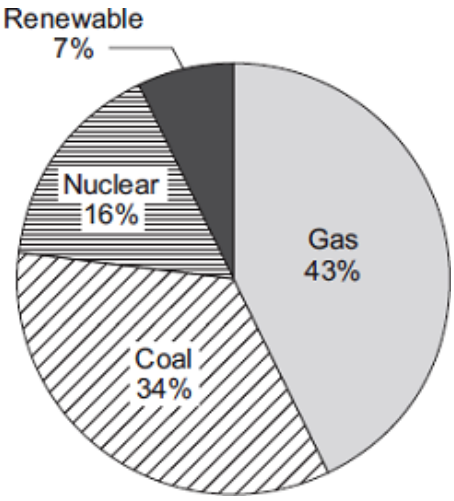
Q1. (a) The pie chart shows the proportions of electricity generated in the UK from different energy sources in 2010.



(i) Calculate the percentage of electricity generated using fossil fuels.

.....

Percentage = ... %

(1)

(ii) The pie chart shows that 7% of electricity was generated using renewable energy sources.

Which **one** of the following is **not** a renewable energy source?

Tick (✓) **one** box.

Oil ☐

Solar ☐

Wind ☐

(1)

(b) Complete the following sentence.

In some types of power station, fossil fuels are burned to heat ..... to produce steam.

(1)

(c) Burning fossil fuels releases carbon dioxide into the atmosphere.

Why do many scientists think adding carbon dioxide to the atmosphere is harmful to the environment?

Tick (✓) **one** box.

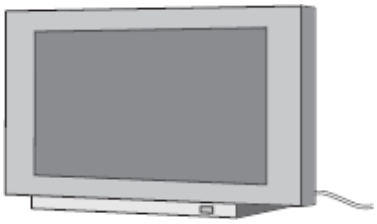
Carbon dioxide is the main cause of acid rain. ☐

Carbon dioxide causes global warming. ☐

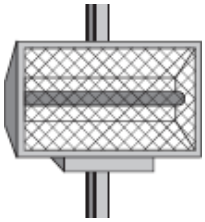
Carbon dioxide causes visual pollution. ☐

(1)
(Total 4 marks)

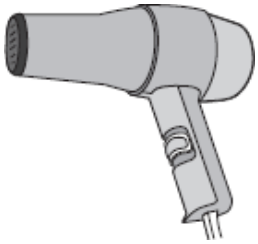
Q2. The data included in the diagrams gives the power of the electrical appliances.



TV
160 W

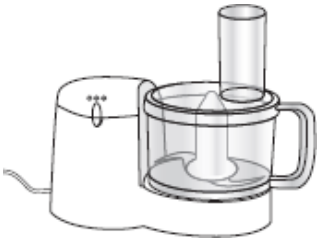


Radiant heater
1.0 kW



Hairdryer
1100 W

Sandwich toaster
1.1 kW



Food processor
0.4 kW

Table lamp
40 W

(a) (i) Which appliance is designed to transform electrical energy to light and sound?

.....

(1)

(ii) Which **two** appliances transform energy at the same rate?

..... and .....

(1)

(b) During one week, the food processor is used for a total of 3 hours.

(i) Use the equation in the box to calculate the energy transferred, in kilowatt-hours, by the food processor in 3 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Show clearly how you work out your answer.

.....

.....

.....

.....

Energy transferred = ... kWh

(2)

(ii) Electricity costs 15 pence per kilowatt-hour.

Use the equation in the box to calculate the cost of using the food processor for 3 hours.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

.....

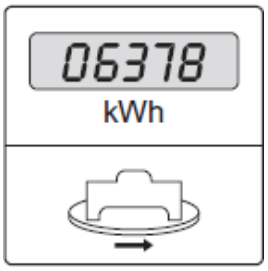
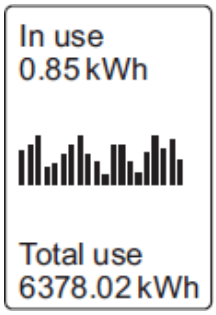
.....

