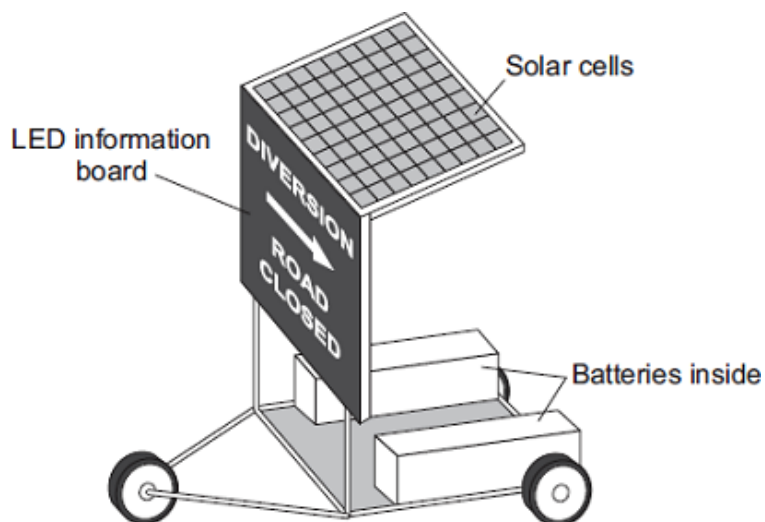


**Q1.** The picture shows a temporary road traffic information board.



The batteries power the LEDs used in the information board.  
The solar cells keep the batteries charged.

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

<b>chemical</b>	<b>electrical</b>	<b>light</b>	<b>sound</b>
-----------------	-------------------	--------------	--------------

The solar cells transfer light energy to ..... energy.

The batteries transfer ..... energy to electrical energy.

The LEDs transfer electrical energy to ..... energy.

(3)

(b) When the total energy input to the solar cells is 200 joules, the useful energy output from the solar cells to the batteries is 50 joules.

Calculate the efficiency of the solar cells.

Use the correct equation from the Physics Equations Sheet.

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

Efficiency = .....

(2)

- (c) Which **one** of the following statements gives the reason for using solar cells to charge the batteries?

Tick (✓) **one** box.

Solar cells will charge the batteries day and night.

☐

The information board can be used anywhere it is needed.

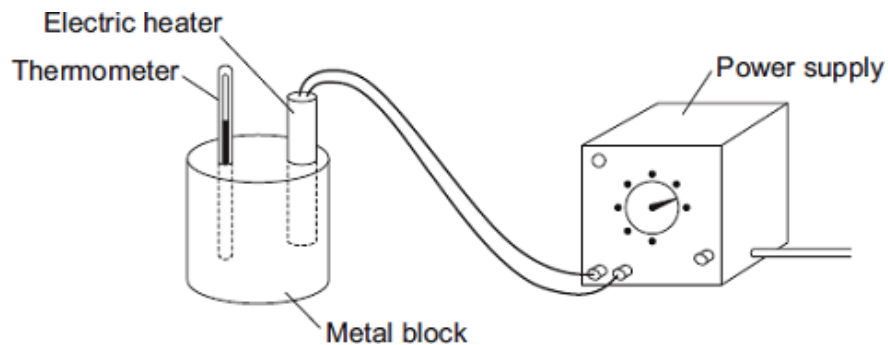
☐

A small number of solar cells produce a lot of electricity.

☐

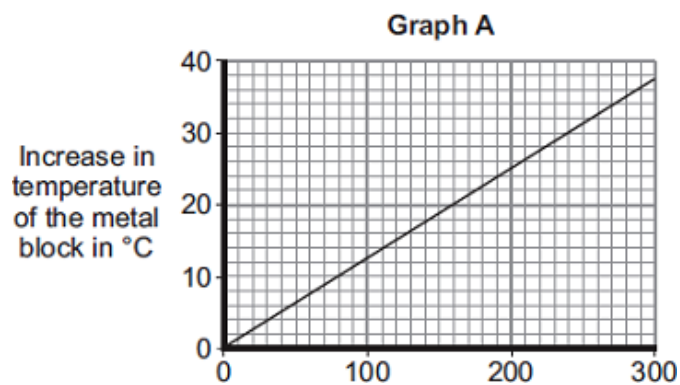
(1)  
(Total 6 marks)

- Q2.** (a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.



