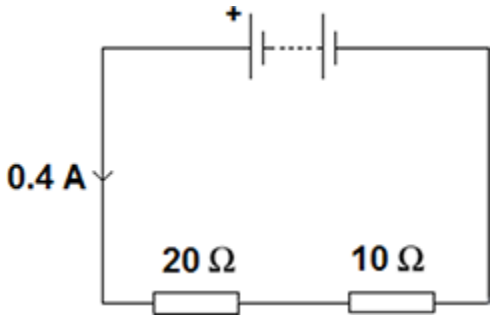
1 An electrical circuit is shown in the figure below.



(a) The current in the circuit is direct current.

What is meant by direct current?

Tick **one** box.

Current that continuously changes direction. ☐

Current that travels directly to the component. ☐

Current that is always in the same direction. ☐

(1)

(b) The equation which links current, potential difference and resistance is:

potential difference = current × resistance

Calculate the potential difference across the battery in the circuit in the figure above.

.....

.....

Potential difference = ... V

(3)

(c) The equation which links current, potential difference and power is:

power = current × potential difference

Calculate the power output of the battery in the figure above.

Give your answer to one significant figure.

.....

Power = ... W

(2)

(Total 6 marks)

2 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in the figure below.

© Michael Priest

(a) The electrician should **not** change the shower unless he switches off the mains electricity supply.

Explain why.

.....

.....

.....

.....

(2)

(b) The new shower has a power output of 10 690 W when it is connected to the 230 V mains electricity supply.

The equation which links current, potential difference and power is:

$$\text{current} = \frac{\text{power}}{\text{potential difference}}$$

Calculate the current passing through the new shower.

Give your answer to two significant figures.

.....

.....

.....

Current = ... A

(4)

(c) The new shower has a higher power rating than the old shower.

How does the power of the new shower affect the cost of using the shower?

Give a reason for your answer.

.....

.....

.....

.....

(2)

(Total 8 marks)

3 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in **Figure 1**.

Figure 1

© Michael Priest

(a) If the electrician touches the live wire he will receive an electric shock.

Explain why.

.....

.....

.....

.....

.....

.....

.....

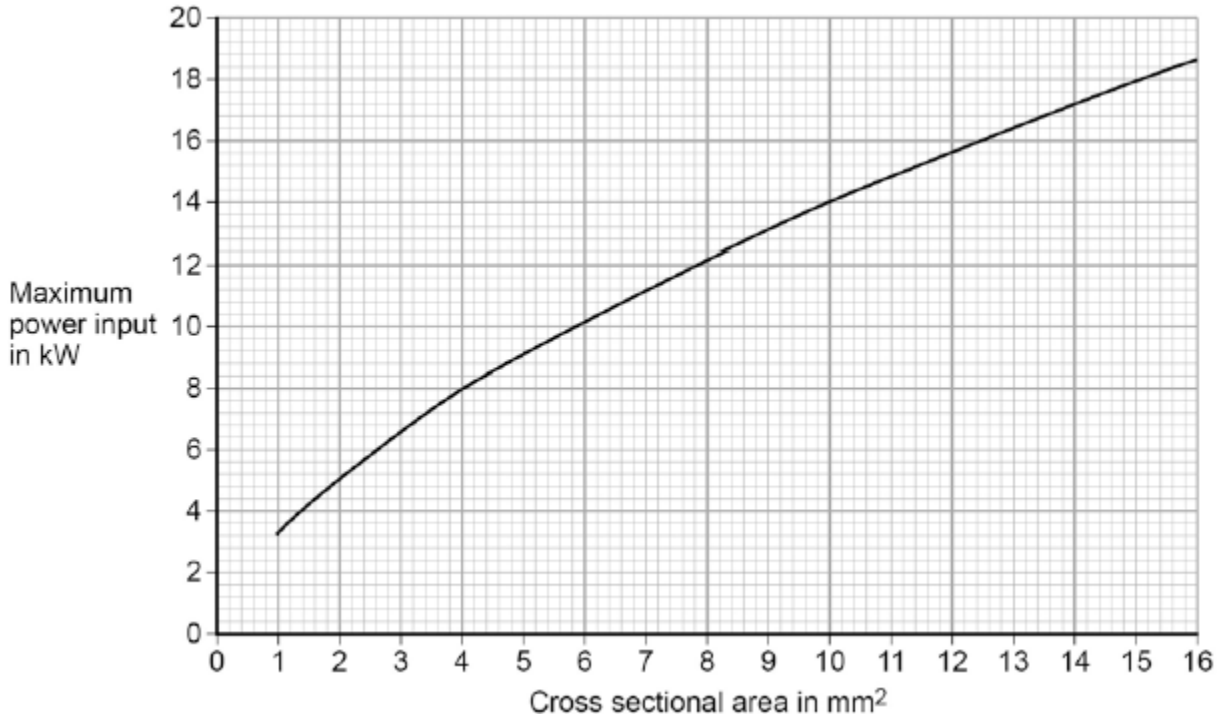
.....

(4)

(b) Different electrical wires need to have a cross-sectional area that is suitable for the power output.

Figure 2 shows the recommended maximum power input to wires of different cross-sectional areas.

Figure 2



The new electric shower has a power input of 13.8 kW.

Determine the minimum **diameter** of wire that should be used for the new shower.

The diameter, d, can be calculated using the equation:

$$d = \sqrt{\frac{4A}{\pi}}$$

A is the cross-sectional area of the wire.

.....

.....

Minimum diameter = ... mm

(2)

(c) The charge that flows through the new shower in 300 seconds is 18 000 C.
The new electric shower has a power of 13.8 kW.

Calculate the resistance of the heating element in the new shower.

Write down any equations you use.

.....

.....

.....

.....

.....

.....

.....

Resistance = ... Ω

(5)
(Total 11 marks)

4 Energy can be transferred through some materials by convection.

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

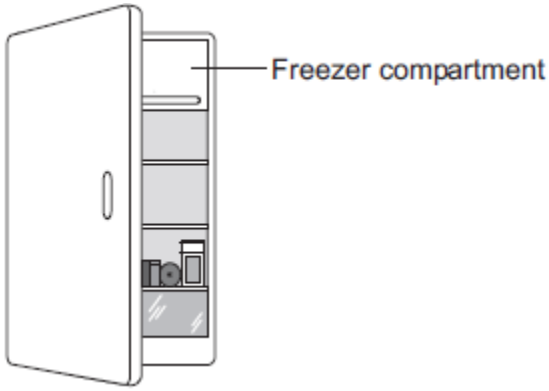
gas	**liquid**	**solid**

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)

5 Electricity can be generated using various energy sources.

(a) Give **one** advantage and **one** disadvantage of using nuclear power stations rather than gas-fired power stations to generate electricity.

Advantage .....

.....

Disadvantage .....

.....

(2)

(b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

.....

.....

.....

Energy output = ... kWh

(2)

(ii) Why, on average, do wind turbines operate at maximum power output for only 30% of the time?

.....

.....

(1)

(c) An on-shore wind farm is made up of many individual wind turbines.

They are connected to the National Grid using underground power cables.

Give **one** advantage of using underground power cables rather than overhead power cables.

.....

.....

(1)
(Total 6 marks)

6 (a) Iceland is a country that generates nearly all of its electricity from renewable sources.

In 2013, about 80% of Iceland's electricity was generated using hydroelectric power stations (HEP).

Describe how electricity is generated in a hydroelectric power station. Include the useful energy transfers taking place.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) The UK produces most of its electricity from fossil fuels.

Many people in the UK leave their televisions in ‘stand by’ mode when not in use, instead of switching them off.

It is better for the environment if people switch off their televisions, instead of leaving them in ‘stand by’ mode.

Explain why.

.....

.....

.....

.....

.....

.....

(3)

(c) A scientist wrote in a newspaper:

‘Appliances that do not automatically switch off when they are not being used should be banned.’

Suggest why scientists alone cannot make the decision to ban these appliances.

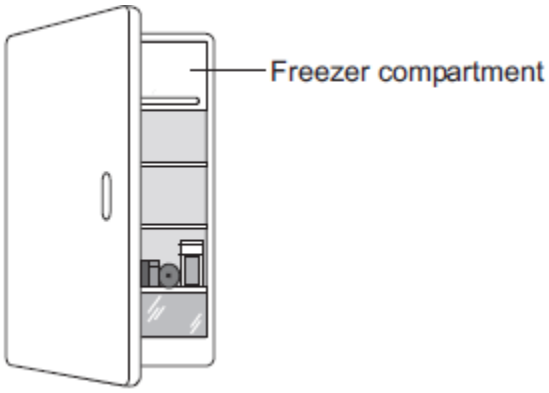
.....

.....

(1)
(Total 8 marks)

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

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



The air inside the fridge forms a convection current when the fridge door is closed.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) The table below shows information about four fridges.

Fridge	Volume in litres	Energy used in one year in kWh
A	250	300
B	375	480
C	500	630
D	750	750

A householder concludes that the energy used in one year is directly proportional to the volume of the fridge.

Explain why her conclusion is **not** correct.

Use data from the table in your answer.

.....

.....

.....

.....

(2)

(c) New fridges are more efficient than fridges made twenty years ago.

Give **one** advantage and **one** disadvantage of replacing an old fridge with a new fridge.

Ignore the cost of buying a new fridge.

Advantage .....

.....

Disadvantage .....

.....

(2)
(Total 8 marks)

8 **Table 1** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 1

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

(a) (i) Calculate the useful power output of the CFL bulb.

.....

.....

.....

Useful power output = ... watts

(2)

(ii) Use your answer to part **(i)** to calculate the waste energy produced each second by a CFL bulb.

.....

Waste energy per second = ... joules

(1)

(b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

The figure below shows a growth cabinet.

In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

.....

.....

.....

.....

.....

.....

(4)

(ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

.....

Give a reason for your answer.

.....

.....

(1)

(c) **Table 2** gives further information about both a halogen bulb and a LED bulb.

Table 2

Type of bulb	Cost to buy	Lifetime in hours	Operating cost over the lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than a LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 12 marks)

9 Solar panels are often seen on the roofs of houses.

(a) Describe the action and purpose of a solar panel.

.....

.....

.....

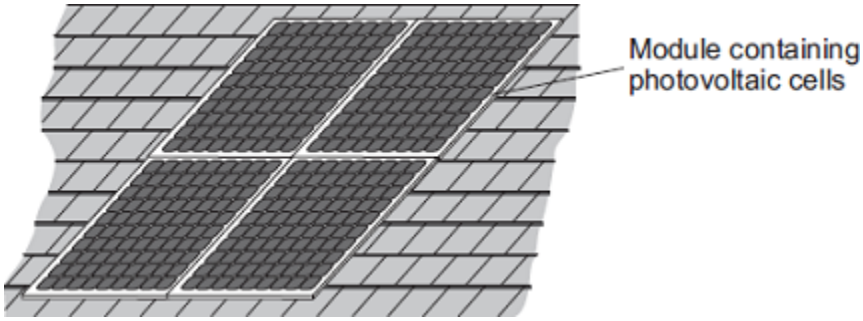
.....

(2)

(b) Photovoltaic cells transfer light energy to electrical energy.

In the UK, some householders have fitted modules containing photovoltaic cells on the roofs of their houses.

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

The maximum power available from the photovoltaic cells shown in the diagram is 1.4×10^3 W.

How long, in minutes, does it take to transfer 168 kJ of energy?

.....

.....

.....

.....

.....

..... Time = ... minutes

(3)

(c) When the modules are fitted on a roof, the householder gets an extra electricity meter to measure the amount of energy transferred by the photovoltaic cells.

(i) The diagram shows two readings of this electricity meter taken three months apart. The readings are in kilowatt-hours (kWh).

21 November	0	0	0	4	4
21 February	0	0	1	9	4

Calculate the energy transferred by the photovoltaic cells during this time period.

.....

Energy transferred = ... kWh

(1)

(ii) The electricity company pays 40p for each kWh of energy transferred.

Calculate the money the electricity company would pay the householder.

.....

.....

Money paid = ...

(2)

(iii) The cost of the four modules is £6000.

Calculate the payback time in years for the modules.

.....

.....

Payback time = ... years

(3)

(iv) State an assumption you have made in your calculation in part **(iii)**.

.....

.....

(1)

(d) In the northern hemisphere, the modules should always face south for the maximum transfer of energy.

State **one** other factor that would affect the amount of energy transferred during daylight hours.

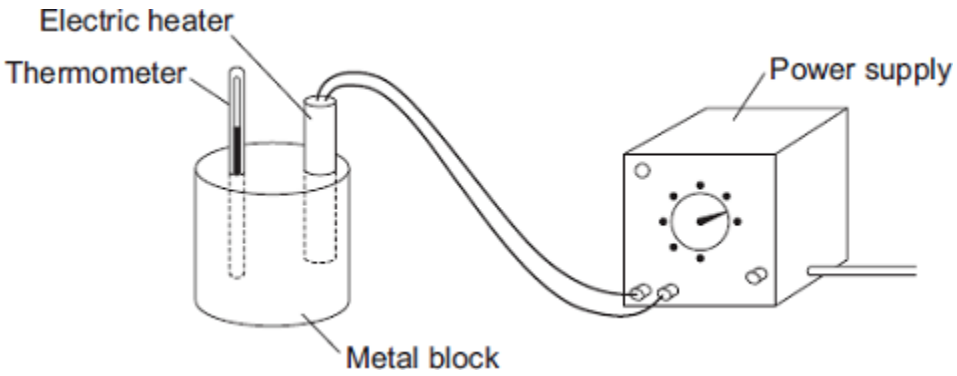
.....

.....

(1)

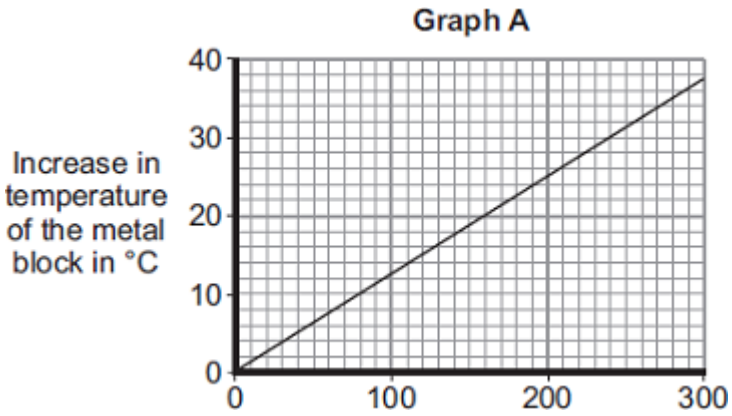
(Total 13 marks)

10 (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**.

.....

.....

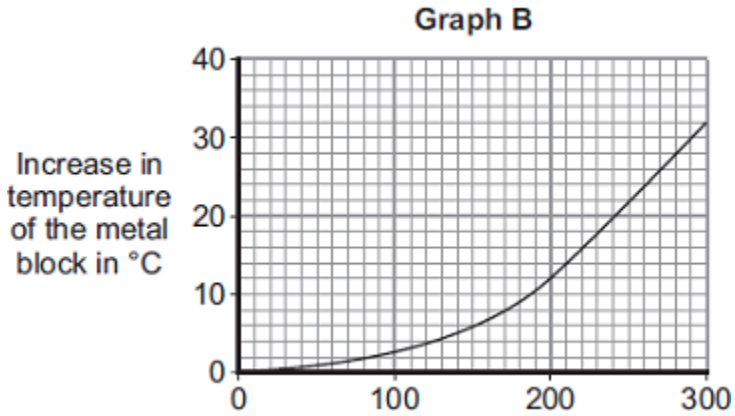
.....