Cost = ... pence

(2)

(c) A homeowner decides to monitor the amount of electrical energy used in his home.

He can do this by using an electricity meter or by using a separate electronic device.

Electricity meter	Electronic device
Records to the nearest kilowatt-hour	Records to the nearest 1/100th kilowatt-hour
	

(i) Use one word from the box to complete the following sentence.

precise	reliable	valid

The reading given by the electronic device is more ..... than the reading given by the electricity meter.

(1)

(ii) Monitoring the electrical energy used in a home may help people to save money by encouraging them to use less electricity.

Explain why, apart from saving money, it is important for people to use less electricity.

.....

.....

.....

.....

(2)
(Total 9 marks)

Q3. Energy can be transferred through some materials by convection.

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

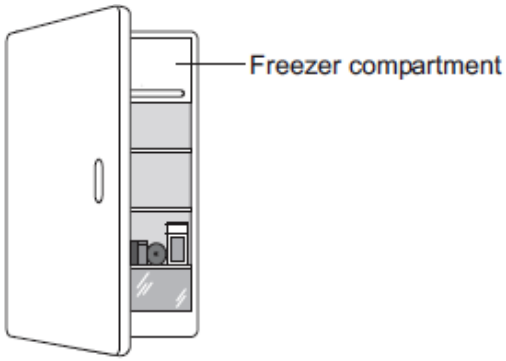
gas	liquid	solid

Energy **cannot** be transferred by convection through a ..... .

(1)

(b) The figure below shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is –5 °C.



Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

decreased	**unchanged**	**increased**

When the air near the freezer compartment is cooled, the energy of the air particles is ..... .

The spaces between the air particles are ..... .

The density of the air is ..... .

(3)

(c) The table below shows some information about three fridges, **A**, **B** and **C**.

The efficiency of each fridge is the same.

Fridge	Volume in litres	Energy used in one year in kWh
A	232	292
B	382	409
C	622	524

(i) Which fridge, **A**, **B** or **C**, would cost the least to use for 1 year? ☐

Give **one** reason for your answer.

.....

.....

(2)

(ii) A householder looks at the data in the table above.

What should she conclude about the pattern linking the volume of the fridge and the energy it uses in one year?

.....

.....

(1)

(iii) The householder could not be certain that her conclusion is correct for all fridges.

Suggest **one** reason why not.

.....

.....

(1)

(Total 8 marks)

Q4. (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 ..... .

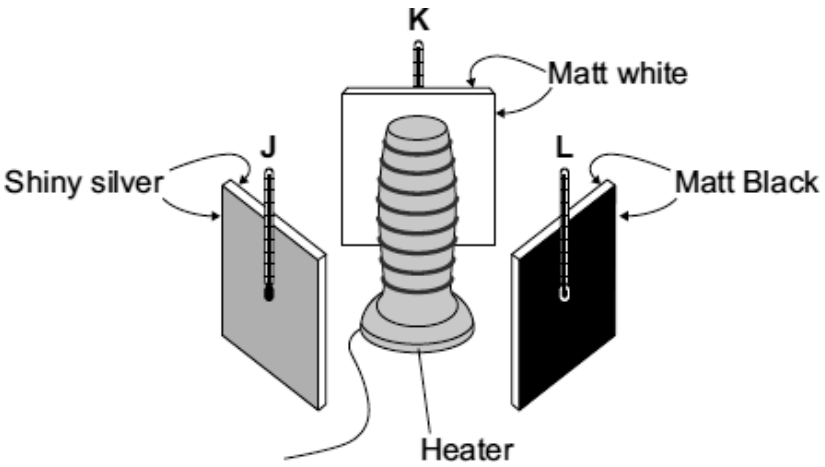
(1)

(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)