- (i) Before starting the experiment, the student drew **Graph A**.

**Graph A** shows how the student expected the temperature of the metal block to change after the heater was switched on.



Describe the pattern shown in **Graph A**.

.....

.....

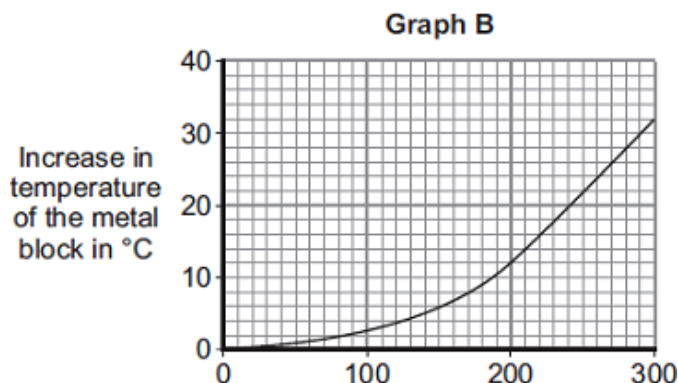
.....

.....

(2)

- (ii) The student measured the room temperature. He then switched the heater on and measured the temperature of the metal block every 50 seconds.

The student calculated the increase in temperature of the metal block and plotted **Graph B**.



After 300 seconds, **Graph B** shows the increase in temperature of the metal block is lower than the increase in temperature expected from **Graph A**.

Suggest **one** reason why.

.....

.....

(1)

- (iii) The power of the electric heater is 50 watts.

Calculate the energy transferred to the heater from the electricity supply in 300 seconds.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Energy transferred = ..... J

(2)

- (b) The student uses the same heater to heat blocks of different metals. Each time the heater is switched on for 300 seconds.

Each block of metal has the same mass but a different specific heat capacity.

Metal	Specific heat capacity in J/kg°C
Aluminium	900
Iron	450
Lead	130

Which **one** of the metals will heat up the most?

Draw a ring around the correct answer.

**aluminium**

**iron**

**lead**

Give, in terms of the amount of energy needed to heat the metal blocks, a reason for your answer.

.....

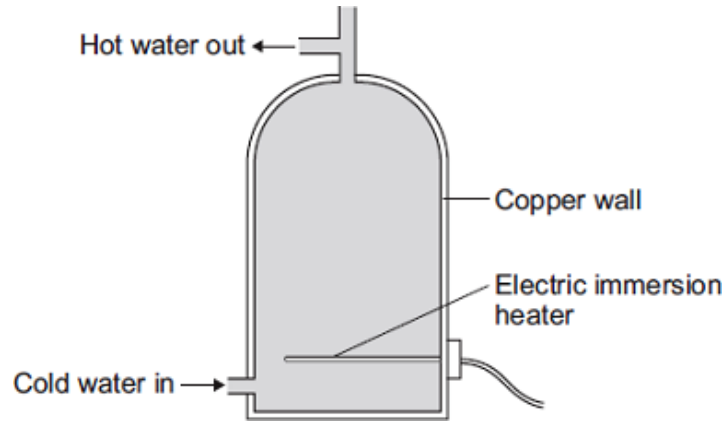
.....

.....

.....

(2)

- (c) A homeowner uses an electric immersion heater to heat the water in his hot water tank. The hot water tank has no insulation.



- (i) Draw a ring around the correct answer to complete each sentence.

Energy is transferred through the water by

conduction.  
convection.  
evaporation.

Energy is transferred through the copper wall of the hot water tank by

conduction.  
convection.  
evaporation.

(2)

- (ii) To keep the water in the tank hot for longer, the homeowner fits an insulating jacket around the tank. The insulating jacket costs £12 to buy.

The homeowner expects to save £16 each year from reduced energy bills.

Calculate the pay-back time for the insulating jacket.

