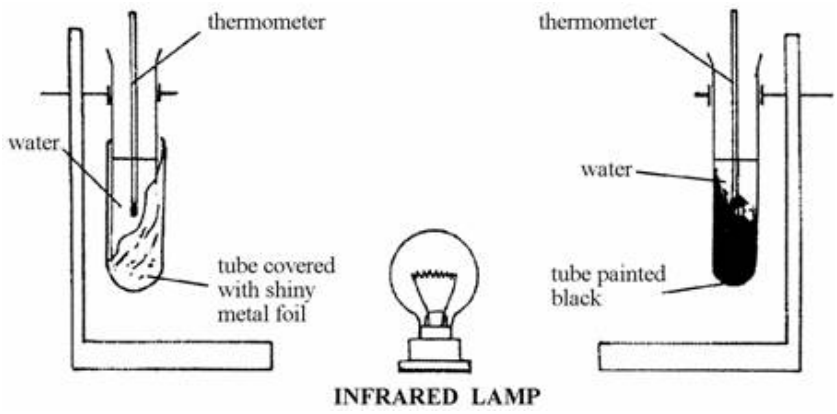
Q1. The diagram shows an experiment to find out what happens to infrared waves when they strike different surfaces.



(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.)

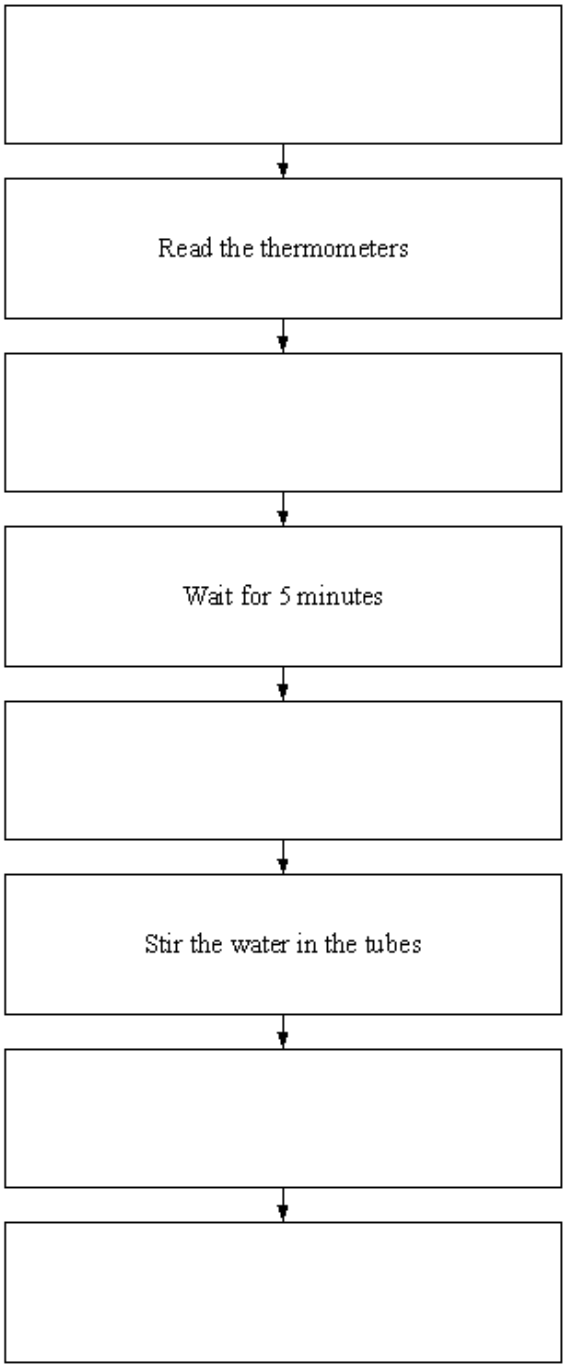
A Switch off the lamp

B Switch on the lamp

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

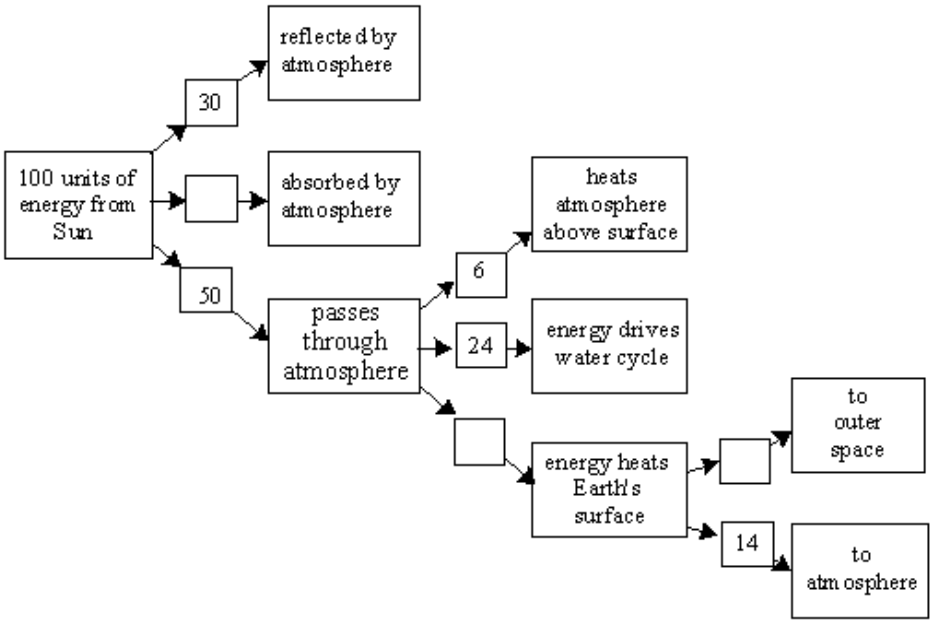
D Read the thermometers

E Wait for the temperature to stop rising



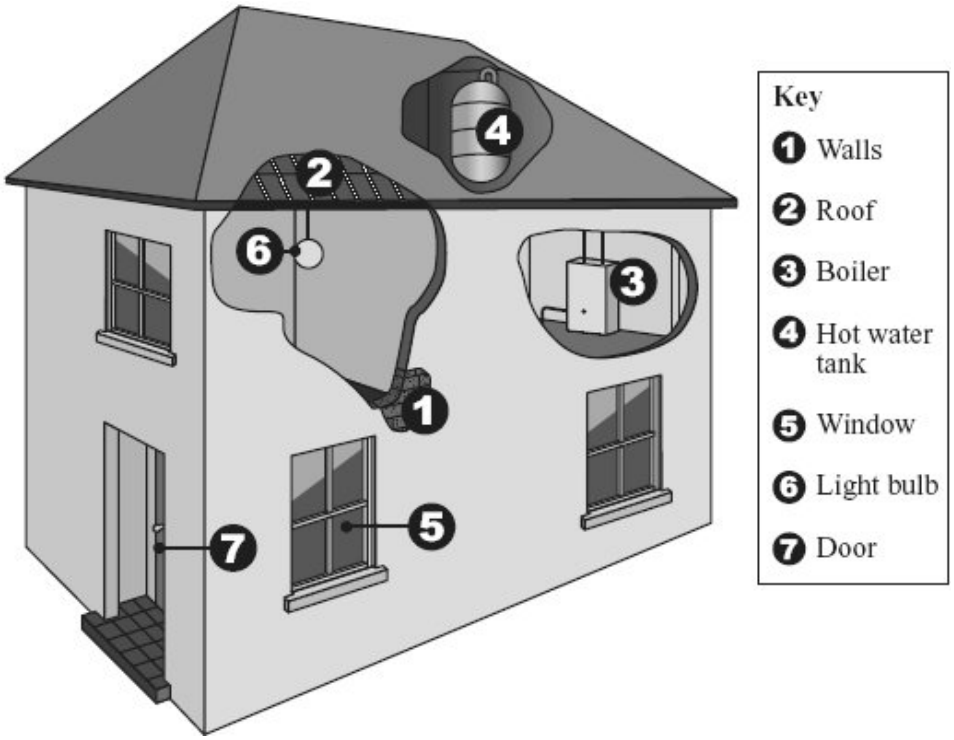
(5)
(Total 8 marks)

Q2. Complete the boxes on the chart to show what happens to the energy from the Sun.



(Total 3 marks)

Q3. The drawing shows parts of a house where it is possible to reduce the amount of energy lost.



(a) Give **one** way in which the amount of energy lost can be reduced from each of the following parts of the house.

1, **2** and **4** .....

5 .....

7 .....

(3)

(b) Energy consumption can be reduced by using a more efficient boiler or more efficient light bulbs.

What is meant by a *more efficient* light bulb?

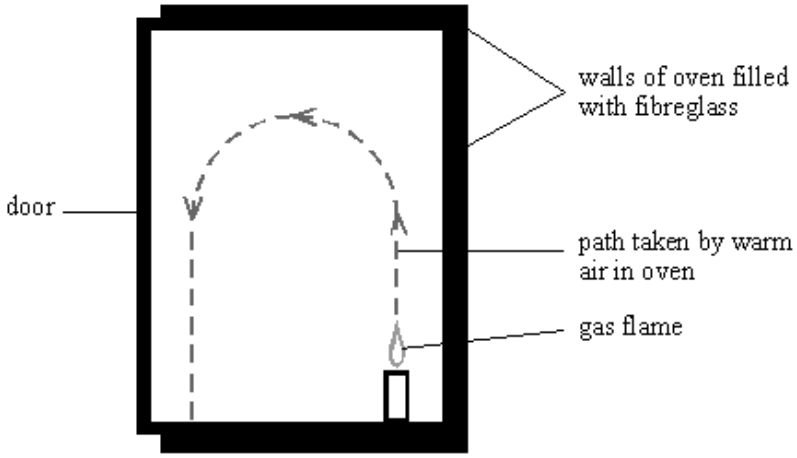
.....

.....

(1)

(Total 4 marks)

Q4. The diagram shows a section through a gas oven.



Use words from the list to complete the sentences.

conduction **convection** **insulation** **radiation** **resistance**

The outside of the door gets hot because energy is transferred through

the door by .....

Energy is transferred from the gas flame to the rest of the oven by the movement of air.

This type of energy transfer is called .....

