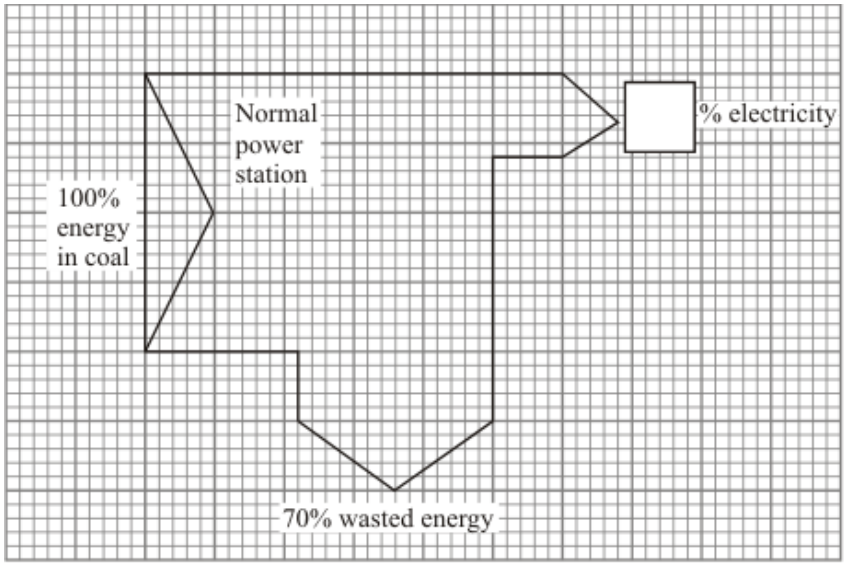
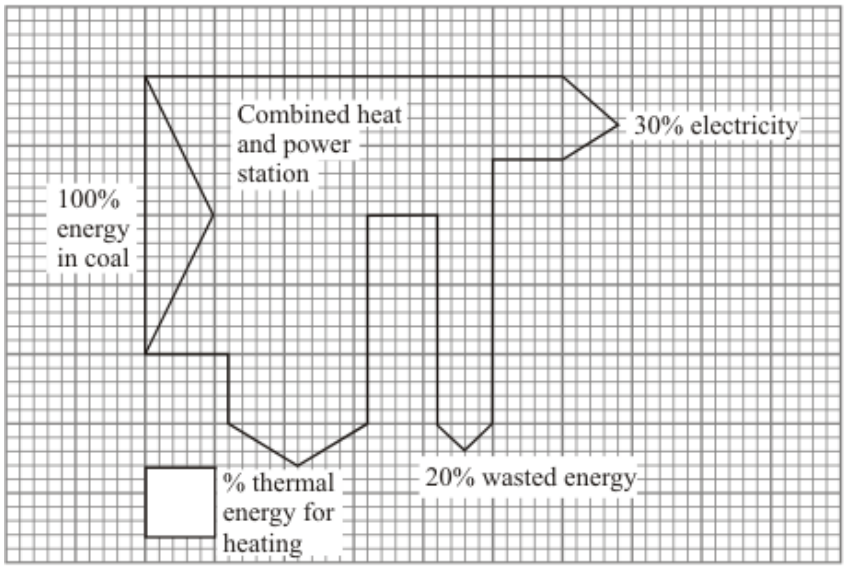
Q1. Power stations are usually not very efficient. A lot of energy is wasted as thermal energy. The diagrams show the percentage of energy transferred by two coal-burning power stations.





(a) Write the **two** missing figures in the boxes on the diagrams.

(2)

(b) Which power station is the most efficient **overall**, the normal power station or the combined heat and power station? Give reasons for your answer.

.....

.....

.....

.....

(2)

(c) Some heat energy released from burning coal on an open fire is emitted by radiation. Tick (✓) the main type of electromagnetic radiation emitted by hot coal.

Type of electromagnetic radiation	Tick (✓)
gamma	
infra red	
ultraviolet	
X-ray	

(1)

(d) Radiation can be reflected or absorbed when it strikes a surface. What type of surface is a poor reflector but a good absorber of radiation?

.....

.....

(1)

(Total 6 marks)

Q2. Complete the following sentences.

A TV set is designed to transfer electrical energy into .....

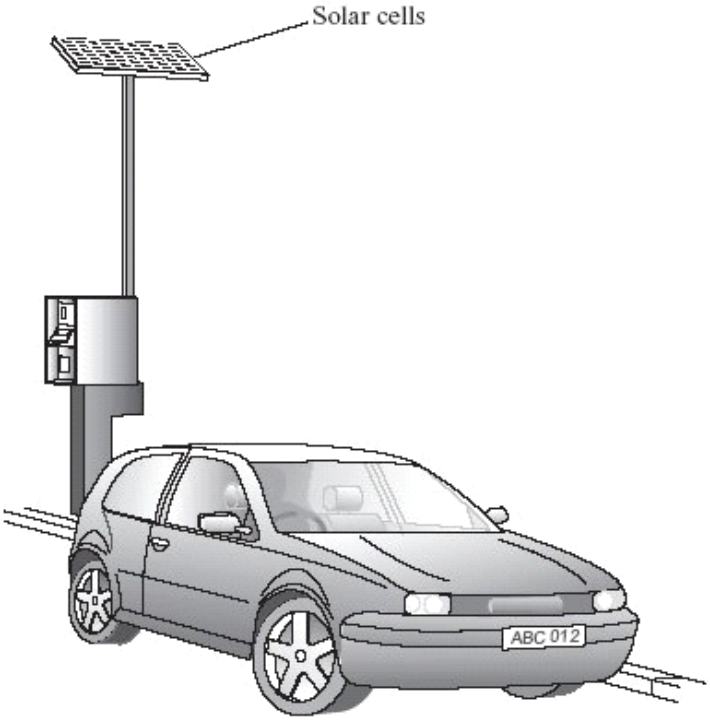
energy and ..... energy.