.....

(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.

.....

.....

.....

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.

.....

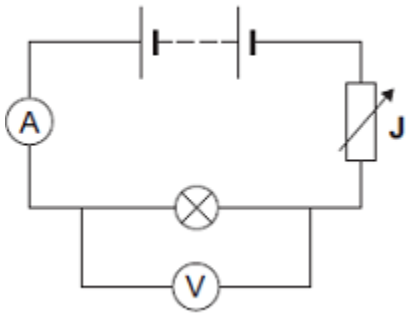
.....

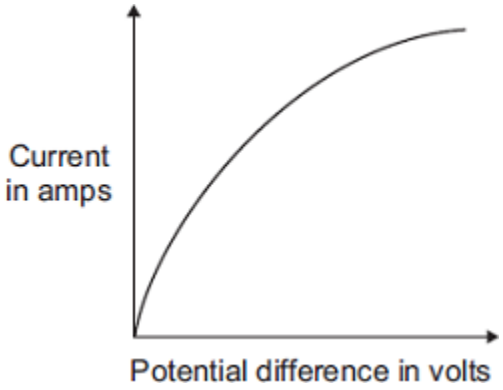
.....

.....

(2)
(Total 7 marks)

11 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





(i) Why is the component labelled '**J**' included in the circuit?

.....

.....

(1)

(ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1)

(iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

.....

.....

.....

Power = ...

(3)

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

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10%	£1.95	2 000
Light Emitting Diode (LED)	32%	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

.....

.....

.....

.....

.....

.....

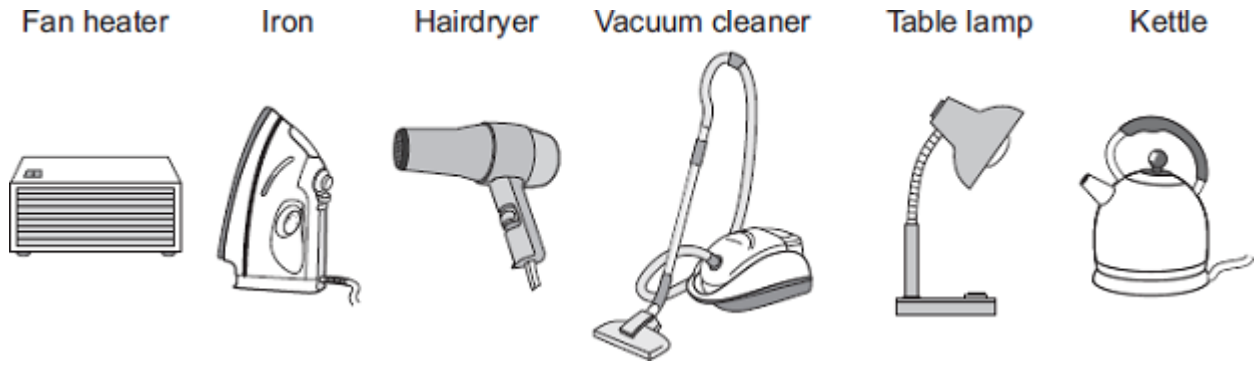
.....

.....

.....

(6)
(Total 11 marks)

12 The pictures show six different household appliances.



(a) Four of the appliances, including the fan heater, are designed to transform electrical energy into heat.

Name the other **three** appliances designed to transform electrical energy into heat.

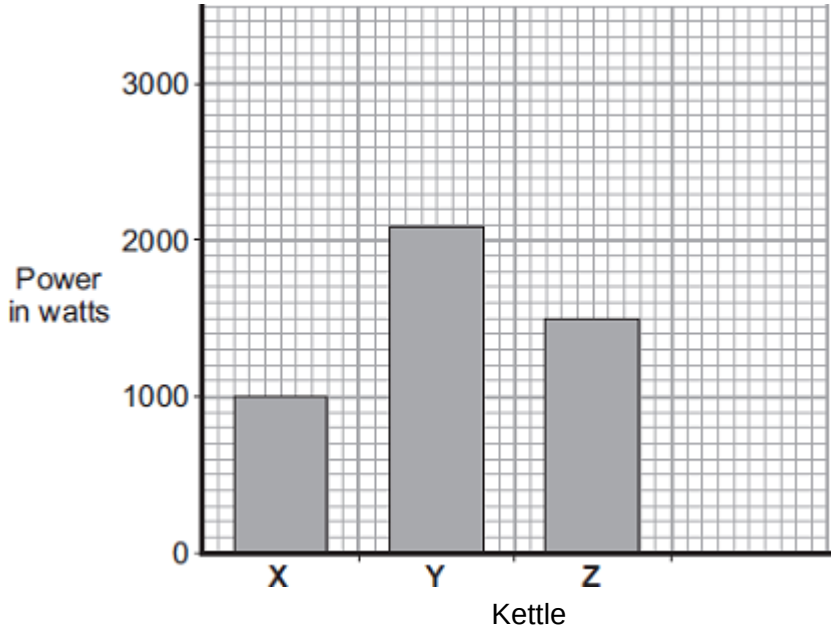
1 .....

2 .....

3 .....

(3)

(b) The bar chart shows the power of three electric kettles, **X**, **Y** and **Z**.



(i) In one week, each kettle is used for a total of 30 minutes.

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

X ☐

Y ☐

Y ☐

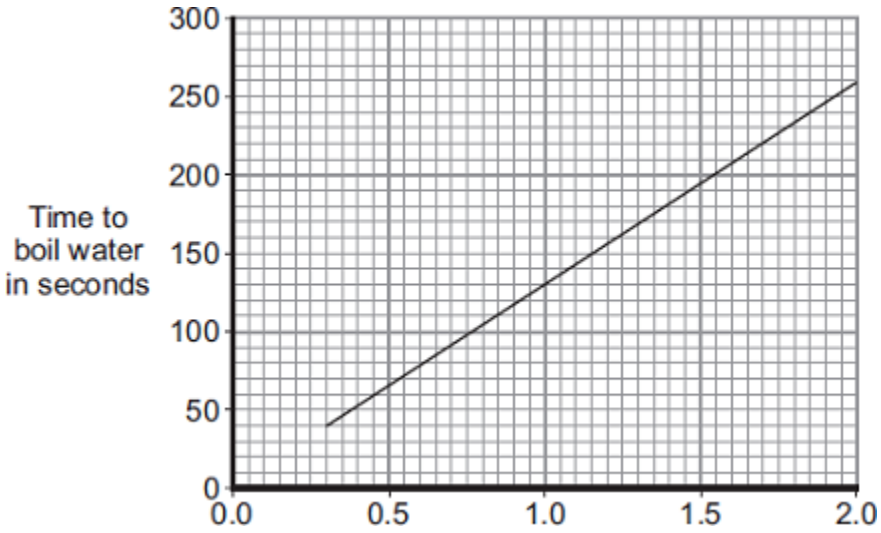
(1)

(ii) A new 'express boil' kettle boils water faster than any other kettle.

Draw a fourth bar on the chart to show the possible power of an 'express boil' kettle.

(1)

(c) The graph shows how the time to boil water in an electric kettle depends on the volume of water in the kettle.



A householder always fills the electric kettle to the top, even when only enough boiling water for one small cup of coffee is wanted.

Explain how the householder is wasting money.

.....

.....

.....

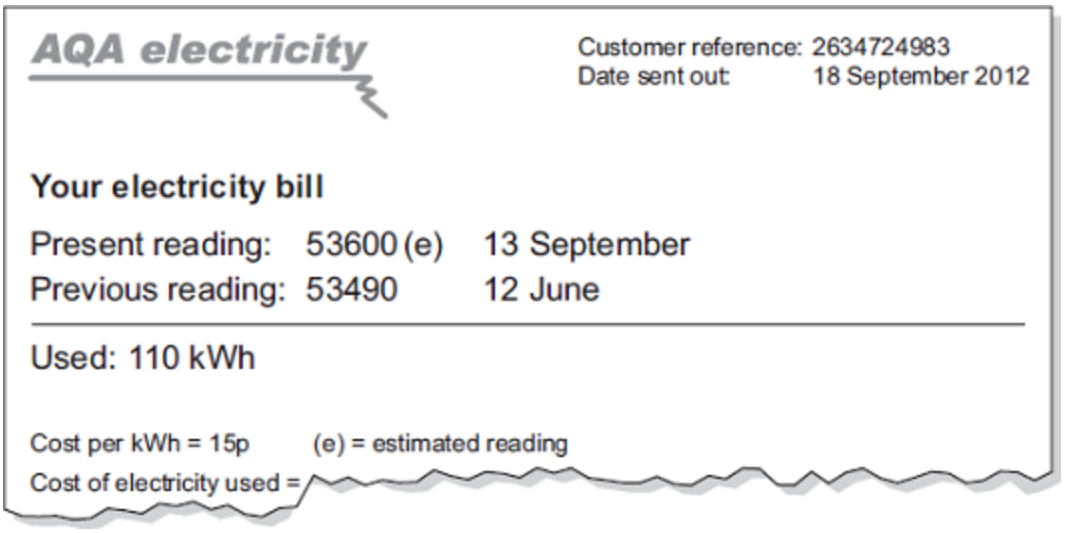
.....

.....

.....

(3)
(Total 8 marks)

13 A householder was out shopping when her electricity meter reading should have been taken. The electricity company estimated the reading and sent the following bill. Unfortunately, the bill was damaged in the post.



AQA electricity

Customer reference: 2634724983
Date sent out: 18 September 2012

Your electricity bill

Present reading: 53600 (e) 13 September
Previous reading: 53490 12 June

Used: 110 kWh

Cost per kWh = 15p (e) = estimated reading
Cost of electricity used =

(a) Use the equation in the box to calculate the cost of the electricity used between 12 June and 13 September.

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

Show clearly how you work out your answer.

.....

.....

Total cost = ...

(2)

(b) The estimated reading shown on the bill was not very accurate. The correct reading was 53782.

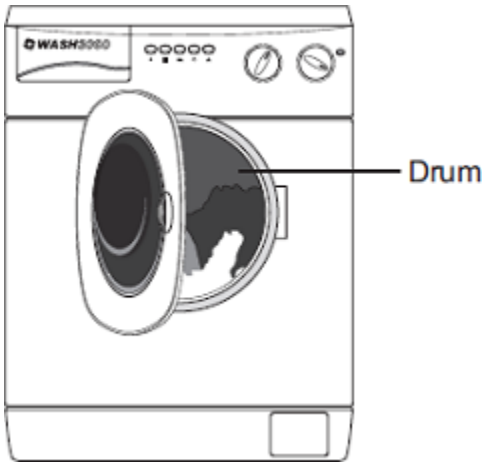
How many kilowatt-hours of electricity had the householder actually used between 12 June and 13 September?

.....

.....

(2)
(Total 4 marks)

14 The picture shows a washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

..... energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1)

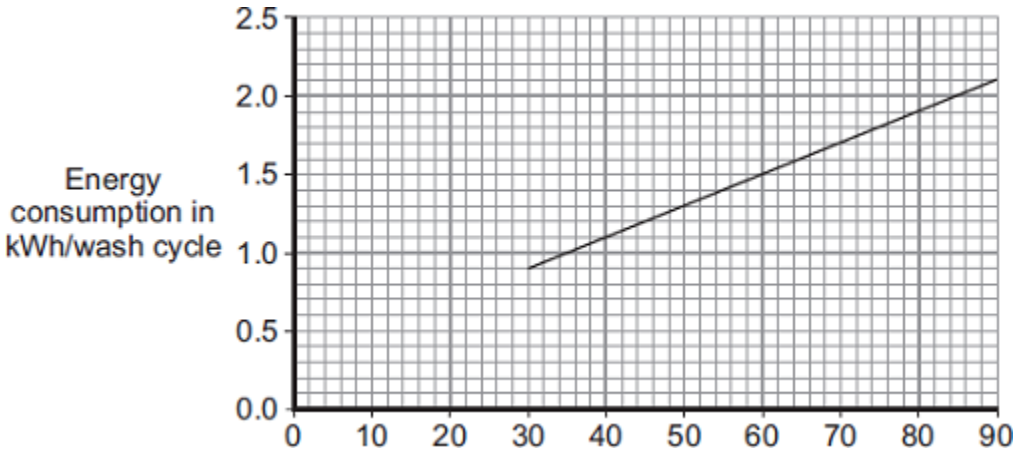
(b) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 15p per kilowatt-hour (kWh).

The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

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

Show clearly how you work out your answer.

.....

.....

Money saved = ...

(2)

(ii) Reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

Explain why.

.....

.....

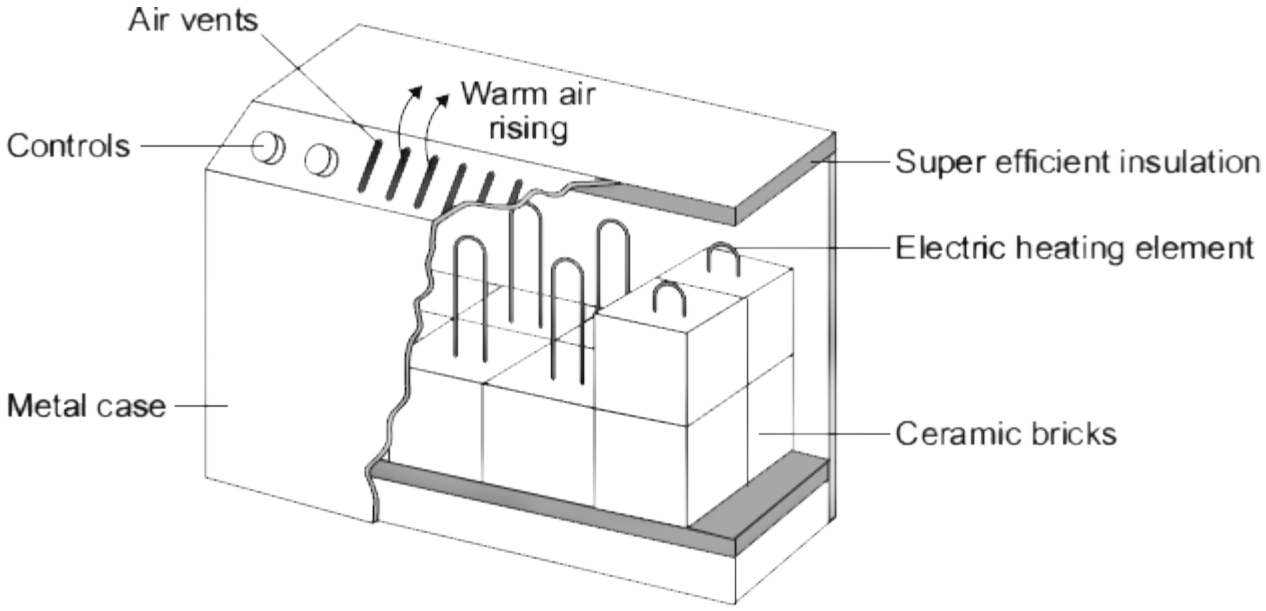
.....

.....

(2)

(Total 7 marks)

15 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.

conduction	**convection**	**evaporation**

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.

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.

Show clearly how you work out your answer.

.....

.....