The walls of the oven are packed with fibreglass to reduce energy transfer. Energy transfer

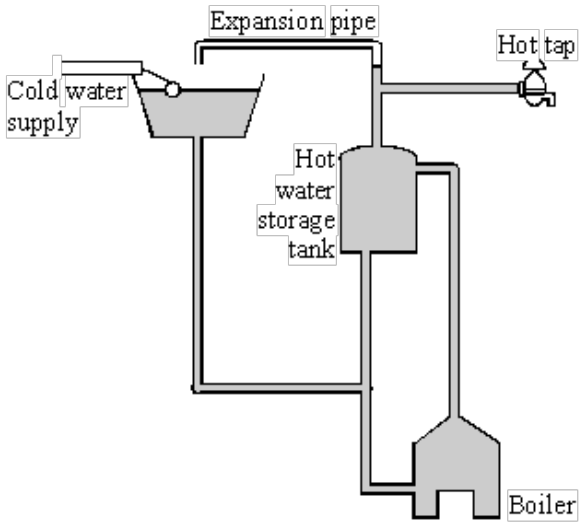
is reduced because fibreglass provides good .....

The outside of the cooker is white and shiny.

This reduces energy transfer by .....

(Total 4 marks)

Q5. (a) The diagram shows a hot water system.



(i) Explain why the boiler is below the hot water tank.

.....

.....

.....

(ii) Why is heat energy transferred from hot water in the tank to the surrounding air?

.....

.....

(iii) Name the process by which energy is transferred through the sides of the tank.

.....

(iv) How may heat loss from the hot water tank be reduced?

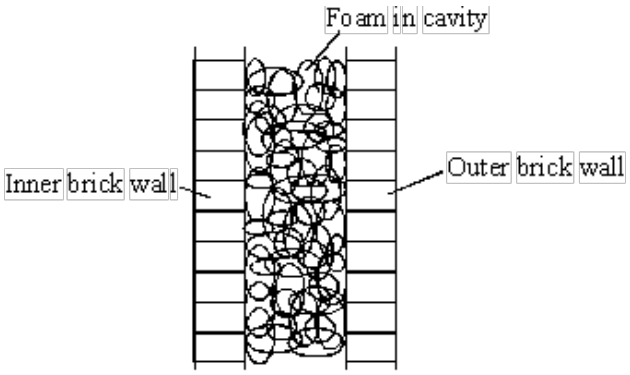
.....

.....

.....

(6)

(b) One way of reducing heat loss from a house is by cavity wall insulation. Foam is pumped between the inner and outer brick walls as shown in the diagram.



How is heat loss from a house reduced by:

(i) having a cavity wall?

.....

.....

.....

.....

(ii) filling the cavity with foam?

.....

.....

(3)
(Total 9 marks)

Q6. (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.

.....

.....

.....

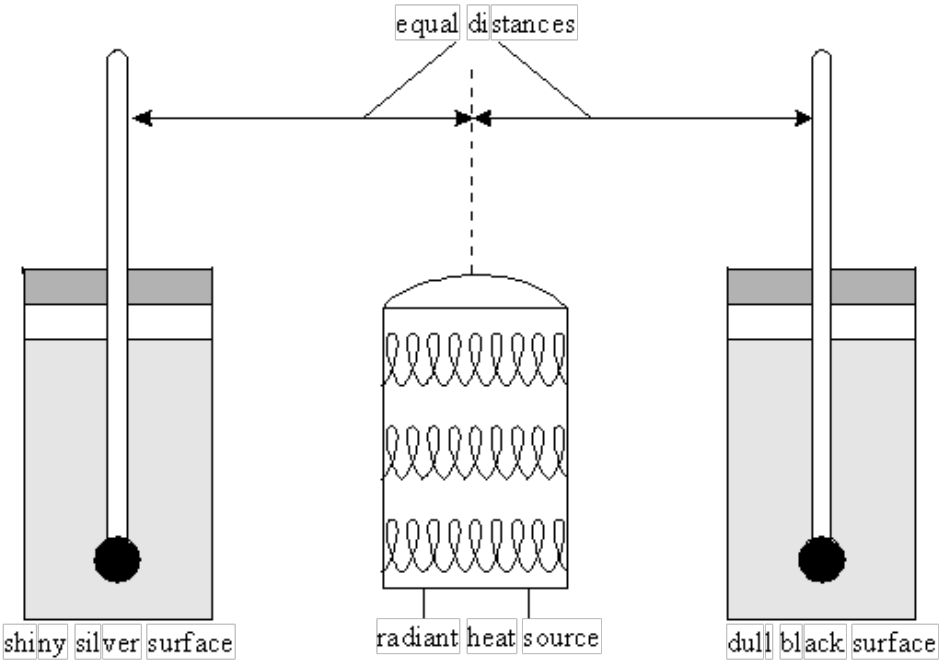
(iii) Describe how heat losses from the surface of a metal kettle may be kept small.

.....

.....

(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).

.....

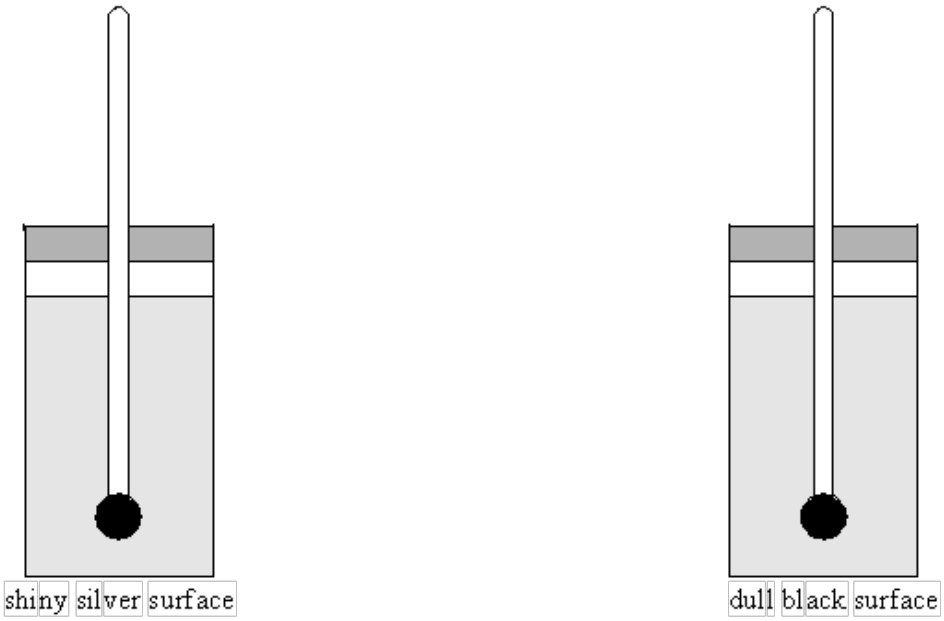
.....

.....

.....

(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.

.....

.....

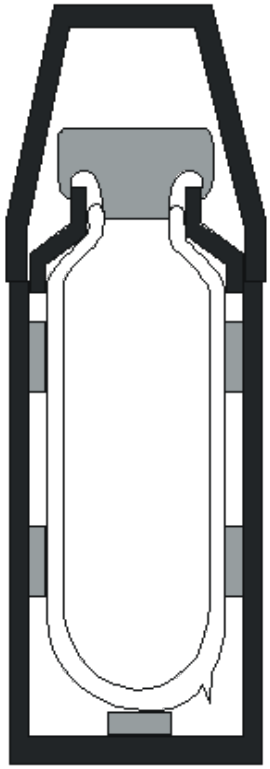
(ii) Explain your answer to part (i).

.....

.....

(3)
(Total 10 marks)

Q7. The diagram below shows a vacuum flask.



(a) Give **two** features of the flask which reduce heat loss by conduction.

1. .....

2. .....

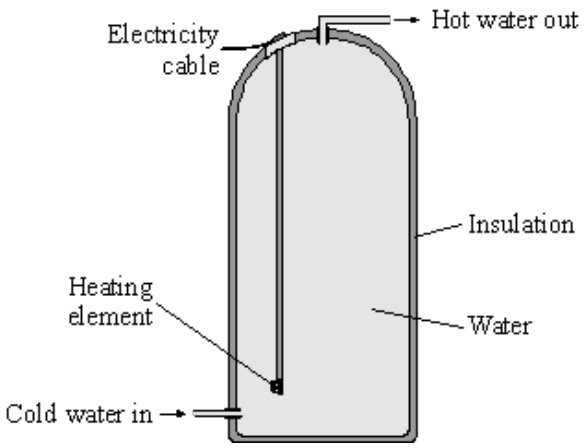
(2)

(b) Give **one** feature of the flask which reduces heat loss by radiation.

.....

(1)
(Total 3 marks)

Q8. (a) The diagram shows an immersion heater used to heat water inside a tank. Heat is transferred through the water by convection.



(i) Draw arrows on the diagram to show the movement of the water in the tank when the heating element is switched on.

(2)

(ii) Explain how a convection current is set up in the water. The explanation has been started for you.

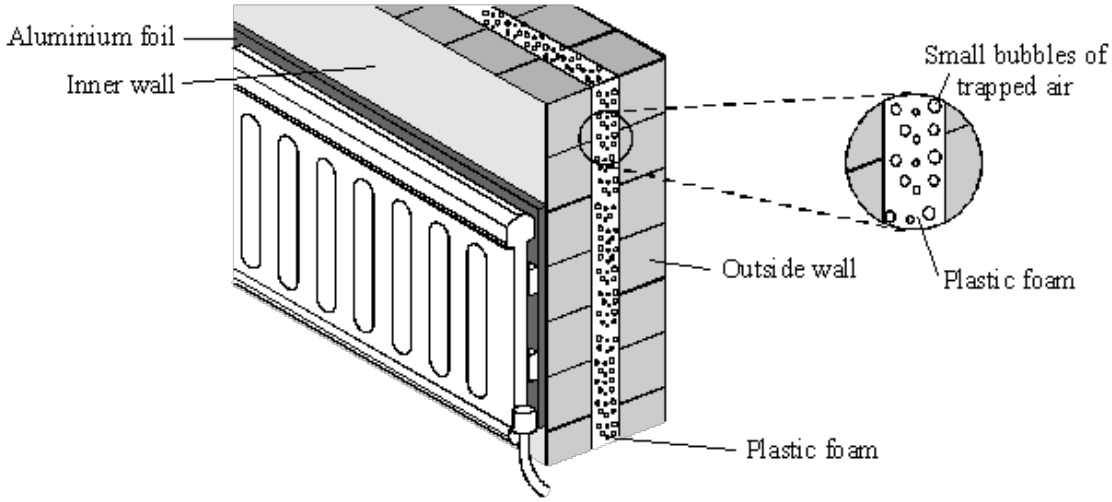
When the heating element is switched on, the hot water nearest the element rises because .....

.....

.....

(2)

(b) The diagram shows **two** ways to reduce heat loss through the walls of a house.



(i) How is the aluminium foil able to reduce heat loss?

.....

.....