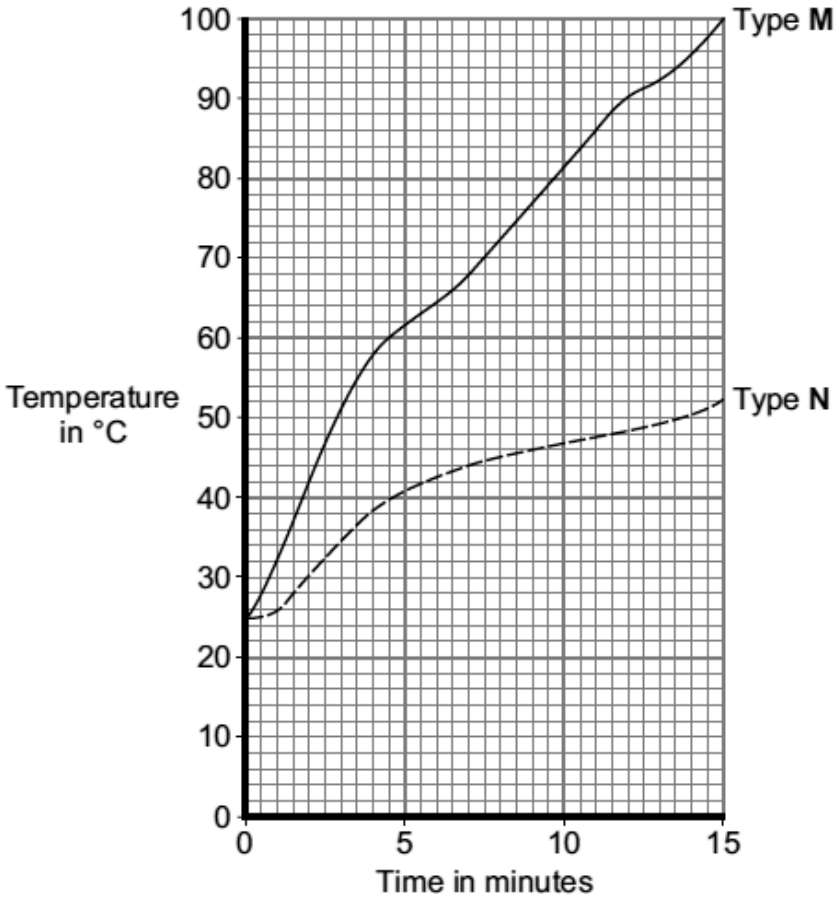
(ii) Why is the outside layer of the clothing shiny?

.....

.....

(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)

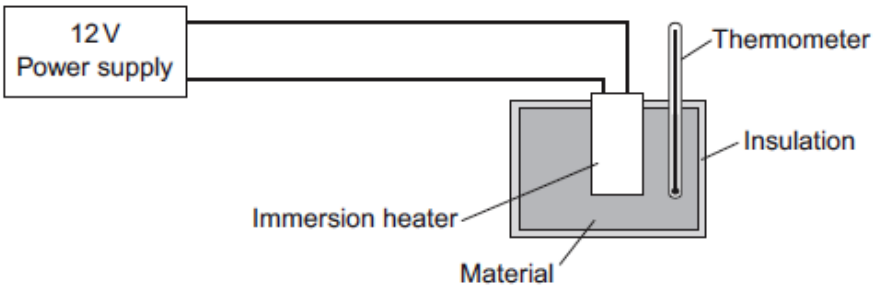
Q5. A student used the apparatus in **Figure 1** to compare the energy needed to heat blocks of different materials.

Each block had the same mass.

Each block had holes for the thermometer and the immersion heater.

Each block had a starting temperature of 20 °C.

Figure 1



The student measured the time taken to increase the temperature of each material by 5 °C.

(a) (i) State **two** variables the student controlled.