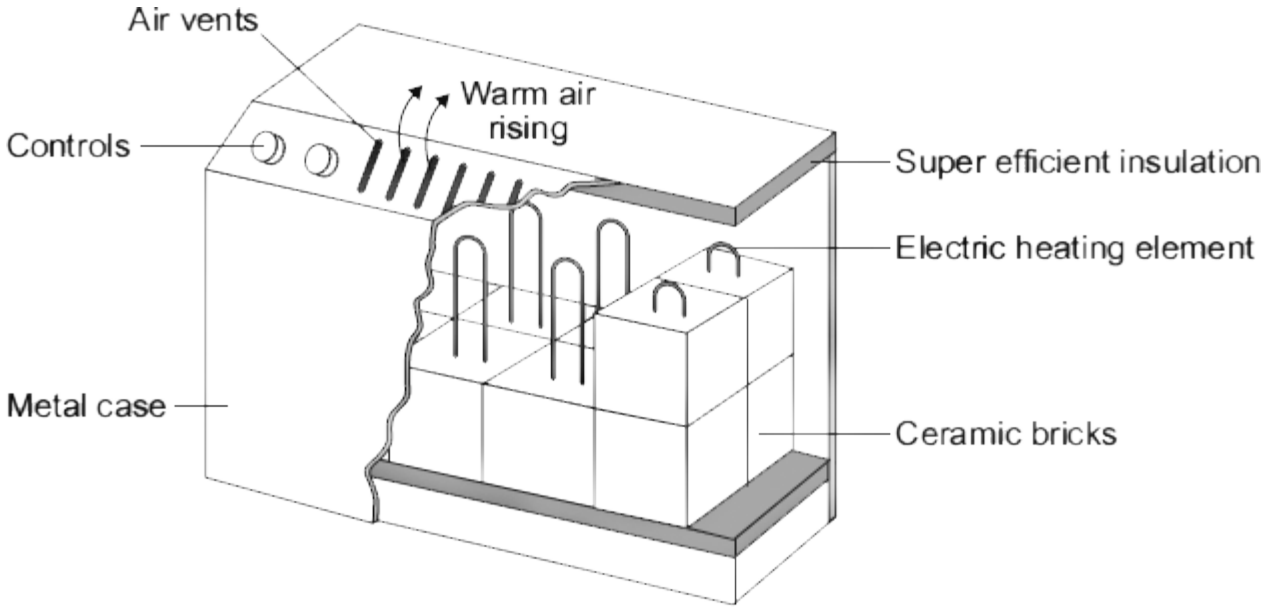
.....

.....

Energy transferred = ... J

(2)
(Total 8 marks)

16 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.

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

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.

.....

.....

.....

.....

(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.

Show clearly how you work out your answer.

.....

.....

.....

.....

Mass = ... kg

(2)
(Total 8 marks)

17 The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20%	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

(a) Both types of bulb produce the same useful power output.

(i) Calculate the useful power output of the CFL.

Show clearly how you work out your answer.

.....

.....

.....

Useful power output = ... W

(2)

(ii) Calculate the efficiency of the LED bulb.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(1)

(b) LED bulbs are expensive. This is because of the large number of individual electronic LED chips needed to produce sufficient light from each bulb.

(i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

.....

.....

.....

.....

(2)

(ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

Suggest **one** benefit of developing brighter and more efficient LED chips.

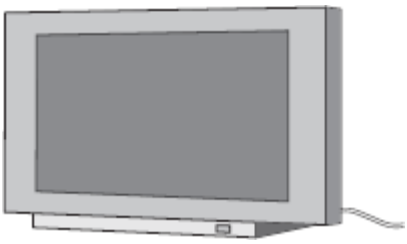
.....

.....

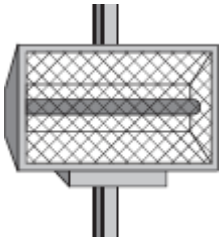
(1)

(Total 6 marks)

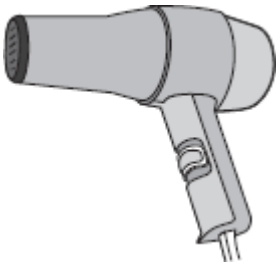
18 The data included in the diagrams gives the power of the electrical appliances.



TV
160 W

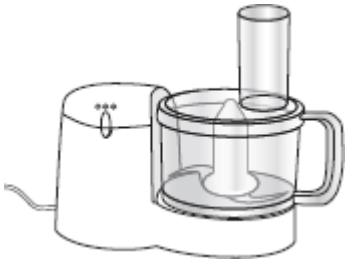


Radiant heater
1.0 kW



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.

.....

.....

.....

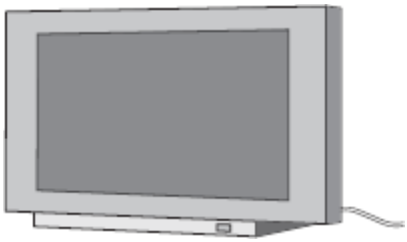
.....

Cost = ... pence

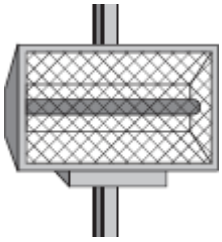
(2)

(Total 6 marks)

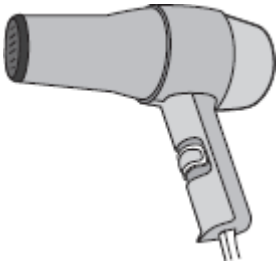
19 The data included in the diagrams gives the power of the electrical appliances.



TV
160 W

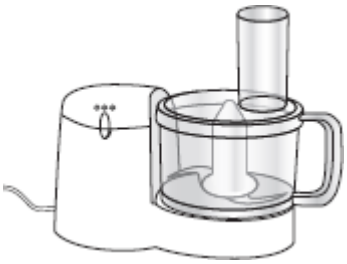


Radiant heater
1.0 kW



Hairdryer
1100 W

Sandwich toaster
1.1 kW



Food processor
0.4 kW

Table lamp
40 W

(a) (i) Which of the appliances are designed to transform electrical energy to kinetic energy?

.....

.....

(1)

(ii) Which of the appliances waste energy as heat?

.....

.....

(1)

(b) Leaving the radiant heater switched on is likely to lead to more carbon dioxide being emitted into the atmosphere than leaving the table lamp on for the same length of time.

Explain why.

.....

.....

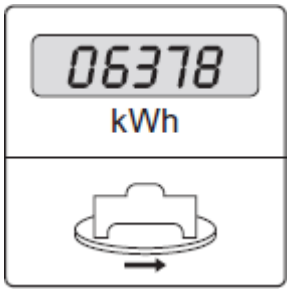
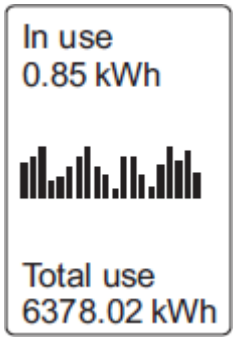
.....

.....

(2)

(c) A homeowner decides to monitor the amount of electrical energy used in his home. He can do this by using the home's electricity meter or by using a separate electronic device.

The table gives some information about each method.

Electricity meter	Electronic device
Records to the nearest kilowatt-hour	Records to the nearest 1/100th kilowatt-hour
Homeowner takes readings at regular intervals	Energy use recorded continuously and stored for one year
	Displays a graph showing energy use over a period of time
	

(i) Complete the following sentence.

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

(1)

(ii) Suggest how data collected and displayed by the electronic device could be useful to the homeowner.

.....

.....

.....

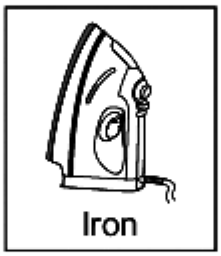
.....

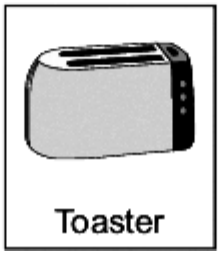
.....

.....

(3)
(Total 8 marks)

20 The appliances shown below transfer electrical energy to other types of energy.





(a) The vacuum cleaner is designed to transfer electrical energy to kinetic energy.

Three more of the appliances are also designed to transfer electrical energy to kinetic energy. Which **three**?

Draw a ring around each correct appliance.

3

(b) Which **two** of the following statements are true?

Tick (✓) **two** boxes.

Appliances only transfer part of the energy usefully. ☐

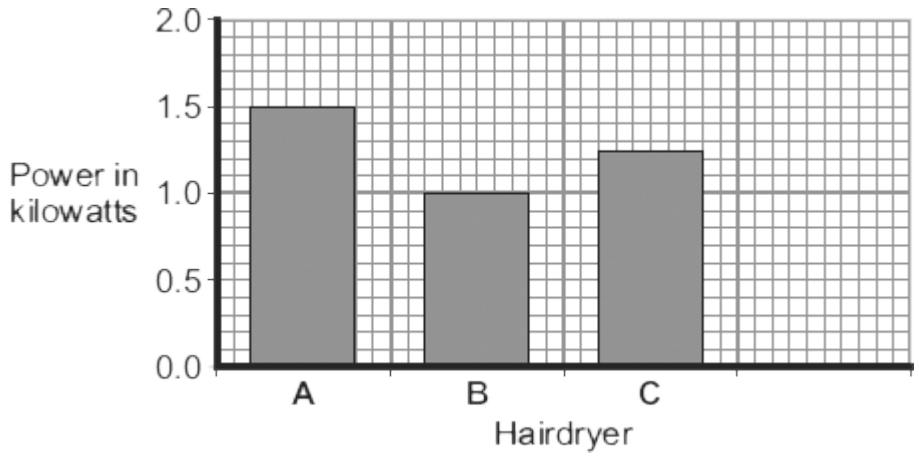
The energy transferred by appliances will be destroyed. ☐

The energy transferred by appliances makes the surroundings warmer. ☐

The energy output from an appliance is bigger than the energy input. ☐

(2)
(Total 5 marks)

21 (a) The bar chart shows the power of three different electric hairdryers.



(i) Which **one** of the hairdryers, **A**, **B** or **C**, would transfer the most energy in 5 minutes?

Write the correct answer in the box. ☐

(1)

(ii) A small 'travel' hairdryer has a power of 500 watts.

Draw a fourth bar on the bar chart to show the power of the 'travel' hairdryer.

(1)

(b) A family shares the same hairdryer.
The hairdryer has a power of 1.2 kW. The hairdryer is used for a total of 2 hours each week.

(i) Calculate how many kilowatt-hours (kWh) of energy the hairdryer transfers in 2 hours.

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... kWh

(2)

(ii) Electricity costs 15 pence per kWh.

Calculate the cost of using the hairdryer for 2 hours.

Show clearly how you work out your answer.

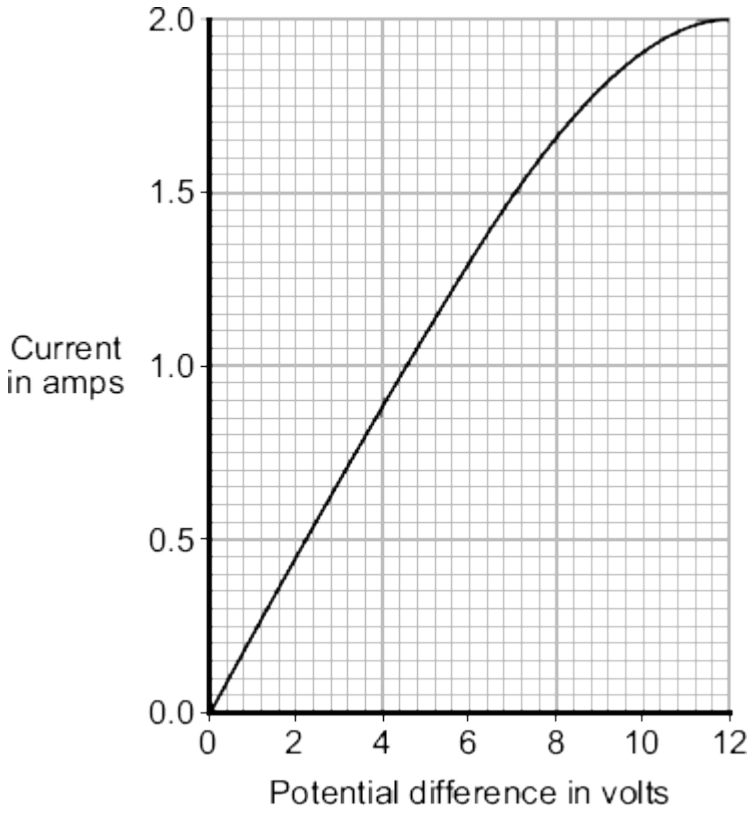
.....

.....

Cost = ... pence

(2)
(Total 6 marks)

22 The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.



(a) What is the meaning of the following terms?

electric current

.....

.....

potential difference

.....

.....

(2)

(b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V.

Show clearly how you work out your answer.

.....

.....

Rate of energy transfer = ... W

(2)

(Total 7 marks)

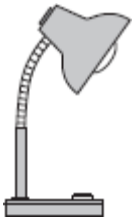
23 Each letter, **A**, **B**, **C**, **D** and **E**, represents an energy transformation.

A electrical to chemical
B electrical to heat
C electrical to kinetic
D electrical to light
E electrical to sound

Match each of the following devices to the useful energy transformation that the device is designed to make.

Write the correct letter, **A**, **B**, **C**, **D** or **E**, in the box below each device.

Use each letter no more than once.

Fan	**Kettle**	**Lamp**	**Radio**
			

(Total 4 marks)

24 A homeowner had a new gas boiler installed.

(a) The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)
Efficiency	0.95

(i) Calculate the energy transferred each second by the gas boiler to the water inside the boiler.

Show clearly how you work out your answer.

.....

.....

Energy transferred by the gas boiler each second = ... kJ

(2)

(ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Calculate the total number of hours that the gas boiler would operate for £30.

Show clearly how you work out your answer.

.....

.....

.....

.....

Number of hours = ...

(2)

(b) Although the gas boiler is very efficient, some energy is wasted.

Explain what happens to the waste energy.

.....

.....

.....

.....

(2)
(Total 6 marks)

25 The diagram shows four electrical appliances. Each appliance is designed to transform electrical energy into one form of output energy.


Kettle


Toaster


Radio


Hair straighteners

(a) Which **one** of the appliances is designed to give a different form of output energy from the other three appliances?

.....

Give a reason for your answer.

.....

.....

(2)

(b) The power of each appliance is given in the table.

Appliance	Power
Kettle	2.5 kW
Toaster	920 W
Radio	15 W
Hair straighteners	75 W

Each appliance is switched on for 5 minutes.

Which appliance transforms the most energy?

.....

(1)

(c) The 75 watt hair straighteners are switched on for a few minutes each day.
In one year, the amount of energy transferred from the mains electricity supply to the hair straighteners is 4 kilowatt-hours.

Electricity costs 15 p per kilowatt-hour.

Use the equation in the box to calculate the yearly cost of using the hair straighteners.

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

Show clearly how you work out your answer.