(1)

(ii) The plastic foam is good at reducing heat loss through the walls. Explain why.

.....

.....

.....

.....

.....

(3)

(c) Evaporation is an important heat transfer process. When sweat evaporates, it takes heat energy from your body. As humidity increases, you are more likely to feel hot and uncomfortable. Explain why.

.....

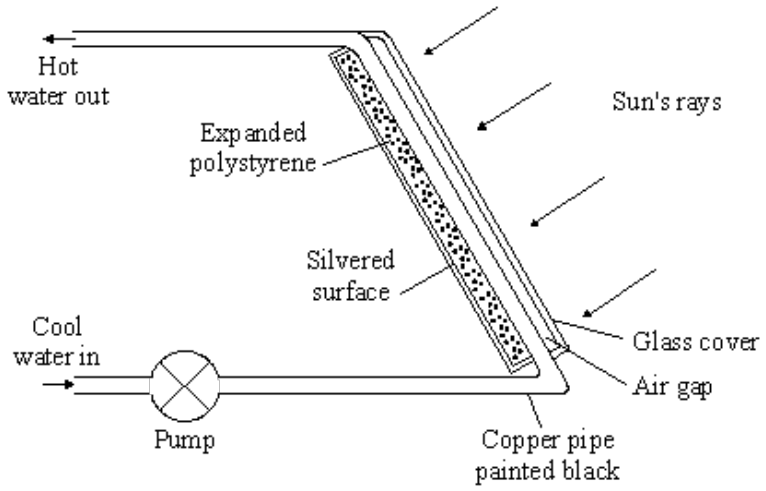
.....

.....

(2)

(Total 10 marks)

Q9. 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.

.....

.....

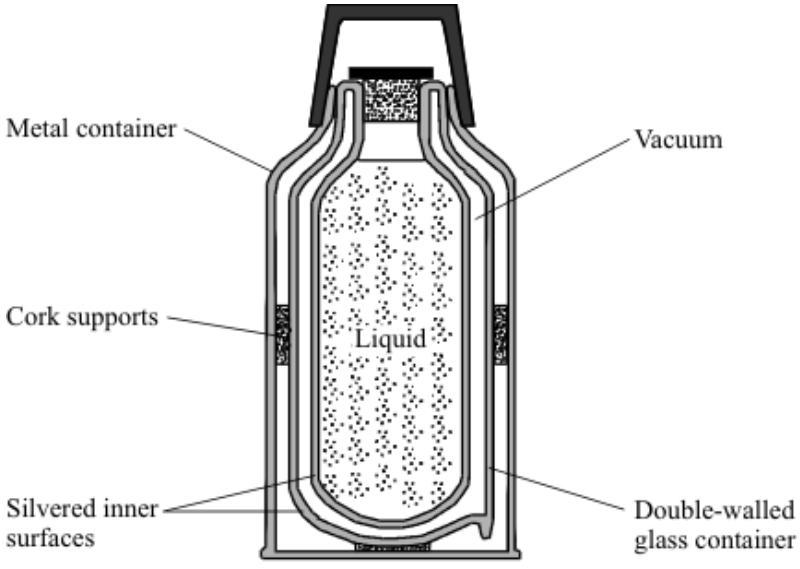
.....

.....

(2)

(Total 5 marks)

Q10. 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.

.....

.....

.....

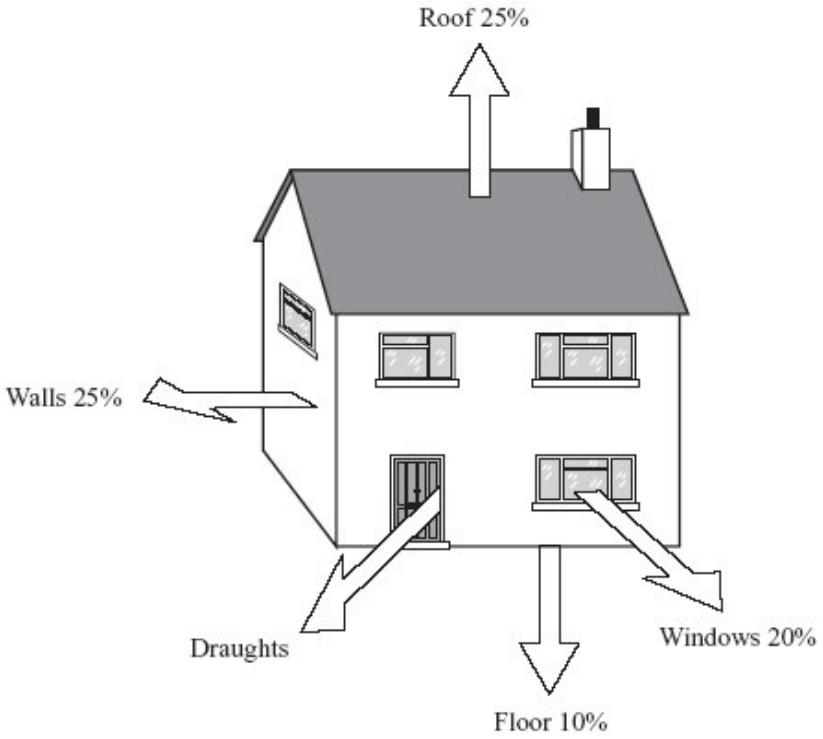
.....

.....

.....

(2)
(Total 6 marks)

Q11. (a) The diagram shows the ways in which heat energy can be transferred from an old house.



(i) Calculate the percentage of energy transferred by draughts.

% energy transferred by draughts = ...

(1)

(ii) Complete the following sentence using **one** of the words from the box.

conduction	**convection**	**radiation**

Draughts transfer heat energy by .....

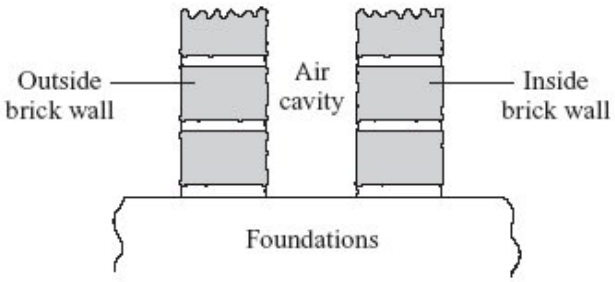
(1)

(iii) State **one** way of reducing the heat transfer by draughts.

.....

(1)

(b) The diagram shows a section through the walls of a house built in 1930.



Explain how the air cavity between the two walls reduces the heat transfer from the house.

.....

.....

.....

.....

(2)

(c) The table shows the installation costs and yearly savings on energy bills for different methods of insulating a house.

Method of insulation	**Installation cost in £**	**Yearly saving on energy bills in £**
Double glazing	4000	65
Loft insulation	240	60
Cavity wall insulation	600	80

(i) Give **one** reason why loft insulation is often fitted to an old house before double glazing or cavity wall insulation.

.....

.....

(1)

(ii) The time it takes for the saving on energy bills to equal the cost of installing the insulation is called the pay-back time.

Calculate the pay-back time for loft insulation.

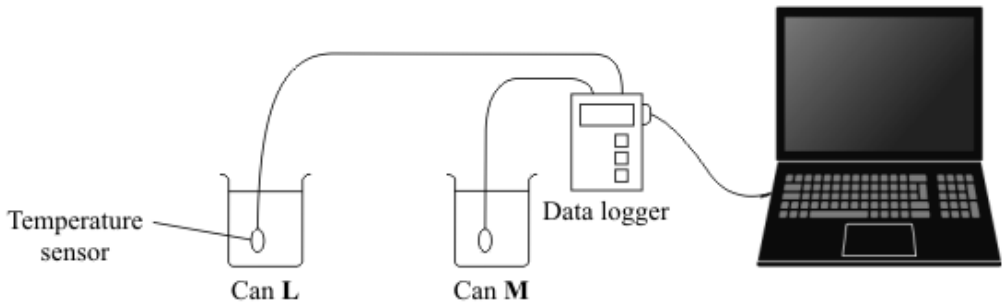
.....

Pay-back time = ... years

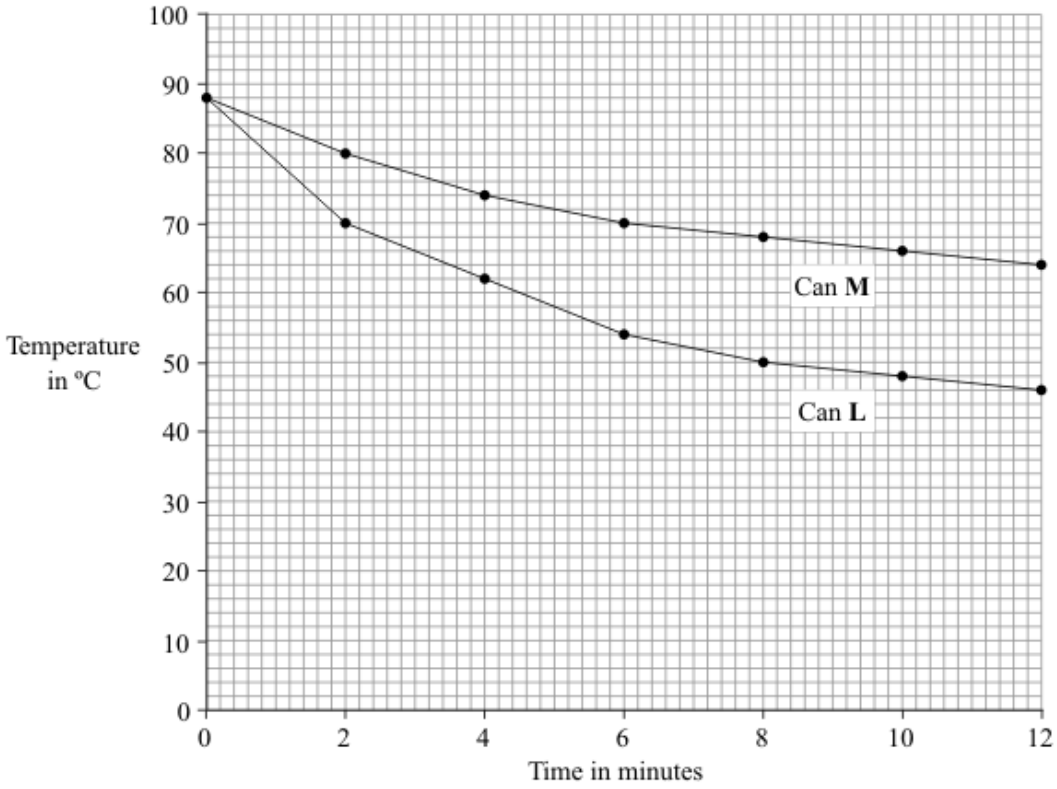
(1)

(Total 7 marks)

Q12. 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.