A hair dryer is designed to transfer electrical energy into .....

energy and ..... energy.

(Total 4 marks)

Q3. A castle is a long way from the nearest town. Batteries power the car park ticket machine. Solar cells are used to keep the batteries charged.



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

chemical	**electrical**	**heat**	**light**	**sound**

(i) The energy input to the solar cells is ..... energy.

(1)

(ii) The useful energy output from the solar cells is ..... energy.

(1)

(b) For every 500 J of energy absorbed by the solar cells, 75 J of energy are transferred to the batteries.

Use the following equation to calculate the efficiency of the solar cells. Show clearly how you work out your answer.

$$\text{Efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

.....

.....

Efficiency = ……

(2)

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

Tick (✓) the box next to your choice.

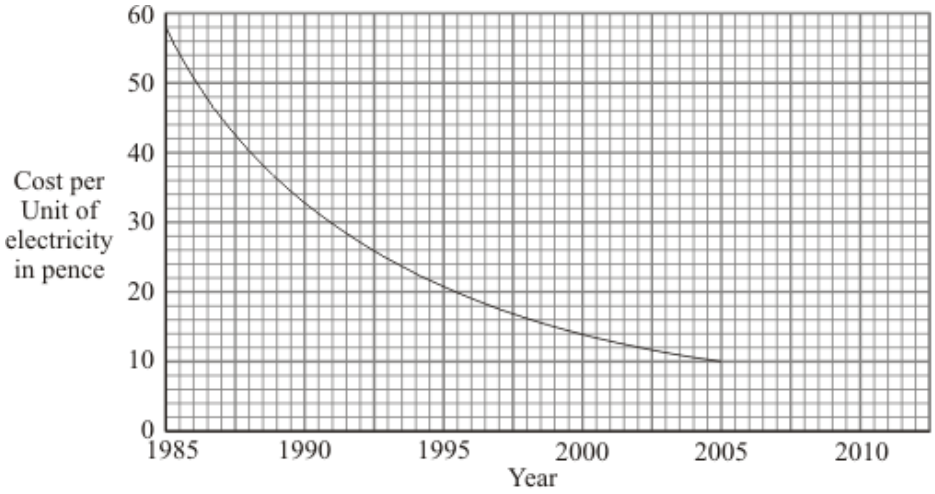
Solar cells give a constant supply of electricity. ☐

A few solar cells can provide a large amount of electricity. ☐

The ticket machine is a long way from other electricity supplies. ☐

(1)

(d) The graph shows how the cost of producing electricity using solar cells has changed.



Use the graph to predict the cost of one Unit of electricity in 2010.

.....

(1)

(Total 6 marks)

##

(a) In Britain most power stations burn fuel to produce heat. The diagram shows the stages by which the heat is transferred into electrical energy.
Complete the diagram by filling in the missing word.

Water heated to produce steam	→	Steam turns a turbine	→	Turbine turns a coil in a	→	Electricity is produced

(1)

(b) A fuel burning power station uses 2000 joules of fuel energy to generate 600 joules of electrical energy. The rest of the fuel energy is wasted as heat.

(i) For every 600 joules of electrical energy generated, how much fuel energy is wasted as heat?

.....

.....

(1)

(ii) Use the following equation to calculate the efficiency of the power station. Show clearly how you work out your answer.

$$\text{efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

.....

.....

efficiency = ...

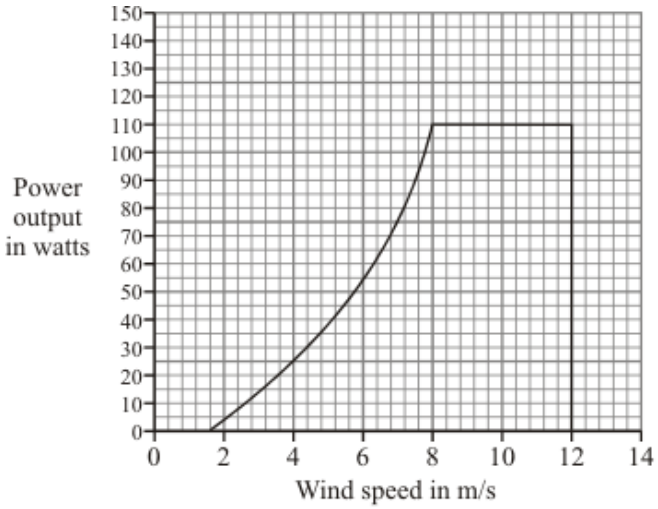
(2)

(c) List **A** gives three energy resources used to generate electricity. List **B** gives environmental problems that may be caused by using different energy resources. Draw a straight line from each energy resource in List **A** to the environmental problem it may cause in List **B**. Draw **three** lines only.

List A **Energy resource**	**List B** **Environmental problem that may be caused**
Wind	Destroys the habitat of wading birds in river estuaries
	Produces a lot of noise
Tides	
	Produces the gas sulphur dioxide
Falling water (hydroelectricity)	
	Floods land used for farming or forestry

(3)

(d) A small wind generator is used to charge a battery. The graph shows the power output of the generator at different wind speeds.



(i) What is the maximum power produced by the generator?

..... watts

(1)

(ii) The generator is designed to stop if the wind speed is too high.

At what wind speed does the generator stop working?

..... m/s

(1)

(iii) Give **one** disadvantage of using a wind generator to charge a battery.