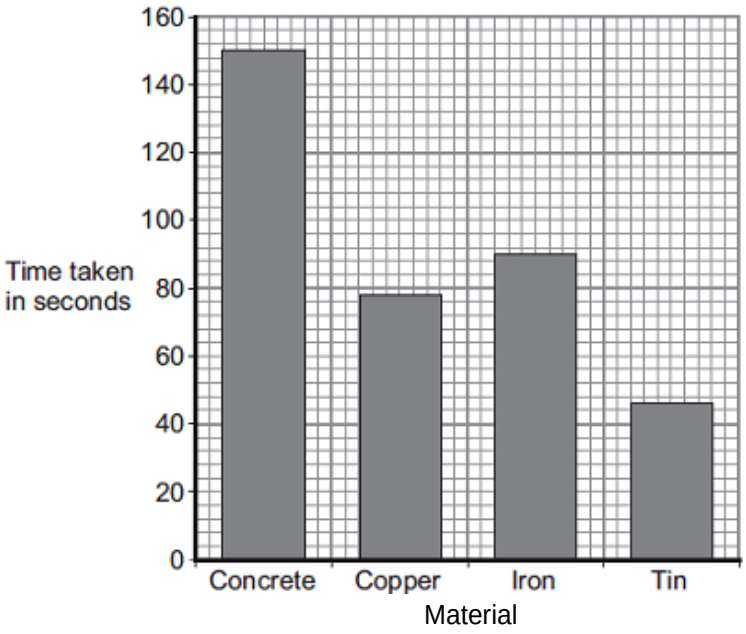
1 .....

2 .....

(2)

Figure 2 shows the student's results.

Figure 2



(ii) Why was a bar chart drawn rather than a line graph?

.....

.....

(1)

(iii) Which material was supplied with the most energy?

.....

Give the reason for your answer.

.....

.....

(2)

(iv) The iron block had a mass of 2 kg.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 5 °C.

Use the correct equation from the Physics Equations Sheet.

The specific heat capacity of iron is 450 J / kg °C.

.....

.....

.....

Energy transferred = ... J

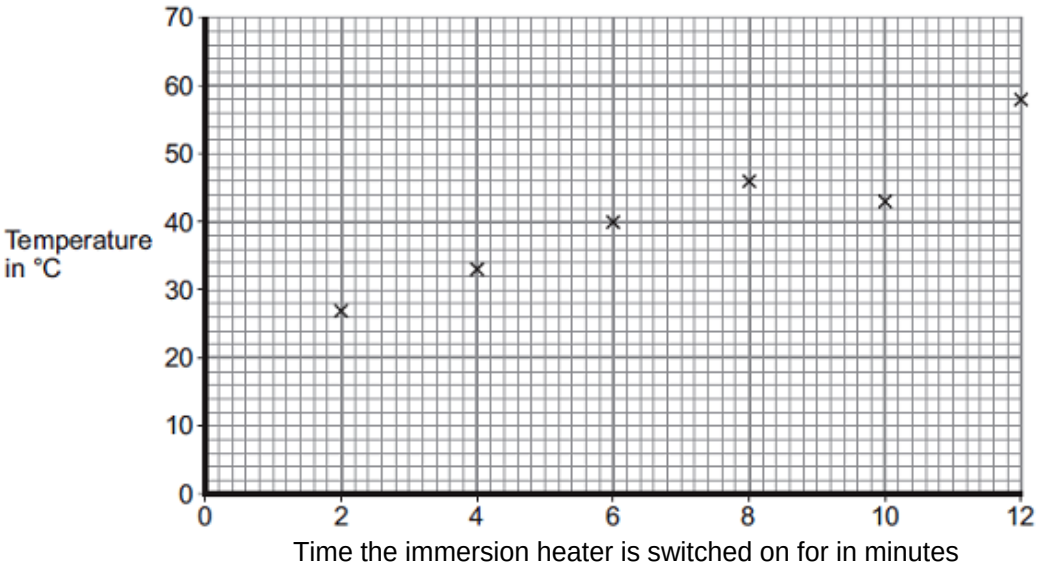
(2)

(b) The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 3**.

Figure 3



(i) One of the student's results is anomalous.

Draw a ring around the anomalous result.

(1)

(ii) Draw the line of best fit for the points plotted in **Figure 3**.