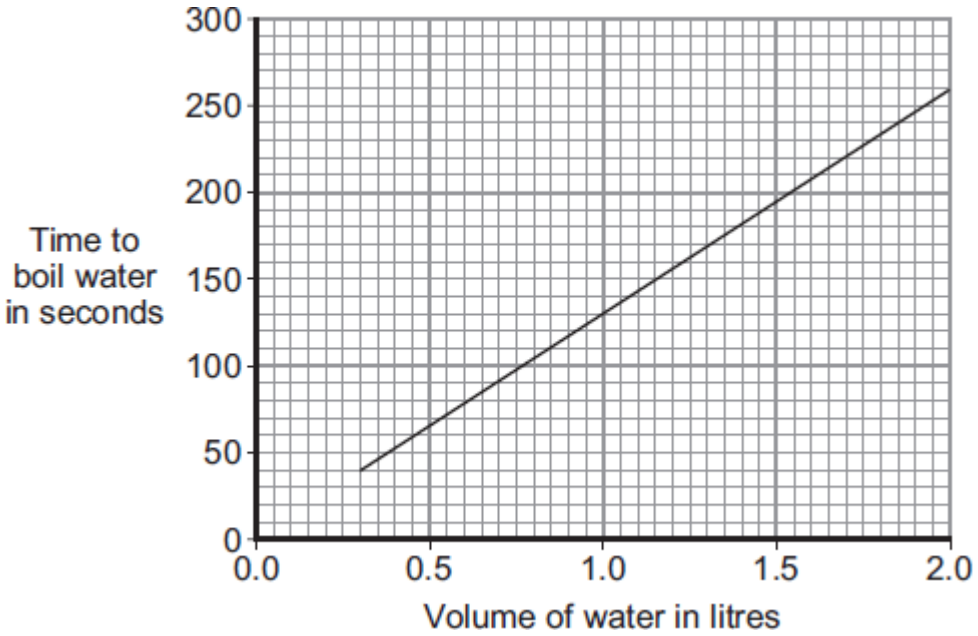
.....

.....

Total cost = ... pence

(2)

(d) The graph shows how the time to boil water in an electric kettle depends on the volume of water in the kettle.



A householder always fills the electric kettle to the top, even when only enough boiling water for one small cup of coffee is required.

Explain how the householder is wasting money.

.....

.....

.....

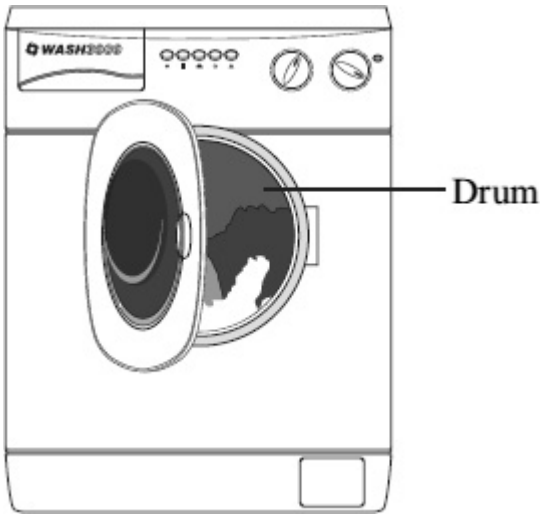
.....

.....

.....

(3)
(Total 8 marks)

26 The picture shows a new washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



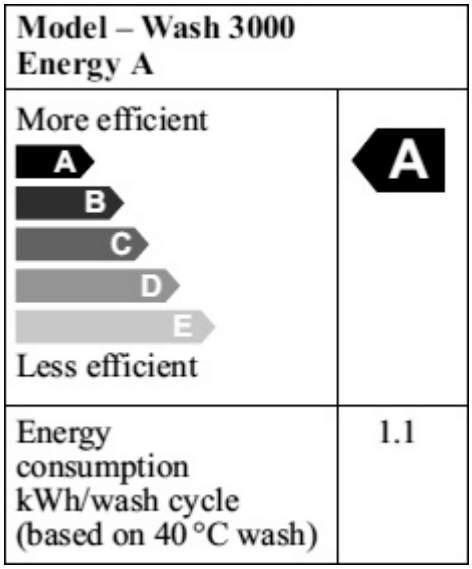
(a) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(b) The diagram shows the label from the new washing machine.



An 'A' rated washing machine is *more energy efficient* than a 'C' rated washing machine.

Explain what being *more energy efficient* means.

.....

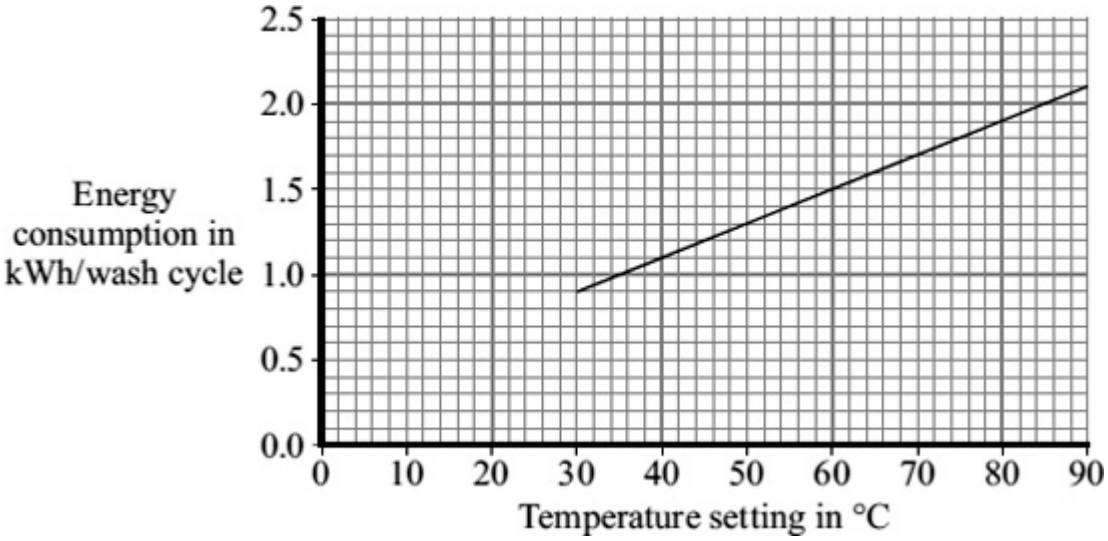
.....

.....

.....

(2)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 12 p per kilowatt-hour (kWh).
The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

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

Show clearly how you work out your answer.

.....

.....

Money saved = ... p

(2)

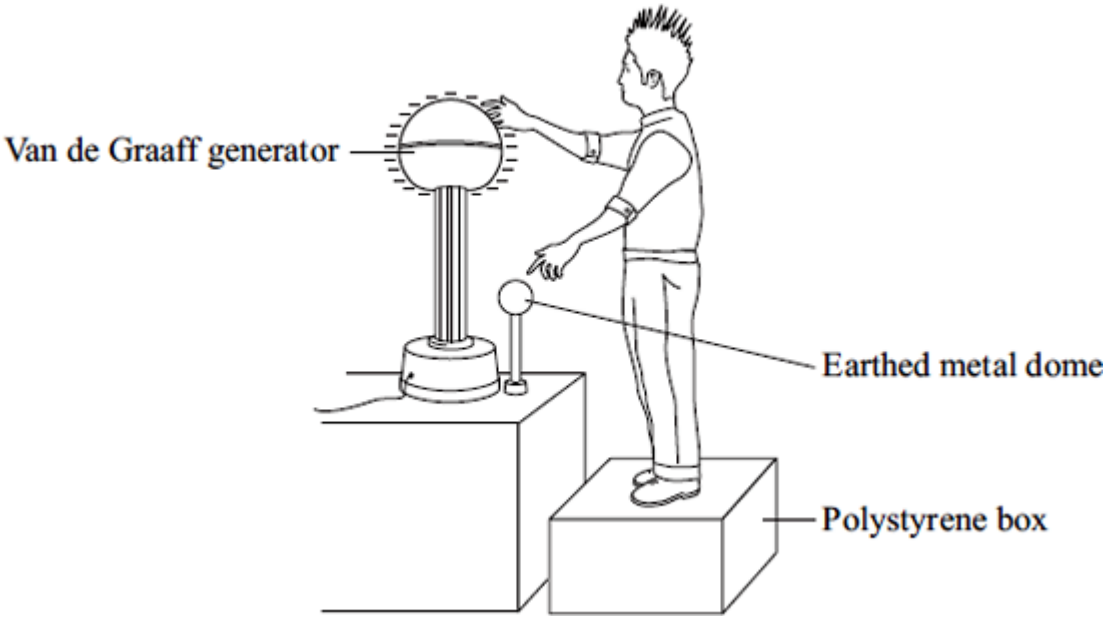
(ii) Suggest why reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

.....

.....

(1)
(Total 6 marks)

27 (a) The diagram shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.



Explain why the student's hair stands on end when the generator is switched on.

.....

.....

.....

(2)

(b) When the potential difference between the student and a nearby earthed metal dome reached 15 kV, a spark jumped between the student and the earthed dome. The spark transformed 30 mJ of energy into heat, light and sound. (1 mJ = 0.001 J)

Calculate the charge carried by the spark.

.....

.....

Charge transferred =..... coulombs

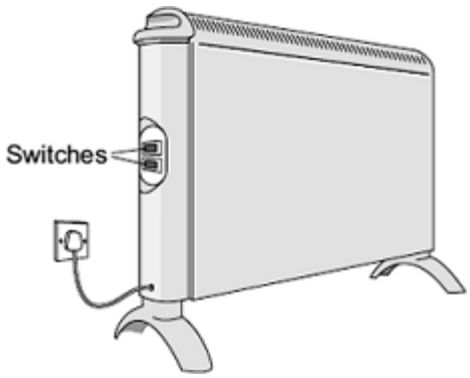
(2)

(c) What name is given to the rate of flow of charge?

.....

(1)
(Total 5 marks)

28 (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 kW
Low	0.5
Medium	1.5
High	

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

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

.....

Power = ... kW

(1)

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

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

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

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... kWh

(2)

(iii) Electricity costs 12 pence per kilowatt-hour.

Use the equation in the box to calculate how much the heater costs to use on **medium** power for three hours.

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

Show clearly how you work out your answer.

.....

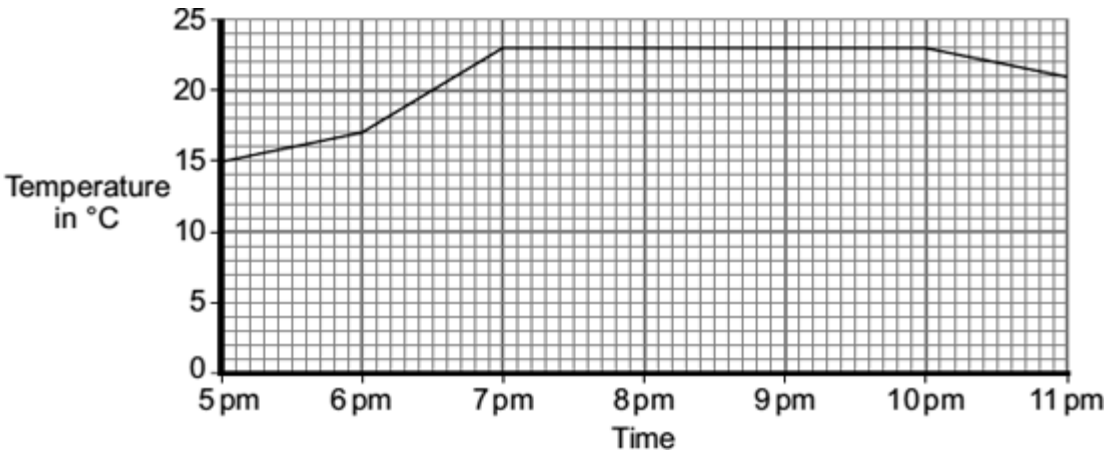
.....

Total cost = ... pence

(2)

(b) The heater is used to warm a room.

The graph shows how the temperature of the room changes from the moment the heater is switched on.



The heater was first used on the medium setting.

(i) At what time was the heater setting changed to the **high** setting?

.....

Give a reason for your answer.

.....

.....

.....

(2)

(ii) From 7 pm until 10 pm, the temperature of the room is **not** changing.

Which **one** of the following statements gives the reason why the temperature of the room is **not** changing?

Put a tick (✓) in the box next to your answer.

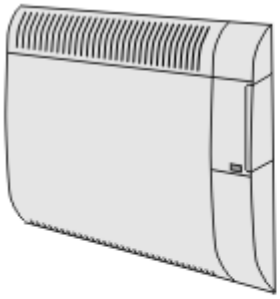
The room is losing energy slower than the heater supplies energy. ☐

The room is losing energy as fast as the heater supplies energy. ☐

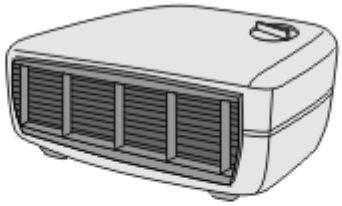
The room is losing energy faster than the heater supplies energy. ☐

(1)
(Total 8 marks)

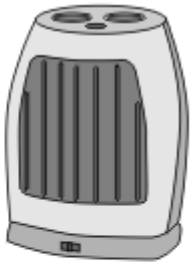
29 The pictures show three different types of electric heater.



400W oil-filled panel heater (wall mounted)
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



3kW fan heater
- 2 heat settings
- Power indicator light
- Cool air fan setting



1800W ceramic heater
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out

(a) The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in joules, the amount of energy transferred from the mains to the heater.

energy transferred = power × time

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... joules

(2)

(b) Which heater will be the most expensive to run on its highest heat setting?

.....

(1)

(c) A heater is needed for a small office.

Comparing each type of heater with the other two, give **one** advantage of using each type of heater in the office.

oil-filled panel heater .....

.....

fan heater .....

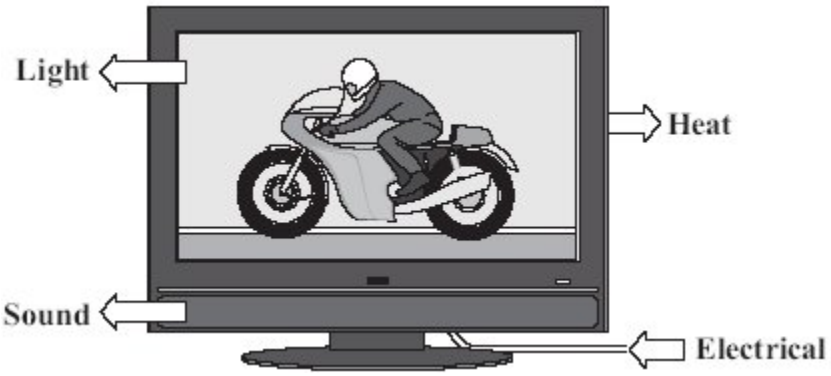
.....

ceramic heater .....

.....

(3)
(Total 6 marks)

30 The diagram shows the energy transformations produced by a TV.



(a) Use words from the diagram to complete the following sentence.

The TV is designed to transform ..... energy into

light and ..... energy.

(2)

(b) Which **one** of the following statements is **false**?

Put a tick (✓) in the box next to the **false** statement.

The energy transformed by the TV makes the surroundings warmer. ☐

The energy transformed by the TV becomes spread out. ☐

The energy transformed by the TV will be destroyed. ☐

(1)

(c) Two different makes of television, **A** and **B**, transform energy at the same rate.
Television **A** wastes less energy than television **B**.

Complete the following sentence by drawing a ring around the correct line in the box.

Television **A** has

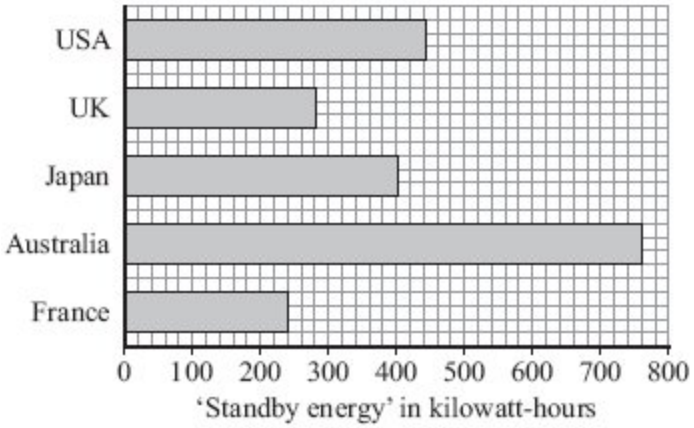
a higher efficiency than
the same efficiency as
a lower efficiency than

television **B**.