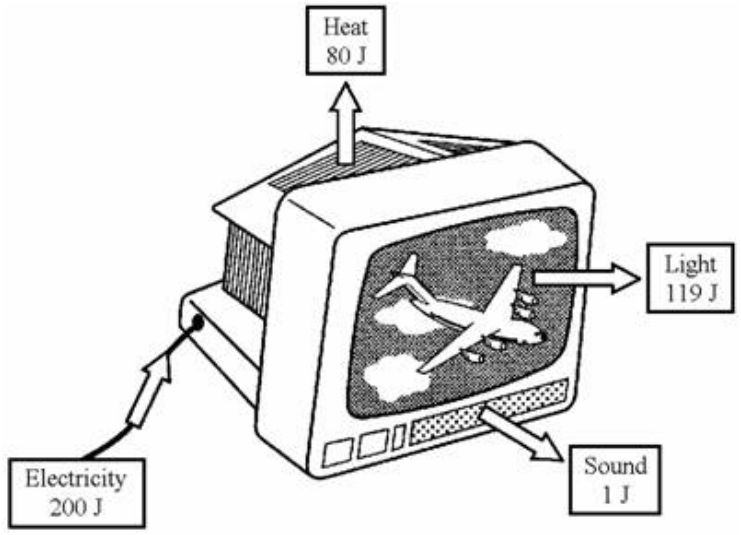
.....

.....

(1)

(Total 10 marks)

Q5. (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) Use the following equation to calculate the efficiency of the television set.

$$\text{efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

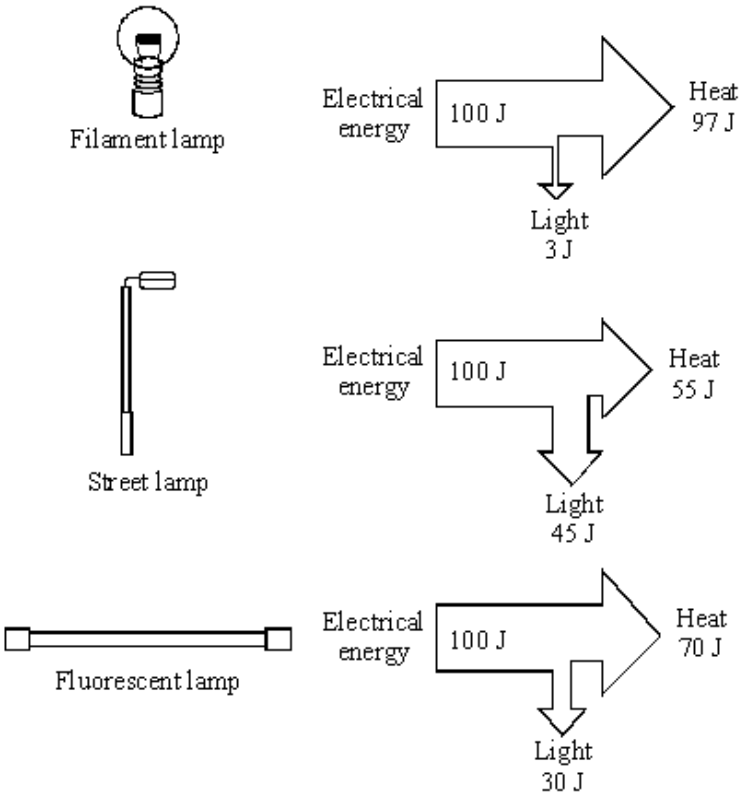
.....

.....

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.

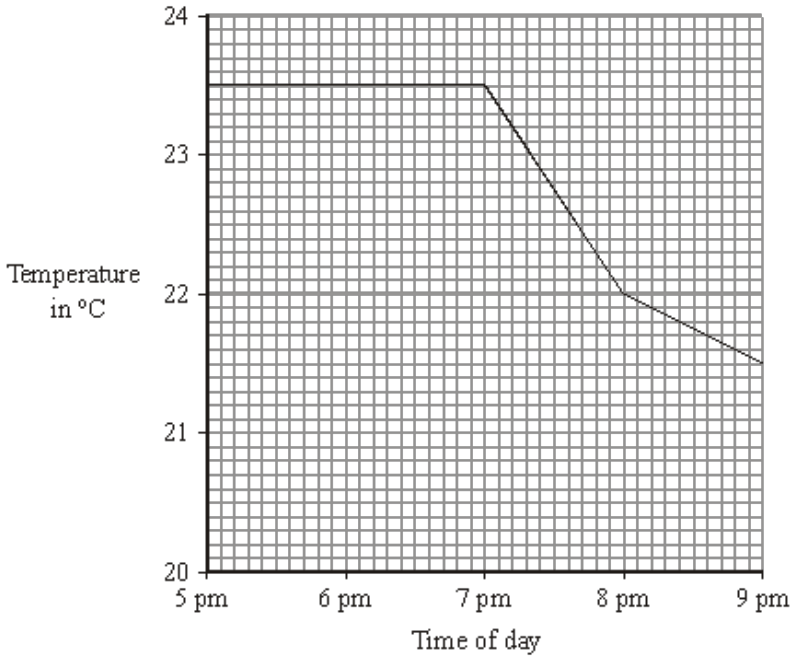
.....

.....

(2)

(Total 6 marks)

Q6. (a) The graph shows the temperature inside a flat between 5 pm and 9 pm. The central heating was on at 5 pm.



(i) What time did the central heating switch off?

.....

(1)

(ii) Closing the curtains reduces heat loss from the flat.

What time do you think the curtains were closed?

