EXAM PAPERS PRACTICE

Energy Transfers

These practice questions can be used by students and teachers and is

Suitable for GCSE AQA Physics Topic Question 8463

Level: GSCE AQA 8463

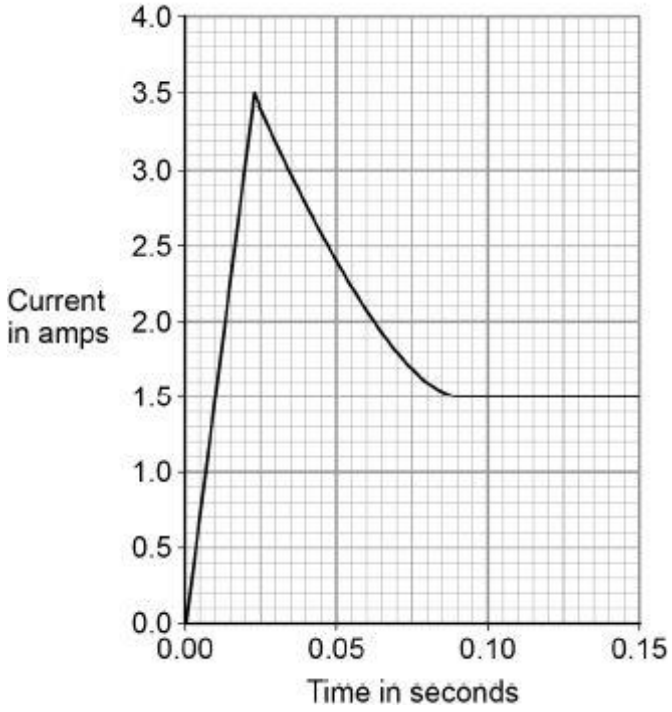
Subject: Physics

Exam Board: GCSE AQA

Topic: Energy Transfers

Q1.

The graph below shows how the current through a filament lamp changes after the lamp is switched on.



(a) The normal current through the filament lamp is 1.5 A.

For how many seconds is the current through the filament lamp greater than 1.5 A?

Tick **one** box.

0.01 s ☐

0.08 s ☐

0.09 s ☐

0.14 s ☐

(1)

(b) Why might the filament inside a lamp melt when the lamp is first switched on?

_____

_____

(1)

(c) The lamp is connected to a 24 V power supply. The current through the lamp is 1.5 A.

Calculate the power of the lamp.

Use the equation:

power = potential difference × current

_____

_____

_____

_____

Power = _____ W

(2)

(d) LED lamps are much more efficient than filament lamps.

What does this statement mean?

Tick **one** box.

LED lamps have a similar power output to filament lamps.	☐
LED lamps waste a smaller proportion of the input energy than filament lamps.	☐
LED lamps have a higher power input than filament lamps.	☐
LED lamps waste a larger proportion of the input energy than filament lamps.	☐

(1)

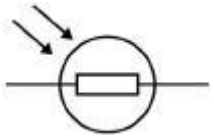
(Total 5 marks)

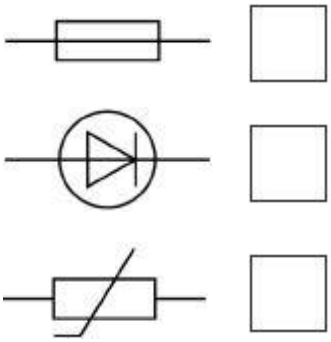
Q2.

The plug of an electrical appliance contains a fuse.

(a) What is the correct circuit symbol for a fuse?

Tick **one** box.

 ☐



(1)

(b) The appliance is connected to the mains electrical supply. The mains potential difference is 230 V.

Calculate the energy transferred when 13 C of charge flows through the appliance.

Use the equation:

energy transferred = charge flow × potential difference

_____

_____

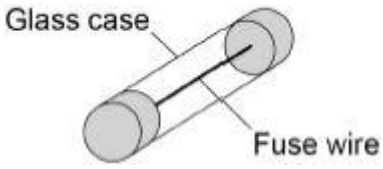
_____

_____

Energy transferred = _____ J

(2)

The diagram below shows the structure of a fuse.



(c) Write down the equation that links charge flow, current and time.

_____

(1)

(d) The fuse wire melts when 1.52 coulombs of charge flows through the fuse in 0.40 seconds.

Calculate the current at which the fuse wire melts.

_____

_____

_____

_____

Current = _____ A

(3)

(e) The mass of the fuse wire is 0.00175 kg. The specific latent heat of fusion of the fuse wire is 205 000 J/kg.

Calculate the energy needed to melt the fuse wire.

Use the Physics Equations Sheet.

_____

_____

_____

_____

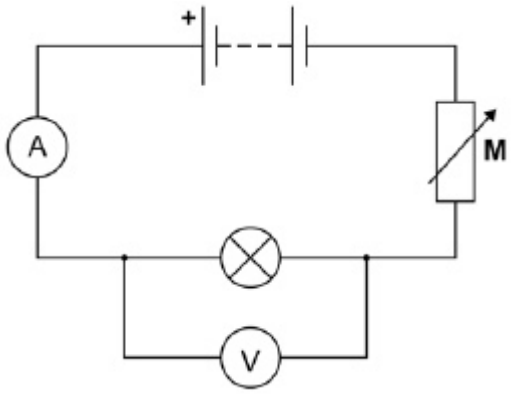
Energy = _____ J

(2)

(Total 9 marks)

Q3.

The diagram shows the circuit used to obtain the data needed to plot the current-potential difference graph for a filament lamp.



(a) Why is component **M** included in the circuit?

Tick **one** box.

To keep the current constant. ☐

To keep the potential difference constant. ☐

To vary the current. ☐

(1)

(b) Why does the resistance of the lamp increase as the potential difference across the lamp increases?

_____

_____

_____

(1)

(c) The potential difference across the lamp is 12.0 V

Calculate the energy transferred by the lamp when 8.5 C of charge flows through the lamp.

Use the equation:

energy transferred = charge flow × potential difference

_____

_____

_____

Energy transferred = _____ J

(2)

(d) The table gives data about two types of lamp that householders may use in their homes.

Type of lamp	Energy efficiency	Mean lifetime in hours
Halogen	10%	2000
LED	90%	36000

Both types of lamp produce the same amount of light.

Describe the environmental advantages of using the LED lamp compared with the halogen lamp.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

Q4.

The photograph below shows a coffee machine. The coffee machine uses an electric element to heat water.

(a) The coffee machine has a metal case.

Why would it be dangerous for the live wire of the electric cable to touch the metal case?

_____

_____

(1)

(b) The power output of the coffee machine is 2.53 kW.

The mains potential difference is 230 V.

Calculate the current in the coffee machine.

_____

_____

_____

_____

Current = _____ A

(3)

(c) The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

_____

_____

_____

_____

_____

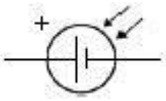
Mass = _____ kg

(5)

(Total 9 marks)

Q5.

Solar cells produce electricity using light from the Sun.

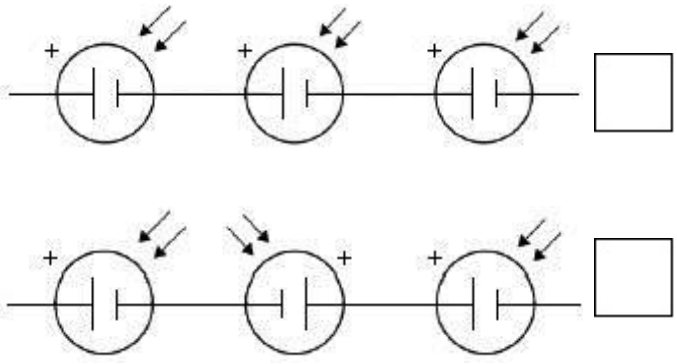
The symbol for a solar cell is: 

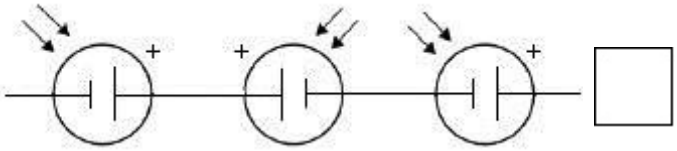
A householder has three solar cells.

Each solar cell has an output potential difference of 0.70 V

(a) Which arrangement of three solar cells will give a potential difference of 2.10 V?

Tick **one** box.





(1)

(b) A solar cell has a resistance of 2.5 Ω when the output potential difference is 0.70 V

Calculate the current through the solar cell.