.....

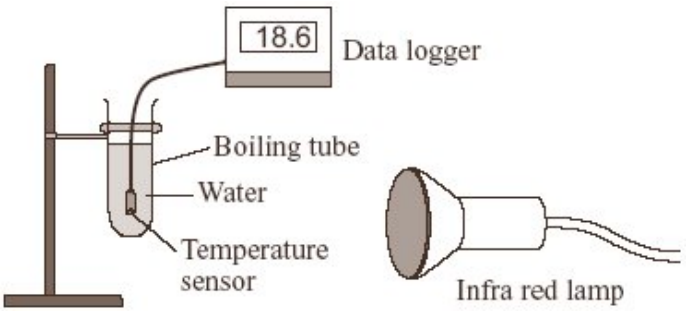
.....

.....

(3)
(Total 7 marks)

Q13. A student had read about a glacier that had been covered in insulating material. The idea was to slow down the rate at which the glacier melts in the summer.

She investigated this idea using the apparatus shown in the diagram.



(a) These are the steps taken by the student.

- Measure 30 cm^3 of cold water into a boiling tube.
- Place the boiling tube 25 cm from an infra red lamp.
- Record the temperature of the water.
- Switch on the infra red lamp.
- Record the temperature of the water every minute for 5 minutes.
- Repeat with boiling tubes covered in different insulating materials.

(i) Why did she use an infra red lamp?

.....

(1)

(ii) Name **one** control variable in this investigation.

.....

(1)

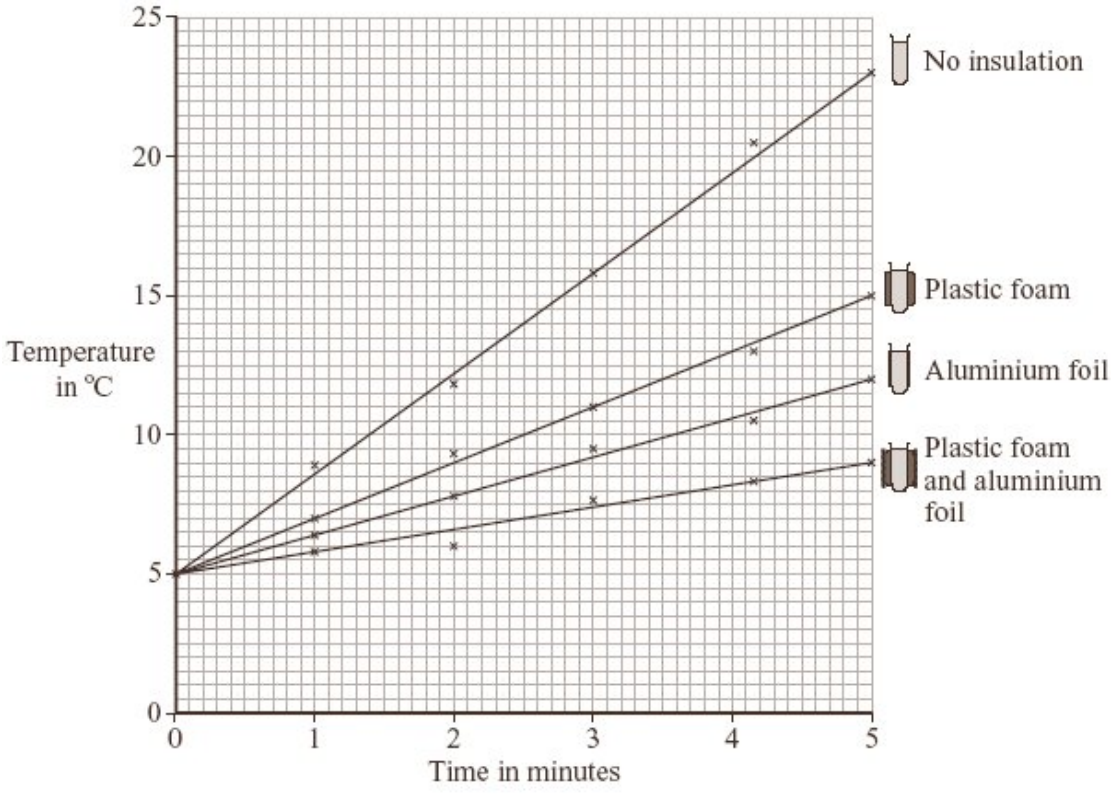
(iii) Give **one** advantage of using a temperature sensor and data logger instead of a glass thermometer to measure temperature.

.....

.....

(1)

(b) The results of the investigation are shown in the graph.



(i) Why did the student use a boiling tube with no insulation?

.....

.....

(1)

(ii) From her results, what should she recommend is used to insulate the glacier?

.....

(1)

(iii) Explain why the insulation recommended by the student will reduce the heat transfer from the Sun to the glacier.

.....

.....

.....

.....

.....

(2)

(c) Explain, in terms of particles, how heat is transferred through the glass wall of a boiling tube.

.....

.....

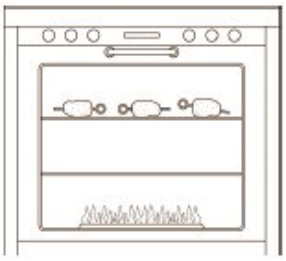
.....

.....

(2)

(Total 9 marks)

Q14. The diagram shows potatoes being baked in a gas oven. Each potato has a metal skewer pushed through it.



(a) Explain how heat is transferred by the process of convection from the gas flame at the bottom of the oven to the potatoes at the top of the oven.

.....

.....

.....

.....

.....

.....

(3)

(b) The metal skewers help the potatoes to cook by transferring heat to the inside of the potatoes.

By what method is heat transferred through a metal skewer?

.....

(1)

(c) When the potatoes are taken from the oven, they start to cool down.

Suggest **one** factor that will affect how fast a potato cools down.

.....

(1)

(d) If the potatoes need to be kept hot, they may be wrapped in shiny aluminium foil.

Why does this help to keep the potatoes hot?

.....

(1)

(Total 6 marks)

Q15. (a) In winter, energy is transferred from the warm air inside a house to the air outside.

(i) What effect will the energy transferred from the house have on the air outside?

.....

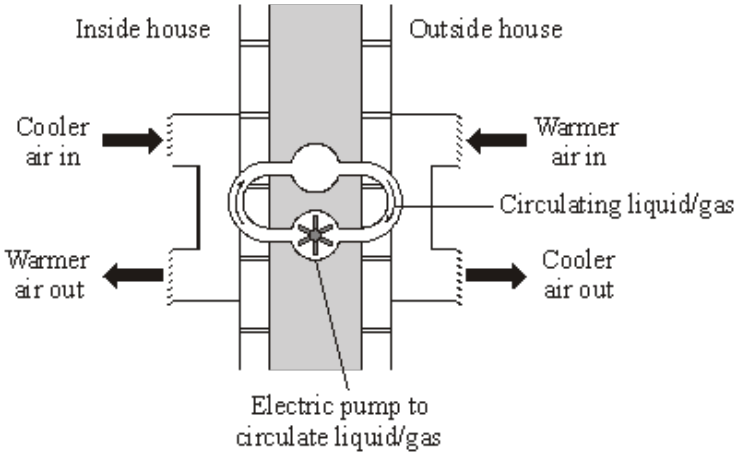
(1)

(ii) What would happen to the energy transfer if the temperature inside the house were reduced? Assume the temperature outside the house does not change.

.....

(1)

(b) To increase energy efficiency, a householder installs a heat exchanger to an outside wall of the house. The heat exchanger uses heat from the air outside to warm the inside of the house. The diagram shows the idea of the heat exchanger.



Physics Through Applications edited by J Jardine et el (OUP, 1989), copyright © Oxford University Press, reprinted by permission of Oxford University Press.

(i) Why does the heat exchanger cost money to run?

.....

(1)

(ii) The heat exchanger is cost effective in reducing energy consumption. Explain why.

.....

.....

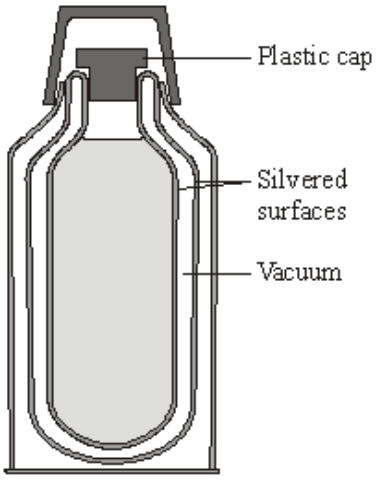
.....

.....

(2)

(Total 5 marks)

Q16. 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	✓	✓	
silvered surfaces			
plastic cap			

(2)

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

.....

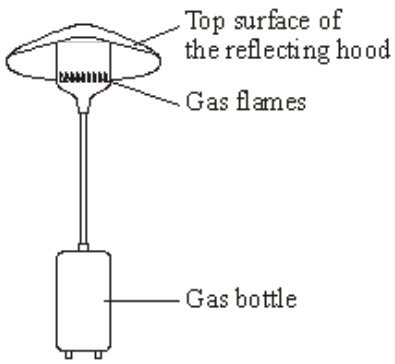
.....

.....

.....

(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.

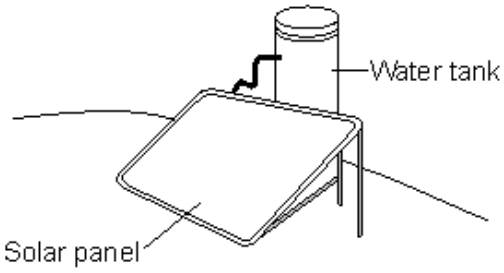
.....

.....

(1)

(Total 9 marks)

Q17. The picture shows one type of solar water heater. Water from the tank is slowly pumped through copper pipes inside the solar panel where the water is heated by energy from the Sun.



(a) Explain why the copper pipes inside the solar panel are painted black.

.....

.....

.....

.....

(2)

(b) Each day the average European family uses 100 kg of hot water.
To kill bacteria, the water going into the tank at 20 °C must be heated to 60 °C.

Calculate the energy needed to increase the temperature of 100 kg of water by 40 °C.

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

Write down the equation you use, and then show clearly how you work out your answer.

.....

.....