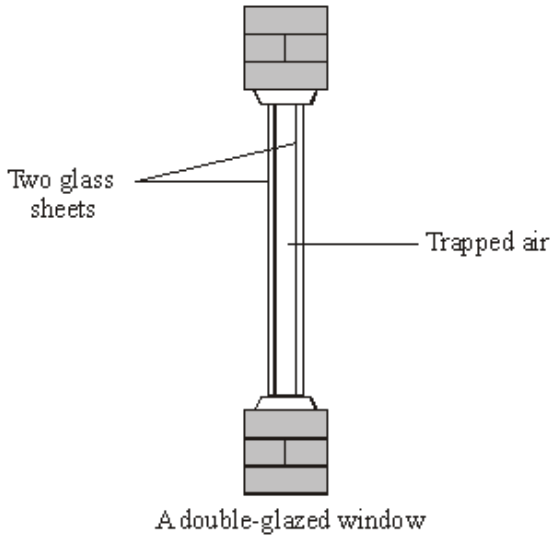
.....

Give a reason for your answer.

.....

(2)

(b) Less heat is lost through double-glazed windows than through single-glazed windows.



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

conduction	**conductor**	**convection**	**evaporation**	**insulator**	**radiation**

Air is a good ..... . When trapped between two sheets of glass it reduces heat loss by ..... and .....

(3)

(c) The table gives information about three types of house insulation.

Type of insulation	Cost to install	Money save each year on heating bills	Payback time
Double glazing	£4000	£200	20 years
Loft insulation	£300	£100	3 years
Cavity wall insulation	£600	£150	

(i) Use the information in the table to calculate the payback time for cavity wall insulation.

.....

(1)

(ii) Explain why people often install loft insulation before installing double glazing or cavity wall insulation.

.....

.....

.....

.....

(2)

(Total 9 marks)

Q7. (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.

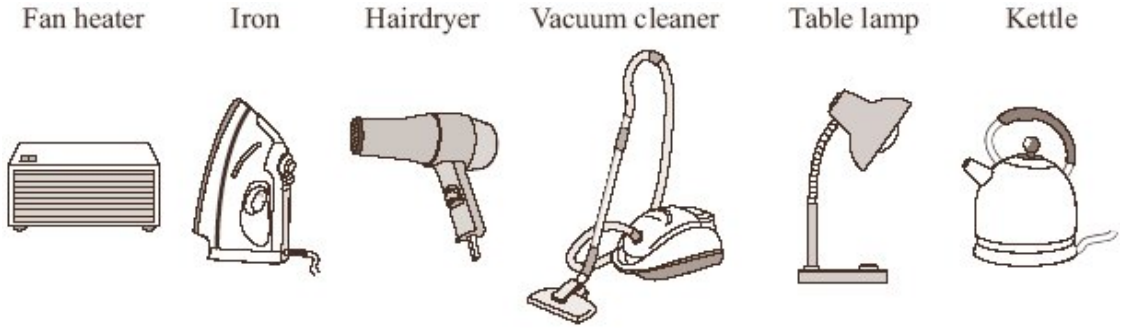
.....

.....

(1)

(Total 5 marks)

Q8. 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.

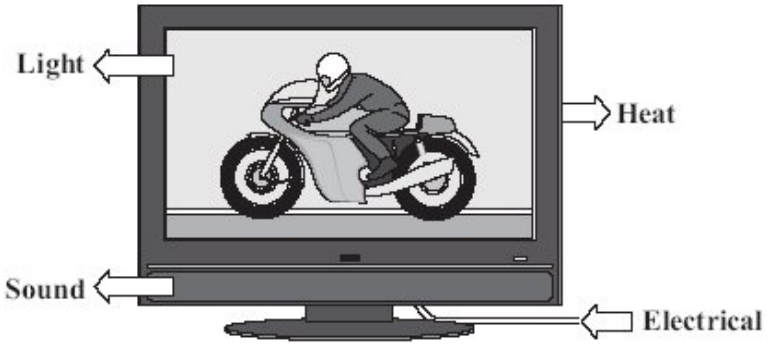
Fan heater **L**

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

fan heater **M**.

(1)
(Total 5 marks)

Q9. 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)

Q10. The picture shows a solar-powered aircraft. The aircraft has no pilot.

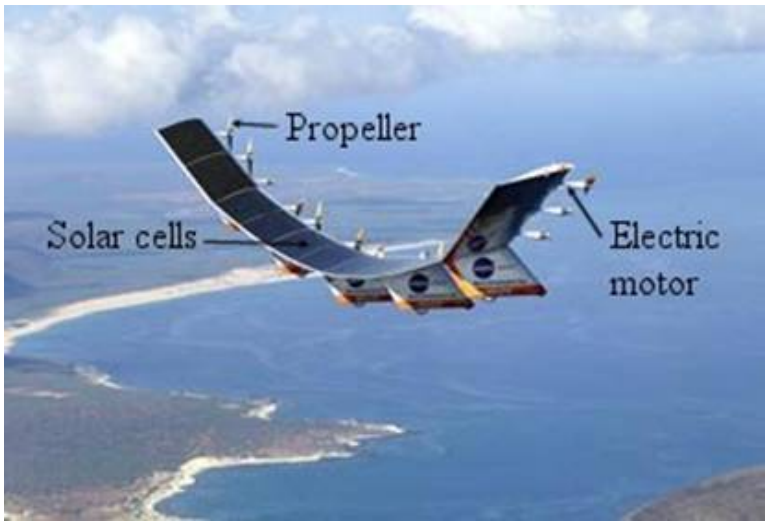


Photo by NASA.

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

electrical	**heat**	**light**	**sound**

Solar cells are designed to transform ..... energy into

..... energy.