Use the equation:

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

_____

_____

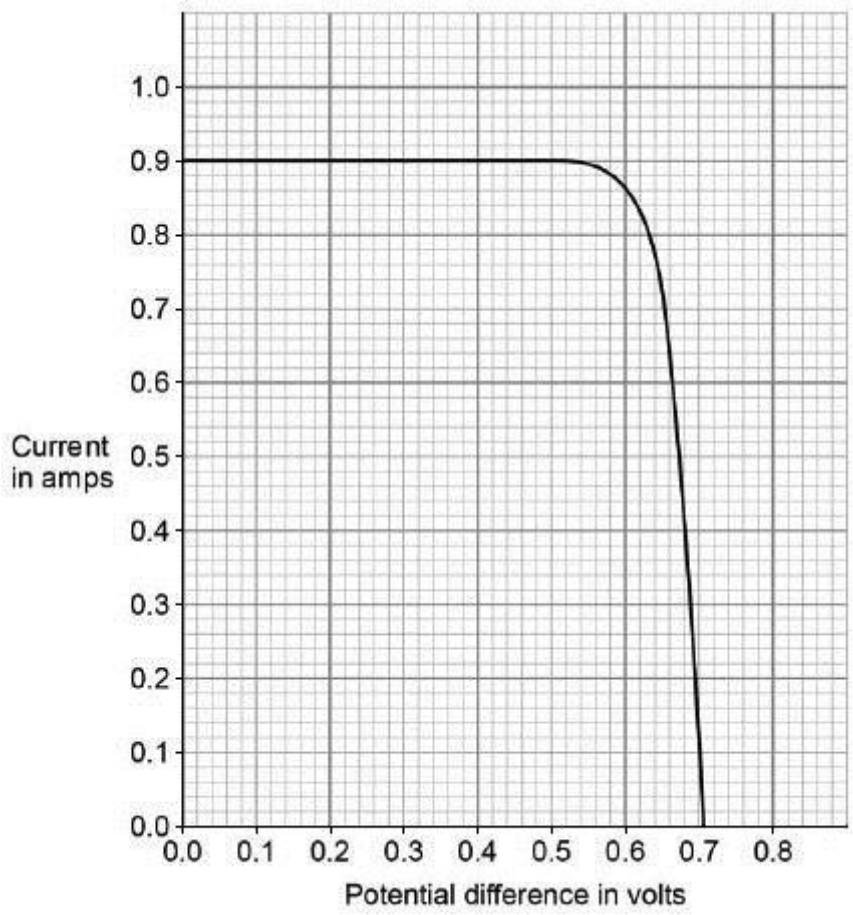
_____

_____

Current = _____ A

(2)

The graph below shows a graph of current against potential difference for a different type of solar cell.



(c) The power output of the solar cell is calculated using the equation.

power = current × potential difference

Which value of potential difference on the graph above gives the maximum power output of the solar cell?

Tick **one** box.

0.1 V ☐ 0.3 V ☐ 0.6 V ☐ 0.7 V ☐

Give the reason for your answer.

_____

_____

_____

(2)

(d) Write down the equation that links efficiency, total power input and useful power output.

_____

_____

(1)

(e) The total power input to the solar cell is 2.4 W when the efficiency is 0.20

Calculate the useful power output of the solar cell.

_____

_____

_____

_____

Useful power output = _____ W

(3)

(Total 9 marks)

Q6.

The image shows a battery-powered drone.

(a) Complete the sentences.

Choose the answers from the box.

chemical	**elastic potential**	
gravitational potential	**kinetic**	**nuclear**

As the drone accelerates upwards

its _____ energy increases

and its _____ energy increases.

The _____ energy store

of the battery decreases.

(3)

(b) In the USA, drones are not allowed to be flown too high above the ground.

Suggest **one** possible risk of flying a drone too high above the ground.

_____

_____

_____

(2)

(c) Write down the equation that links energy transferred, power and time.

_____

(1)

(d) The drone can fly for 25 minutes before the battery needs recharging.

The power output of the battery is 65.0 W

Calculate the maximum energy stored by the battery.

_____

_____

_____

_____

Maximum energy = _____ joules

(3)

(Total 8 marks)

Q7.

Most electric kettles use the ac mains electricity supply.

(a) Complete the sentence.

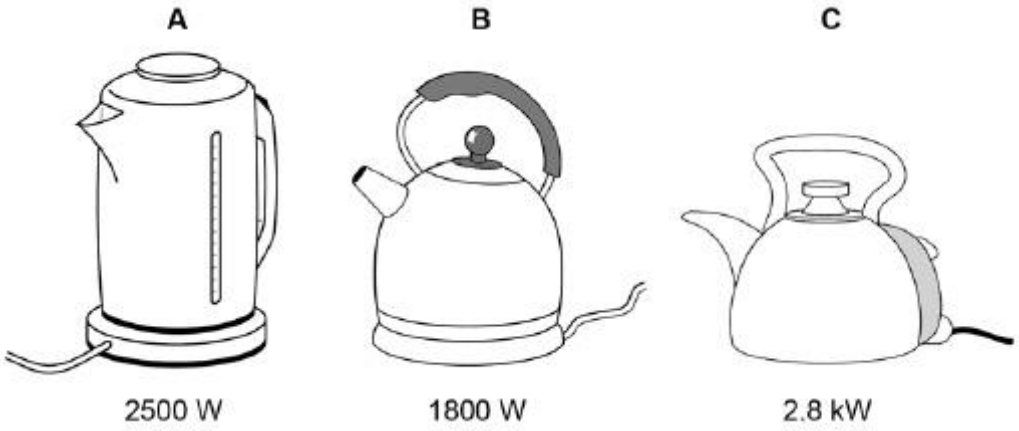
The ac mains supply has a potential difference that continuously

_____ polarity

(1)

Figure 1 gives the power output of three electric kettles.

Figure 1



A student investigated how the power output of a kettle affected the time taken to boil a fixed volume of water.

The water in all three kettles had an initial temperature of 25 °C.

(b) What type of variable was the time?

Tick **one** box.

Control ☐

Dependent ☐

Independent ☐

(1)

(c) Which kettle will boil the water in the shortest time?

Give a reason for your answer.

Kettle _____

Reason _____

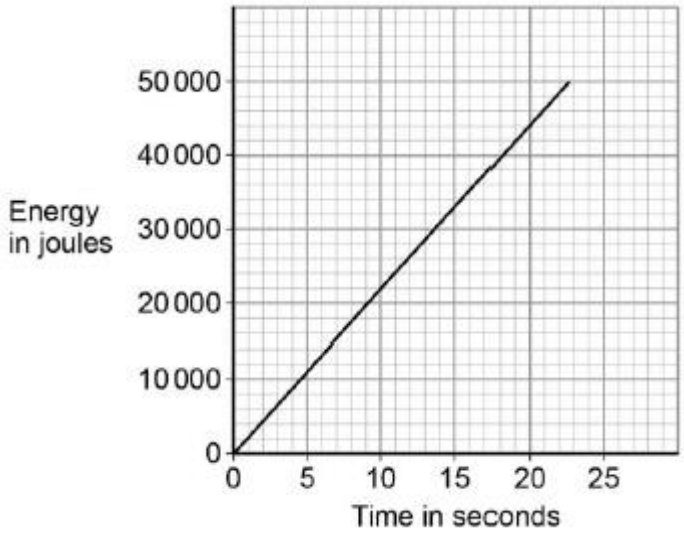
_____

_____

(2)

(d) **Figure 2** shows how the amount of energy transferred by a kettle varies with time.

Figure 2



The power output of the kettle is given by the gradient of the graph.

Calculate the power output of the kettle.

_____

_____

Power output = _____ W

(2)

(e) Write down the equation that links charge flow, current and time.

_____

(1)

(f) Calculate the current through the kettle when 2400 coulombs of charge flows in 250 seconds.

_____

_____

_____

_____

Current = _____ A

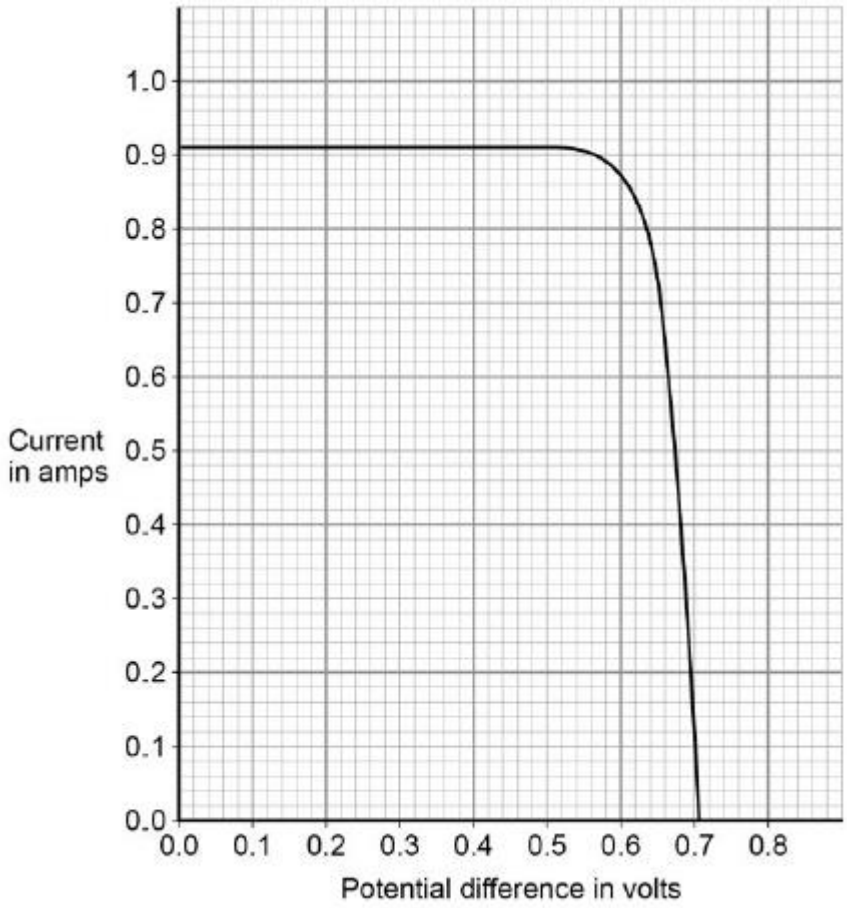
(3)

(Total 10 marks)

Q8.

