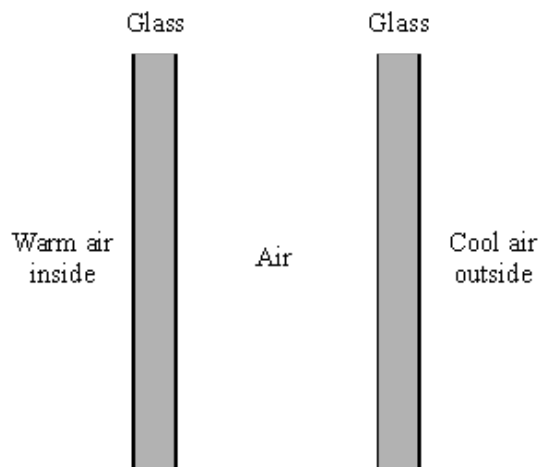


**Q1.** The diagram shows a side view of a double-glazed window.



- (a) Use each of the terms in the box to explain how heat is lost from inside a house through the window.

<b>conduction</b>	<b>convection</b>	<b>radiation</b>
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(3)

- (b) Besides heat, state **one other** form of energy that passes through double-glazed windows.

.....

(1)

- (c) Explain why plastic foam cavity wall insulation cuts down energy transfer between warm inner walls and cooler outer walls.

.....

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(2)

- (d) When it rains the walls and windows of a house get wet.

Explain how the drying process can increase the cooling of the house.

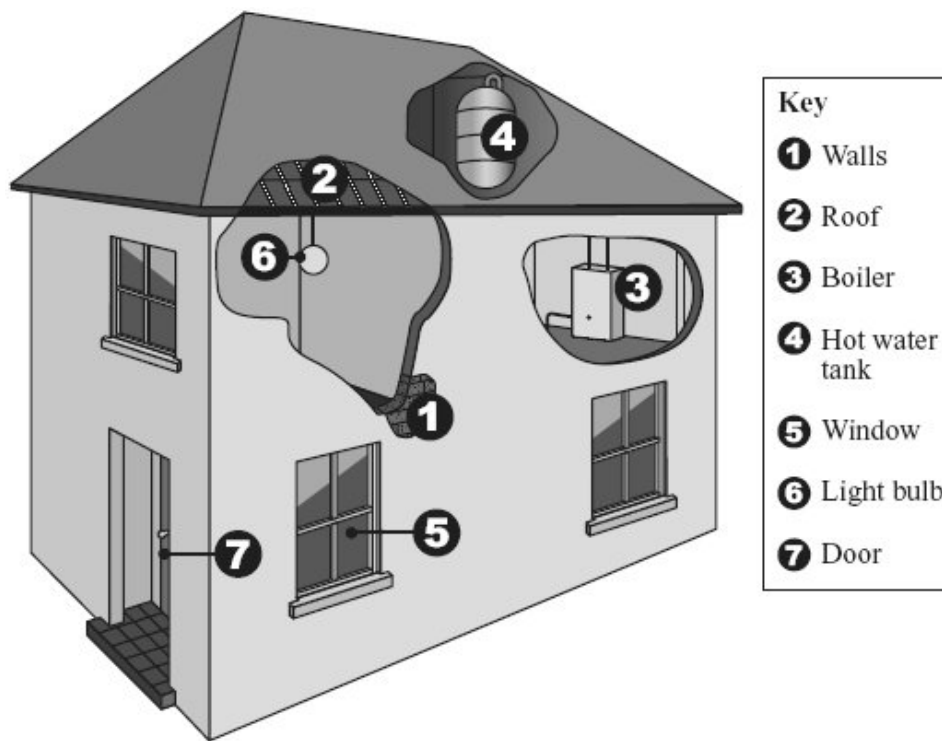
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(2)  
(Total 8 marks)

- Q2.** 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)