(1)

(iii) What was the temperature of the room?

Temperature = ... °C

(1)

(iv) What was the interval of the time values used by the student?

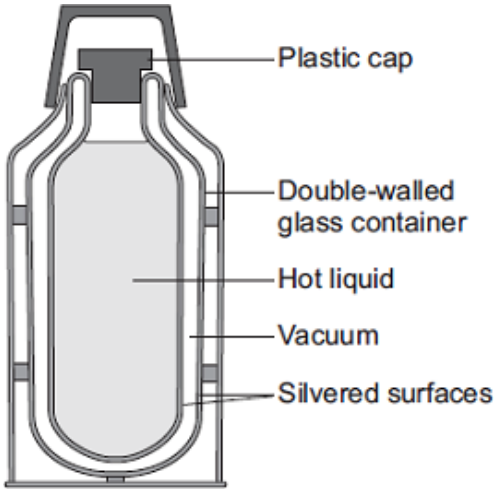
Interval = ... minutes

(1)

(Total 11 marks)

Q6. (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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

(b) Arctic foxes live in a very cold environment.

Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

.....

.....

.....

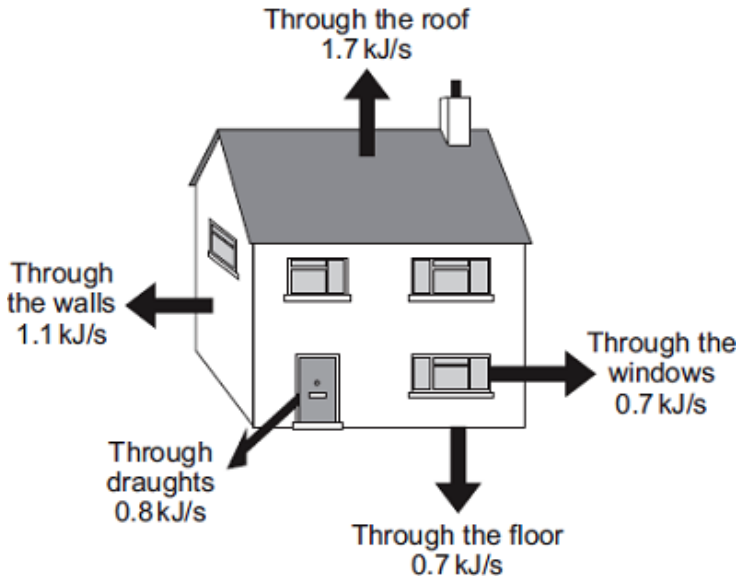
.....

.....

(2)
(Total 8 marks)

Q7. **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.

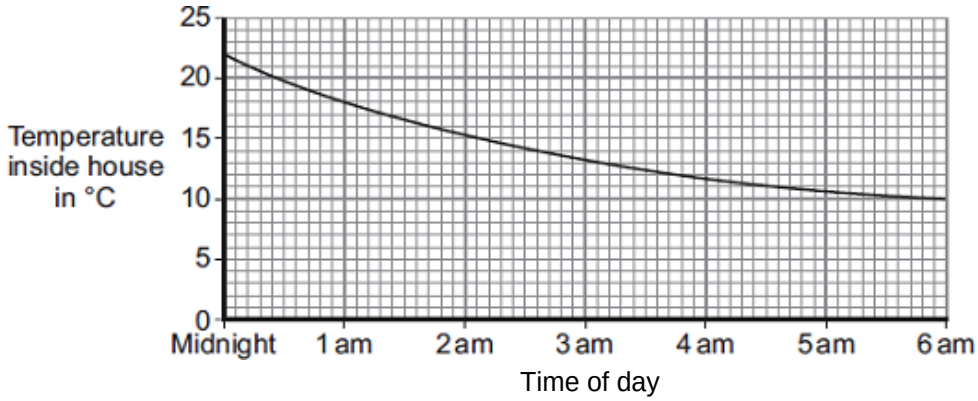
.....