Figure 1 shows a graph of current against potential difference for a solar cell when light of intensity 450 W/m^2 is incident on it.

Figure 1



(a) Determine the power output of the solar cell when the potential difference is 0.5 V

Use data from **Figure 1**.

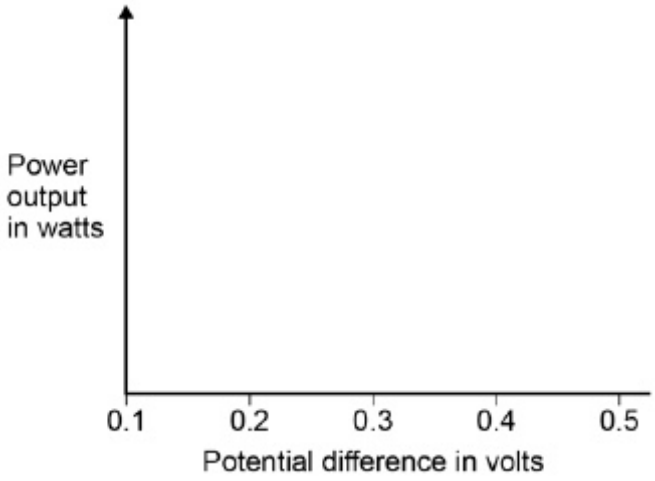
Power = _____ W

(3)

(b) Draw a sketch graph on **Figure 2** to show how the power output of the solar cell varies with potential difference between 0.1 V and 0.5 V

No values need to be included on the vertical axis.

Figure 2



(2)

(c) The maximum power output of this solar cell is 0.52 W

When the light intensity is 450 W/m^2 the cell has an efficiency of 0.15 at the maximum power output.

Calculate the area of the solar cell.

Area = _____ m^2

(4)

(d) A householder has four solar cells.

Each of the solar cells has a resistance of 0.78 Ω

Explain how the solar cells should be connected so that the total resistance is as low as possible.

(2)

(Total 11 marks)

Q9.

The image shows a battery-powered drone.

(a) The battery in the drone can store 97.5 kJ of energy.

When the drone is hovering, the power output of the battery is 65.0 W

Calculate the time for which the drone can hover.

Time = _____ seconds

(3)

(b) The battery powers 4 motors in the drone.

Each motor has a resistance of 1.60 Ω when the power input to each motor is 19.6 W

The 4 motors are connected in parallel with the battery.

Calculate the current through the battery.

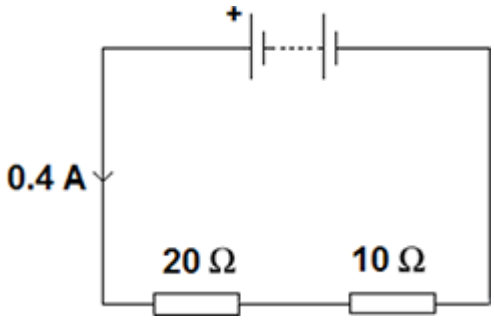
Current = _____ A

(4)

(Total 7 marks)

Q10.

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)

Q11.

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)

Q12.

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.

_____

_____

_____

_____

_____

_____

_____

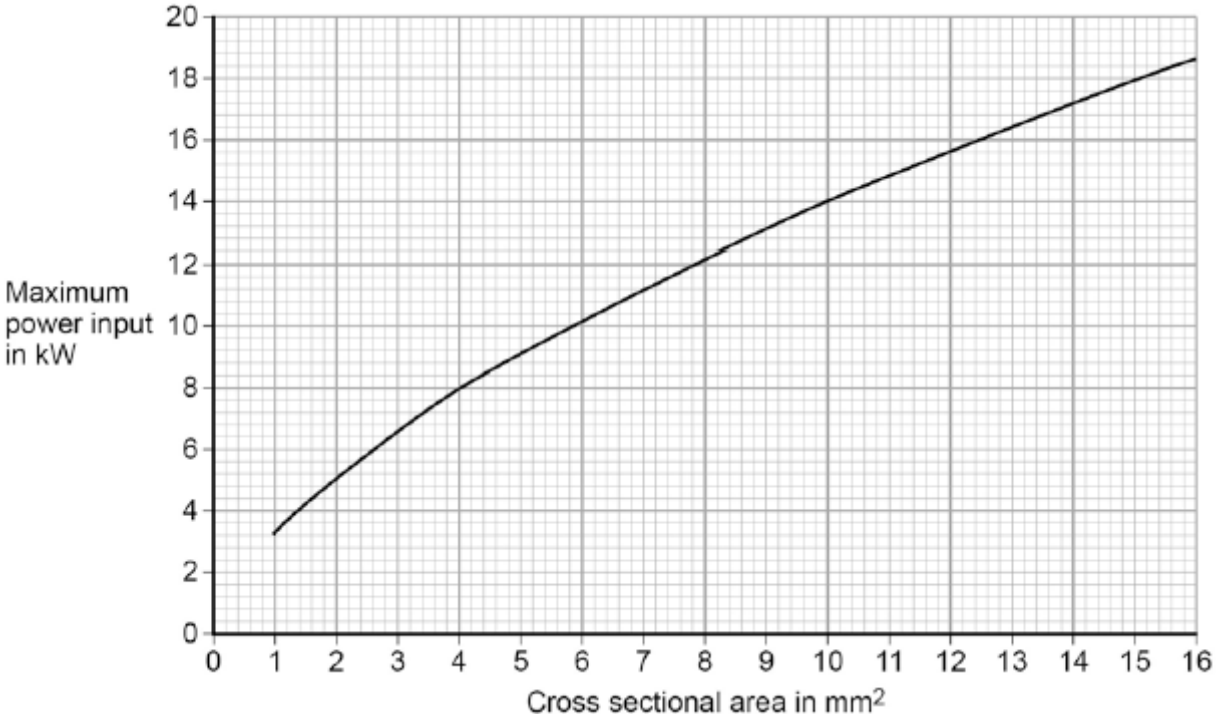
_____

(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)

Q13.

A small community of people live in an area in the mountains.
The houses are not connected to the National Grid.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

Figure 1 shows where these people live.

Figure 1

© Brian Lawrence/Getty Images

(a) It would not be economical to connect the houses to the National Grid.
Give **one** reason why.

(1)

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

Information about the two electricity generation systems is given in **Figure 2**.

Figure 2

The wind turbine costs £50 000 to buy and install. The hydroelectric generator costs £20 000 to buy and install. The average power output from the wind turbine is 10 kW. The hydroelectric generator will produce a constant power output of 8 kW.

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy sources as well as information from **Figure 2**.

(6)

(Total 7 marks)

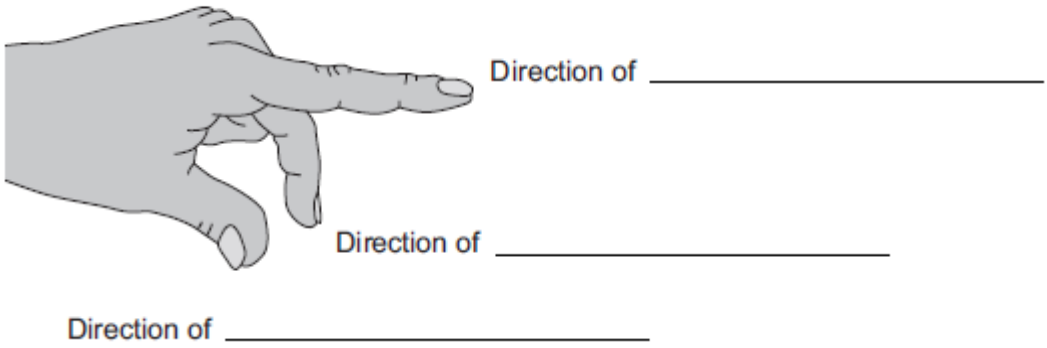
Q14.

The left-hand rule can be used to identify the direction of the force acting on a current-carrying conductor in a magnetic field.

(a) Use words from the box to label **Figure 1**.

current	**field**	**force**	**potential difference**

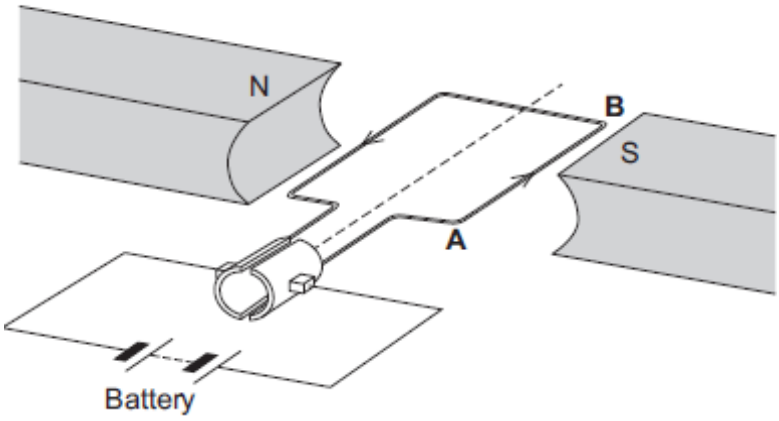
Figure 1



(3)

(b) **Figure 2** shows an electric motor.