(2)

(b) On a summer day, 175 000 joules of energy are supplied to the aircraft's solar cells every second. The useful energy transferred by the solar cells is 35 000 joules every second.

(i) Use the equation in the box to calculate the efficiency of the solar cells.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(ii) What happens to the energy that is **not** usefully transferred by the solar cells?

.....

(1)

(c) The aircraft propellers are driven by electric motors. As well as the solar cells, there are fuel cells that provide additional power to the electric motors.

(i) Suggest **one** advantage of the aircraft having fuel cells as well as the solar cells.

.....

(1)

(ii) Give **one** environmental advantage of using electric motors to drive the aircraft propellers rather than motors that burn a fuel.

.....

.....

(1)

(iii) Eventually, the designers want to produce an unmanned aircraft that can fly at twice the height of a passenger jet for up to six months.

Suggest **one** possible use for an aircraft such as this.

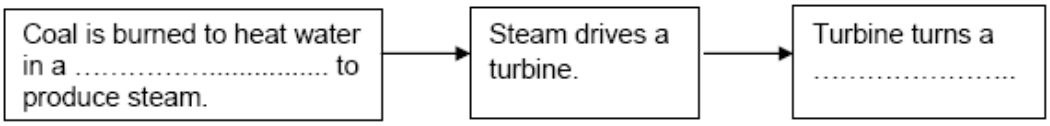
.....

.....

(1)

(Total 8 marks)

Q11. (a) The block diagram shows the important parts of a coal burning power station.

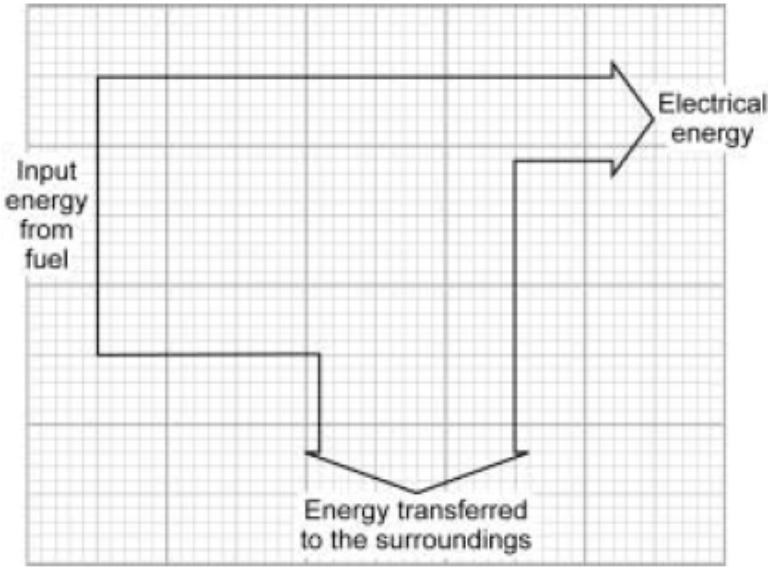


Use words from the box to complete the block diagram

boiler	**condenser**	**furnace**	**generator**

(2)

(b) The diagram shows the energy transformations in a coal burning power station.



Calculate the efficiency of the power station.
Write down the equation you use, and then show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(2)

(c) Draw a ring around the correct answer to complete the following sentence.

If fewer coal burning power stations are used to generate electricity the amount of

carbon dioxide emitted into the atmosphere will

decrease.
not change.
increase.

(1)

(d) Some types of power station generate electricity by burning a biofuel.

Give **one** example of a biofuel.

.....

(1)

(e) Nuclear power stations generate electricity without burning a fuel.

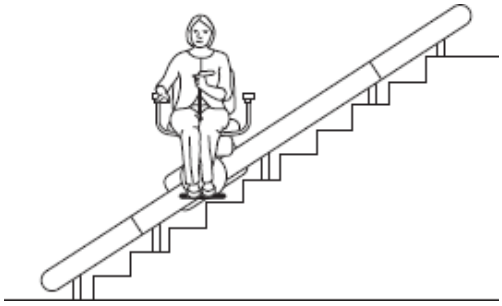
Name the process by which a nuclear fuel provides the energy needed to generate electricity.

.....

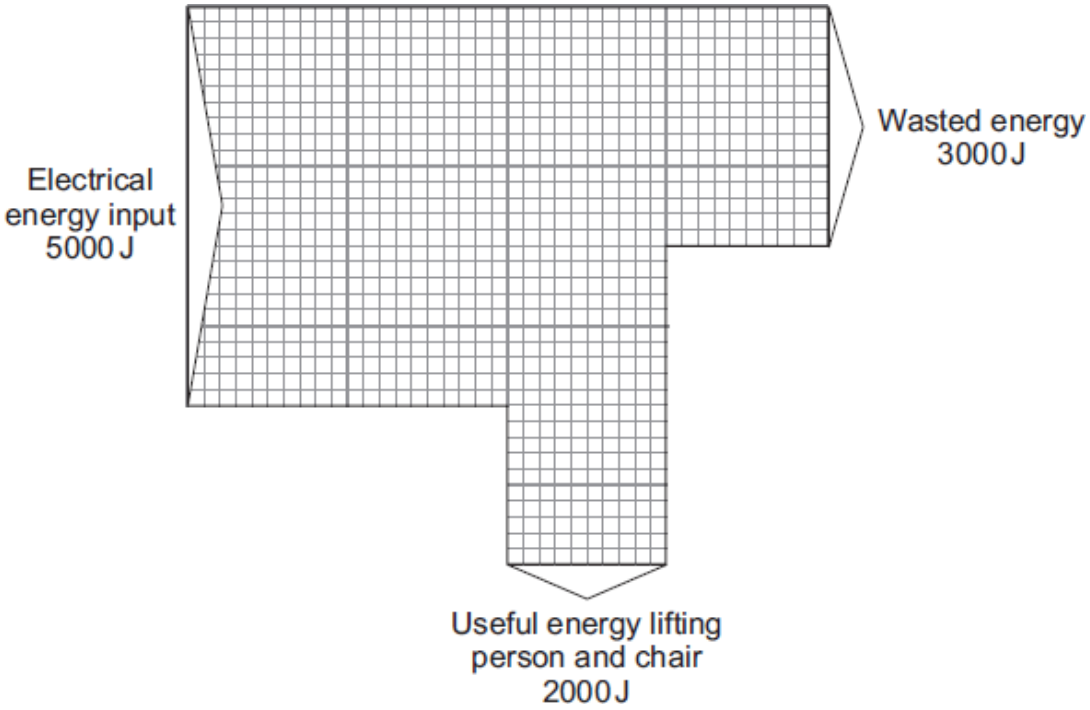
(1)