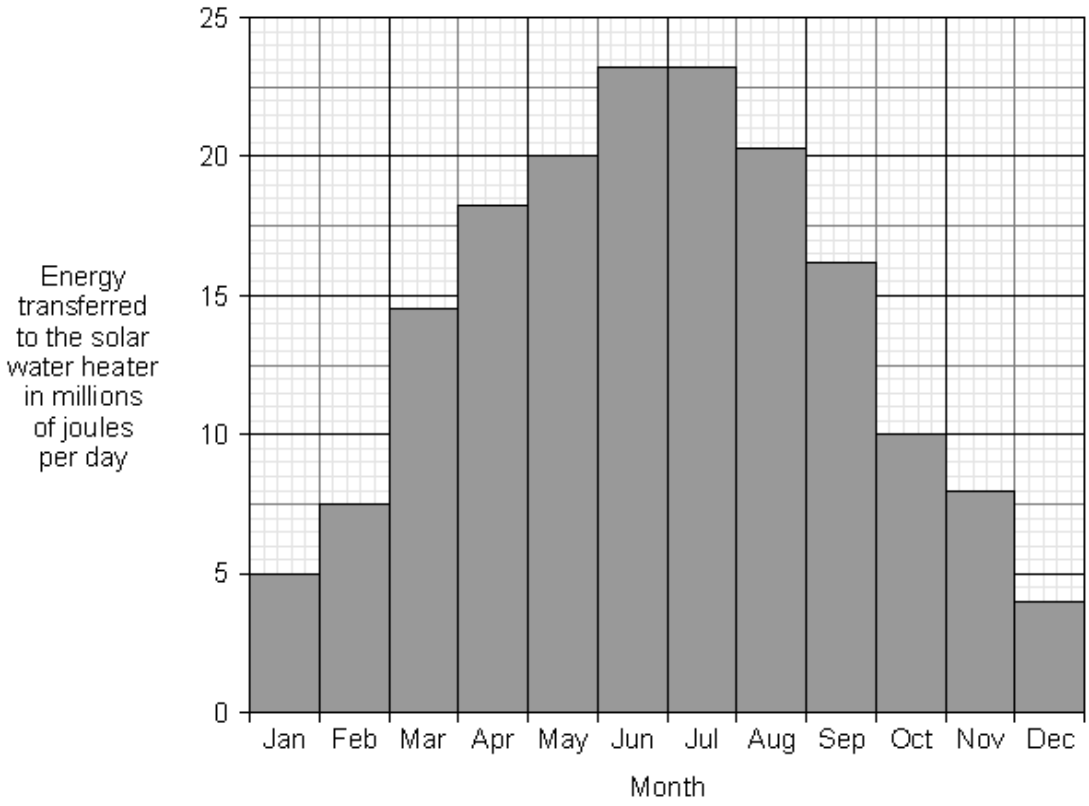
.....

.....

Energy transferred = ... J

(2)

(c) The bar chart shows how the amount of solar energy transferred to the water heater varies throughout the year.



How many months each year will there **not** be enough solar energy to provide the hot water used by an average European family?

..... months

(1)

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

The water in the tank could be heated by using an electric immersion heater.

Outline the advantages and disadvantages of using solar energy to heat the water rather than using an electric immersion heater.

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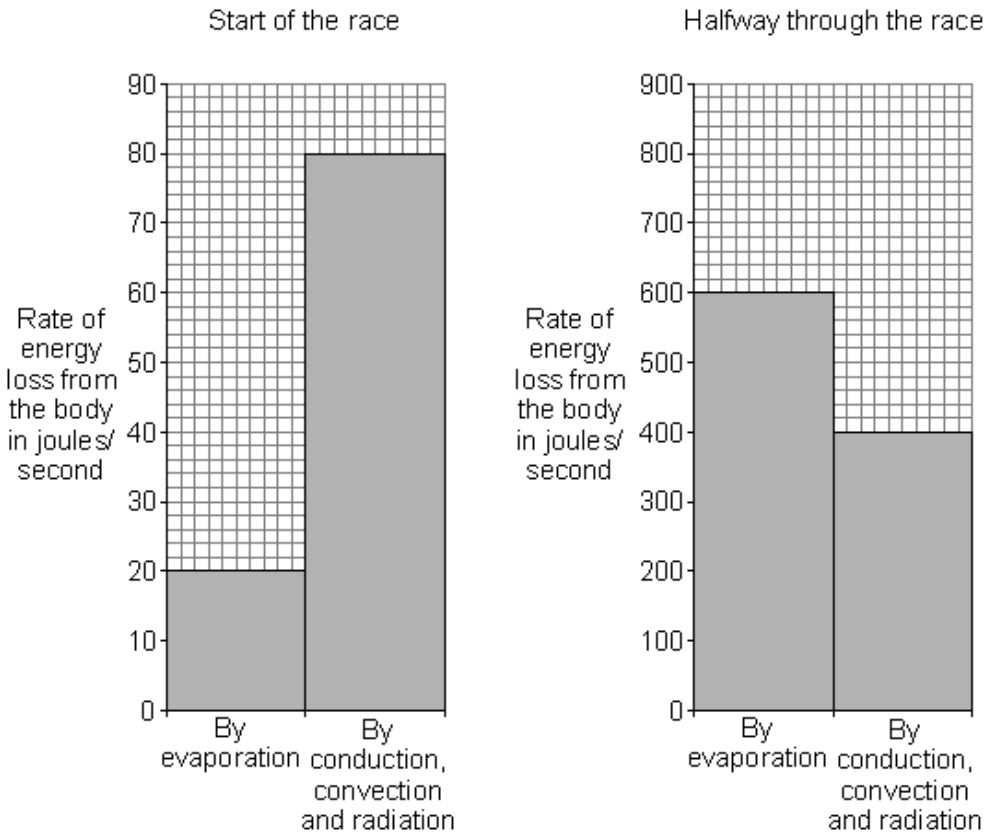
(6)
(Total 11 marks)

Q18. The bar charts show the rate of energy loss from the body of a runner at the start of a marathon race and half way through the race.



(a) It is important that the energy loss by evaporation increases during the race.

Explain why.

.....

.....

.....

.....

.....

(2)

(b) At the end of the marathon the runner covers herself in a silvered space blanket.

Explain how the space blanket helps keep the runner warm.

.....

.....

.....

.....

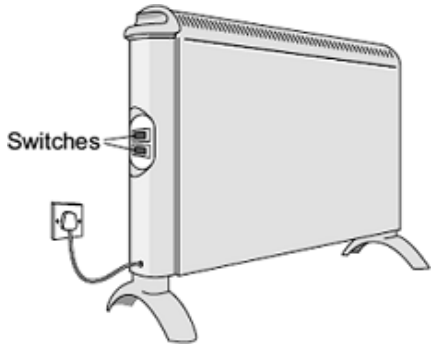
.....

.....

.....

(2)
(Total 4 marks)

Q19. (a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.



Setting	Power in watts
Low	700
Medium	1400
High	

(i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

.....

Power = ... kilowatts

(1)

(ii) The heater is used on the **high** power setting. It is switched on for 1½ hours.

Use the equation in the box to work out the energy transferred from the mains to the heater in 1½ hours.

energy transferred = power × time

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

.....

.....

.....

Energy transferred = ...

(3)

(iii) This type of heater is a very efficient device.

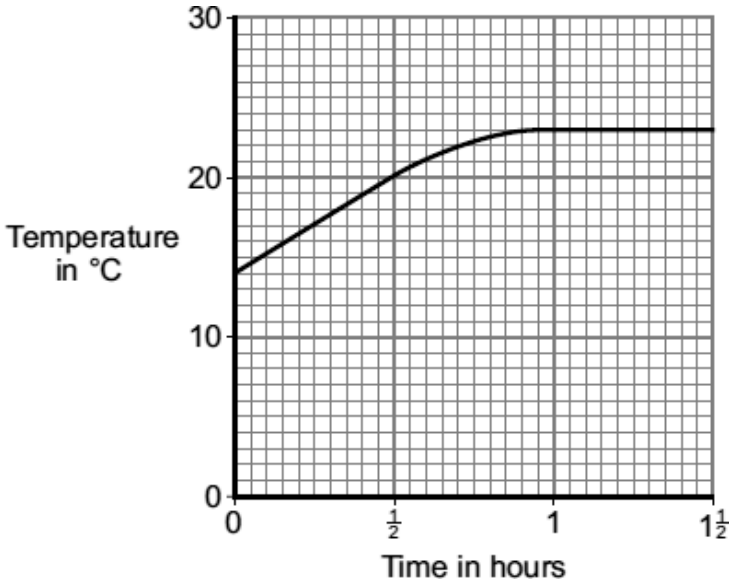
What is meant by a device being very efficient?

.....

.....

(1)

(b) The graph shows how the temperature of a room changes during the 1½ hours that the heater is used.



After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

.....

.....

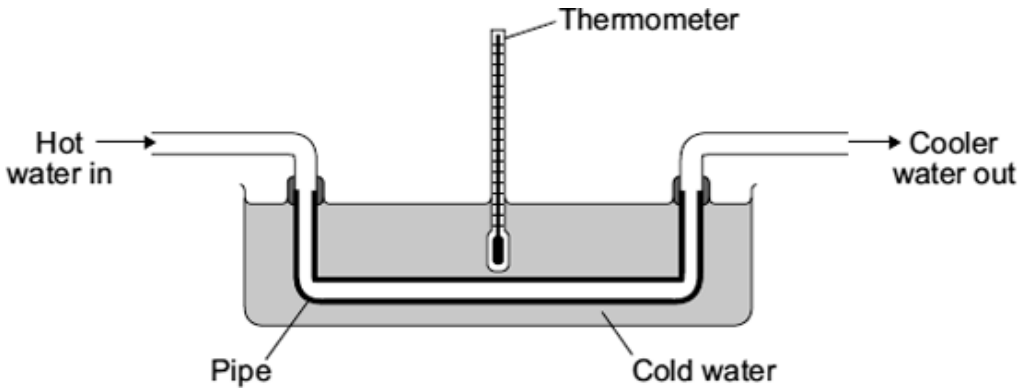
.....

.....

(2)
(Total 7 marks)

Q20. Heat exchangers are devices that are used to transfer heat from one place to another.

The diagram shows a simple heat exchanger used by a student in an investigation.
Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.



(a) By which process is heat transferred from the hot water inside the pipe to the cold water outside the pipe?