Figure 2



(i) Draw an arrow on **Figure 2** to show the direction of the force acting on the wire **AB**.

(1)

(ii) Suggest **two** changes that would increase the force acting on the wire **AB**.

1. _____

2. _____

(2)

(iii) Suggest **two** changes that would reverse the direction of the force acting on the wire **AB**.

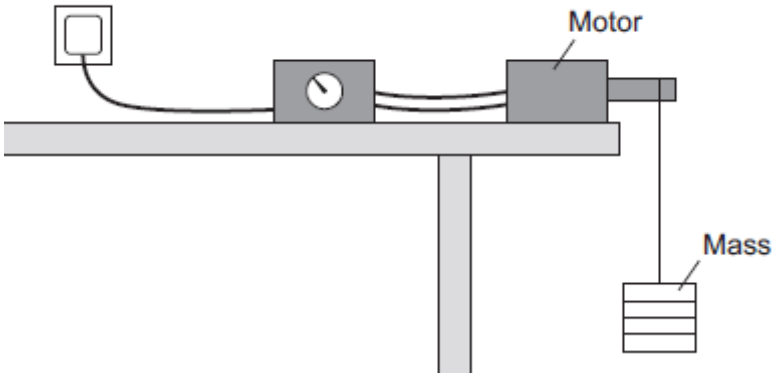
1. _____

2. _____

(2)

(c) A student used an electric motor to lift a mass. This is shown in **Figure 3**.

Figure 3



The student varied the electrical input power to the motor. For each different electrical input power, he recorded the time taken to lift the mass and calculated the output power of the motor.

The results are shown in the table.

Test	Electrical input power in watts	Work done lifting the mass in joules	Time taken to lift the mass in seconds	Output power in watts
A	20	24	2.4	10
B	40	24	1.2	20
C	60	24	0.8	30
D	80	24	0.2	120

The result for **Test D** is anomalous.

(i) Calculate the efficiency of the motor in **Test D**.

_____

_____

Efficiency = _____

(2)

(ii) Comment on your answer to part (c)(i).

_____

_____

(1)

(iii) Suggest a reason for this anomalous result.

_____

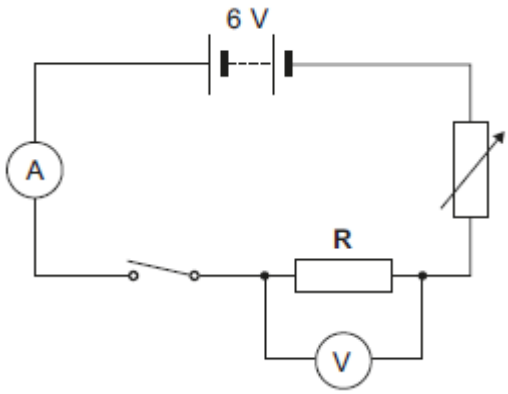
_____

(1)

(Total 12 marks)

Q15.

The diagram shows an electrical circuit.



(a) The 6 V battery shown in the diagram is made up of a number of identical 1.5 V cells.

Calculate the minimum number of cells needed to make the battery.

_____

Number of cells = _____

(1)

(b) The switch in the diagram is shown in the open position. Closing the switch completes the circuit.

Charge flows through the completed circuit and a reading is shown on both the ammeter and the voltmeter.

(i) In 10 seconds, 20 coulombs of charge flows through the circuit.

Calculate the current reading shown on the ammeter.

_____

_____

Current = _____ A

(2)

(ii) For 20 coulombs of charge to flow through the resistor R, 100 joules of work must be done.

Calculate the potential difference reading given by the voltmeter.

_____

_____

Potential difference = _____ V

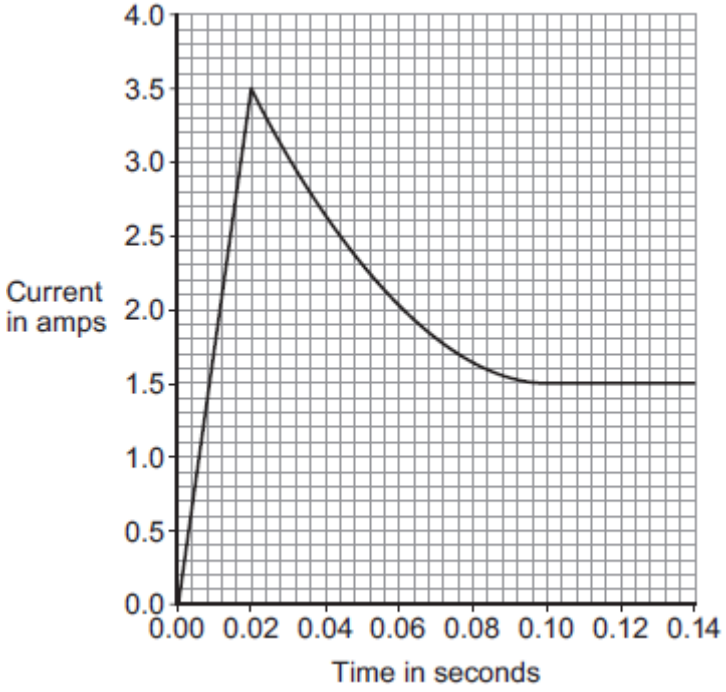
(2)

(Total 5 marks)

Q16.

The graph shows how the current through a filament bulb changes after the bulb is switched

on.



(a) What happens to the current through the bulb in the first 0.02 seconds after the bulb is switched on?

_____

(1)

(b) Between 0.02 seconds and 0.08 seconds the current through the bulb decreases.

(i) What, if anything, happens to the **resistance** of the bulb between 0.02 seconds and 0.08 seconds?

Draw a ring around the correct answer.

decreases **does not change** **increases**

(1)

(ii) What, if anything, happens to the **temperature** of the bulb between 0.02 seconds and 0.08 seconds?

Draw a ring around the correct answer.

decreases **does not change** **increases**

(1)

(c) The bulb is connected to a 12 V power supply.

Calculate the power of the bulb when the current through the bulb is 1.5 A.

Choose the unit from the list below.

coulomb **joule** **watt**

_____

_____

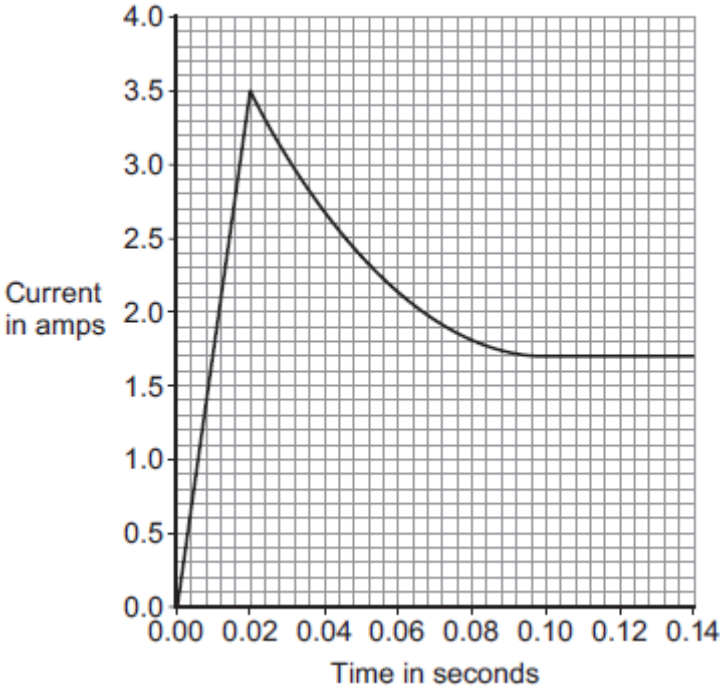
Power = _____ unit _____

(3)

(Total 6 marks)

Q17.

A 12 V filament bulb is connected to a 12 V power supply.
The graph shows how the current changes after the bulb is switched on.



(a) (i) After 0.10 seconds, the bulb works at its normal brightness.

What is the current through the bulb when it is working at normal brightness?

Current = _____ A

(1)

(ii) The bulb works at normal brightness for 30 seconds before it is switched off.

Calculate the charge that flows through the bulb in the 30 seconds before it is switched off. Give the unit.

_____

_____

_____

Charge = _____ unit _____

(3)

(iii) Calculate the energy transferred by the 12 V bulb when it is working at normal brightness for 30 seconds.

_____

_____

Energy transferred = _____ J

(2)

(b) Between 0.02 seconds and 0.08 seconds, there is an increase in both the resistance and the temperature of the metal filament inside the bulb.

Explain, in terms of the electrons and ions inside the filament, why both the temperature and the resistance increase.