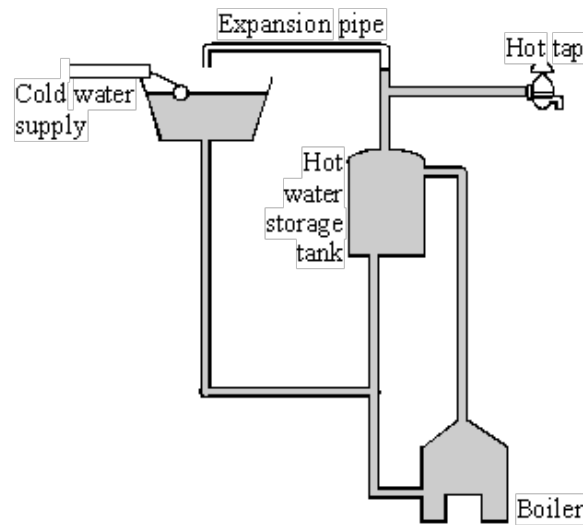
- (b) Energy consumption can be reduced by using a more efficient boiler or more efficient light bulbs.

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

.....  
.....

(1)  
(Total 4 marks)

- Q3.** (a) The diagram shows a hot water system.



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

.....  
.....  
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- (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?

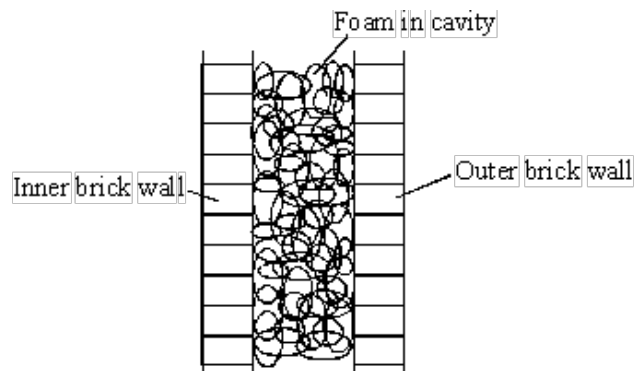
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(6)

(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?

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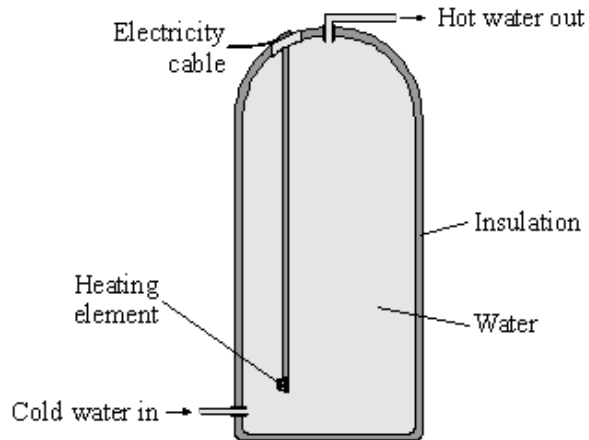
(ii) filling the cavity with foam?

.....

.....

(3)  
(Total 9 marks)

- Q4.** (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*

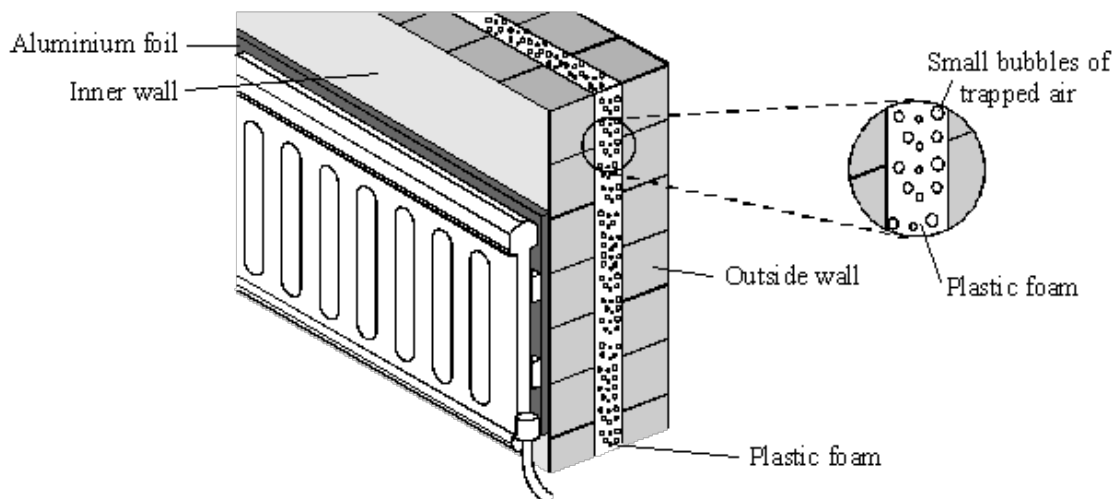
*because .....*

.....