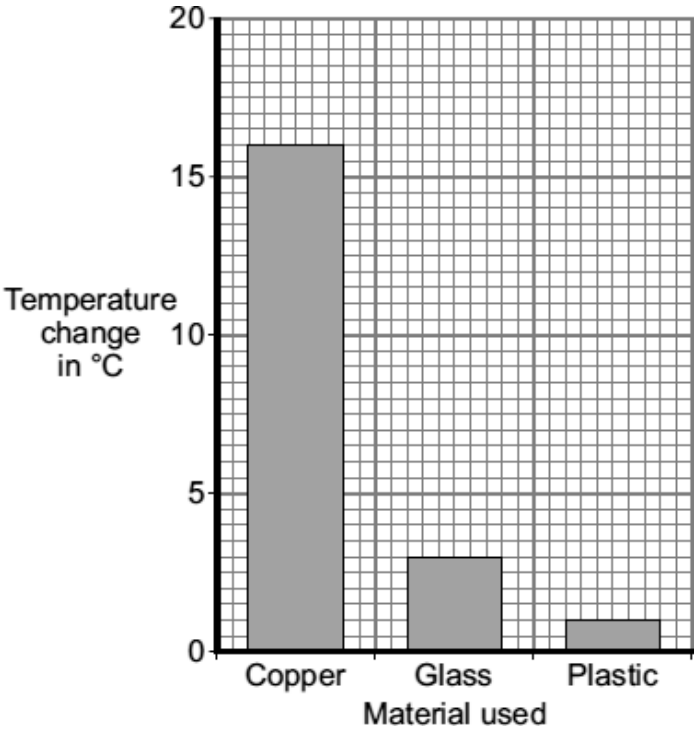
.....

(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 results obtained by the student are recorded in the table and displayed in the bar chart.

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.

.....

(1)

(ii) Why did the student draw a bar chart rather than a line graph?

.....

.....

(1)

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

.....

Give a reason for your answer.

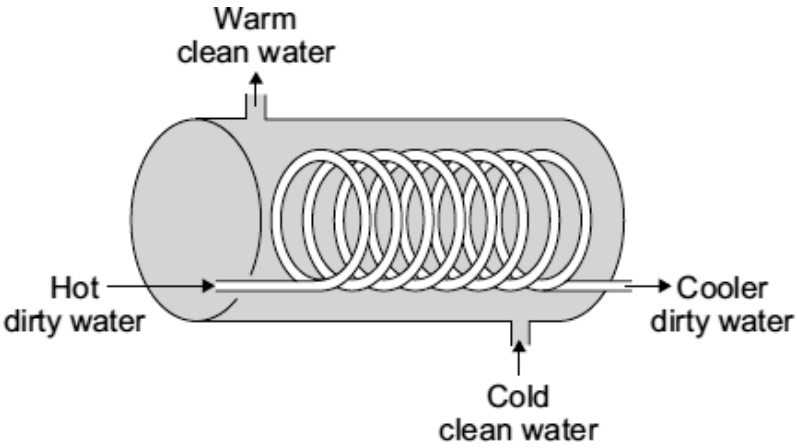
.....

.....

.....

(2)

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



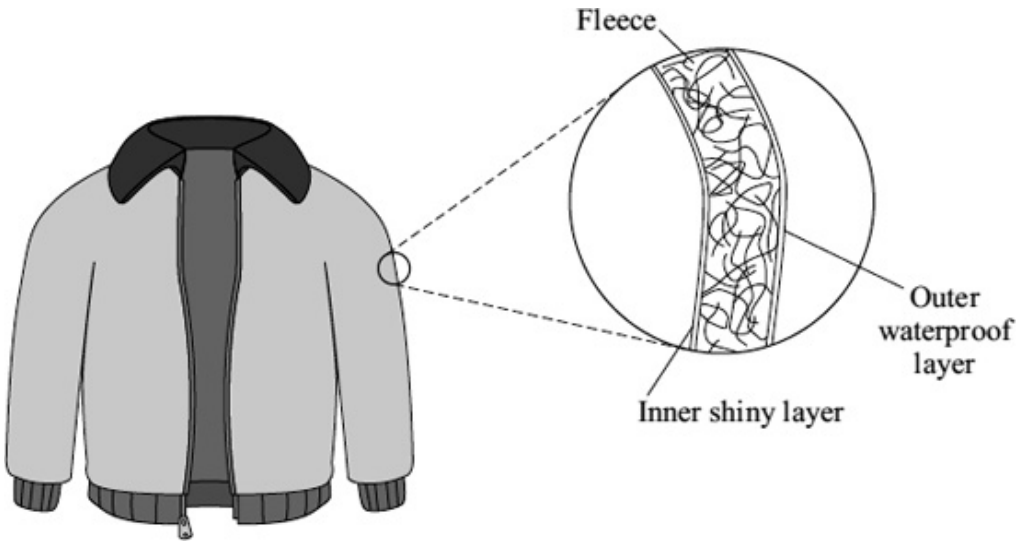
Why does this heat exchanger transfer heat faster than the heat exchanger used by the student in the investigation?

.....

.....

(1)
(Total 6 marks)

Q21. (a) The diagram shows a ski jacket that has been designed to keep a skier warm. The jacket is made from layers of different materials.



(i) The inner layer is shiny to reduce heat transfer.

Which process of heat transfer will it reduce?

.....

(1)

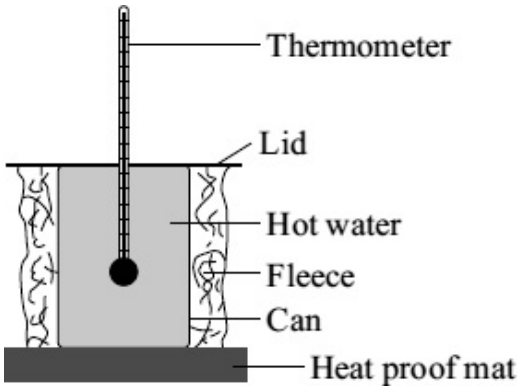
(ii) Why is the layer of fleece good at reducing the transfer of heat from a skier's body?

.....

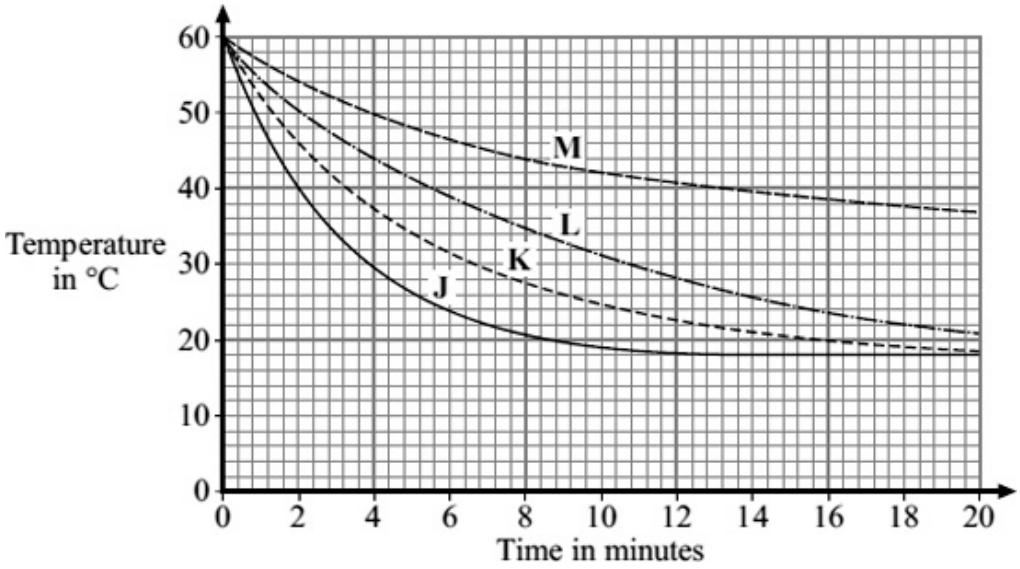
.....

(1)

(b) A student tested four different types of fleece, **J**, **K**, **L** and **M**, to find which would make the warmest jacket. Each type of fleece was wrapped around a can which was then filled with hot water.
The temperature of the water was taken every two minutes for 20 minutes.



The graph shows the student's results.



(i) In each test, the water cooled faster during the first five minutes than during the last five minutes. Why?

.....

.....

(1)

(ii) To be able to compare the results, it was important to use the same volume of water in each test.

Give **one** other quantity that was the same in each test.

.....

.....

(1)

(iii) Look at the graph line for fleece **K**.

Estimate what the temperature of the water in the can wrapped in fleece **K** would be after 40 minutes.

.....

(1)

(iv) Which type of fleece, **J**, **K**, **L** or **M**, should the student recommend to be used in the ski jacket?

.....

Give a reason for your answer.

.....

.....

.....

.....

(2)
(Total 7 marks)

Q22. 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.

Use the correct equation from the Physics Equations Sheet.

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.

Use the correct equation from the Physics Equations Sheet.

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

.....

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.....

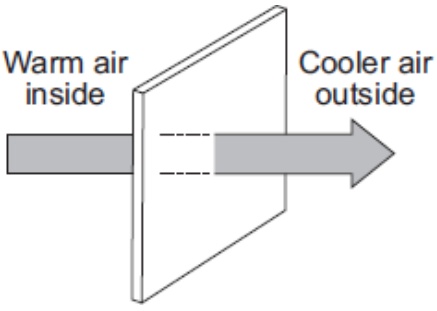
.....

Energy required = ...

(3)

(Total 10 marks)

Q23. The diagram shows the direction of heat transfer through a single-glazed window.



(a) (i) Name the process by which heat is transferred **through** the glass.

.....

(1)

(ii) Explain how heat is transferred **through** the glass.

.....

.....

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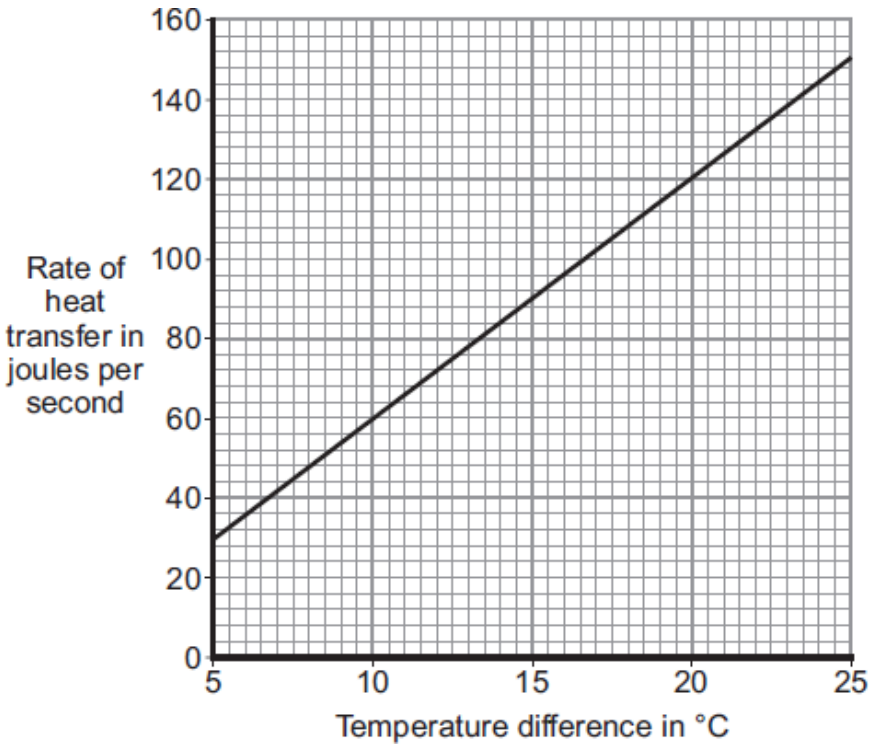
.....

