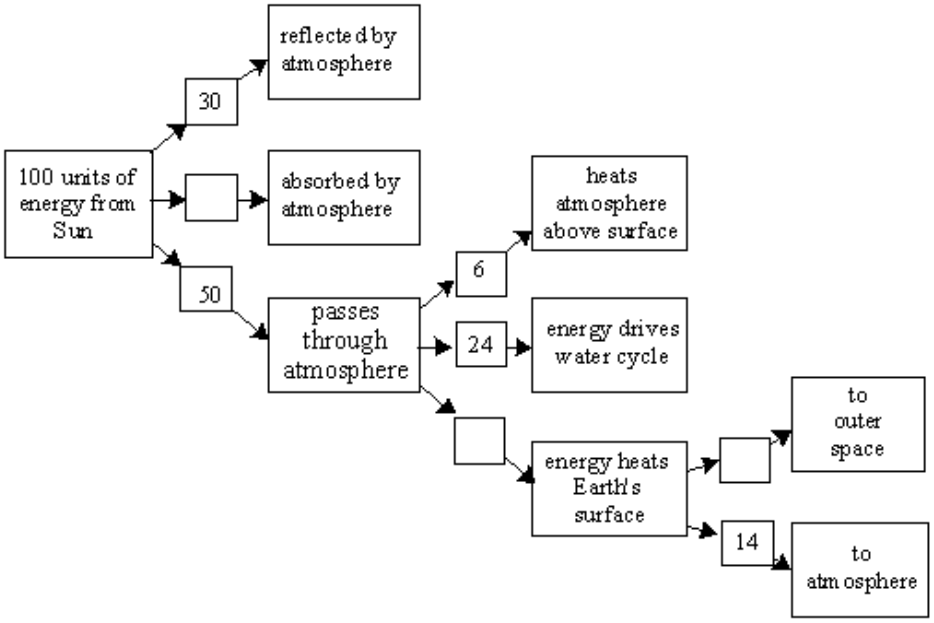
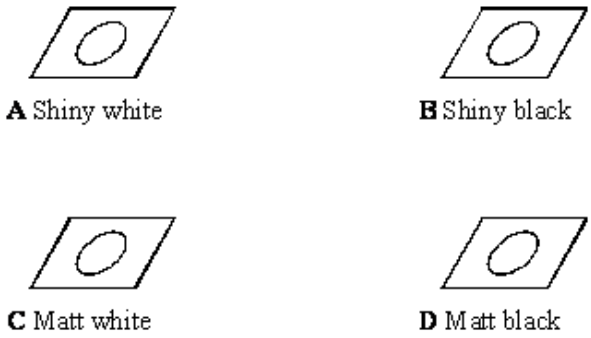
Q1. Complete the boxes on the chart to show what happens to the energy from the Sun.



(Total 3 marks)

Q2. 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.



(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)

Q3. (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.

.....

.....

.....

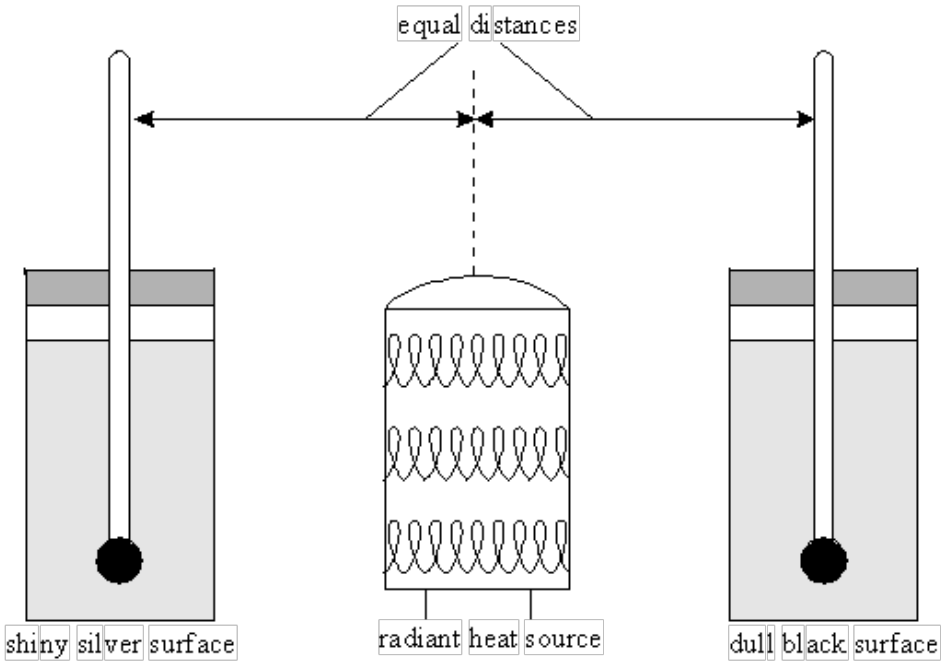
(iii) Describe how heat losses from the surface of a metal kettle may be kept small.