.....

(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.

.....

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(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.

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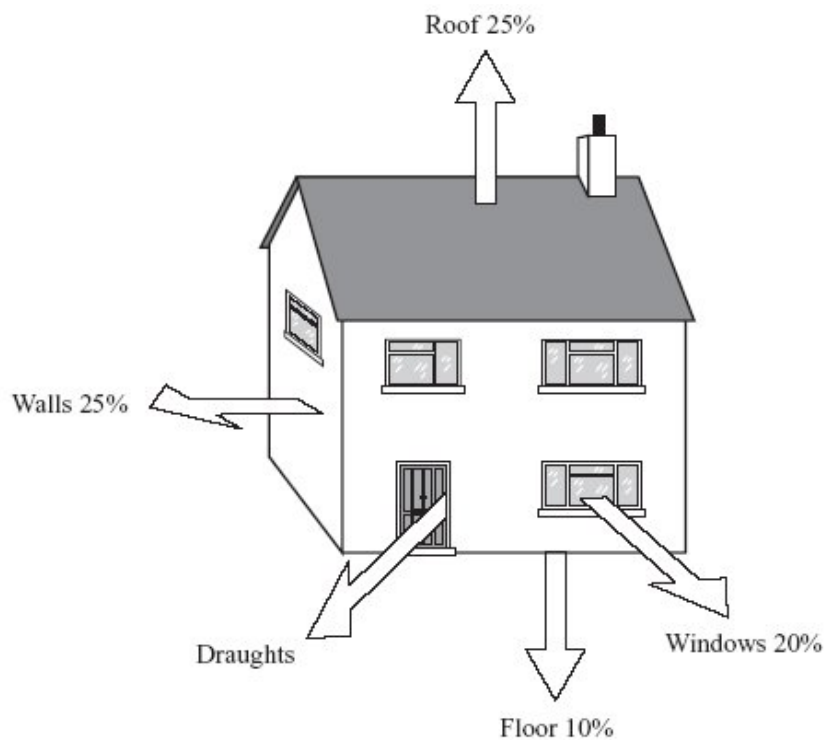
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(2)

(Total 10 marks)

- Q5.** (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.

<b>conduction</b>	<b>convection</b>	<b>radiation</b>
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Draughts transfer heat energy by .....

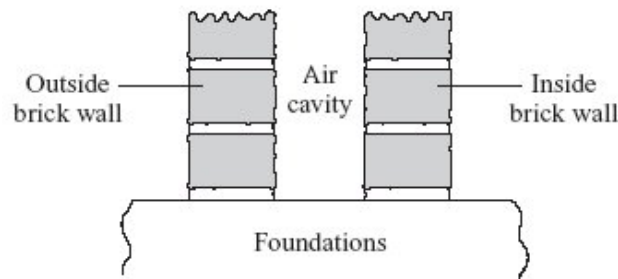
(1)

- (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.

<b>Method of insulation</b>	<b>Installation cost in £</b>	<b>Yearly saving on energy bills in £</b>
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.

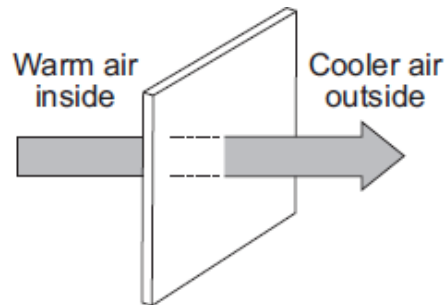
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Pay-back time = ..... years

(1)

(Total 7 marks)

- Q6.** 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.