(2)

(b) The rate of heat transfer through a window depends on the difference between the inside and outside temperatures.

The graph shows the rate of heat transfer through a 1 m^2 single-glazed window for a range of temperature differences.



(i) What is the range of temperature differences shown in the graph?

From ..... to .....

(1)

(ii) A student looks at the graph and concludes:

'Doubling the temperature difference doubles the rate of heat transfer.'

Use data from the graph to justify the student's conclusion.

.....

.....

.....

.....

(2)

(iii) A house has single-glazed windows. The total area of the windows in the house is 15 m^2.

On one particular day, the difference between the inside and outside temperatures is 20 °C.

Use the graph to calculate the total rate of heat transfer through all of the windows on this particular day.

Show clearly how you work out your answer.

.....

.....

.....

.....

Rate of heat transfer = ... J/s

(2)

(c) A homeowner plans to replace the single-glazed windows in his home with double-glazed windows. He knows that double-glazed windows will reduce his annual energy bills.

The table gives information about the double glazing to be installed by the homeowner.

Cost to buy and install	**Estimated yearly savings on energy bills**	**Estimated lifetime of the double-glazed windows**
£5280	£160	30 years

Explain, in terms of energy savings, why replacing the single-glazed windows with these double-glazed windows is not cost effective.

To gain full marks you must complete a calculation.

.....

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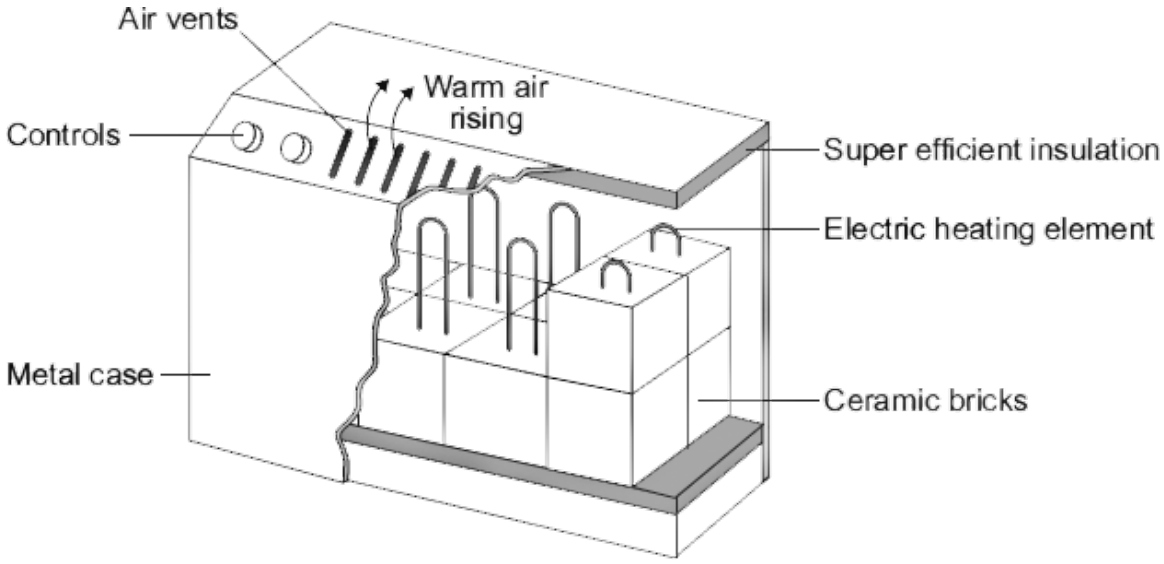
.....

.....

(2)
(Total 10 marks)

Q24. The diagram shows how one type of electric storage heater is constructed. The heater has ceramic bricks inside. The electric elements heat the ceramic bricks during the night. Later, during the daytime, the ceramic bricks transfer the stored energy to the room.



(a) In winter, the electricity supply to a 2.6 kW storage heater is switched on each day between midnight and 7 am. Between these hours, electricity costs 5 p per kilowatt-hour.

Calculate the daily cost of using the storage heater.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

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.....

.....

Cost = ... p

(3)

(b) Homes with electric storage heaters have a separate meter to measure the electricity supplied between midnight and 7 am. Another meter measures the electricity supplied at other times. This electricity supplied at other times costs 15 p per kilowatt-hour.

Electricity companies encourage people to use electricity between midnight and 7 am by selling the electricity at a lower cost.

Suggest why.

.....

.....

(1)

(c) By 7 am, the temperature at the centre of the ceramic bricks is about 800 °C. The temperature of the outside metal casing is about 80 °C.

The ceramic bricks are surrounded by 'super-efficient' insulation.

Explain why.

.....

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.....

.....

(2)

(d) At 7 am, the electricity supply switches off and the temperature of the ceramic bricks starts to fall. The temperature of the bricks falls by 100 °C over the next four hours. During this time, 9 000 000 J of energy are transferred from the bricks.

Calculate the total mass of ceramic bricks inside the heater.

Specific heat capacity of the ceramic bricks = 750 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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.....

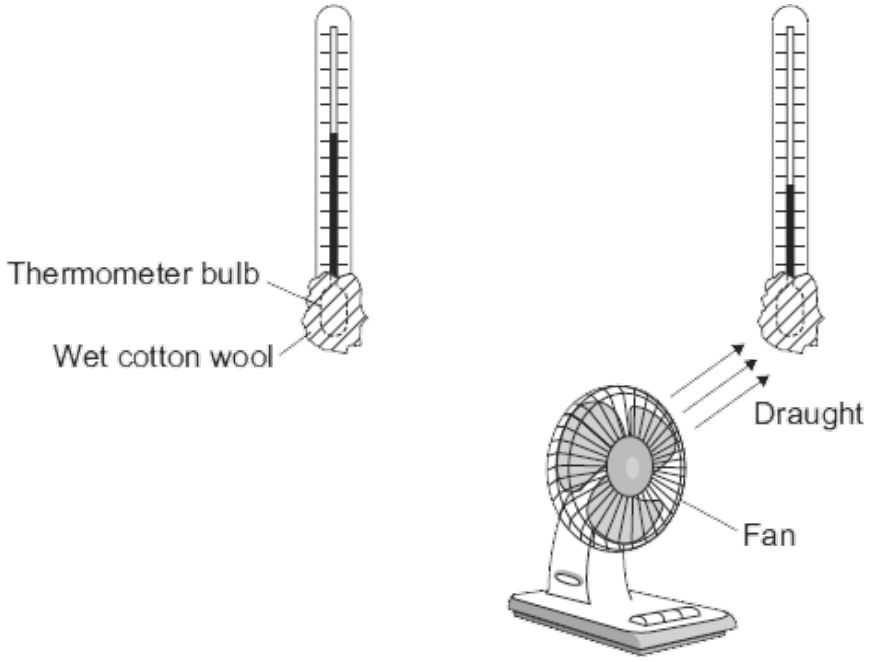
.....

Mass = ... kg

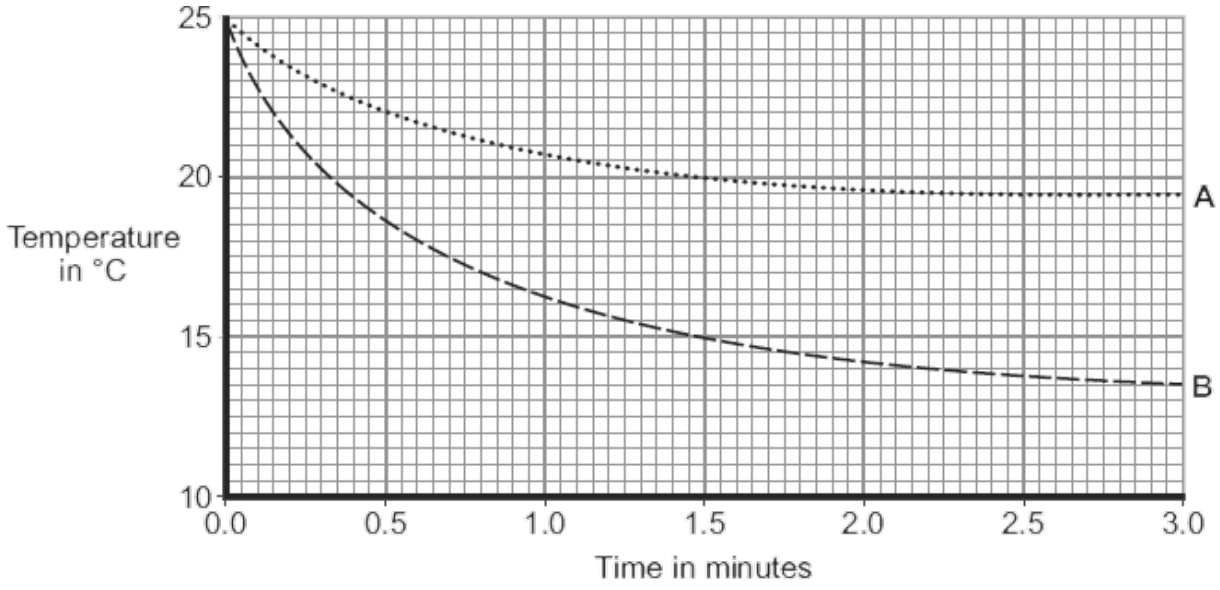
(2)

(Total 8 marks)

Q25. 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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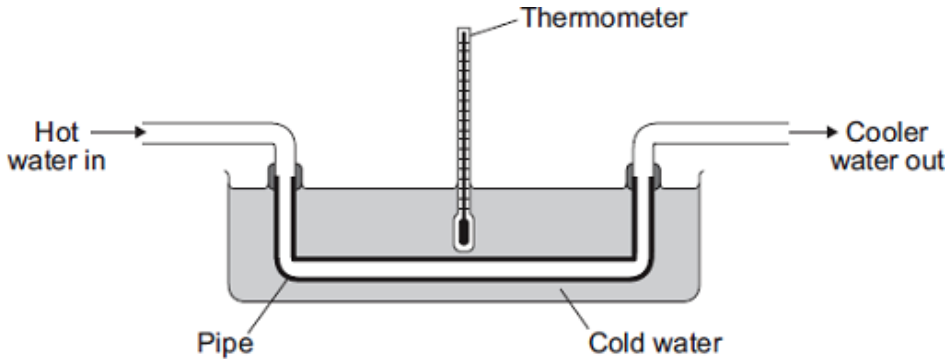
.....