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.

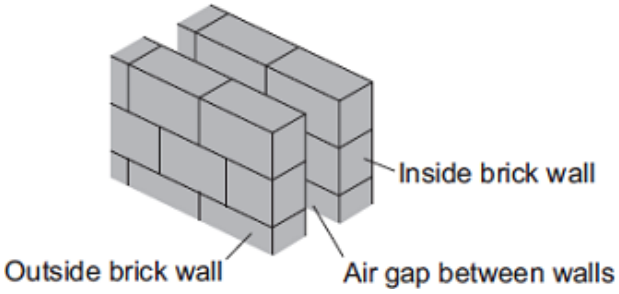
.....

.....

(2)

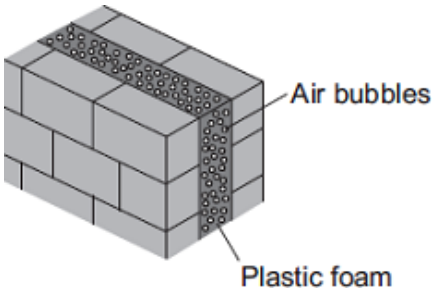
(b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

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.

.....

.....

.....

.....

.....

(2)

(Total 11 marks)

M1. (a) (i) 77

1

(ii) Oil

1

(b) water

accept H_2O

1

(c) Carbon dioxide causes global warming

1

[4]

M2. (a) (i) TV

1

(ii) hairdryer and sandwich toaster

both required either order but no others

1

(b) (i) 1.2

*allow **1** mark for correct substitution*

ie 0.4 × 3 provided that no subsequent step is shown

2

(ii) 18

accept £0.18 for both marks

or

their (b)(i) × 15 correctly calculated

*an answer 0.18 scores **1** mark*

*allow **1** mark for correct substitution*

ie 1.2 or their (b)(i) × 15 provided that no subsequent step is shown

2

(c) (i) precise

accept any correct indication

1

(ii) any **two** from:

- less electricity needs to be generated
- less fuels needed
  accept a named fuel used in any type of power station
- less air / atmospheric pollution
  accept named pollutant eg CO_2
  accept reduces carbon / carbon dioxide emissions
  accept reduces radioactive waste
- (non-renewable) energy sources last longer
  accept running out of fossil fuels / a named fossil fuel
- slows global warming / greenhouse effect
  *do **not** accept stops global warming*
  environmentally friendly is insufficient
  less pollution is insufficient

2

[9]

M3. (a) solid

1

(b) decreased

correct order only

1

decreased

1

increased

1

(c) (i) A

reason only scores if A chosen

1

uses least / less energy (in 1 year)

a comparison is required
accept uses least power
accept uses least kWh

1

(ii) greater the volume the greater the energy it uses (in 1 year)

1

(iii) a very small number sampled

accept only tested 3

accept insufficient evidence / data

*allow not all fridges have the same efficiency **or** a correct description implying different efficiencies*

only tested each fridge once is insufficient

there are lots of different makes is insufficient

1

[8]

M4. (a) (i) convection

1

(ii) conduction

1

(b) (i) 2

1

black is the best <u>absorber</u> (of thermal energy / heat)

accept black is the best emitter (of thermal energy / heat)

note that a comparative is needed (eg better or best)

1

(ii) the colour of the metal plates

1

(iii) any **one** from:

- more precise / accurate / reliable
  *do **not** accept better reading*
  *do **not** accept thermometer is unreliable*
- can measure continuously
- take many readings in a small time
- removes (human) reading error
  accept easier to read
- can compare / draw graphs automatically
- records data automatically

1

(c) (i) radiation

accept radiates

accept infra red (IR) waves

*do **not** accept heat waves*

1

(ii) to reflect (heat away from the fire fighter)

accept it reflects

accept it is a poor absorber (of thermal radiation / heat)