(1)
(Total 4 marks)

31 Electrical appliances that are left on standby still use energy.

The bar chart compares the *average* amount of 'standby energy' wasted each year in every home in five countries.



(i) In which country are the homes that waste, on average, the smallest amount of 'standby energy'?

Draw a ring around your answer.

Australia **France** **Japan** **UK** **USA**

(1)

(ii) Suggest a reason why an *average* value is used for the 'standby energy' wasted in the homes.

.....

.....

(1)

(b) (i) Australia has one of the lowest electricity prices in the world.

How does this low price seem to affect the amount of 'standby energy' wasted?

.....

.....

(1)

(ii) In Australia, most electricity is generated in coal-burning power stations. The Australian government wants less electricity to be wasted.

Wasting less electricity would be good for the Australian environment.

Explain why.

.....

.....

.....

.....

(2)

(c) Energy is not usually measured in kilowatt-hours.

Which **one** of the following units is usually used to measure energy?

Draw a ring around your answer.

hertz **joule** **watt**

(1)

(d) (i) Electricity in Japan costs the equivalent of 17 pence per kilowatt-hour.

Use the information in the bar chart and the equation in the box to calculate how much the 'standby energy' used in an average Japanese home costs each year.

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

Show clearly how you work out your answer.

Give your answer in pence.

.....

.....

Cost = ... pence

(3)

(ii) In Japan, the largest proportion of electricity is generated using nuclear fuels.

Which **one** of the following statements gives a good reason for using nuclear fuels to generate electricity?

Put a tick (✓) in the box next to your answer.

A nuclear power station is very expensive to build. ☐

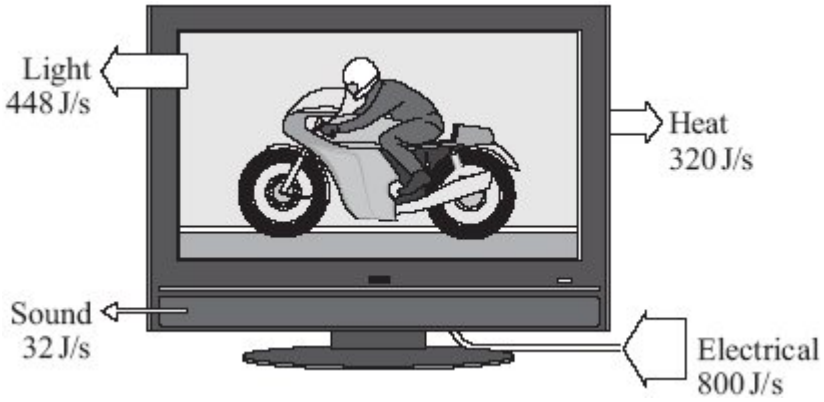
A small amount of nuclear fuel generates a large amount of electricity. ☐

It is easy to store nuclear waste safely. ☐

(1)

(Total 10 marks)

32 (a) The diagram shows the energy transformations produced by a TV.



(i) Calculate the efficiency of the TV, using the information in the diagram..

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(ii) What eventually happens to the useful energy transferred by the TV?

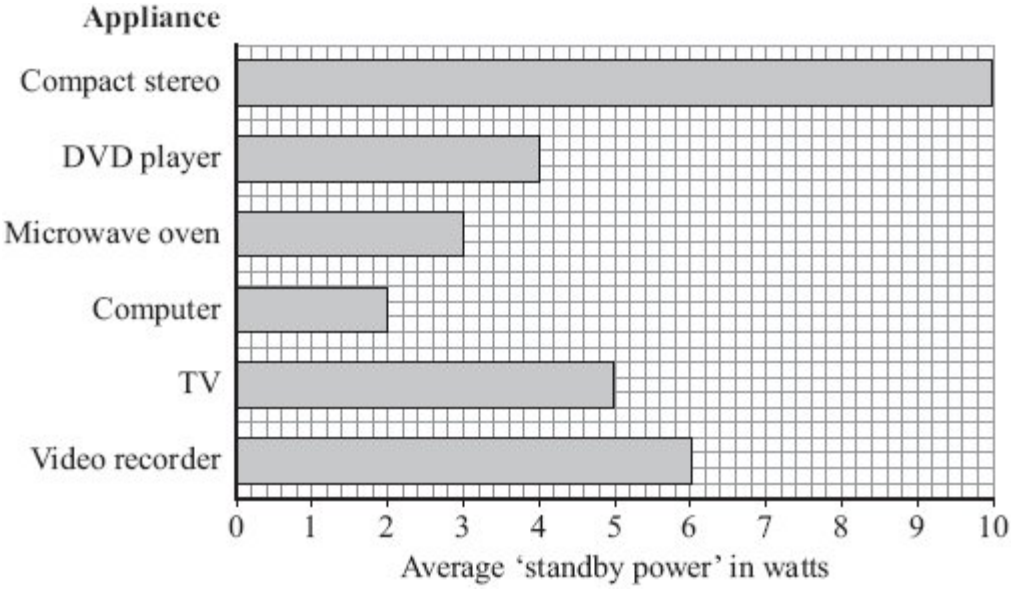
.....

.....

(1)

(b) Electrical appliances left on standby use energy.

The bar chart shows the power for the appliances that one family leaves on standby when they go on holiday.



The family is on holiday for a total of 175 hours.

(i) Use the information in the bar chart and the equation in the box to calculate the energy wasted by leaving the compact stereo on standby while the family is on holiday.

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

Show clearly how you work out your answer.

.....

.....

Energy wasted = ... kilowatt-hours

(2)

(ii) Electricity costs 12 p per kilowatt-hour.

Use the equation in the box to calculate the cost of leaving the compact stereo on standby while the family is on holiday.

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

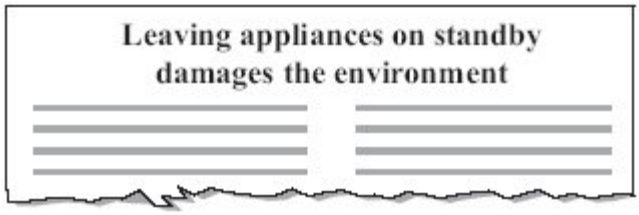
Show clearly how you work out your answer.

.....

Cost = ... p

(1)

(c) A headline from a recent newspaper article is shown below.



Explain why leaving appliances on standby damages the environment.

.....

.....

.....

.....

(2)
(Total 8 marks)

33 (a) Each letter **A, B, C, D** and **E** represents an energy transformation.

A electrical to gravitational potential

B electrical to heat

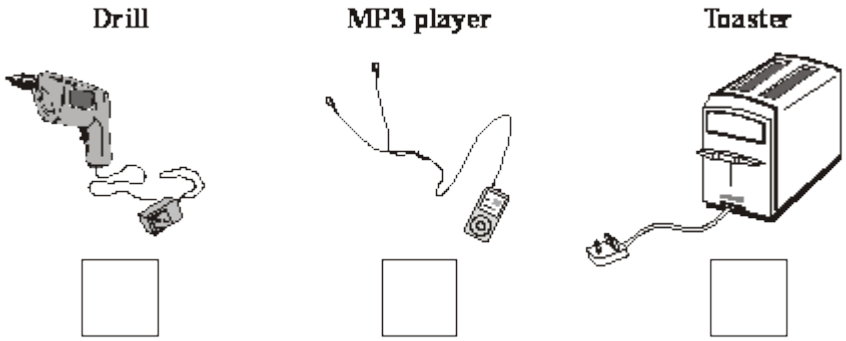
C electrical to kinetic

D electrical to light

E electrical to sound

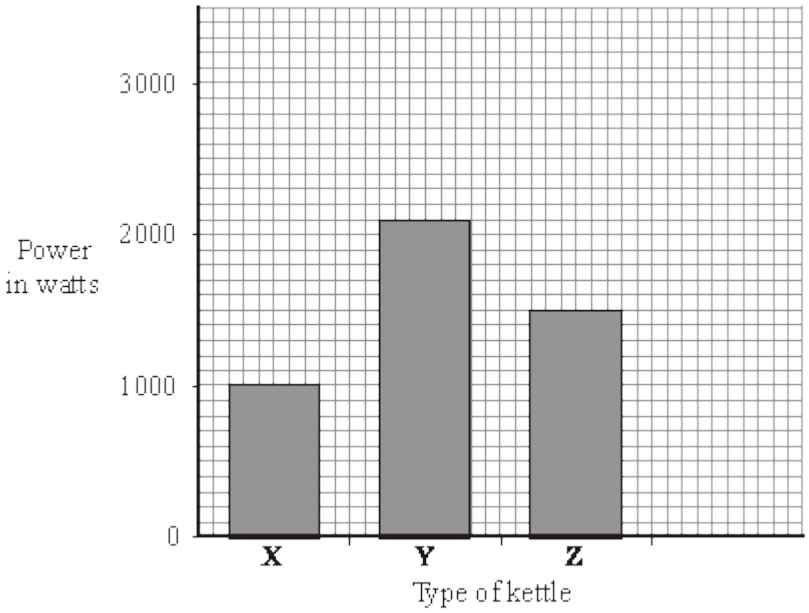
Match each of the following devices to the useful energy transformation that it is designed to make.

Write the correct letter, **A, B, C, D** or **E**, in the box below the device. Use each letter once or not at all.



(3)

(b) The bar chart shows the power of three electric kettles.



(i) What is the power of kettle **Y**?

.....

(1)

(ii) In one week each kettle is used for a total of 30 minutes.

Which kettle costs the most to use?

.....

(1)

(iii) A new 'express boil' kettle boils water faster than any other kettle.

Draw a fourth bar on the chart to show the possible power of an 'express boil' kettle.

(1)

(c) Some friends are going on holiday. They want to be able to boil water to make their own hot drinks. They cannot decide which to take, a travel kettle or a small portable immersion heater that can be placed in a mug.

Travel Kettle
• 1 k W element
• Holds 1 litre
• Works on 110V or 230V
• Washable water filter

Immersion heater
• 0.4 k W element
• Heates up to 0.5 litres of water
• Works on 230 V only
• Small compact size

(i) Give **one** advantage of taking the travel kettle.

.....

.....

(1)

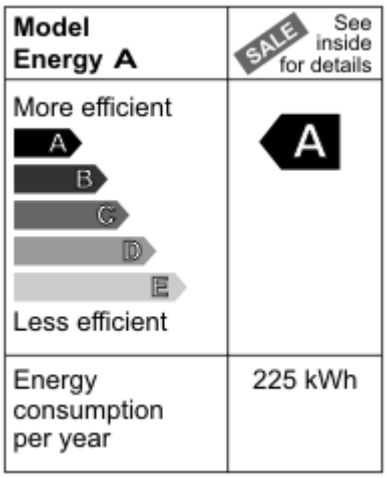
(ii) Give **one** advantage of taking the immersion heater.

.....

.....

(1)
(Total 8 marks)

34 The diagram shows the label from a new freezer.



(a) An old freezer has an energy consumption per year of 350 kWh.

Use the equation in the box to calculate the extra cost of using the old freezer for one year compared with using a new 'A' rated freezer.

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

Assume 1 kilowatt-hour (kWh) of energy costs 12 p.

Show clearly how you work out your answer.

.....

.....

Extra cost per year = £ .....

(2)

(b) The price of the new freezer was reduced in a sale.

Reducing the price reduces the payback time for replacing the old freezer from 12 years to 9 years.

Calculate, in pounds, how much the new freezer was reduced in the sale.

Show clearly how you work out your answer.

.....

.....

Price reduced by = £ .....

(2)

(c) An advertisement in a shop claims that:

'Replacing an old freezer with a new 'A' rated freezer will benefit the environment.'

Do you agree that replacing the freezer will benefit the environment?

Answer yes or no. .....

Explain the reasons for your answer.

.....

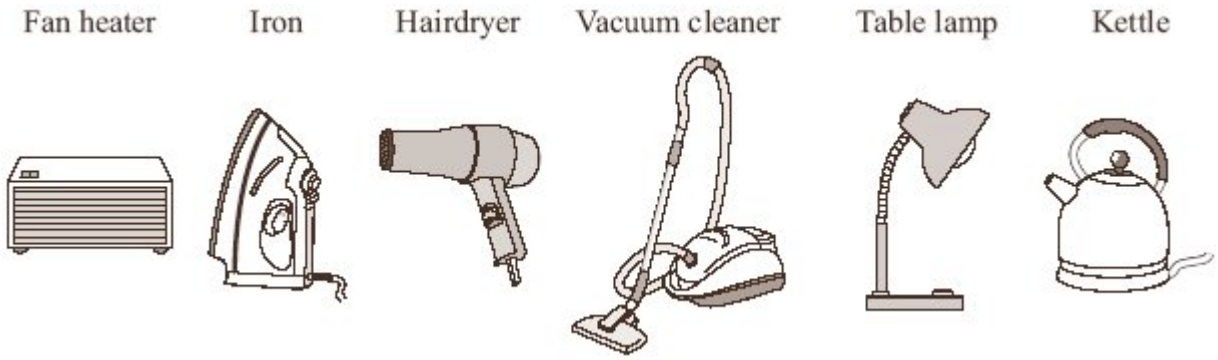
.....

.....

.....

(2)
(Total 6 marks

35 The pictures show six different household appliances.



(a) Four of the appliances, including the fan heater, are designed to transform electrical energy into heat.

Name the other **three** appliances designed to transform electrical energy into heat.

1 .....

2 .....

3 .....

(3)

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

chemical	**heat**	**kinetic**	**sound**

Energy that is not usefully transformed by the fan heater is wasted as

..... energy.

(1)

(c) The table gives information about two different fan heaters.

	Useful energy transferred each second in joules	**Wasted energy transferred each second in joules**
Fan heater **L**	1200	10
Fan heater **M**	1200	20

Complete the following sentence by drawing a ring around the line in the box that is correct.

Fan heater **L**

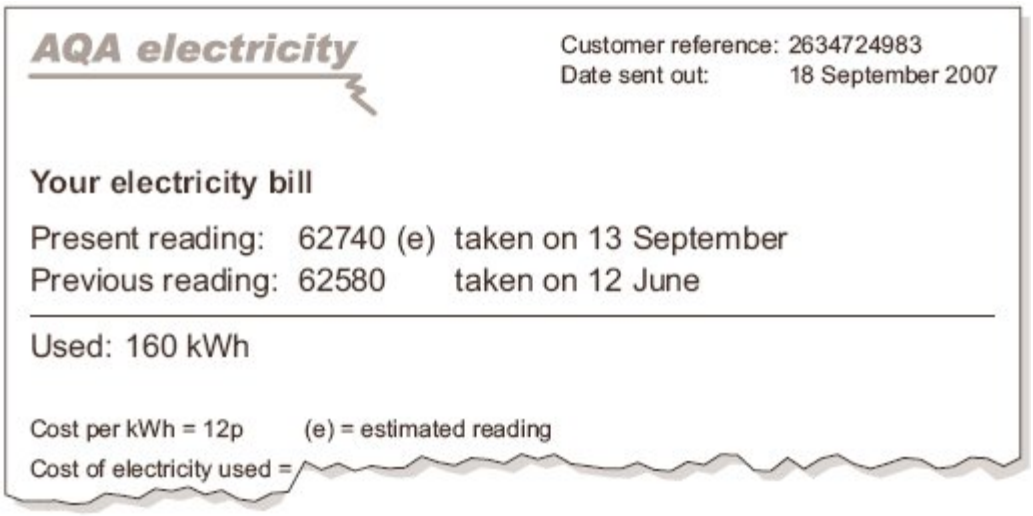
is more efficient than
has the same efficiency as
is less efficient than

fan heater **M**.