(Total 7 marks)

Q12. A person uses a stairlift to go upstairs. The stairlift is powered by an electric motor.



The Sankey diagram shows the energy transfers for the electric motor.



(a) Complete the following sentence.

The electric motor wastes energy as ..... energy.

(1)

(b) Use the equation in the box to calculate the efficiency of the electric motor.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

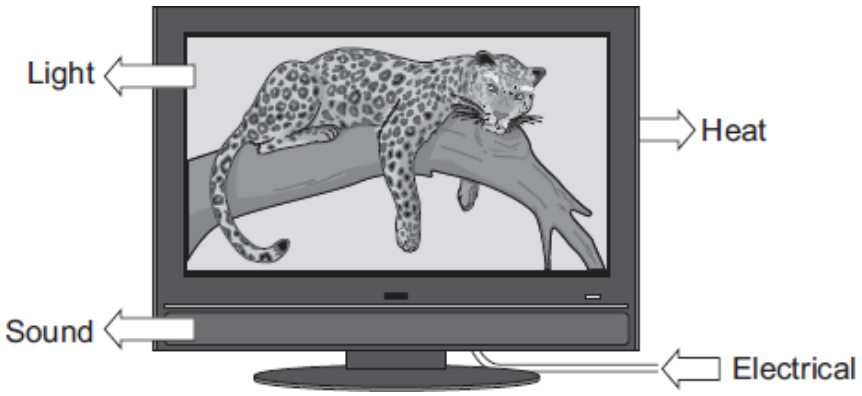
.....

Efficiency = ...

(2)

(Total 3 marks)

Q13. (a) The diagram shows the energy transformations produced by a television.



When the television is working, 1200 joules of energy are supplied to the television every second. The useful energy transferred by the television is 720 joules every second.

(i) Use the equation in the box to calculate the efficiency of the television.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(ii) Use **one** word from the diagram to complete the following sentence.

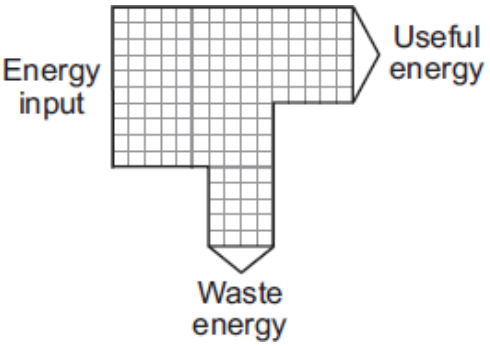
The electrical energy that is **not** usefully transformed by the television is wasted as

..... .

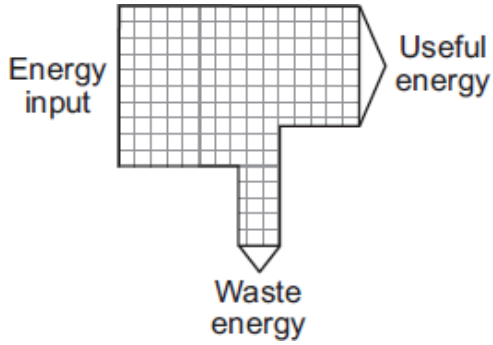
(1)

(b) Drawn below are the Sankey diagrams for three televisions, **J**, **K** and **L**.
The diagrams are drawn to the same scale.

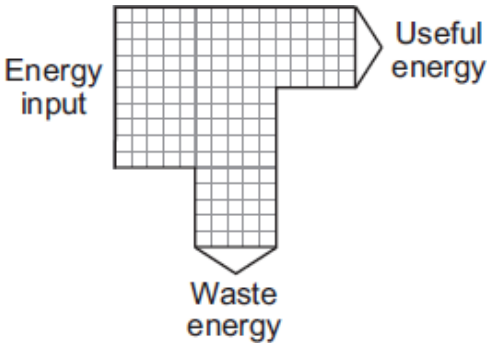
J



K



L



Which **one** of the televisions, **J**, **K** or **L**, is the most efficient?

Write your answer in the box.

Give a reason for your answer.

.....

.....

(2)

(c) A homeowner is sent an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 800 kilowatt-hours.
Electrical energy costs 15p per kilowatt-hour.

Use the equation in the box to calculate the cost of the energy transferred from the mains electricity supply.

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

Show clearly how you work out your answer and give the unit.

.....

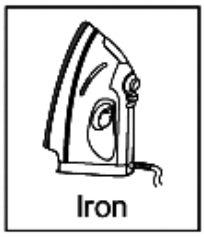
.....

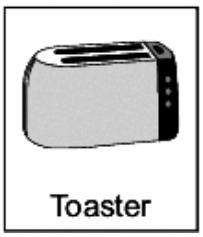
Cost = ...