*do **not** accept deflect / bounce for reflect*

1

(d) **N**

*the mark is for the reason which does not score if **M** is chosen*

transfers / absorbs less heat
or
gives smallest increase in temperature

accept will keep fire fighters cooler

*accept **N** is cooler (after 15 minutes)*

*an answer **N** goes up to 52°C and **M** goes up to 100°C is insufficient*

1

[9]

M5. (a) (i) any **two** from:

- mass (of block)
  accept weight for mass
- starting temperature
- final / increase in temperature
  temperature is insufficient
- voltage / p.d.
  same power supply insufficient
- power (supplied to each block)
- type / thickness of insulation
  same insulation insufficient

2

(ii) one of variables is categoric
or
(type of) material is categoric

accept the data is categoric

accept a description of categoric

*do **not** accept temp rise is categoric*

1

(iii) concrete

reason only scores if concrete chosen

1

(heater on for) longest / longer time

a long time or quoting a time is insufficient

*do **not** accept it is the highest bar*

1

(iv) 4500 (J)

*allow **1** mark for correct substitution ie*

2 × 450 × 5 provided no subsequent step shown

2

(b) (i) point at 10 minutes identified

1

(ii) line through all points except anomalous

line must go from at least first to last point

1

(iii) 20 (°C)

if 20°C is given, award the mark.

If an answer other than 20°C is given, look at the graph. If the graph shows a correct extrapolation of the candidate's best-fit line and the intercept value has been correctly stated, allow 1 mark.

1

(iv) 2 (minutes)

1

[11]

M6. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

Level 1(1-2 marks)
There is a basic explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **one** feature.

Level 2(3-4 marks)
There is a clear explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **two** features.

Level 3(5-6 marks)
There is a detailed explanation of at least **two** features
or
a simple statement relating reduction in energy transfer to all **four** features.

Examples of the points made in response

extra information

accept throughout:
heat for energy
loss for transfer

plastic cap:

- plastic is a poor conductor
  accept insulator for poor conductor
- stops convection currents forming at the top of the flask so stopping energy transfer by convection
- molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation
- plastic cap reduces / stops energy transfer by conduction / convection / evaporation

glass container:

- glass is a poor conductor so reducing energy transfer by conduction
- glass reduces / stops energy transfer by conduction

vacuum:

- both conduction and convection require a medium / particles
- so stops energy transfer between the two walls by conduction and convection
- vacuum stops energy transfer by conduction / convection

silvered surfaces:

- silvered surfaces reflect infrared radiation
  accept heat for infrared
- silvered surfaces are poor emitters of infrared radiation
- infrared radiation (partly) reflected back (towards hot liquid)
- silvered surfaces reduce / stop energy transfer by radiation

6

(b) (the ears have a) small <u>surface</u> <u>area</u>
ears are small is insufficient

1

so reducing energy radiated / transferred (from the fox)
accept heat lost for energy radiated
*do **not** accept stops heat loss*

1

[8]

M7. (a) (i) 5(.0)

1

(ii) 35 **or** their (a)(i) × 7 correctly calculated

*allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

2

(iii) 525(p)
or
(£) 5.25
or
their (a)(ii) × 15 correctly calculated

if unit p or £ given they must be consistent with the numerical answer

1

(iv) decreases

1

temperature difference (between inside and outside) decreases

accept gradient (of line) decreases

*do **not** accept temperature (inside) decreases*

*do **not** accept graph goes down*

1

(b) (i) air (bubbles are) trapped (in the foam)

*do **not** accept air traps heat*
foam has air pockets is insufficient

1

(and so the) air cannot circulate / move / form convection current

air is a good insulator is insufficient
no convection current is insufficient

answers in terms of warm air from the room being trapped are incorrect and score no marks

1

(ii) how effective / good a material is as an insulator / at keeping energy in

accept heat for energy
accept the lower the U-value the better the insulator
accept the lower the U-value the lower the rate of energy / heat transfer

1

(c) it will increase

room will be cooler is insufficient

1

because the glass is not (such) a good insulator (as the wall)

the U-value has increased is insufficient

1

[11]