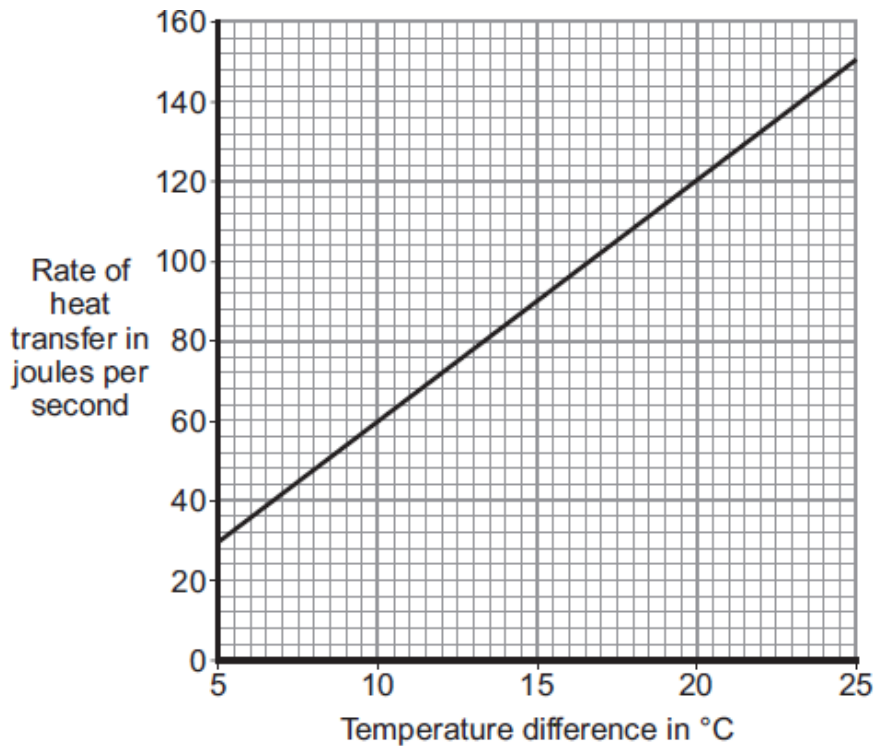
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.....  
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(2)



- (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  $1 \text{ m}^2$  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  $15 \text{ m}^2$ .

On one particular day, the difference between the inside and outside temperatures is  $20^\circ\text{C}$ .

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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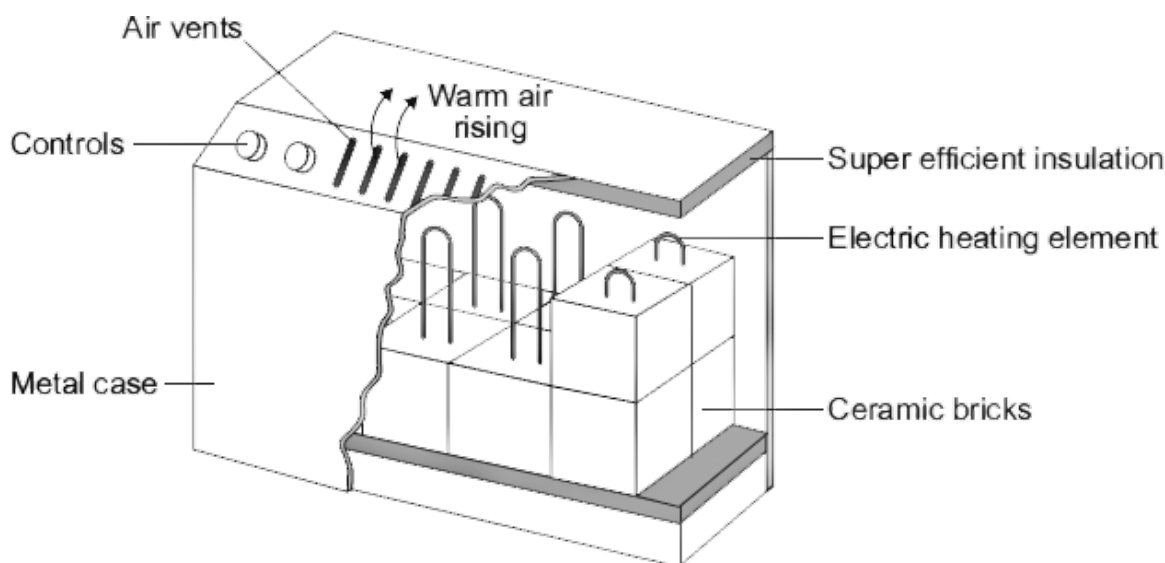
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(2)  
(Total 10 marks)

- Q7.** 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) (i) Complete the following sentences using words from the box.