(1)

(Total 5 marks)

36 A householder was out shopping when her electricity meter reading should have been taken. The electricity company estimated the reading and sent the following bill. Unfortunately, the bill was damaged in the post.



AQA electricity

Customer reference: 2634724983
Date sent out: 18 September 2007

Your electricity bill

Present reading: 62740 (e) taken on 13 September
Previous reading: 62580 taken on 12 June

Used: 160 kWh

Cost per kWh = 12p (e) = estimated reading
Cost of electricity used =

(a) Use the equation in the box to calculate the cost of the electricity used between 12 June and 13 September.

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

Show clearly how you work out your answer.

.....

.....

Total cost = ...

(2)

(b) The estimated reading shown on the bill was not very accurate. The correct reading was 62920.

How many kilowatt-hours of electricity had the householder actually used between 12 June and 13 September?

.....

.....

(2)
(Total 4 marks)

37 (a) The picture shows a new washing machine.

Complete the following sentence using **one** of the words in the box.

kinetic	**light**	**sound**

A washing machine is designed to transform electrical energy into heat and

..... energy

(1)

(b) The instruction booklet for the washing machine contains the following information.

Wash cycle	Average power during cycle	Time taken to run cycle
HOT	1.5 kW	2 hours
COOL	1.1 kW	1½ hours
FAST	1.0 kW	¾ hour

(i) Use the following equation to calculate the energy transferred, in kilowatt-hours, to the washing machine during the HOT wash cycle. Show how you work out your answer.

energy transferred = power × time

.....

.....

Energy transferred = ... kWh

(2)

(ii) Why does it cost more to use the washing machine on the HOT cycle than on the COOL or FAST cycle?

.....

.....

(1)

(iii) Before buying a washing machine, a householder researched several makes to find out which washing machine was the most energy efficient.

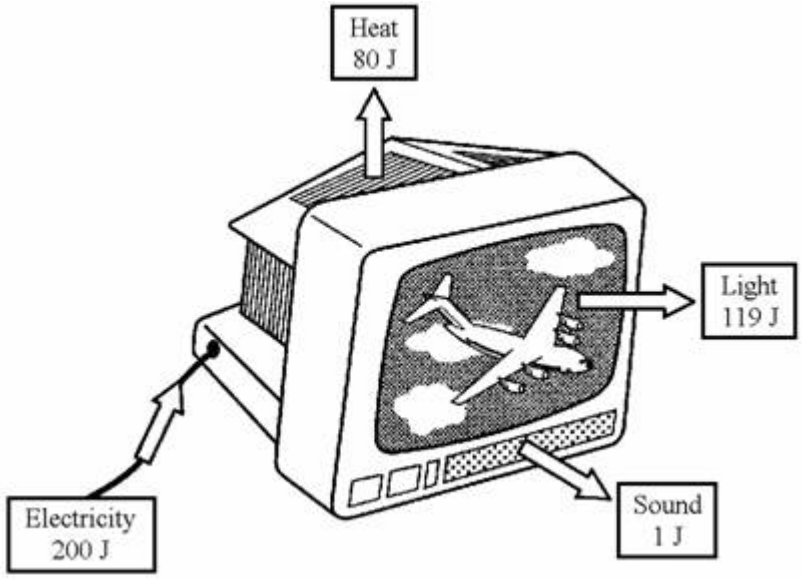
Write down **one** way that he could have done this research.

.....

.....

(1)
(Total 5 marks)

38 (a) The drawing shows the energy transferred each second by a television set.



(i) What form of energy is transferred as waste energy by the television set?

.....

(1)

(ii) What effect will the waste energy have on the air around the television set?

.....

(1)

(iii) Calculate the efficiency of the television set.

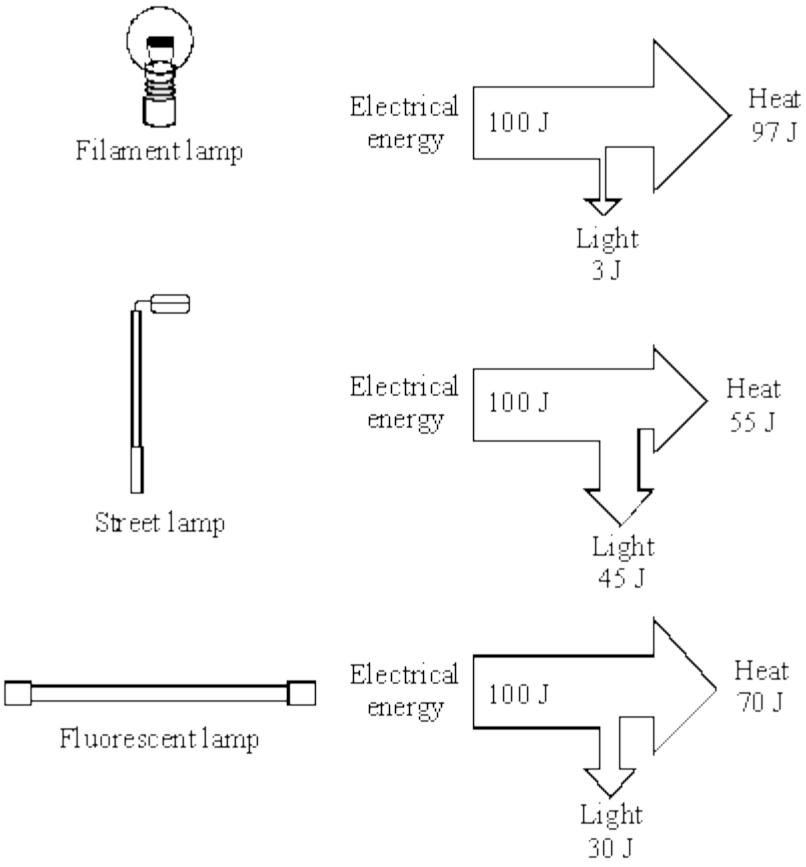
.....

.....

Efficiency = ...

(2)

(b) The diagrams show the energy transferred each second for three different types of lamp. For each lamp the electrical energy input each second is 100 joules.



Which type of lamp is the most efficient?

.....

Give a reason for your choice.

.....

.....

(2)
(Total 6 marks)

39 (a) List **A** shows three electrical devices. List **B** gives different forms of useful energy. Draw a straight line from each of the devices in List **A** to the useful energy form it produces in List **B**.Draw only **three** lines.

List A Device		List B Useful energy
Toaster		Light
Fan		Kinetic
Personal stereo		Sound
		Heat

(3)

(b) The power of each device is given in the table.

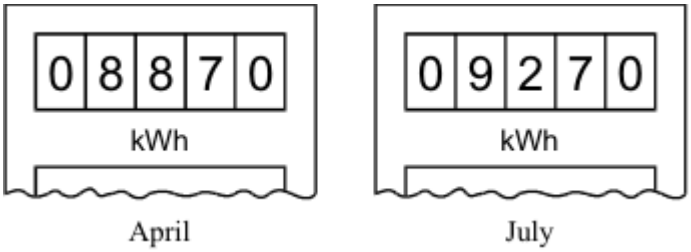
Device	**Power**
Toaster	1.2 kW
Fan	30 W
Personal Stereo	10 W

Which **one** of the devices will transfer the most energy in 10 minutes?

.....

(1)

(c) The diagrams show the readings on a domestic electricity meter in April and July.



(i) How many Units (kWh) of electricity were used between the two meter readings?

.....

.....

Number of Units = ...

(1)

(ii) One Unit costs 6p.

Use the following equation to calculate the cost of the electrical energy used between the two meter readings. Show clearly how you work out your answer.

total cost = number of Units × cost per Unit

.....

.....

Cost = ...

(2)

(d) A 3000 watt electric cooker is switched on for 2 hours.

Use the following equation to calculate the number of Units of energy transferred by the cooker. Show clearly how you work out your answer.

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

.....

.....

Energy transferred = ...kWh

(2)

(Total 9 marks)

40 (a) (i) Complete the sentence by choosing the correct word from the box.

electrons	neutrons	protons

An electric current is a flow of .....

(1)

(ii) What is the name and circuit symbol for the instrument used to measure electric current?

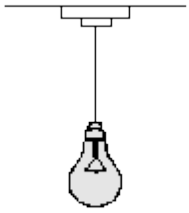
Name: .....

Symbol:

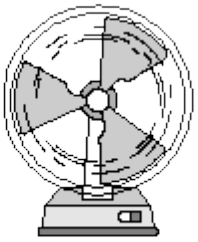
(2)

(b) When an electric current flows through a wire, the wire will get hot. **Two** of the following make use of this heating effect. Which **two**?

Microwave oven



Light bulb



Fan

Hairdryer

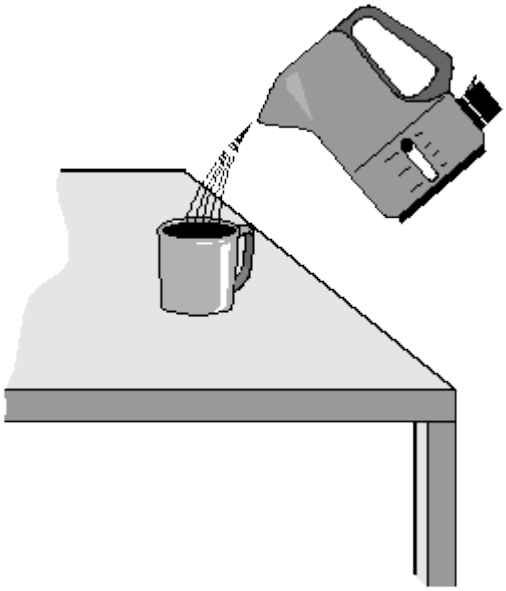
1. .....

2. .....

(2)

(Total 5 marks)

41 (a) The diagram shows hot water being poured into a mug.



(i) Complete the sentence by choosing the correct words from the box. Each word may be used once or not at all.

air	mug	table	water

Heat energy is being transferred from the ..... to

the ..... .

(1)

(ii) When will this transfer of heat energy stop?

.....

.....

(1)

(b) In the box are the names of four types of fuel used to heat homes.

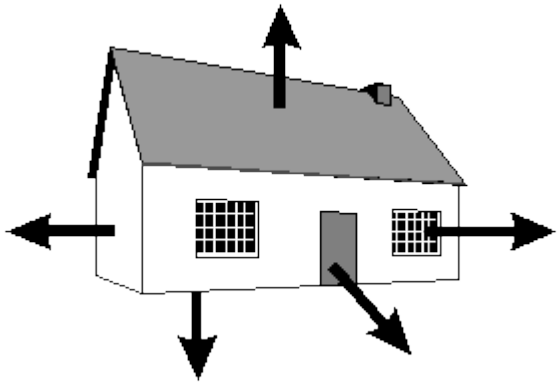
coal	gas	oil	wood

Which **one** of these types of fuel is renewable?

.....

(1)

(c) The diagram shows where heat energy is lost from a house.



(i) Complete the sentences by choosing the correct words from the box. Each word may be used once or not at all.

conduction	conductor	convection	electric	evaporation	insulator

The amount of heat energy lost through the windows by

..... can be reduced by using thick

curtains. The curtains trap a layer of air and air is a good

..... . The curtains will also stop

..... currents pulling cold air

into the room through small gaps in the window.

(3)

(ii) Write down **one** other way of reducing heat loss from a house.

.....

.....

(1)
(Total 7 marks)

42 There are many forms of energy. Some of these forms of energy can be "stored" ready to be used when the energy is needed. The chemical energy in fuels is one example of stored energy.

(a) Complete the following sentences by adding the missing words.

The chemical energy in fuels such as coal came originally from the ..... .

Energy from fuels can be used to ..... .

(2)

(b) An electric milk float has its batteries charged up overnight. Early in the morning the milkman sets off on his round. Describe the energy transfers which take place in the milk float as the milkman does his rounds.

.....

.....

.....

.....

.....

.....

(4)

(c) Give another example of energy other than fuels which can be classed as “stored” energy. Give a use of the “stored” energy.

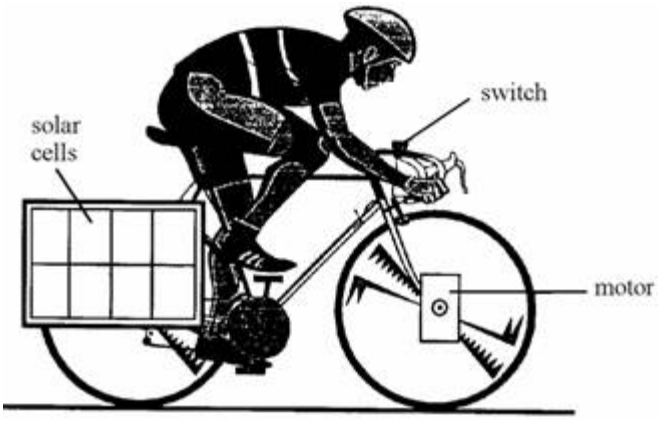
Type of “stored” energy .....

Use .....

.....

(2)
(Total 8 marks)

43 The diagram shows an experimental solar-powered bike.



A battery is connected to the solar cells.
The solar cells charge up the battery.
There is a switch on the handlebars.
When the switch is closed, the battery drives a motor attached to the front wheel.

(a) Use words from the list to complete the following sentences. Words may be used once, more than once, or not at all.

chemical **electrical** **heat (thermal)** **kinetic**

light **potential** **sound**

(i) The solar cells transfer ..... energy to ..... energy.

(ii) When the battery is being charged up, ... energy is

transferred to ..... energy.

(iii) The motor is designed to transfer ..... energy

to ..... energy.

(6)

(b) (i) The cyclist stops pedalling for 10 seconds. During this time the motor transfers 1500 joules of energy. Calculate the power of the motor.

.....

.....

Power ..... W

(2)

(ii) Name **one** form of wasted energy which is produced when the motor is running.

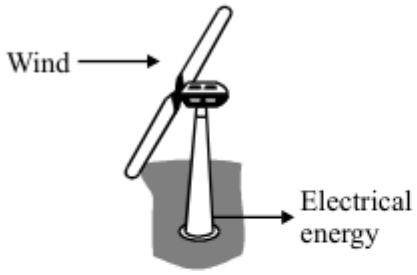
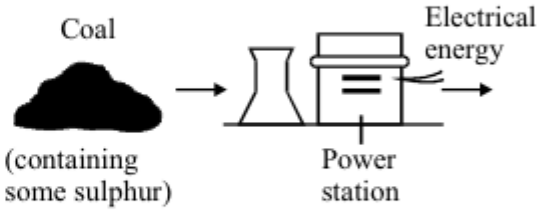
.....

(1)

(Total 9 marks)

44 Electricity is a useful form of energy.

(a) Different energy sources can be used to generate electricity.

Wind is an energy source	**Coal, a fossil fuel, is an energy source**
	
This wind turbine generates 1 MW. (1 MW = 1000 kW)	This coal-fired power station generates 1000 MW.
Electricity demand in the UK can be 48 000 MW.	