_____

_____

_____

_____

_____

_____

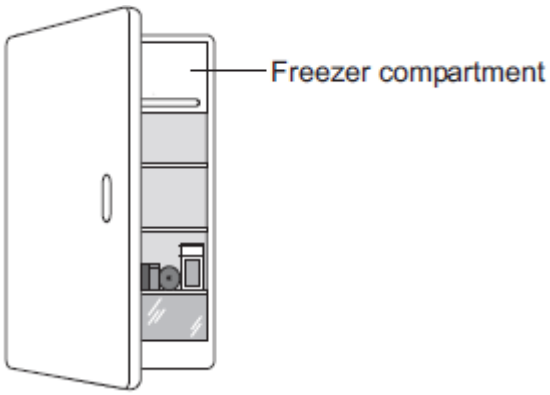
(2)

(Total 8 marks)

Q18.

(a) 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)

(b) 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 7 marks)

Q19.

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.

_____

_____

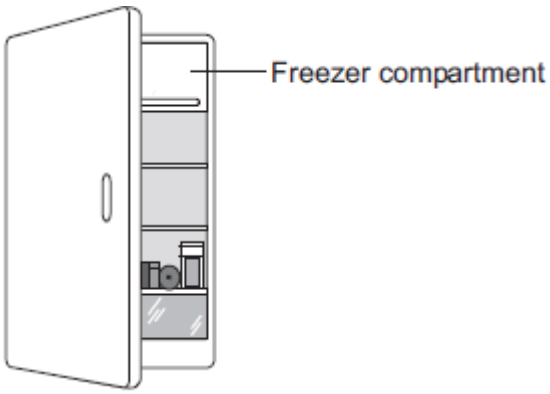
(1)

(Total 6 marks)

Q20.

(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)

Q21.

(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)

Q22.

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)

Q23.

Solar panels are often seen on the roofs of houses.

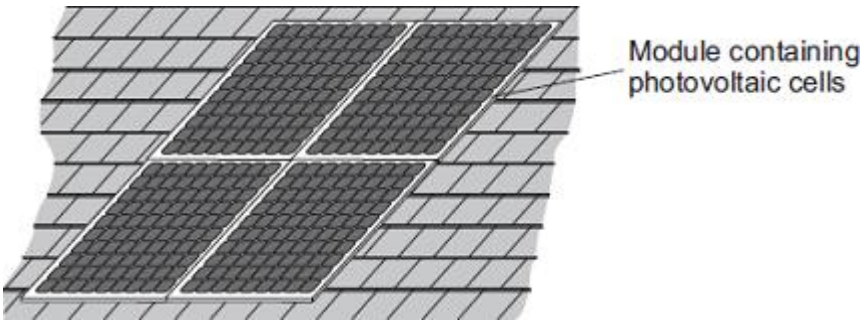
(a) Describe the action and purpose of a solar panel.

(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.

_____

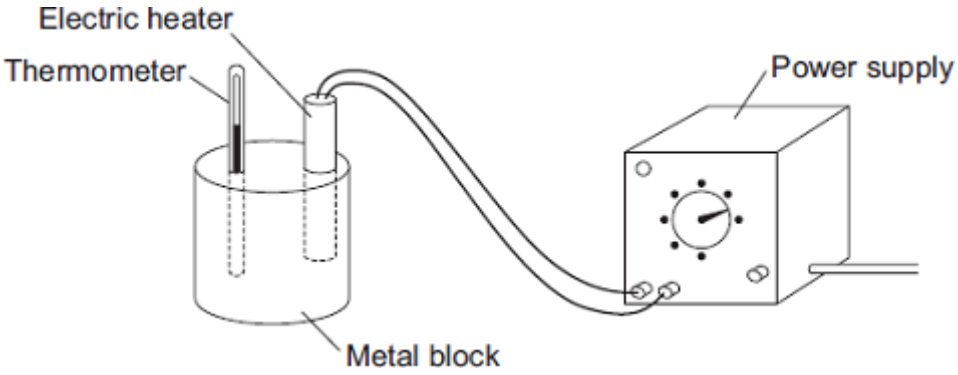
_____

(1)

(Total 13 marks)

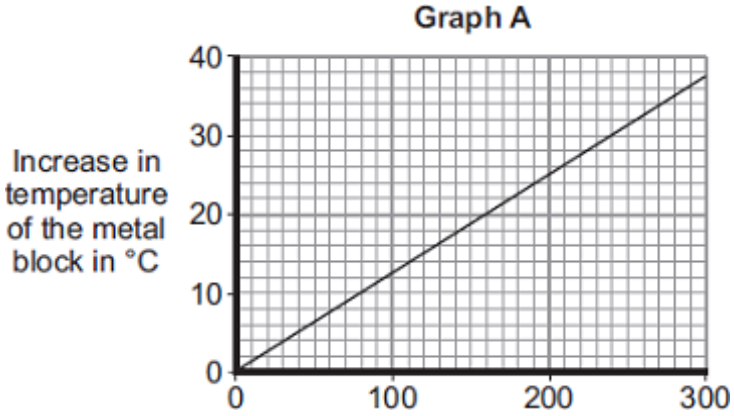
Q24.

(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**.

_____

_____

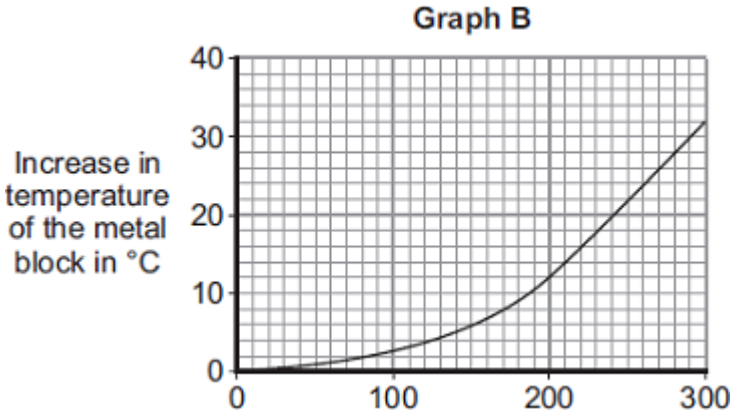
_____

_____

(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.

_____

_____

_____

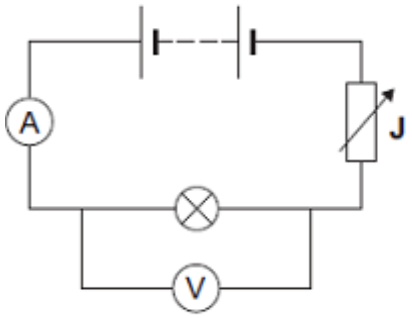
_____

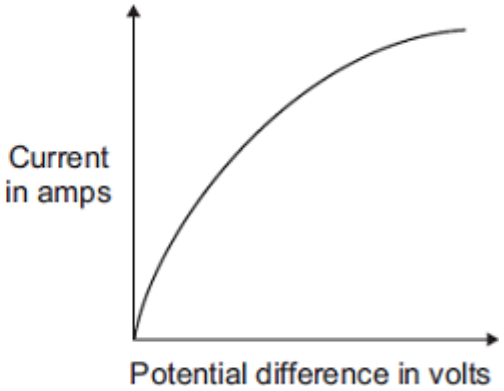
(2)

(Total 7 marks)

Q25.

(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.

_____

_____

_____

_____

_____

_____

_____

_____

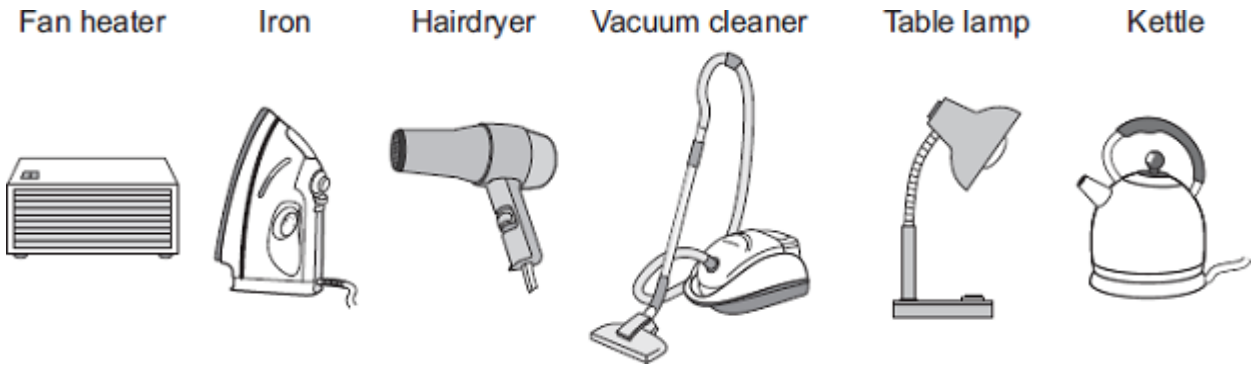
_____

(6)

(Total 11 marks)

Q26.

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.