.....

.....

(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).

.....

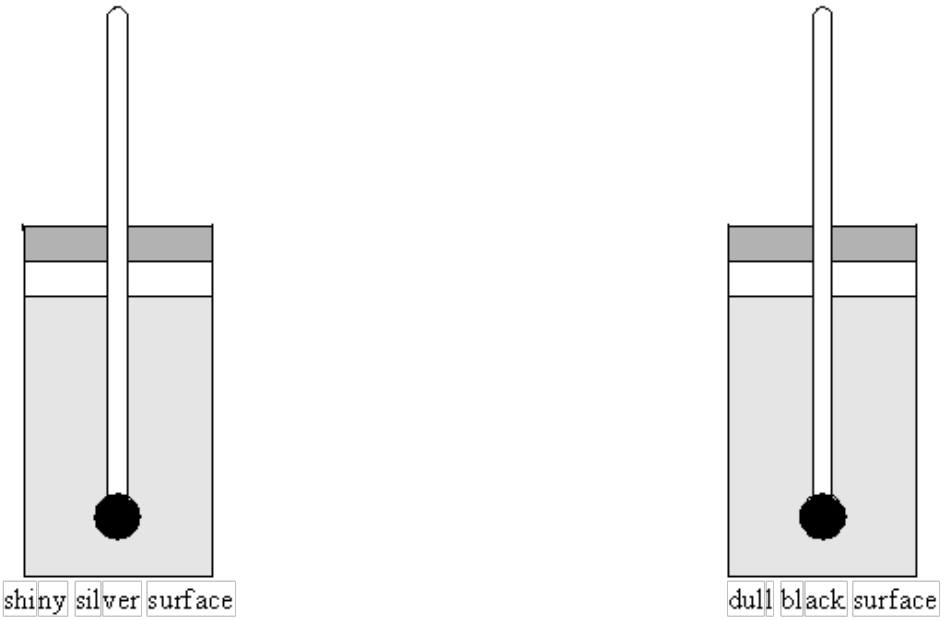
.....

.....

.....

(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.

.....

.....

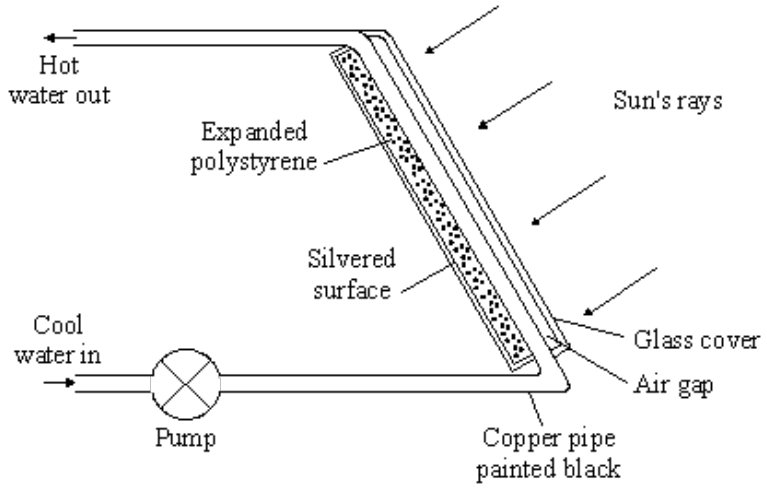
(ii) Explain your answer to part (i).

.....