(2)

(Total 7 marks)

Q14. 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

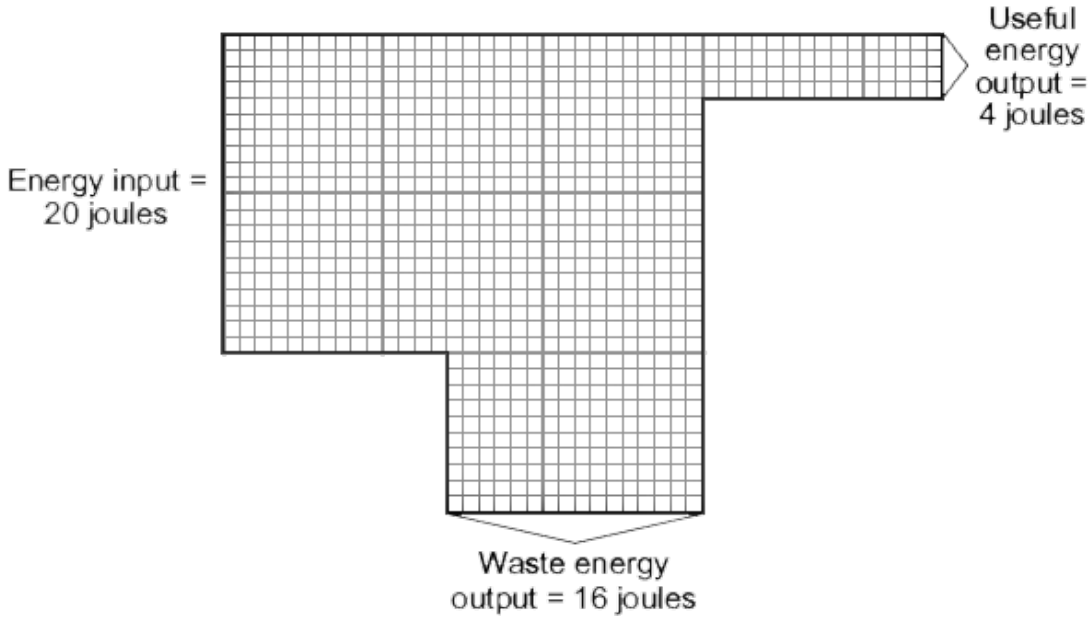
(b) Which **two** of the following statements are true?

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)

Q15. (a) The Sankey diagram for a low energy light bulb, known as a CFL, is shown below.



(i) What is the useful energy output that the CFL is designed to produce?

.....

(1)

(ii) What effect does the waste energy output have on the surrounding air?

.....

.....

(1)

(iii) Use the information in the diagram to calculate the efficiency of the CFL.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Efficiency = ...

(2)

(iv) CFLs contain mercury. Mercury is a poisonous substance.

It is important that old CFLs are sent for recycling and not thrown into a rubbish bin.

Suggest **one** reason why.

.....

.....

(1)

(b) A new type of low energy bulb uses light emitting diodes (LEDs).

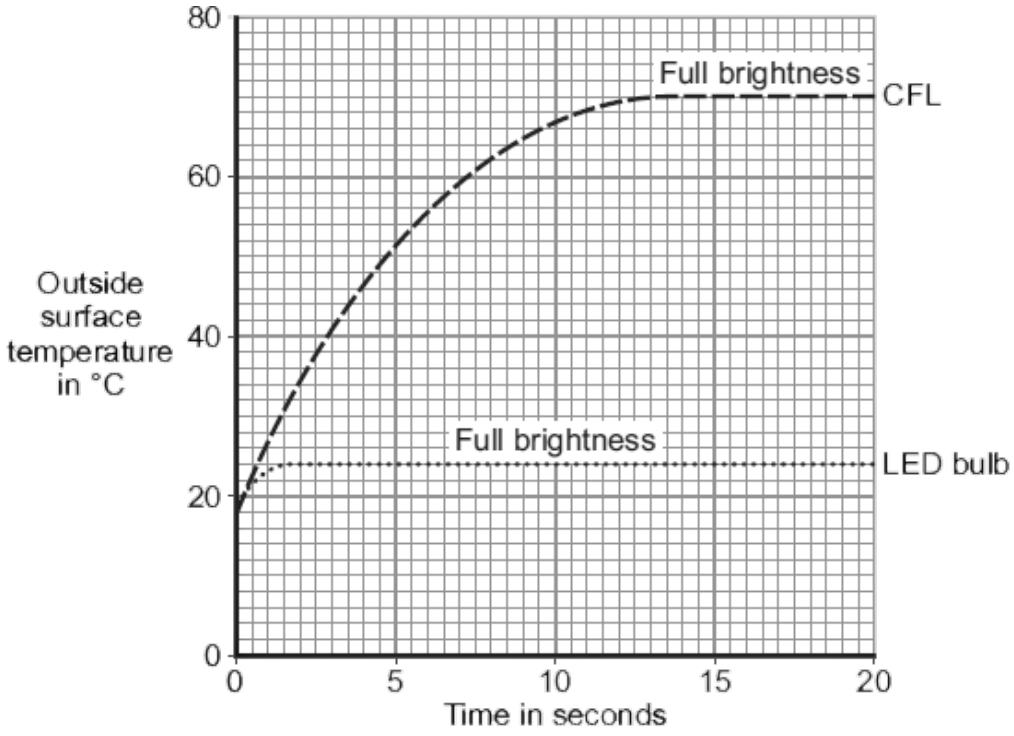
Draw a ring around the correct answer in the box to complete the sentence.