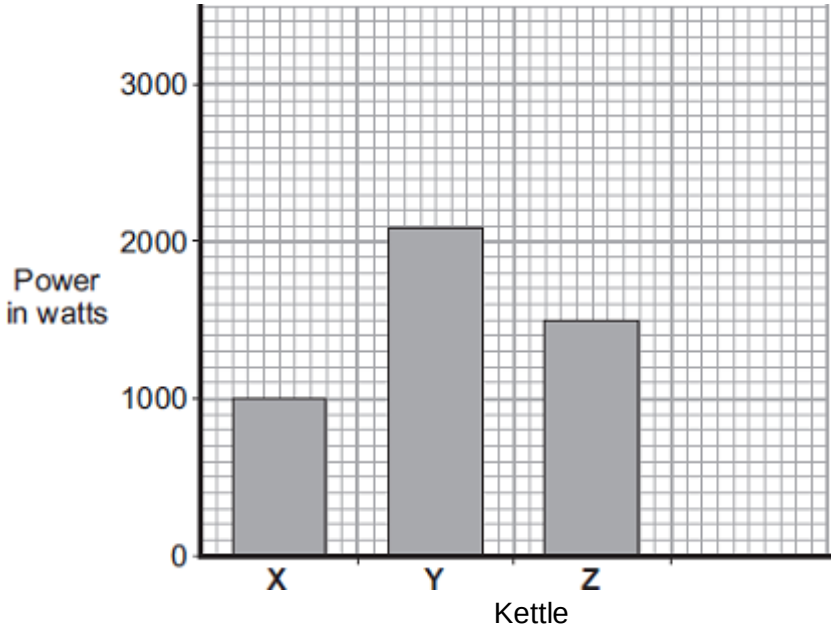
1. _____

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 ☐

Z ☐

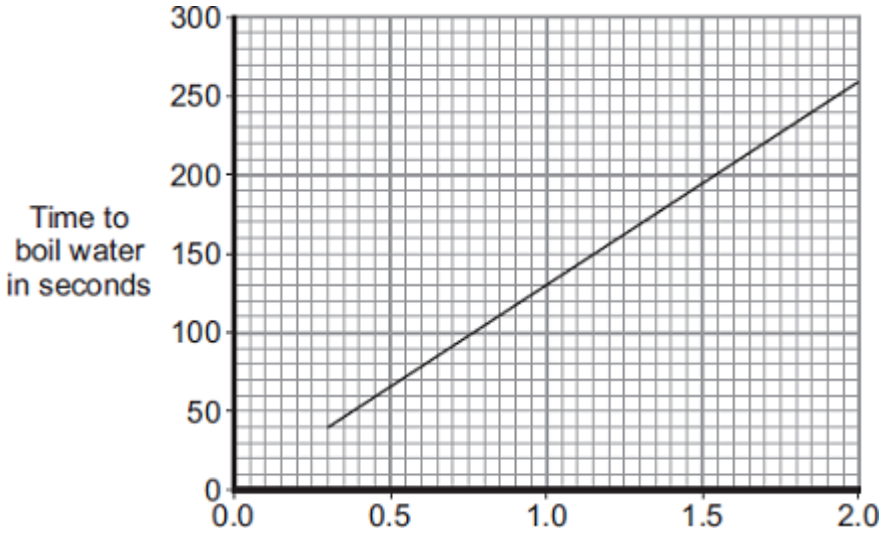
(1)

(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.

_____

_____

_____

_____

_____

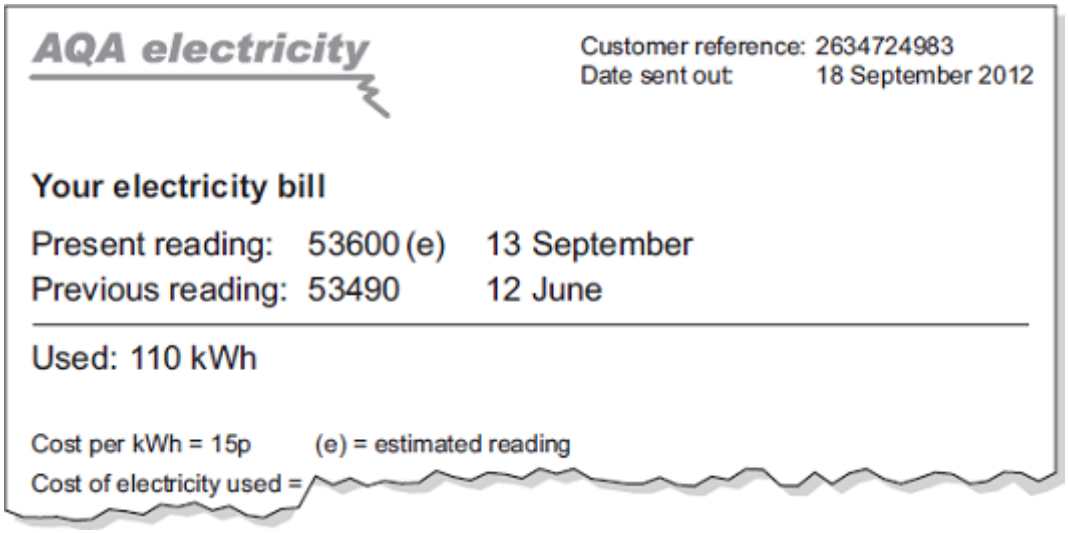
_____

(3)

(Total 8 marks)

Q27.

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.

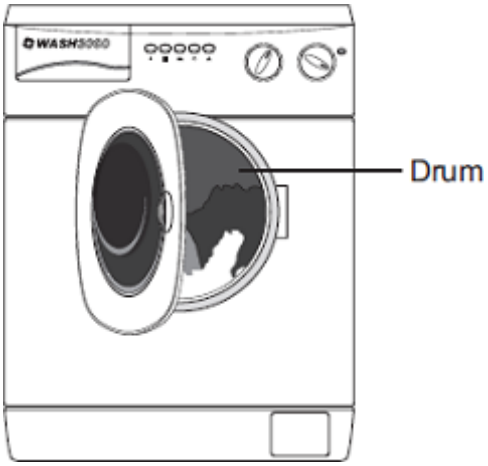
How many kilowatt-hours of electricity had the householder actually used between 12 June and 13 September?

(2)

(Total 4 marks)

Q28.

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)

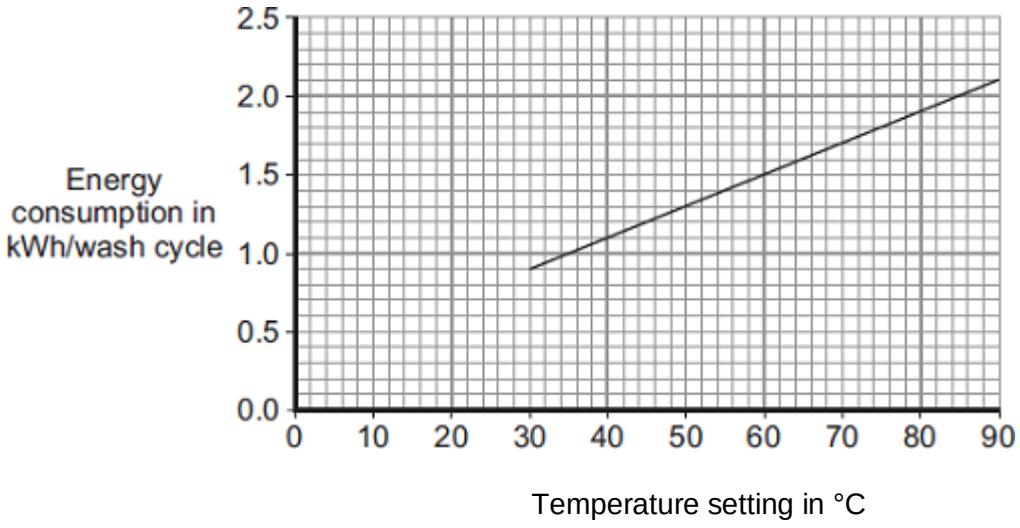
(b) What happens to the energy wasted by the electric motor?

_____

_____

(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.

_____

_____

_____

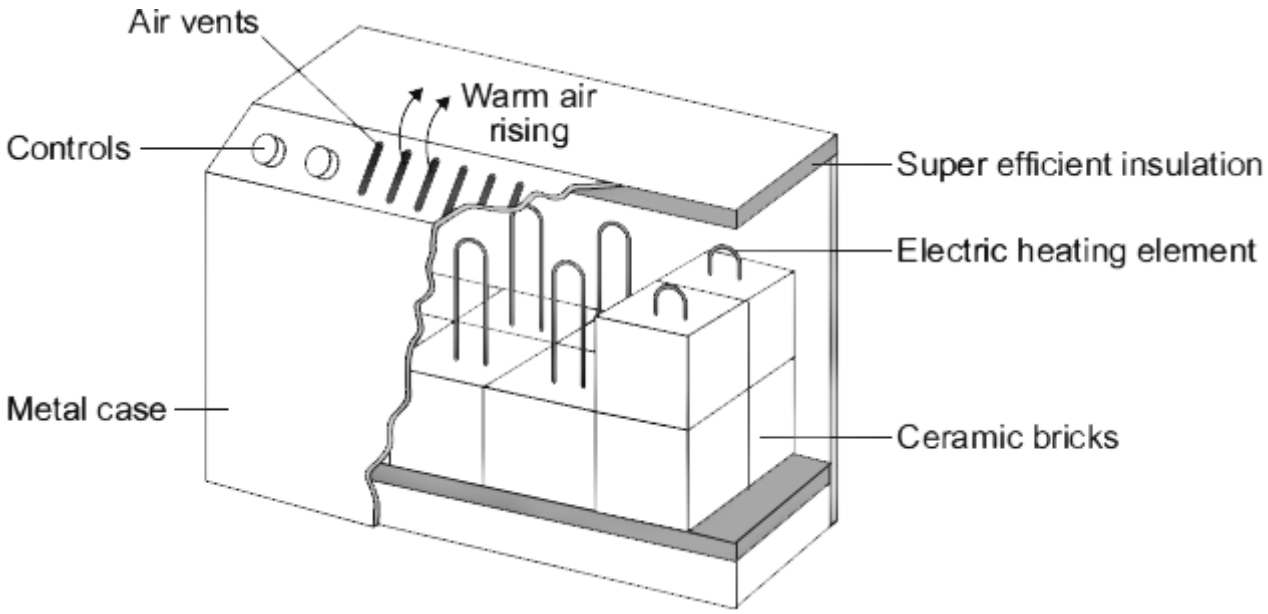
_____

(2)

(Total 7 marks)

Q29.