.....

(3)
(Total 10 marks)

Q4. 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.

.....

.....

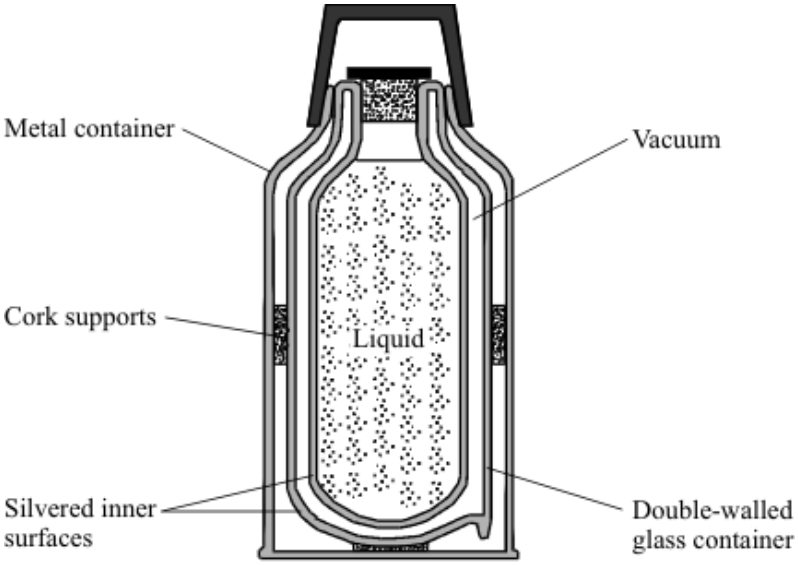
.....

.....

(2)

(Total 5 marks)

Q5. 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)

Q6. The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.

Explain why the shiny silver-coloured material helps to make ironing easier.

.....

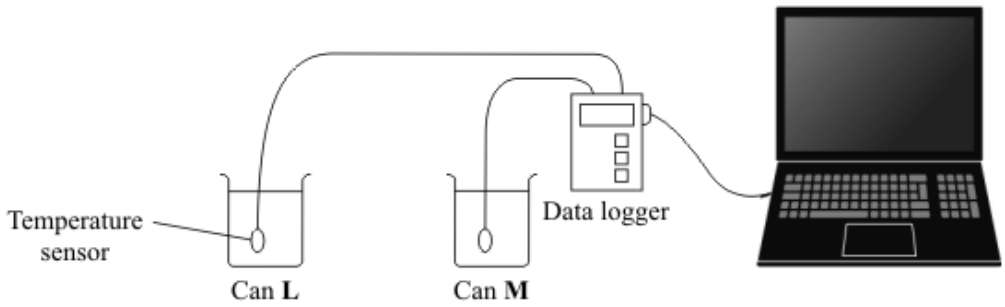
.....

.....