<b>conduction</b>	<b>convection</b>	<b>evaporation</b>
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Energy is transferred through the metal casing by .....

The warm air rising from the heater transfers energy to the room by .....

(2)

- (ii) The inside of the metal case is insulated.

Which **one** of the following gives the reason why?

Tick (✓) **one** box.

To transfer energy from the ceramic bricks to the room faster

☐

To stop energy from the room transferring into the heater

☐

To keep the ceramic bricks hot for a longer time

☐

(1)

- (b) In winter, the electricity supply to a 2.6 kW storage heater is switched on for seven hours each day.

- (i) Calculate the energy transferred, in kilowatt-hours, from the electricity supply to the heater in seven hours.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....  
.....

Energy transferred = ..... kWh

(2)

- (ii) The electricity supply to the heater is always switched on between midnight and 7 am. Between these hours, electricity costs 5 p per kilowatt-hour.

Calculate how much it costs to have the heater switched on between midnight and 7 am.

.....  
.....

Cost = ..... p

(1)

- (c) Between 7 am and 8 am, after the electricity supply is switched off, the temperature of the ceramic bricks falls by 25 °C.

Calculate the energy transferred from the ceramic bricks between 7 am and 8 am.

Total mass of ceramic bricks = 120 kg.

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.

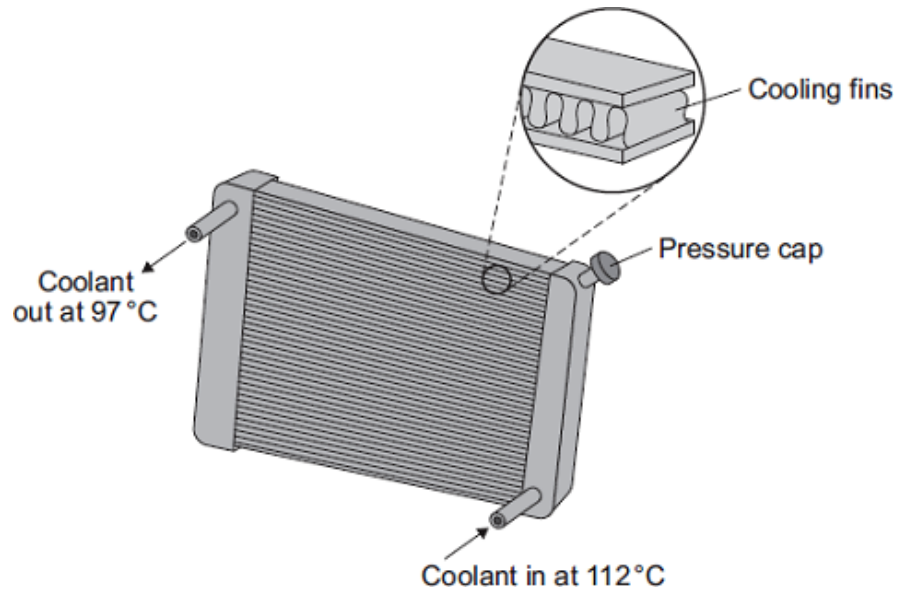
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Energy transferred = ..... J

(2)

(Total 8 marks)

**Q8.** 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?

.....

.....

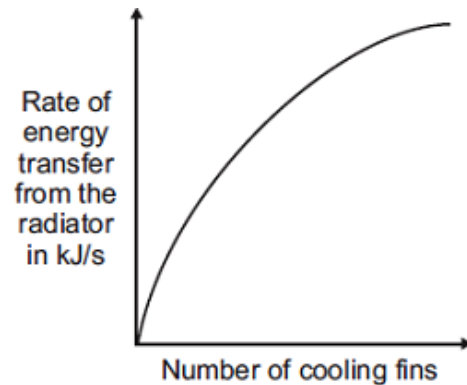
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(2)