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.

_____

_____

_____

_____

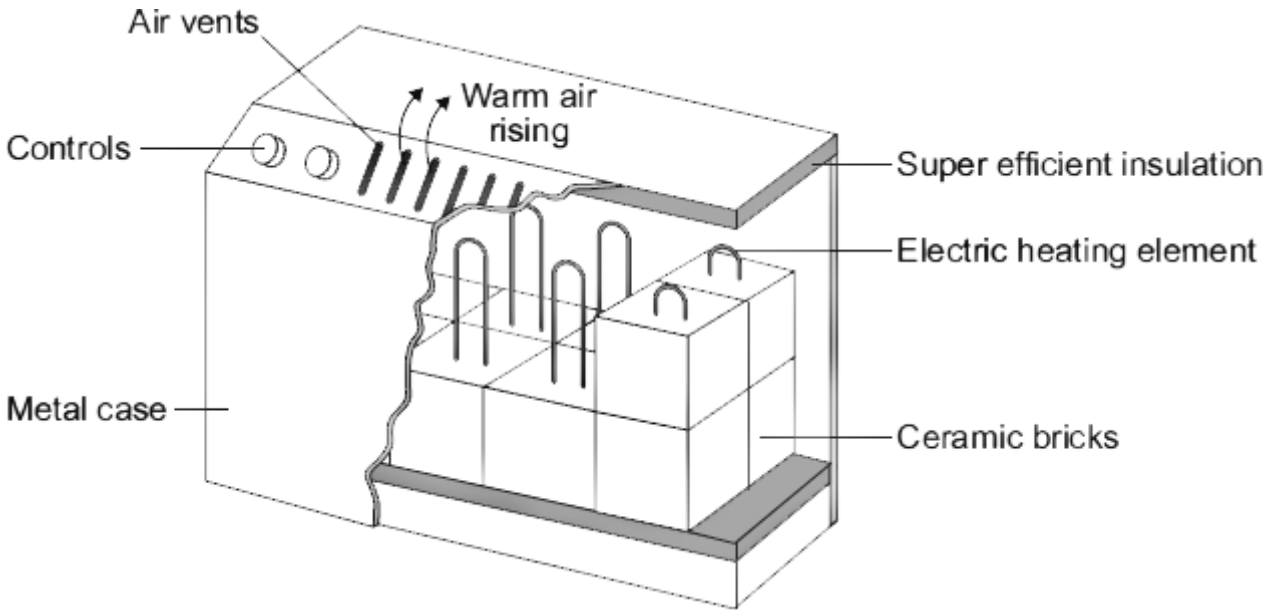
Energy transferred = _____ J

(2)

(Total 8 marks)

Q30.

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)

Q31.

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.

_____

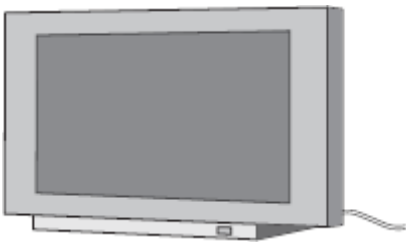
_____

(1)

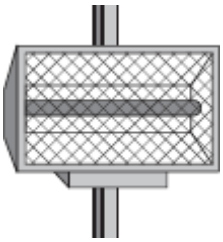
(Total 6 marks)

Q32.

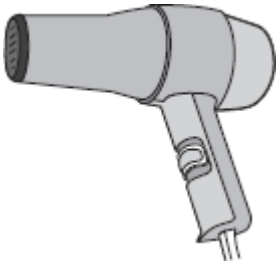
The data included in the diagrams gives the power of the electrical appliances.



TV
160 W

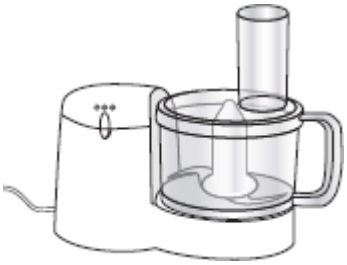


Radiant heater
1.0 kW



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.

_____

_____

_____

_____

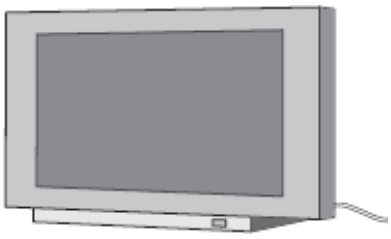
Cost = _____ pence

(2)

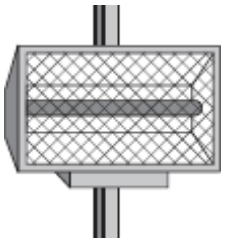
(Total 6 marks)

Q33.

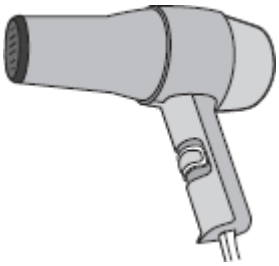
The data included in the diagrams gives the power of the electrical appliances.



TV
160 W

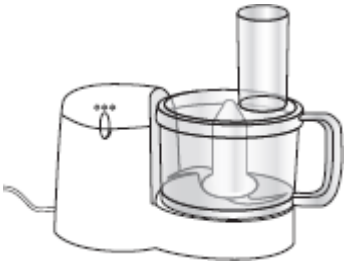


Radiant heater
1.0 kW



Hairdryer
1100 W

Sandwich toaster



Food processor

Table lamp

1.1 kW 0.4 kW 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.

_____

_____

_____

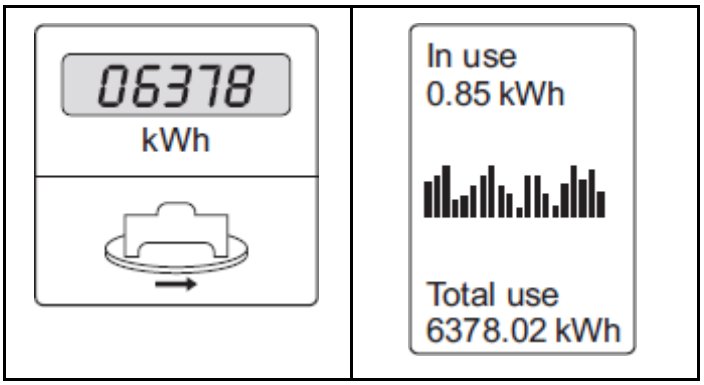
_____

(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.

_____

_____

_____

_____

_____

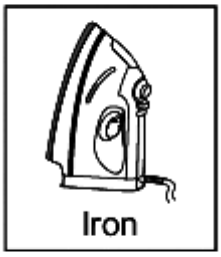
_____

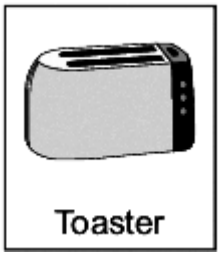
(3)

(Total 8 marks)

Q34.

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. ☐

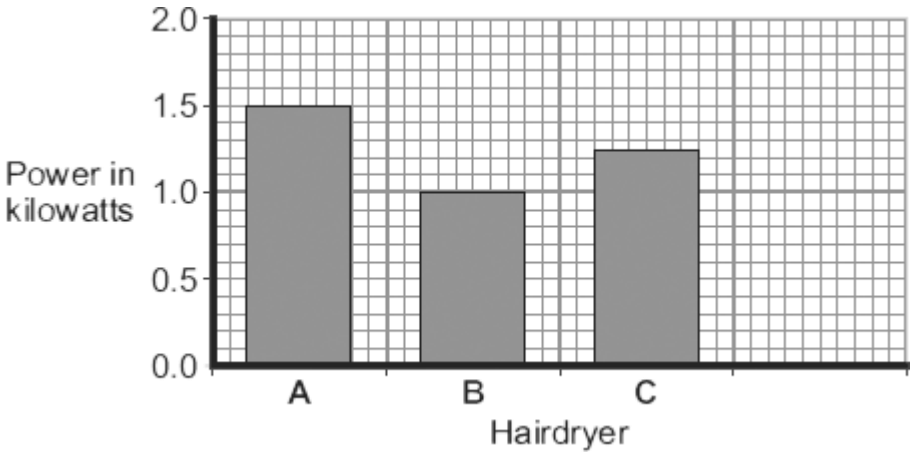
The energy output from an appliance is bigger than the energy input. ☐

(2)

(Total 5 marks)

Q35.

(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)

Mark schemes

Q1.