(2)
(Total 5 marks)

Q26. 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.

.....

(1)

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

.....

Give a reason for your answer.

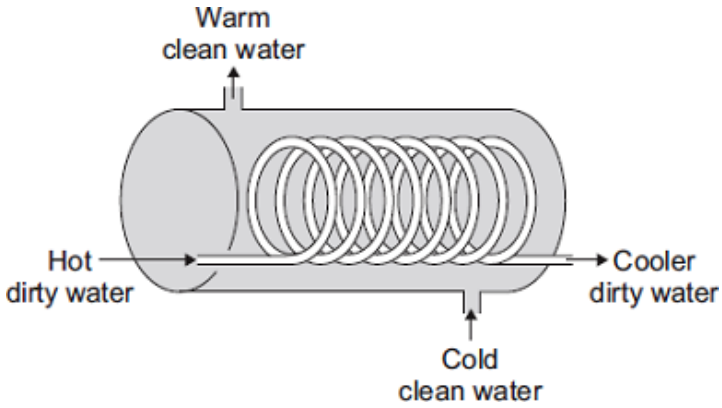
.....

.....

.....

(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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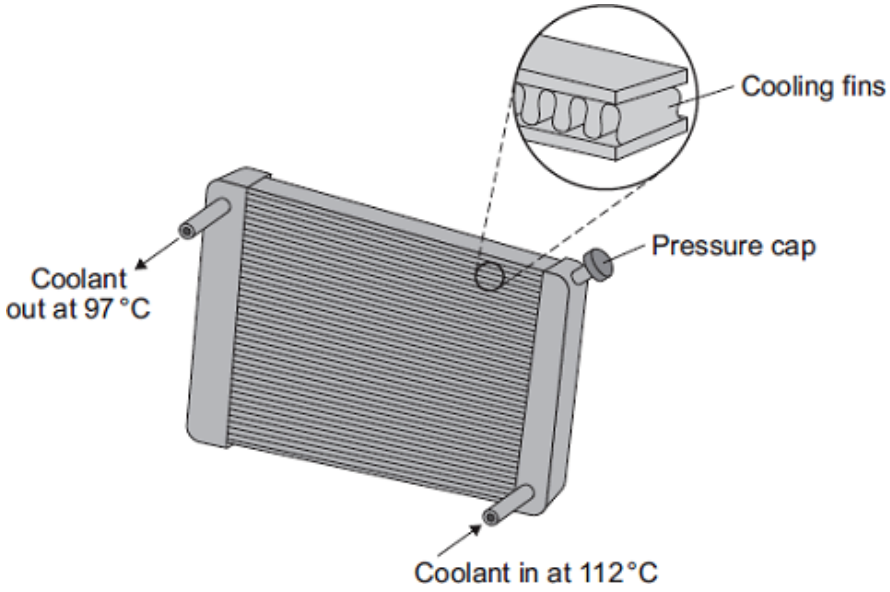
.....

(2)
(Total 6 marks)

Q27. 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?

.....

.....

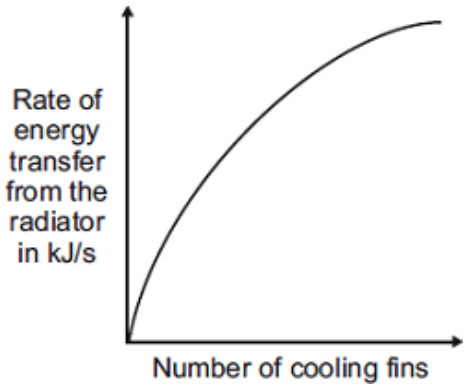
.....

.....

(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.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

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.

.....

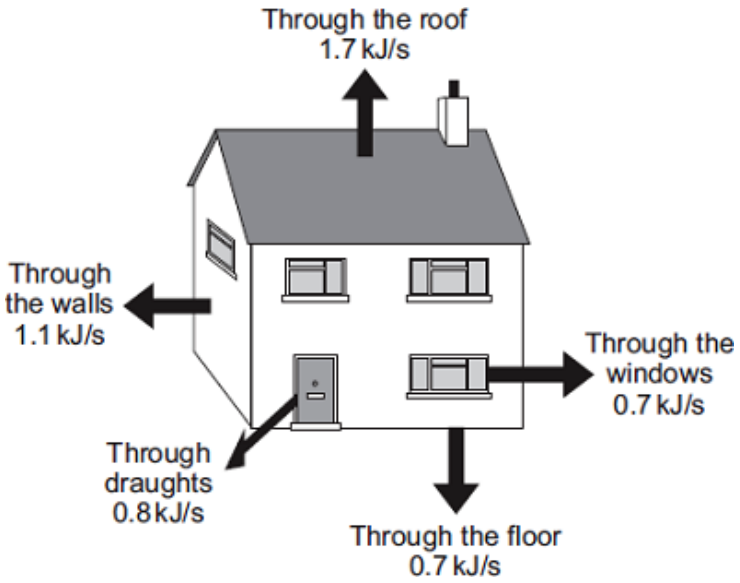
.....

.....

(2)
(Total 9 marks)

Q28. **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)

.....

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.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred each day = ... kWh

(2)

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

Calculate the cost of heating the house for one day.

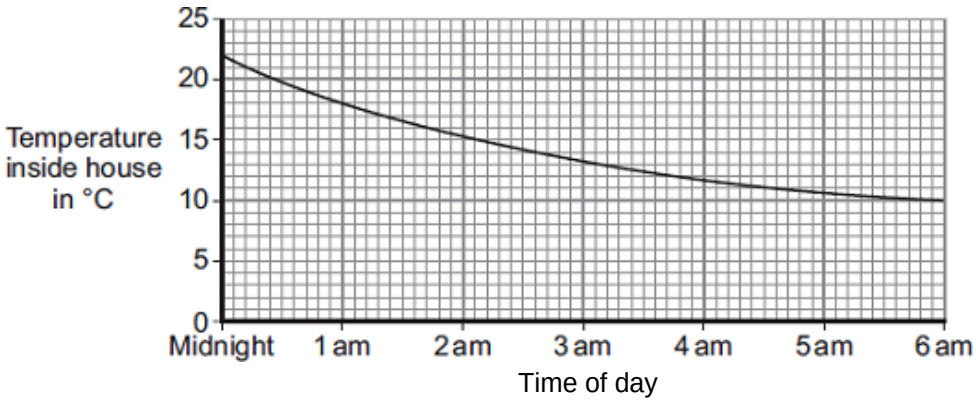
.....

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

decreases.
decreases then stays constant.
increases.

Give the reason for your answer.

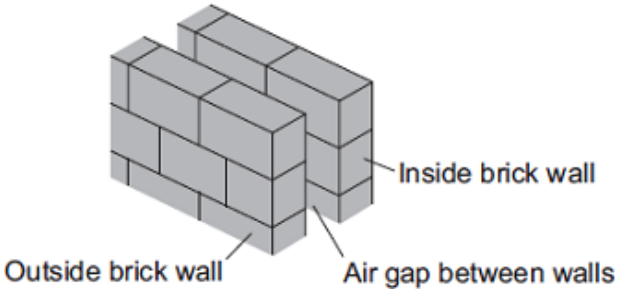
.....

.....

(2)

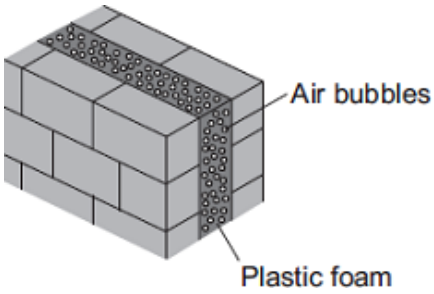
(b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2



U-value of the wall = 0.7

Diagram 3



U-value of the wall = 0.3

(i) The plastic foam reduces energy transfer by convection.

Explain why.

.....

.....

.....

.....

(2)

(ii) Filling the air gap with plastic foam reduces the U-value of the wall.

What is meant by the term *U-value*?

.....

.....

(1)

(c) A homeowner has part of the outside wall of her house removed and replaced with double-glazed glass doors.

U-value of the wall = 0.3

U-value of glass doors = 1.8

Explain the effect of replacing part of the outside wall with glass doors on the rate of energy transfer from the house.

.....

.....

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.....

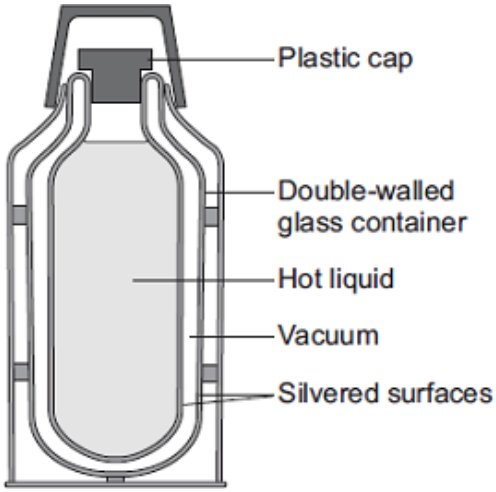
.....

(2)

(Total 11 marks)

Q29. (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.

© Purestock/Thinkstock

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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.....

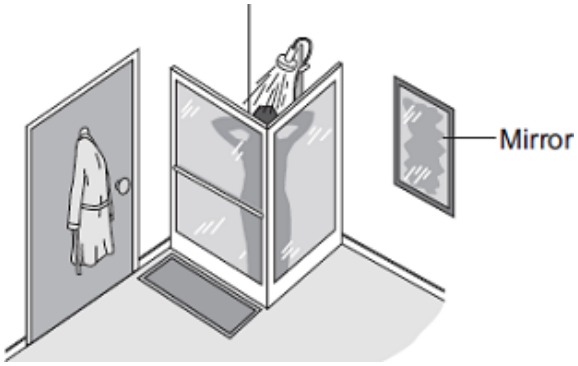
.....

.....

(2)

(Total 8 marks)

Q30. 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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.....

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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?

.....

.....

.....

.....

.....

(2)
(Total 5 marks)