LED bulbs are more efficient than CFLs. This means that LED bulbs

waste | a smaller / the same / a bigger | proportion of the input energy compared to CFLs.

(1)

(c) The graph shows how the outside surface temperatures of a CFL and an LED bulb change after they are switched on.



Apart from a higher efficiency, suggest **one** advantage of using an LED bulb rather than a CFL.

.....

.....

(1)

(d) At the moment, LED bulbs are much more expensive to buy than CFLs.

Which **two** of the following would a homeowner need to know to decide whether it would be cost-effective to replace a CFL with an equally bright LED bulb?

Tick (✓) **two** box.

The number of hours each bulb lasts before needing to be replaced ☐

The power of each bulb in watts ☐

The voltage of the mains electricity supply ☐

(1)
(Total 8 marks)

Q16. The picture shows a solar-powered aircraft. The aircraft has no pilot.

By NASA/Nick Galante [Public domain], via Wikimedia Commons

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

electrical	**heat**	**light**	**sound**

Solar cells are designed to transform ..... energy

into ..... energy.

(2)

(b) On a summer day, 175 000 joules of energy are supplied to the aircraft's solar cells every second. The useful energy transferred by the solar cells is 35 000 joules every second.

Use the equation in the box to calculate the efficiency of the solar cells.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(c) The aircraft propellers are driven by electric motors.

Give **one** environmental advantage of using electric motors to drive the aircraft propellers rather than motors that burn a fuel.

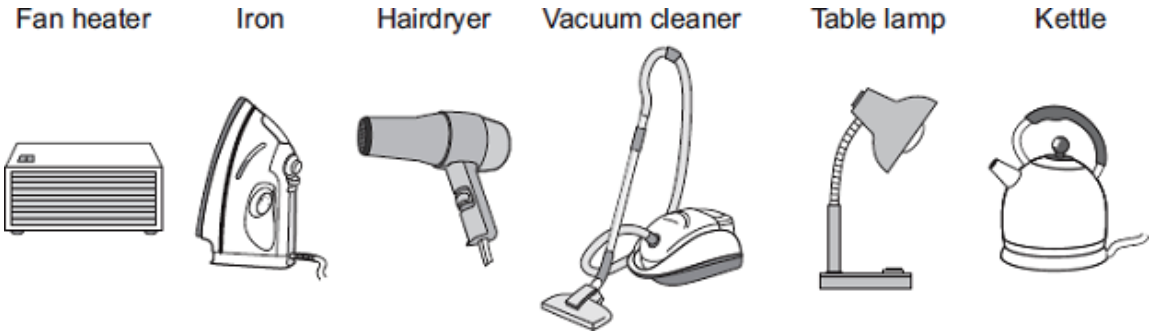
.....

.....

(1)

(Total 5 marks)

Q17. 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.

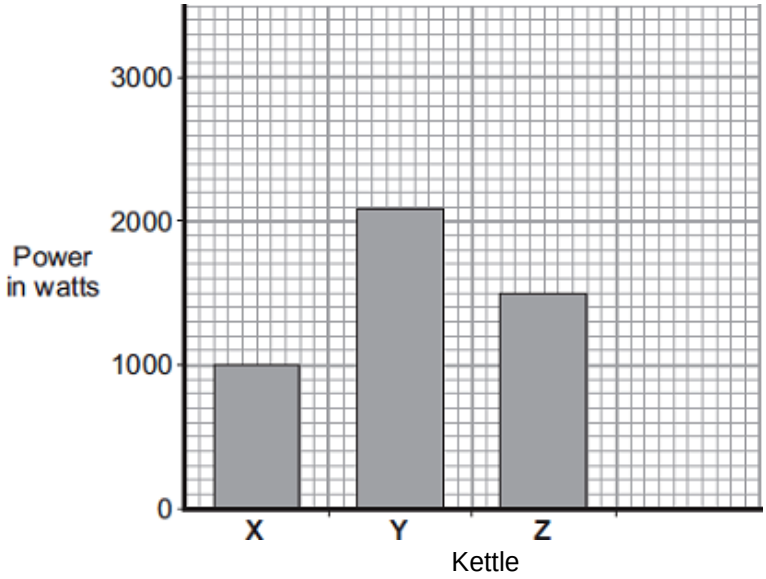
1 .....

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 ☐

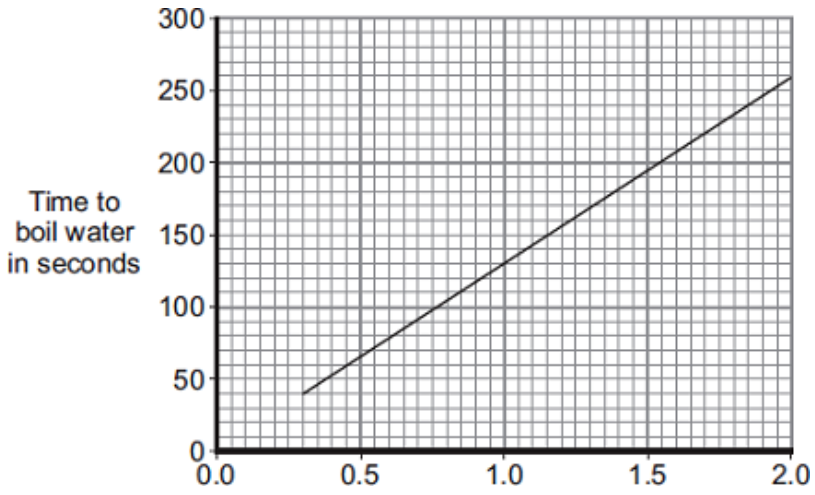
(1)

(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.

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(3)

(Total 8 marks)