(a) 0.08 (s)

1

(b) the current goes higher than normal value

allow the current goes (too) high

or

the current goes higher than 1.5 A

1

(c) P = 1.5 × 24

1

P = 36 (W)

1

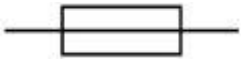
*an answer of 36 (W) scores **2** marks*

(d) LED lamps waste a smaller proportion of the input energy than filament lamps

1

[5]

Q2.

(a) 

1

(b) E = 13 × 230

1

E = 2990 (J)

1

*an answer 2990 (J) scores **2** marks*

(c) charge flow = current × time

allow Q = It

1

(d) 1.52 = I × 0.40

1

$$I = \frac{1.52}{0.40}$$

1

I = 3.8 (A)

1

*an answer of 3.8 (A) scores **3** marks*

(e) E = 0.00175 × 205 000

1

E = 359 (J)

*allow an answer that rounds to 360 (J) for **2** marks*

*an answer of 359 (J) scores **2** marks*

1

[9]

Q3.

(a) to vary the current.

1

(b) the temperature of the filament increases

allow the filament heats up

1

(c) E = 12 × 8.5

1

E = 102 (J)

*an answer of 102 (J) scores **2** marks*

1

(d) (LED lamp)

longer lifetime (per lamp)

1

wastes less energy

or

lower input energy (for same light energy output)

1

[6]

Q4.

(a) risk of electric shock (if someone touched the case)

allow risk of electrocution (if someone touched the case)

1

(b) 2530 = I × 230

this mark may be awarded if P is incorrectly / not converted

1

$$I = \frac{2530}{230}$$

this mark may be awarded if P is incorrectly / not converted

1

I = 11 (A)

this answer only

*an answer of 0.011 (A) scores **2** marks*

*an answer of 11 (A) scores **3** marks* 1

(c) E = 2530 × 14

this mark may be awarded if P is incorrectly / not converted 1

E = 35 420 (J)

this answer only 1

35 420 = m × 4200 × 70

allow their calculated E = m × 4200 × 70 1

$$m = \frac{35\,420}{4200 \times 70}$$

$$\textit{allow } m = \frac{\textit{their calculated } E}{4200 \times 70}$$

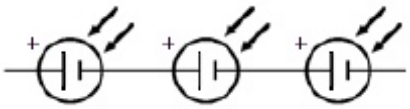
1

m = 0.12 (kg)

allow an answer that is consistent with their calculated value of E 1

[9]

Q5.

(a)  1

(b) $\text{current} = \frac{0.70}{2.5}$ 1

current = 0.28 (A)

*an answer of 0.28 (A) scores **2** marks* 1

(c) 0.60 (V) 1

product of potential difference and current gives highest value 1

(d) $\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$ 1

(e) $0.20 = \frac{\text{useful power output}}{2.4}$

1

useful power output = 0.20 × 2.4

1

useful power output = 0.48 (W)

*an answer of 0.48 (W) scores **3** marks*

1

[9]

Q6.

(a) gravitational potential

1

kinetic

1

chemical

1

(b) flying drones may damage aircraft
or
falling drones may injure people
or
damage buildings / vehicles

allow any sensible suggestion of a hazard caused by a flying / falling drone

1

(c) energy transferred = power × time

allow E = Pt

1

(d) t = 25 × 60 = 1500 (s)

1

E = 65 × 1500

1

E = 97 500 (J)

an answer of 97 500 (J) scores 3 marks

allow 2 marks for an answer of 1625 (J)

1

[8]

Q7.

(a) changes

allow reverses

1

(b) dependent

1

(c) kettle **C**
or
2.8 kW

1

highest power (output)
allow higher power (output)

1

(d) values for gradient calculation shown on graph or on answer lines

1

power input = 2200 (W)
*accept an answer that rounds to 2200 (W) for **2** marks*

1

(e) charge flow = current × time
allow Q = It

1

(f) 2400 = I × 250

1

$$I = \frac{2400}{250}$$

1

I = 9.6 (A)
an answer of 9.6 (A) scores 3 marks

1

[10]

Q8.

(a) current at 0.5 V = 0.91 (A)

1

P = 0.91 × 0.5

1

P = 0.455 (W)
*an answer of 0.455 (W) scores **3** marks*

1

(b) straight line with positive gradient
*allow for **1** mark a straight line that passes through (0.1, 0)*

1

positive y-axis intercept
ignore any values on y-axis

1

(c) $0.15 = \frac{0.52}{\text{total P}}$

1

total P = 3.47 (W)

1

$\text{area} = \frac{3.47}{450}$

1

area = 7.7×10^{-3} (m^2)

*an answer of 7.7×10^{-3} (m^2) scores **4** marks*

allow use of student's calculated incorrect total power for last 2 marking points

1

(d) connect the solar cells in parallel

1

(so that) the current has multiple paths it can take

or

the total resistance is less than the resistance of one solar cell

1

[11]

Q9.

(a) 97 500 = 65.0 × t

1

$t = \frac{97500}{65.0}$

1

t = 1500 (s)

*an answer of 1500 (s) scores **3** marks*

*an answer of 1.5 scores **2** marks*

1

(b) $19.6 = I^2 \times 1.60$

1

$I^2 = \frac{19.6}{1.60}$

1

I = 3.5 (A)

allow 1 mark for a correct value for I correctly multiplied by 4

1

current through battery = 14 (A)

*an answer of 14 (A) scores **4** marks*

1

[7]

Q10.

(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]

Q11.

(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]

Q12.

(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 × 300

1

I = 18000 / 300 = 60

1

13 800 = (60^2) × 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]

Q13.

(a) any **one** from:

- high cost of installing overhead power lines or underground cables or pylons
- high cost as (very) long cables needed
- amount of electricity required is too low

allow not enough (surplus) electricity would be generated

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 apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
clear comparison of advantages **and** disadvantages of **each** method

Level 2 (3 – 4 marks):
at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method

Level 1 (1 – 2 marks):
at least **one** advantage **or one** disadvantage of either method

Level 0 (0 marks):
No relevant information

examples of physics points made in the response

Advantages of both methods:
- both renewable sources of energy
- both have no fuel (cost)
- both have very small (allow 'no') running costs
- no carbon dioxide produced

accept carbon neutral

accept no greenhouse gases

accept doesn't contribute to global warming

Advantages of wind:
- higher average power output

produces more energy is insufficient

Advantages of hydroelectric:
- constant / reliable power (output)
- lower (installation) cost

Disadvantages of wind:
- higher (installation) cost
- variable / unreliable power output
- (may) kill birds / bats

Disadvantages of hydroelectric:
- lower power output
- (may) kill fish or (may) damage habitats
- more difficult to set up (within river)

Disadvantages of both methods:
- (may be) noisy
- visual pollution

ignore payback time unless no other relevant points made

ignore time to build for both

6

[7]

Q14.

(a) field

correct order only

1

current

1

force

accept motion

accept thrust

1

(b) (i) arrow pointing vertically downwards

1

(ii) increase current / p.d.

accept voltage for p.d.

1

increase strength of magnetic field

accept move poles closer together

1

(iii) reverse (poles of) magnets

1

reverse battery / current

1

(c) (i) 1.5 or 150%

efficiency = 120 / 80 (× 100)

*gains **1** mark*

an answer of 1.5 % or 150

*gains **1** mark*

2

(ii) efficiency greater than 100%
or
output is greater than input
or
output should be 40 (W)

1

(iii) recorded time much shorter than actual time

accept timer started too late

accept timer stopped too soon

1

[12]

Q15.

(a) 4

1

(b) (i) 2

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

$I = \frac{100}{20}$

provided no subsequent step

2

(ii) 5

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

$V = \frac{100}{20}$

provided no subsequent step

2

[5]

Q16.

(a) increases

accept reaches highest value
*do **not** accept increases and decreases*

1

(b) (i) increases

1

(ii) increases

1

(c) 18

*allow **1** mark for correct substitution i.e. 12 × 1.5 provided no subsequent step*

2

watt

accept W
answer may be indicated in the list

1

[6]

Q17.

(a) (i) 1.7

1

(ii) 51
or
30 × their (i) correctly calculated

*allow **1** mark for correct substitution i.e. 1.7* $= \frac{Q}{30}$

or their (i) $= \frac{Q}{30}$

2

coulomb / C

*do **not** accept c*

1

(iii) 612

or

their (ii) × 12 correctly calculated

or

their (i) × 360 correctly calculated

*allow **1** mark for correct substitution i.e. E = 12 × 51*

or 12 × their (ii)

or their (i) × 360

2

(b) ions vibrate faster

or

ions vibrate with a bigger amplitude

accept atoms for ions throughout

accept ions gain energy

accept ions vibrate more

ions start to vibrate is insufficient

1

electrons collide more (frequently) with the ions

or

(drift) velocity of electrons decreases

electrons start to collide is insufficient

there are more collisions is insufficient, unless both electrons and ions are implied

1

[8]

Q18.

(a) decreased

correct order only

1

decreased

1

increased

1

(b) (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

[7]

Q19.

(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]

Q20.

(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]

Q21.

(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]

Q22.

(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]

Q23.

(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]

Q24.

(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]

Q25.

(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]

Q26.

(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]

Q27.

(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]

Q28.

(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]

Q29.

(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]

Q30.

(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]

Q31.

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

1.6 (W)

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

2

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

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]

Q32.

(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]

Q33.

(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]

Q34.

(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]

Q35.

(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]