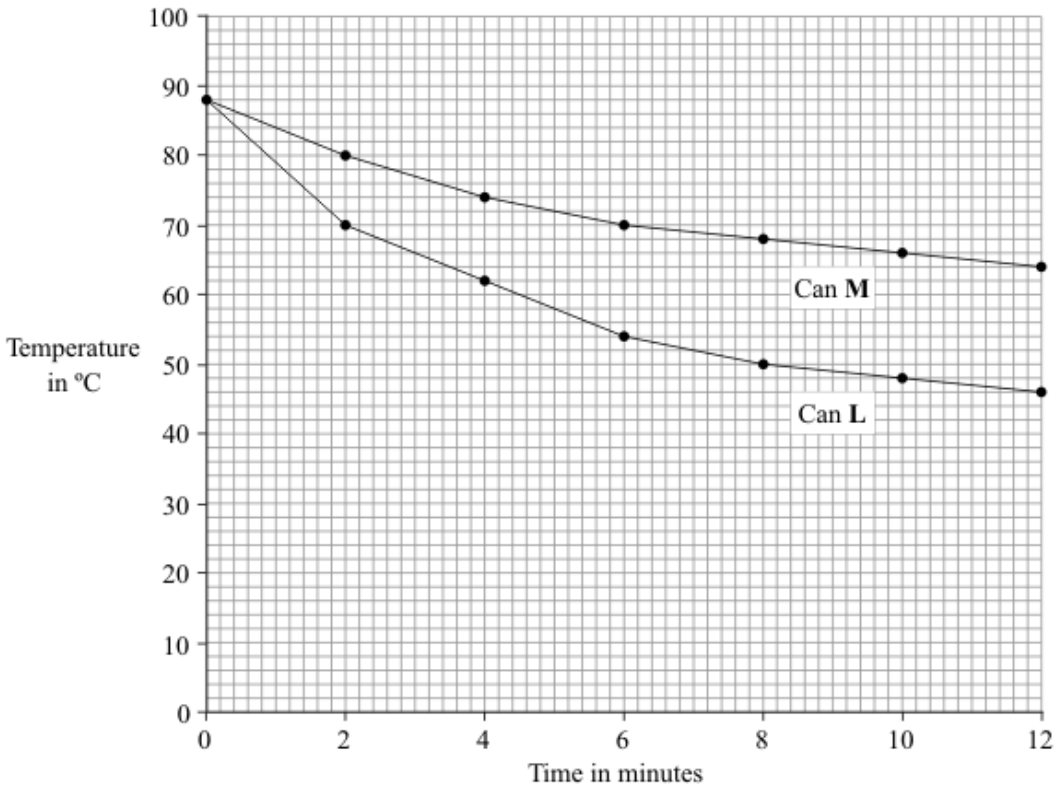
.....

(Total 2 marks)

Q7. 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.

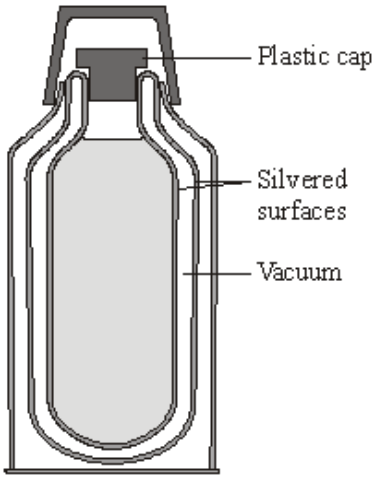
.....

.....

.....

(3)
(Total 7 marks)

Q8. 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.

.....

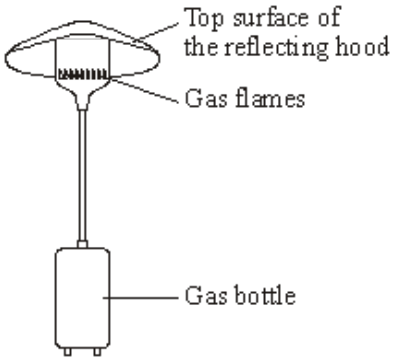
.....

.....

.....

(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)

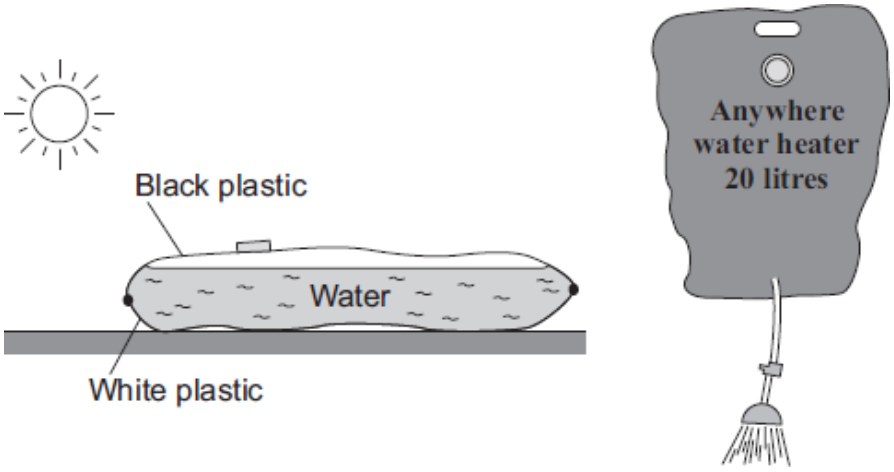
(iii) State why the total energy supplied to the patio heater must always equal the total energy transferred by the patio heater.

.....

.....