- (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**

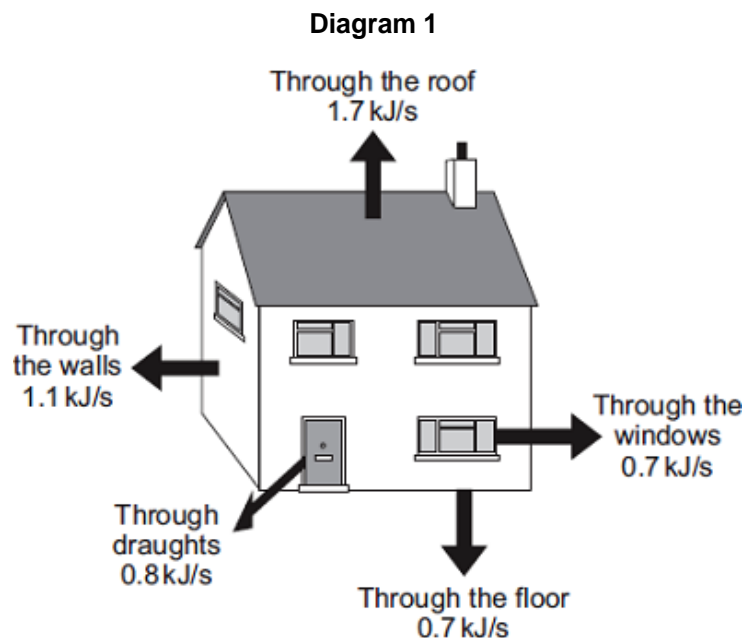
**increases the  
efficiency**

Give a reason for your answer.

.....  
.....  
.....

(2)  
(Total 9 marks)

- Q9.** **Diagram 1** shows the energy transferred per second from a badly insulated house on a cold day in winter.



- (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.

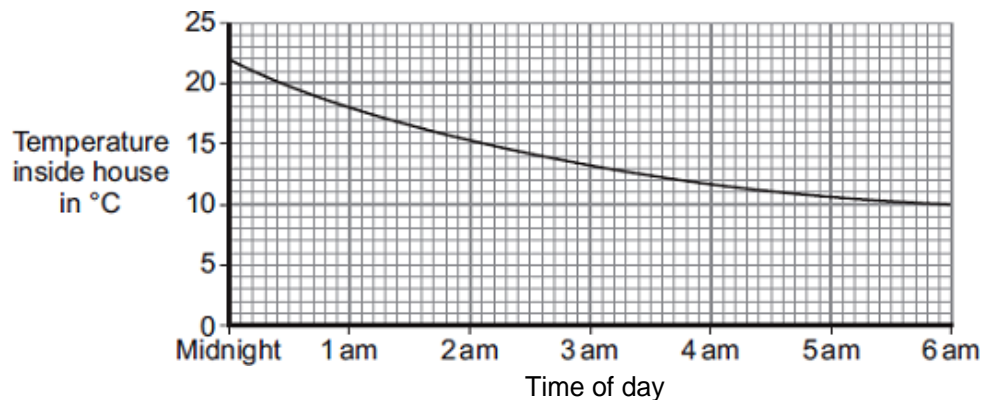
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Cost = .....

(1)

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

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



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

Between midnight and 6 am the rate of energy transfer from

the house

decreases.

decreases then stays constant.

increases.

Give the reason for your answer.

.....

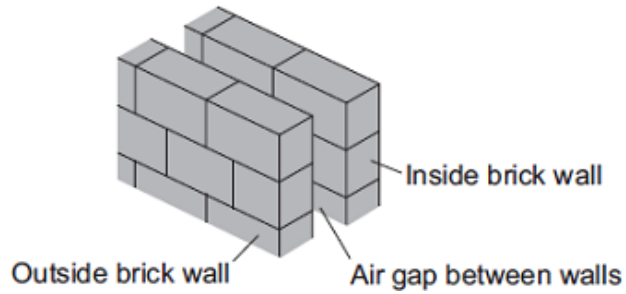
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(2)



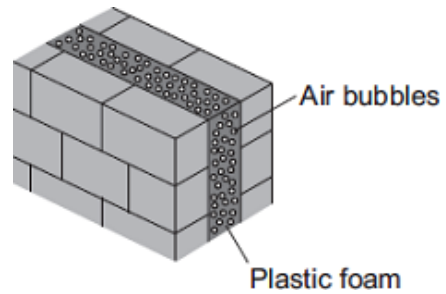
- (b) **Diagram 2** shows how the walls of the house are constructed.  
**Diagram 3** shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

**Diagram 2**



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)