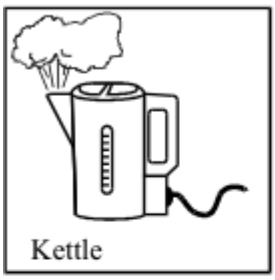
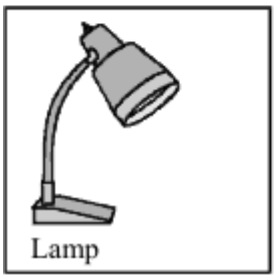
Give **one** advantage and **one** disadvantage (other than cost) of using each energy source to generate electricity in the UK.

Advantage	**Disadvantage**
Using wind	Using wind ....
Using coal	Using coal ....

(4)

(b) List **A** shows three electrical devices.
List **B** gives the type of useful energy transferred.

Draw a straight line from each electrical device in List **A** to the useful energy it transfers in List **B.**

List A	**List B**
Electrical device	**Useful energy transferred**
 Kettle	heat
 Radio	light
 Lamp	sound

(2)
(Total 6 marks)

45 (a) The student is using a microphone connected to a cathode ray oscilloscope (CRO).

The CRO displays the sound waves as waves on its screen. What does the microphone do?

.....

.....

.....

(2)

(b) The amplitude, the frequency and the wavelength of a sound wave can each be either increased or decreased.

(i) What change, or changes, would make the sound quieter?

.....

(1)

(ii) What change, or changes, would make the sound higher in pitch?

.....

(1)
(Total 4 marks)

Mark schemes

1

(a) current that is always in the same direction

1

(b) total resistance = 30 (Ω)

1

V = 0.4 × 30

1

12 (V)

1

*allow 12 (V) with no working shown for **3** marks*
*an answer of 8 (V) or 4 (V) gains **2** marks only*

(c) P = 0.4 × 12 = 4.8

1

5 (W)

1

*allow 5 (W) with no working shown for **2** marks*
*allow 4.8 (W) with no working shown for **1** mark*

[6]

2

(a) he may receive an electric shock

or

he may be electrocuted

1

if he touches the live wire

1

(b) 10 690 = I × 230

1

I = 10 690 / 230

1

46.478(260) (A)

1

46

1

*allow 46 (A) with no working shown for **4** marks*

(c) cost is higher

1

more energy is used (per second)

1

[8]

3 (a) (because the) potential of the live wire is 230 V

1

(and the) potential of the electrician is 0 V

1

(so there is a) large potential difference between live wire and electrician

1

charge / current passes through his body

allow voltage for potential difference

1

(b) diameter between 3.50 and 3.55 (mm)

*allow correct use of value of cross-sectional area of 9.5 to 9.9 (mm^2) with no final answer given for **1** mark*

2

(c) $18000 = I \times 300$

1

$I = 18000 / 300 = 60$

1

$13\ 800 = (60^2) \times R$

1

$R = 13\ 800 / 60^2$

1

3.83 (Ω)

1

*allow 3.83(Ω) with no working shown for **5** marks*

answer may also be correctly calculated using P = IV and V = IR if 230 V is used.

[11]

4 (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]

5 (a) advantage

any **one** from:

- produce no / little greenhouse gases / carbon dioxide

  allow produces no / little polluting gases

  allow doesn't contribute to global warming / climate change

  allow produce no acid rain / sulphur dioxide

  reference to atmospheric pollution is insufficient

  produce no harmful gases is insufficient
- high(er) energy density in fuel

  accept one nuclear power station produces as much power as several gas power stations

  nuclear power stations can supply a lot of or more energy is insufficient
- long(er) operating life

  allow saves using reserves of fossil fuels or gas

1

disadvantage

any **one** from:

- produce (long term) radioactive waste

  accept waste is toxic

  accept nuclear for radioactive
- accidents at nuclear power stations may have far reaching or long term consequences
- high(er) decommissioning costs

  accept high(er) building costs
- long(er) start up time

1

(b) (i) 12 000 (kWh)

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

2000 × 6

or

2 000 000 × 6

or

$$\frac{12\,000\,000}{1000}$$

*an answer of 12 000 000 scores **1** mark*

2

(ii) any idea of unreliability, eg

- wind is unreliable

  reference to weather alone is insufficient
- shut down if wind too strong / weak
- wind is variable

1

(c) any **one** from:

- cannot be seen
- no hazard to (low flying) aircraft / helicopters
- unlikely to be or not damaged / affected by (severe) weather

  unlikely to be damaged is insufficient
- (normally) no / reduced shock hazard

  safer is insufficient

  less maintenance is insufficient

  installed in urban areas is insufficient

1

[6]

6 (a) water moves (from a higher level to a lower level)

1

transferring GPE to KE

1

rotating a turbine to turn a generator

accept driving or turning or spinning for rotating

moving is insufficient

1

transferring KE to electrical energy

*transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers*

1

(b) (TVs in stand-by) use electricity

accept power / energy

1

generating electricity (from fossil fuels) produces CO_2

accept greenhouse gas

accept sulfur dioxide

1

(CO_2) contributes to global warming

accept climate change for global warming

accept greenhouse effect if CO_2 given

accept acid rain if linked to sulfur dioxide

1

(c) a factor other than scientific is given, eg economic, political or legal

personal choice is insufficient

1

[8]

7 (a) air near freezer compartment is cooled or loses energy

accept air at the top is cold

1

cool air is (more) dense or particles close(r) together (than warmer air)

*do **not** allow the particles get smaller / condense*

1

so (cooler) air falls

1

air (at bottom) is displaced / moves upwards / rises

*do **not** allow heat rises*

accept warm air (at the bottom) rises

1

(b) if volume is doubled, energy use is not doubled

or

volume ÷ energy not a constant ratio

1

correct reference to data, eg 500 is 2×250 but 630 not 2×300

1

(c) accept suitable examples, eg

advantage:

- reduces emissions into atmosphere
- lower input power or uses less energy or wastes less energy
- costs less to run

cost of buying or installing new fridge is insufficient

ignore reference to size of fridge

1

disadvantage:

- land fill
- energy waste in production
- cost or difficulty of disposal
- transport costs

1

[8]

8 (a) (i) 5.88 (watts)

*an answer of 5.9 scores **2** marks*

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

$0.42 = \frac{\text{power out}}{14}$

*allow **1** mark for an answer of 0.0588 or 0.059*

2

(ii) 8.12

allow 14 – their (a)(i) correctly calculated

1

(b) (i) input power / energy would be (much) less (reducing cost of running)

accept the converse

electricity is insufficient

1

(also) produce less waste energy / power

accept 'heat' for waste energy

1

(as the waste energy / power) increases temperature of the cabinet

1

so cooler on for less time

1

(ii) line graph

need to get both parts correct

accept scattergram or scatter graph

both variables are continuous

allow the data is continuous

1

(c) number of bulbs used-halogen=24 (LED=1)

1

total cost of LED = £30 + £67.20 = £97.20

accept a comparison of buying costs of halogen £36 and LED £30

1

total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420

or

buying cost of halogen is £36 **and** operating cost is £384

accept a comparison of operating costs of halogen £384 and LED £67.20

*allow for **3** marks the difference in total cost is £322.80 if the number 24 has not been credited*

1

statement based on correct calculations that overall LED is cheaper

*must be **both** buying **and** operating costs*

an alternative way of answering is in terms of cost per hour:

buying cost per hour for LED $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625

buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075

*a calculation of both buying costs scores **1** mark*

operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014

operating cost per hour for halogen= $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008

*a calculation of both operating costs scores **1** mark*

all calculations show a correct unit

***all** units correct scores **1** mark*

statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper

*correct statement scores **1** mark*

1

[12]

9 (a) water heated by radiation (from the Sun)

accept IR / energy for radiation

1

water used to heat buildings / provide hot water

*allow for **1** mark heat from the Sun heats water if no other marks given*

*references to photovoltaic cells / electricity scores **0** marks*

1

(b) 2 (minutes)

$1.4 \times 10^3 = \frac{168 \times 10^3}{t}$

*gains **1** mark*

*calculation of time of 120 (seconds) scores **2** marks*

3

(c) (i) 150 (kWh)

1

(ii) £60(.00) or 6000 (p)

*an answer of £6000 gains **1** mark*

*allow **1** mark for 150 × 0.4(0) 150 × 40*

*allow ecf from **(c)(i)***

2

(iii) 25 (years)

an answer of 6000 / 240
or
*6000 / their **(c)(ii)** × 4*
*gains **2** marks*

an answer of 6000 / 60
or
*6000 / their **(c)(ii)** gains **1** mark, ignore any other multiplier of **(c)(ii)***

3

(iv) any **one** from:

- will get £240 per year

  *accept value consistent with calculated value in **(c)(iii)***
- amount of light is constant throughout the year
- price per unit stays the same
- condition of cells does not deteriorate

1

(d) any **one** from:

- angle of tilt of cells
- cloud cover
- season / shade by trees
- amount of dirt

1

[13]

10 (a) (i) temperature (increase) and time switched on are directly proportional

accept the idea of equal increases in time giving equal increases in temperature

answers such as:

- *as time increases, temperature increases*
- *positive correlation*
- *linear relationship*
- *temperature and time are proportional*

*score **1** mark*

2

(ii) any **one** from:

"it" refers to the metal block

- energy transfer (from the block) to the surroundings

accept lost for transfer

accept air for surroundings

- (some) energy used to warm the heater / thermometer (itself)

accept takes time for heater to warm up

- (metal) block is not insulated

1

(iii) 15 000

*allow **1** mark for correct substitution, ie 50 × 300 provided no subsequent step shown*

2

(b) lead

reason only scores if lead is chosen

1

needs least energy to raise temperature by 1°C

accept needs less energy to heat it (by the same amount)
lowest specific heat capacity is insufficient

1

[7]

11 (a) (i) to obtain a range of p.d. values

accept increase / decrease current / p.d. / voltage / resistance

accept to change / control the current / p.d. / voltage / resistance

to provide resistance is insufficient

a variable resistor is insufficient

*do **not** accept electricity for current*

1

(ii) temperature of the bulb increases

accept bulb gets hot(ter)

accept answers correctly

expressed in terms of collisions between (free) electrons and ions / atoms

bulb gets brighter is insufficient

1

(iii) 36

*allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown*

2

watt(s) / W

accept joules per second / J/s

*do **not** accept w*

1

(b) 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, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)
There is a clear comparison of either the cost aspect or energy efficiency aspect
OR
a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)
There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy
  simply giving cost figures is insufficient
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency

- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

6

[11]

12 (a) iron

1

hairdryer

1

kettle

1

answers can be in any order

(b) (i) **Y**

1

(ii) bar drawn with any height greater than **Y**
ignore width of bar

1

(c) (bigger volume) takes more time (to boil)
accept explanation using data from graph

1

(so) more energy transferred

*do **not** accept electricity for energy*

1

(and) this costs more money

ignore reference to cost of water

wasting more money because heating more water than needed is insufficient

1

[8]

13 (a) £16.50

*allow **1** mark for correct substitution ie 110 × 15*

*an answer of 1650 gains **both** marks*

*an answer of 43.80 gains **both** marks*

*allow **1** mark for 292 × 15*

2

(b) 292

*allow **1** mark for correctly using the reading 53490*
ie 53782 – 53490

accept £43.80 for both marks

2

[4]

14 (a) (i) kinetic

*do **not** accept movement*

1

(ii) thermal sound

accept heat for thermal
*do **not** accept noise for sound*

***both** answers required in either order*

1

(b) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(c) (i) 3 (.0 p)

*allow **1** mark for correct substitution of correct values ie 0.2 x 15*

*allow **1** mark for calculating cost at 40°C (16.5p)*

or

cost at 30°C (13.5p)

2

(ii) any **two** from:

- less electricity needed

  ignore answers in terms of the washing machine releasing less energy
  an answer in terms of the washing machine releasing CO_2 negates mark
  *do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is burned

  accept a correctly named fuel
  *do **not** accept less fuel is needed*

2

[7]

15 (a) (i) conduction

1

convection

1

correct order only

(ii) to keep the ceramic bricks hot for a longer time

1

(b) (i) $E = P \times t$

18.2

*allow **1** mark for correct substitution ie 2.6 × 7 provided that no subsequent step is shown*

2

(ii) 91 (p)
or their (b)(i) × 5 correctly calculated

accept £0.91

*do **not** accept 0.91 without £ sign*

1

(c) $E = m \times c \times \theta$

2 250 000

*allow **1** mark for correct substitution ie 120 × 750 × 25 provided that no subsequent step is shown*

answers 2250 kJ or 2.25 MJ gain both marks

2

[8]

16 (a) $E = P \times t$

91 (p)

an answer £0.91 gains 3 marks

an answer 0.91 gains 2 marks

*allow **2** marks for energy transferred = 18.2 (kWh)*

or

substitution into 2 equations combined, ie 2.6 × 7 × 5

*allow **1** mark for correct substitution into E = P × t, ie E = 2.6 × 7*

or

*allow **1** mark for multiplying and correctly calculating an incorrect energy transfer value by 5*

3

(b) answers should be in terms of supply exceeding demand

accept there is a surplus / excess of electricity (at night)

1

(c) reduce (rate of) energy transfer (from ceramic bricks)

accept heat for energy

*do **not** accept no energy / heat escapes*

*do **not** accept answers in terms of lost / losing heat if this implies heat is wasted energy*

1

so keeping the (ceramic) bricks hot for longer

accept increase time that energy is transferred to the room

accept keep room warm for longer

or

to stop the casing getting too hot

accept so you do not get burnt (on the casing)

1

(d) $E = m \times c \times \theta$

120

*allow **1** mark for correct substitution*
ie 9 000 000 = m × 750 × 100

2

[8]

17 (a) (i) $\text{efficiency} = \frac{\text{useful energy out}}{\text{total energy in}} (\times 100\%)$

1.6 (W)

*allow **1** mark for correct substitution ie* $0.2 / \frac{20}{100} = \frac{\text{output}}{8}$

2

(ii) $\text{efficiency} = \frac{\text{useful energy out}}{\text{total energy in}} (\times 100\%)$

32 (%) / 0.32
or
their (a)(i) ÷ 5 correctly calculated
ignore any units

1

(b) (i) any **two** from:

- comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED
  accept an LED lasts 5 times longer
- link number of bulbs to cost eg 5 CFL's cheaper than 1 LED
  an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks
  an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks
- over the same period of time LEDs cost less to operate (than CFLs)

2

(ii) any **one** from:

- price of LED bulbs will drop
  *do **not** accept they become cheaper*
- less electricity needs to be generated
  accept we will use less electricity
- less CO_2 produced
- fewer chips needed (for each LED bulb)
- fewer bulbs required (for same brightness / light)
- less energy wasted
  *do **not** accept electricity for energy*

1

[6]

18 (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

[6]

19 (a) (i) food processor
hairdryer
both required and no other
either order

1

(ii) TV
Table lamp
Food processor
all required and no other
any order

1

(b) any **two** from:

- transfers / requires / uses more energy / power
  accept more electricity used
  accept higher power
- more electricity needs to be generated
- more (fossil) fuels (likely) to be burnt
  accept a named fossil fuel

2

(c) (i) precise
this answer only

1

(ii) any **three** from:

- can look for trends / patterns
- help reduce energy use / consumption
- reduce bills
  accept save money
- identify appliances which use a lot of energy
- replace appliances with more efficient ones
- see effect of leaving appliances on (standby)
  to monitor usage is insufficient
  answers in terms of environment are insufficient

3

[8]

20 (a) fan

1

drill

1

washing machine

*four circled including correct three scores **1** mark*

five circled scores zero

1

(b) Appliances only transfer part of the energy usefully

1

The energy transferred by appliances makes the surroundings warmer

1

[5]