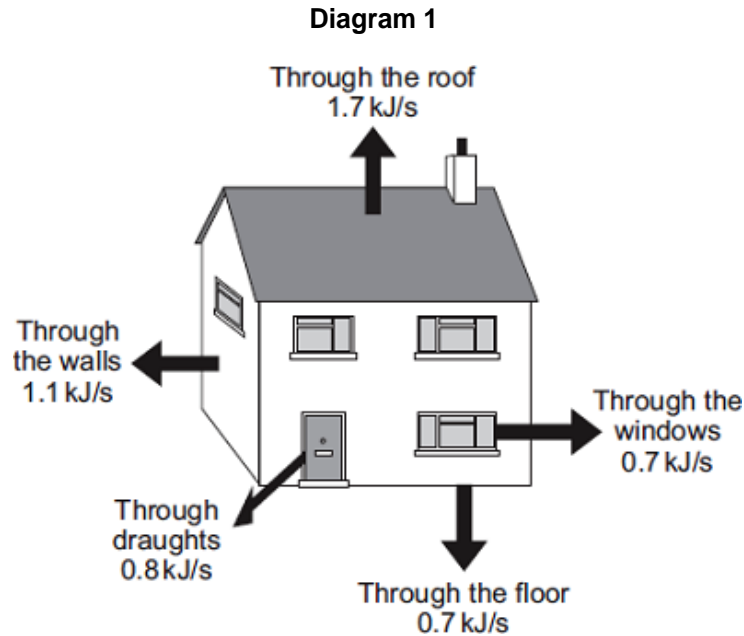
.....  
.....

Pay-back time = ..... years

(2)

(Total 11 marks)

- Q3.** **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.

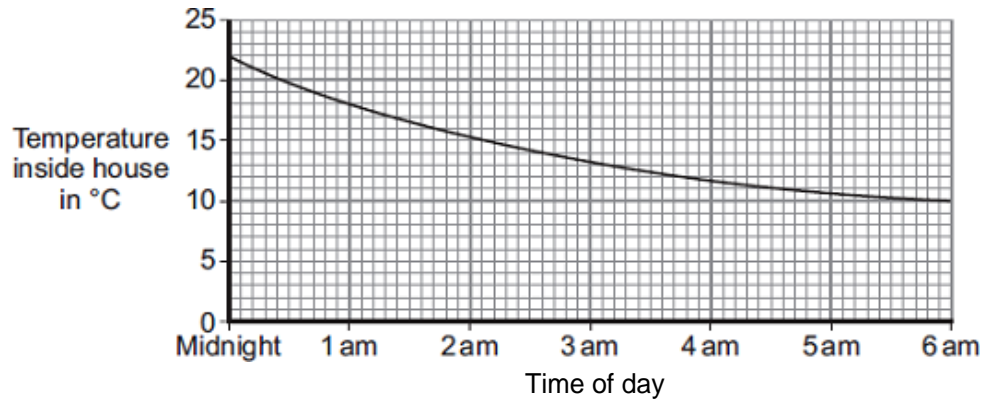
.....

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.

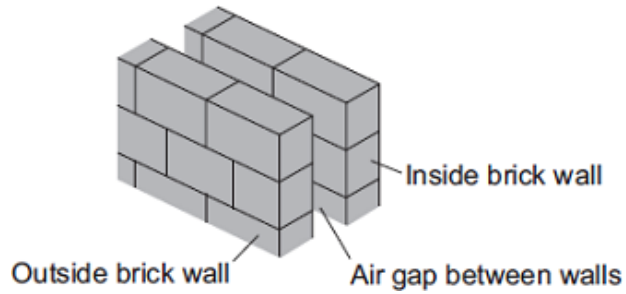
.....  
.....

(2)



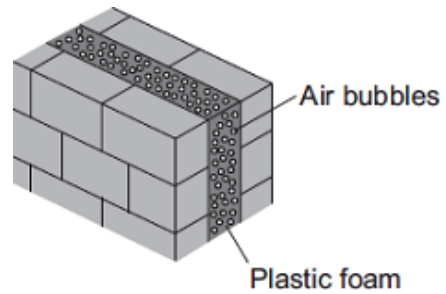
- (b) **Diagram 2** shows how the walls of the house are constructed.  
**Diagram 3** shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

**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.

.....

.....

.....

.....

.....

(2)  
(Total 11 marks)