(1)
(Total 9 marks)

Q9. 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.

.....

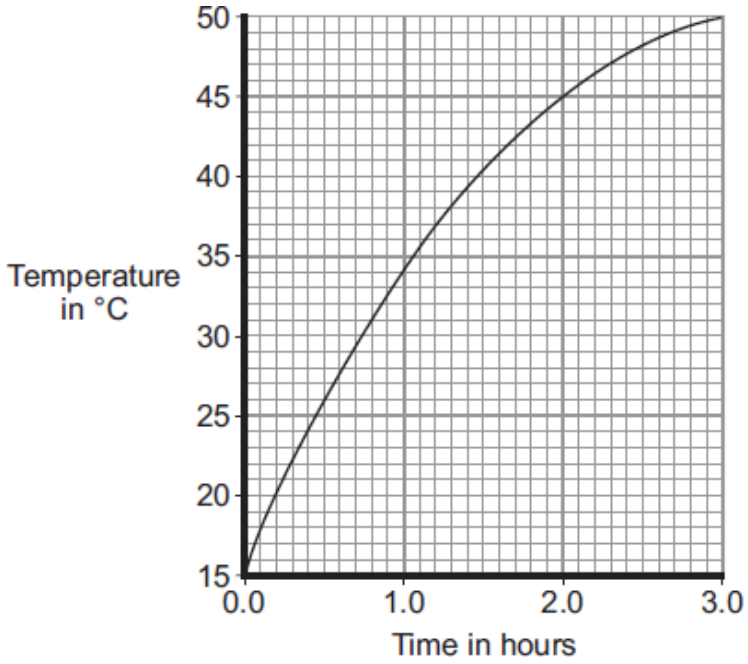
.....

.....

.....

(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 .....

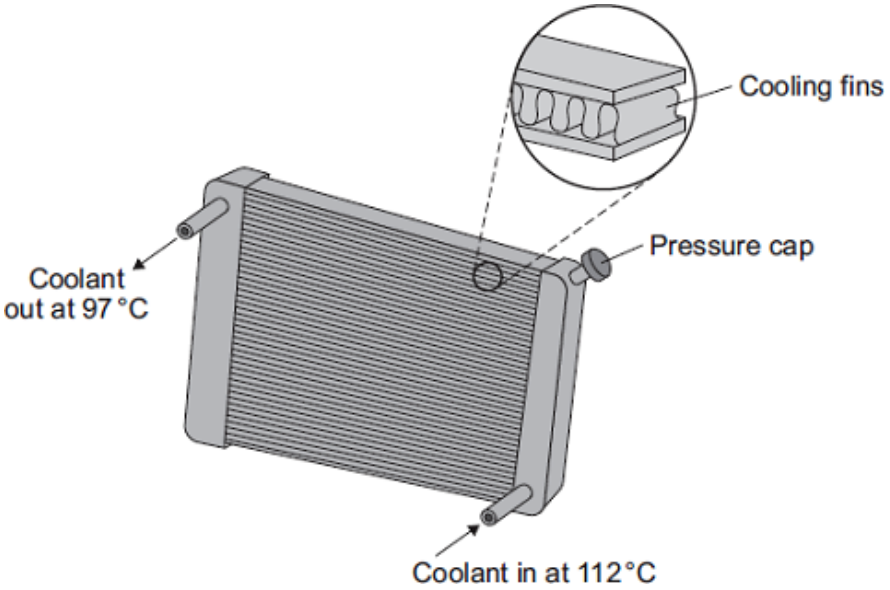
2 .....

(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)

Q10. 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?

.....

.....

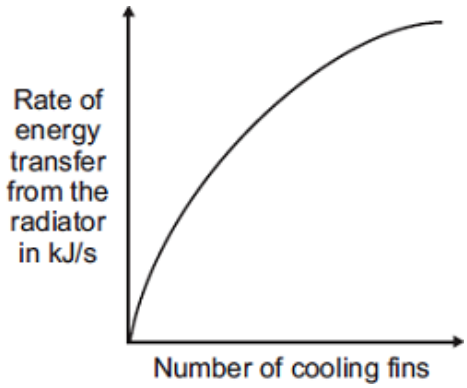
.....

.....

(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)