21 (a) (i) A

1

(ii) bar drawn with correct height

ignore width of bar

1

(b) (i) $E = P \times t$

2.4

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

ie 1.2×2

provided no subsequent step shown

2

(ii) 36 or their (b)(i) × 15 correctly calculated

or

their (b)(i) × 0.15 correctly calculated with an answer given in £

*allow **1** mark for correct substitution*
ie 2.4 × 15

or
their (b)(i) × 15
*allow **1** mark for correct substitution*
provided no subsequent step shown
an answer £0.36 gains both marks

2

[6]

22 (a) electric current
(rate of) flow of (electric) charge / electrons

accept $I = \frac{Q}{t}$

with Q and t correctly named

1

potential difference
work done / energy transferred per coulomb of charge
(that passes between two points in a circuit)

accept $V = \frac{W}{Q}$

with W and Q correctly named

1

(b) metals contain free electrons (and ions)

accept mobile for free

1

as temperature of filament increases ions vibrate faster /
with a bigger amplitude

accept atoms for ions

accept ions/atoms gain energy

accept vibrate more for vibrate faster

do not accept start to vibrate

1

electrons collide more (frequently) with the ions
or
(drift) velocity of electrons decreases

do not accept start to collide

*accept increasing the p.d. increases the temperature (**1** mark)*

and

*(and) resistance increases with temperature (**1** mark) if no other marks scored*

1

(c) 7.8

*allow **1** mark for obtaining value 1.3 from graph*

***or** allow **1** mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive*

2

[7]

23 Fan C

1

Kettle B

1

Lamp D

1

Radio E

1

[4]

24 (a) (i) 7.6

*allow **1** mark for correct substitution and / or transformation*

ie $0.95 = \frac{x}{8}$

95 × 8.0

2

(ii) 25 (hours)

*allow **1** mark for obtaining number of kWh = 200*

an answer of 26(.3) gains both marks

2

(b) any **two** from

- transferred to the surroundings / air / atmosphere
- becomes spread out
- shared between (many) molecules
- (wasted as) heat / sound

2

[6]

25 (a) radio

radio must be chosen for reason to score

1

gives out sound

inclusion of other forms of energy negates mark

or

others give out heat / thermal energy

1

(b) Kettle

accept 2.5 (kW)

1

(c) 60 (p)

accept £0.6(0)

*allow **1** mark for correct substitution ie 4 × 15*

substitution only scores if no subsequent step shown

*£60 scores **1** mark*

2

(d) (bigger volume) takes more time (to boil)

accept explanation using data from graph

1

(so) more energy transferred

*do **not** accept electricity for energy*

1

(and) this costs more money

ignore references to cost of water

1

[8]

26 (a) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(b) a smaller <u>proportion / percentage</u> of the energy supplied is wasted

owtte

*accept a statement such as 'less energy is wasted' for **1** mark*

*do **not** accept costs less to run*

ignore references to uses less energy

2

(c) (i) 2.4 (p)

accept 2 p if it is clear from the working out this is rounded from 2.4 p

*allow **1** mark for correct substitution of correct values*

ie 0.2 × 12

*allow **1** mark for calculating cost at 40 °C (13.2 p)*

or

cost at 30 °C (10.8 p)

2

(ii) any **one** from:

- less electricity needed

  ignore answers in terms of the washing machine releasing less energy

  an answer in terms of the washing machine releasing CO_2 negates the mark

  *do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is <u>burned</u>

  accept a correctly named fuel

  *do **not** accept less fuel is needed*

1

[6]

27 (a) each hair gains the same (type of) charge

or

(each) hair is negatively charged

*do **not** accept hair becomes positively charged*

or

(each) hair gains electrons

1

similar charges repel

accept positive charges repel

providing first marking point is in terms of positive charge

or

negative charges repel

or

electrons repel

1

(b) 0.000002

*accept correct substitution and transformation for **1** mark*

or

2×10^{-6}

ie 30 / 15 or .03 / 15000 or 30 / 15000 or .03 / 15

or

2 μ C

*answers 2 and 0.002 gain **1** mark*

2

(c) current

*do **not** accept amp / amperes*

1

[5]

28 (a) (i) 2(.0)

accept 2000 W or 2000 watt(s)

accept answer given in table

*do **not** accept 2000*

1

(ii) 4.5

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

ie 1.5 × 3

*allow **1** mark for the answers 1.5 or 6(.0)*

2

(iii) 54

or

their (a)(ii) × 12 correctly calculated

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

ie 4.5 × 12

or

their (a)(ii) × 12

*allow **1** mark if correct answer is given in pounds eg £54*

2

(b) (i) 6 pm

1

temperature starts to rise faster

only scores if 6 pm given

or

graph (line) is steeper / steepest

it refers to graph gradient or temperature

accept answers in terms of relative temperature rise

eg 5 to 6 pm 2 °C rise, 6 to 7 pm 6 °C rise

accept temperature rises sharply / rapidly / quickly

*do **not** accept temperature starts to rise*

1

(ii) middle box ticked

1

[8]

29 (a) 32,400,00 J

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

$3.24 \times 10^{\wedge 7\ J}$

2

(b) (3kW) fan heater

accept 3kW

accept the middle one

1

(c)

features common to more than one heater, treat as neutral

<u>oil-filled</u>

low level heat

cannot be knocked over / space saving / no trailing wires

*do **not** accept just wall-mounted*

or more control over heat output

*do **not** accept just 3 heat settings*

1

<u>fan</u>

warms (office) rapidly **or** can be used to cool air (in summer)

accept can be used as a fan

accept cool air fan (setting)

accept 'it has a cool air setting in case it gets too hot'

*do **not** accept a specific reference to cooling the heater*

1

<u>ceramic</u>

can be switched on for set periods of time

*do **not** accept just has a timer*

or can be switched on before office is used / switched off automatically at night

1

[6]

30 (a) electrical

1

sound

correct order only

1

(b) the energy transformed by the TV will be destroyed

1

(c) a higher efficiency than

1

[4]

31 (a) (i) France

1

(ii) any **one** from:

- different homes have different appliances(*)
- different homes have different numbers of appliances(*)

  (*) accept all homes are different
- standby power not the same for all appliances
- some people will switch appliances off

  accept named appliances
  accept people waste different amounts of energy
- homes have different numbers of residents
- can't measure every (individual) home

  accept any sensible suggestions

  *do **not** accept answers in terms of accurate / precise etc*

1

(b) (i) increases amount of energy wasted

accept (encourages) people to leave appliances on (standby)
accept increases it

1

(ii) any **two** from:

- less electricity needed / generated
- fewer power stations needed
- less coal is burned

  *do **not** accept coal is non-renewable / running out*

  answers in terms of fuel stocks neutral
- less pollutant gases produced

  accept named gases
  accept harmful for pollutant
  accept greenhouse gases
  accept reduce / slow / stop global warming
  accept reduces acid rain

2

(c) joule

1

(d) (i) 6800

*accept £68 for **3** marks an answer of 68 gains **2** marks*

*allow **2** marks for correct substitution ie 400 × 17*
*allow **1** mark for obtaining 400*

*answers of 7480, 4760, 12920, 4080 gain **2** marks*

3

(ii) a small . . . . . electricity

1

[10]

32 (a) (i) 0.6

accept 60 %
*allow **1** mark for useful energy = 480*
*answer 0.6 with any unit or 60 gains **1** mark only*

2

(ii) transferred to surroundings

accept goes into the air
accept heats the surroundings up
accept gets spread out
accept transferred into heat (only)

*do **not** accept wasted / lost unless qualified*
destroyed negates mark
transferred into light / sound negates mark

1

(b) (i) 1.75

*allow **1** mark for converting to kW*

*answers of 0.7, 0.525, 0.35, 0.875, 1.05, 5.25 gains **1** mark*
*answers of 1750 or 17.5 gains **1** mark*

2

(ii) 21p or £0.21 or their (b)(i) × 12

1

(c) any **two** from:

- (more) electricity needs to be generated
  (more) electricity is being used
- (more) power stations needed
- (more) fossil fuels burnt
  accept named fossil fuel
- (more) pollutant gases emitted
  accept named gas
  accept harmful for pollutant
  accept greenhouse gases
  accept atmospheric pollution
  accept answer in terms of any form of electricity generation and an associated environmental problem

2

[8]

33 (a) electric drill **C**

1

MP3 player **E**

1

toaster **B**

1

(b) (i) 2100
no unit required / ignore units
accept 2.1 kW must have units for this

1

(ii) **Y**

1

(iii) bar drawn with any height greater than **Y**
ignore width of bar

1

(c) (i) any **one** from:

answers must be a comparison

- holds more water
  *do **not** accept 1 litre of water on its own*
- works in other countries
  accept a named country
  accept works at 2 voltages
- boils faster
- has a more powerful element
  *do **not** accept 1 kW element on its own*
- can filter water

ignore can wash filter

1

(ii) any **one** from:

- it weighs less
- smaller to pack
- cheaper to use

answers must be a comparison
***or** state why the chosen feature is an advantage*
accept boils enough for one drink

1

[8]

34 (a) £15

*allow **1** mark for use of 125 (kWh)*
*allow **1** mark for an answer 1500*
*allow **both** marks for 1500 pence / p*
*allow **1** mark for correct calculation of annual cost for either freezer (£27 and £42)*

2

(b) £45

or their (a) × 3

*allow **1** mark for correct use of 3*
*allow **1** mark for 12 – 9 = 3*

2

(c) any **two** from:

the marks are for the explanation

yes **plus** explanation

- less electricity / energy needed / used

  accept less energy wasted

- less (fossil) fuels burned

  accept a named fossil fuel
  *do **not** accept conserving (fossil) fuels*

- less polluting gases emitted

  accept a named polluting gas / greenhouse gases / carbon emissions / reduce global warming
  accept an answer in terms of nuclear fuel
  eg less nuclear fuel required (1)
  less nuclear waste (1)

2

or no **plus** explanation

- old freezer must be disposed of
- hazardous chemicals inside freezer

  accept CFC gases

- *(*lot of*)* energy used in producing new freezer

[6]

35 (a) iron

1

hairdryer

1

kettle

answers can be in any order

1

(b) sound

1

(c) is more efficient than

1

[5]

36 (a) £19.20

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

ie 160 × 12

*allow **1** mark for an answer (£)1920*

*an answer of 1920p gains **both** marks*

*an answer of £40.80 gains **both** marks*

*allow **1** mark for 340 × 12*

2

(b) 340

*allow **1** mark for correctly using the reading 62580*

ie 62920 − 62580

*accept £40.80 for **both** marks*

2

[4]

37 (a) kinetic

accept movement

1

(b) (i) 3 (kWh)

allow 1 mark for selecting the correct information

1

(ii) transfers more energy

accept transform or use for transfer

accept electricity for energy

*allow higher (average) power **and** switched on for more time*

2

(iii) any **one** from:

- use the internet
- brochures
- reading adverts
- visiting shops
- recommendation from friends / plumbers

1

[5]

38 (a) (i) heat

1

(ii) temperature increases **or** (cause) convection (currents)

accept gets warmer
accept gets hotter

1

(iii) 60% **or** 0.6

60 without % scores 1 mark
0.6 with a unit scores 1 mark
60 with incorrect unit scores 1 mark

or correct substitution $\frac{120}{200}$
for 1 mark

2

(b) street

1

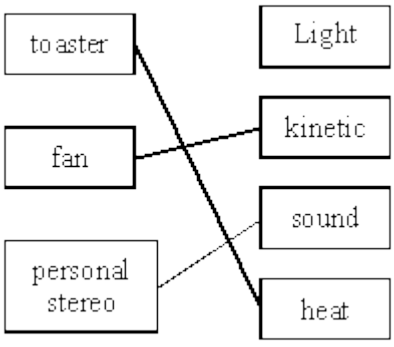
more (energy transferred as) light or less (energy transferred as) heat or useful energy output the highest

can only score this mark if first mark scored
all efficiencies calculated correctly score 2nd mark point

1

[6]

39 (a) each correct line scores 1 mark



if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines

3

(b) toaster

accept 1.2 kW

1

(c) (i) 400

1

(ii) £24 or 2400p

full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit
an answer of 24 or 2400 with no unit or the incorrect unit scores 1 mark
(c)(i) × 6 incorrectly evaluated scores 1 mark

2

(d) 6

allow 6000 for 1 mark
allow 3 × 2 for 1 mark

2

[9]

40 (a) (i) electrons

1

(ii) ammeter

*do **not** accept ampmeter*

1

***must** be capital A*
horizontal lines not required no e.c.f.

1

(b) light bulb

answers in either order

1

hairdryer

1

[5]

41 (a) (i) any **one** from:

water to the mug
water to the air
mug to the air
mug to the table

***both** required*

direction of transfer must be correct

1

(ii) when <u>temperatures</u> are the same

accept a specific example eg when the <u>temperature</u> of the water and mug are the same

accept radiant heat transfer will never stop

1

(b) wood

1

(c) (i) conduction

accept convection if not given as 3rd answer

1

insulator

1

convection

1

(ii) any **one** from:

*do **not** accept any rebuilding of house*

double glazing

loft insulation

accept roof for loft

1

carpets

(cavity) wall insulation

*do **not** accept closing doors and windows*

draft excluders

foil behind radiators

accept blocking chimney

paint inside walls white

[7]

42 (a) Sun
Any valid

for 1 mark each

2

(b) From electric/pe or chemical in battery

for 1 mark

to ke, light, sound, heat

3 for 1 mark each

4

(c) Gravitational pe OR just pe
For any gravity feed
OR Elastic pe
any valid
OR Food
For maintaining body/life etc.
OR Any descriptive answer
e.g. water in a high lake used to produce hydroelectric power

2 for 1 mark each

2

[8]

43 (a) (i) ……. light …… electri

2

for 1 mark each

(ii) ……. electrical……chemi

for 1 mark each

2

(iii) ……. electrical ….. kinet

for 1 mark each

2

(b) (i) 1500 / 10

gains 1 mark

1

but
150

gains 2 marks

1

(ii) heat (thermal) or sound

for 1 mark

1

[9]

44 (a) **Using wind (advantage)**

any **one** from

can be used in remote locations

renewable

clean

accept does not cause pollution to the air / land

1

Using wind (disadvantage)

any **one** from

does not generate much (electrical) energy
many hundreds wind turbines would be needed

*accept many hundreds wind turbines would be needed **or** too much land would be needed for wind farms **or** wind energy is 'dilute'*

the wind is unreliable

*accept the wind does not blow all of the time **or** the wind is not always strong enough*

noise / visual pollution

*do **not** accept just the word pollution*

1

Using coal (advantage)

any **one** from

can generate electricity all of the time

accept reliable electrical / energy supply

generates a lot of (electrical) energy

1

Using coal (disadvantage)

any **one** from

pollution by carbon dioxide / greenhouse gas

*accept slow start-up time **or** production of ash **or** difficult to transport (coal) **or** there's not much coal left*

non renewable

pollution by sulphur dioxide acid rain

1

(b) all link lines correct

accept one link line correct for one mark

2

[6]

45 (a) changes the sound wave(s)

to a varying **or** changing (electric) potential difference **or** p.d. **or** voltage **or** current **or** to an irregular alternating current or a.c. **or** transfers sound energy to electrical energy (1) mark is vibrations **or** pulses **or** of sound **or** in air become electrical waves

*do not credit just 'to electricity' **or** 'to a.c'*

2

(b) (i) decrease **or** reduce the amplitude

accept less amplitude nothing else added

1

(ii) increase the frequency **or** decrease wavelength

accept higher frequency nothing else added

1

[4]