AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.2.4 ENERGY TRANSFERS (PACK 1)

SCORE	PERCENTAGE
/275	%

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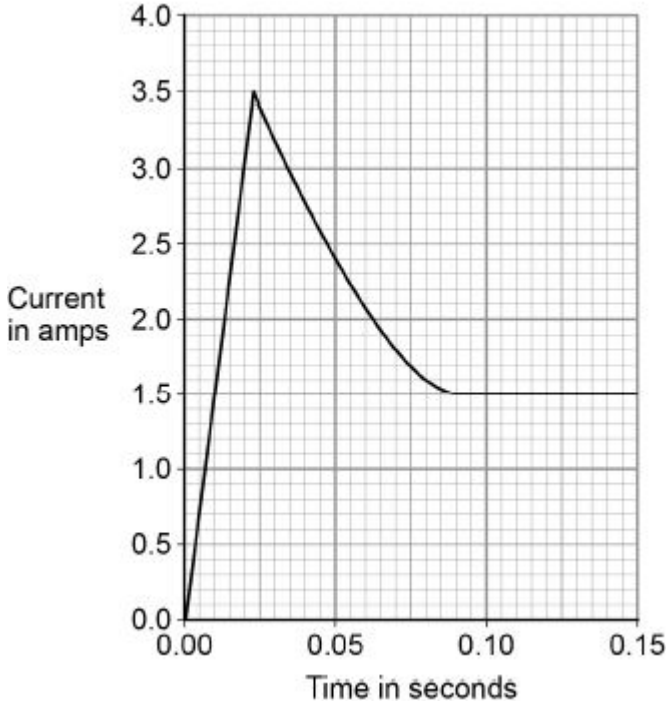
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Q1.

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)

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(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)

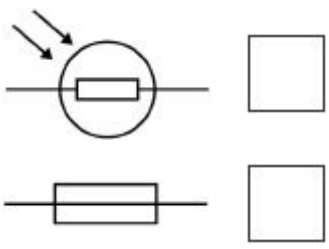
(Total 5 marks)

Q2.

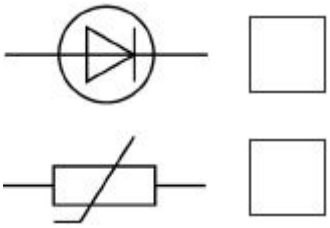
The plug of an electrical appliance contains a fuse.

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

Tick **one** box.



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(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

_____

_____

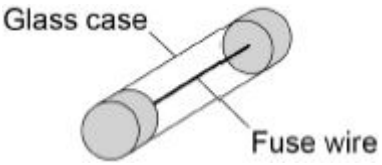
_____

_____

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)

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(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.

_____

_____

_____

_____

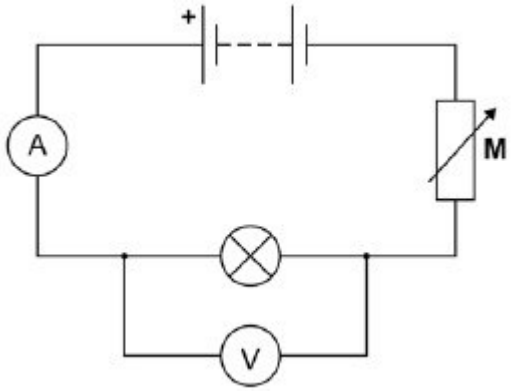
Energy = _____ J

(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?

_____

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_____

_____

(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.

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(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.

_____

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_____

_____

_____

_____

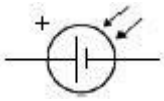
Mass = _____ kg

(5)

(Total 9 marks)

Q5.

Solar cells produce electricity using light from the Sun.

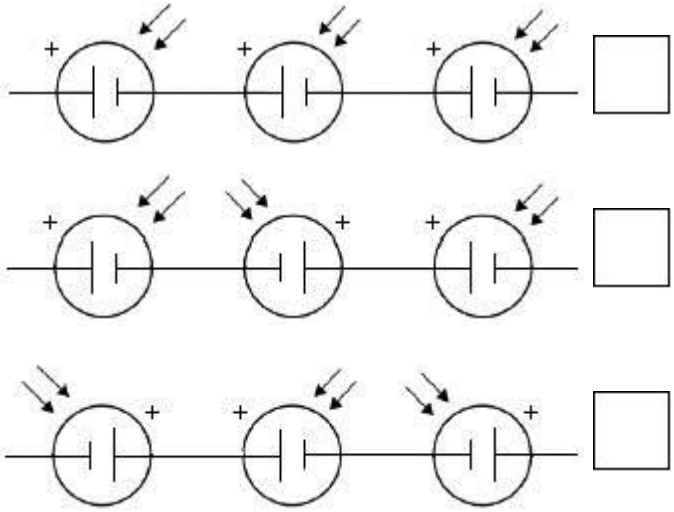
The symbol for a solar cell is: 

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:

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

_____

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_____

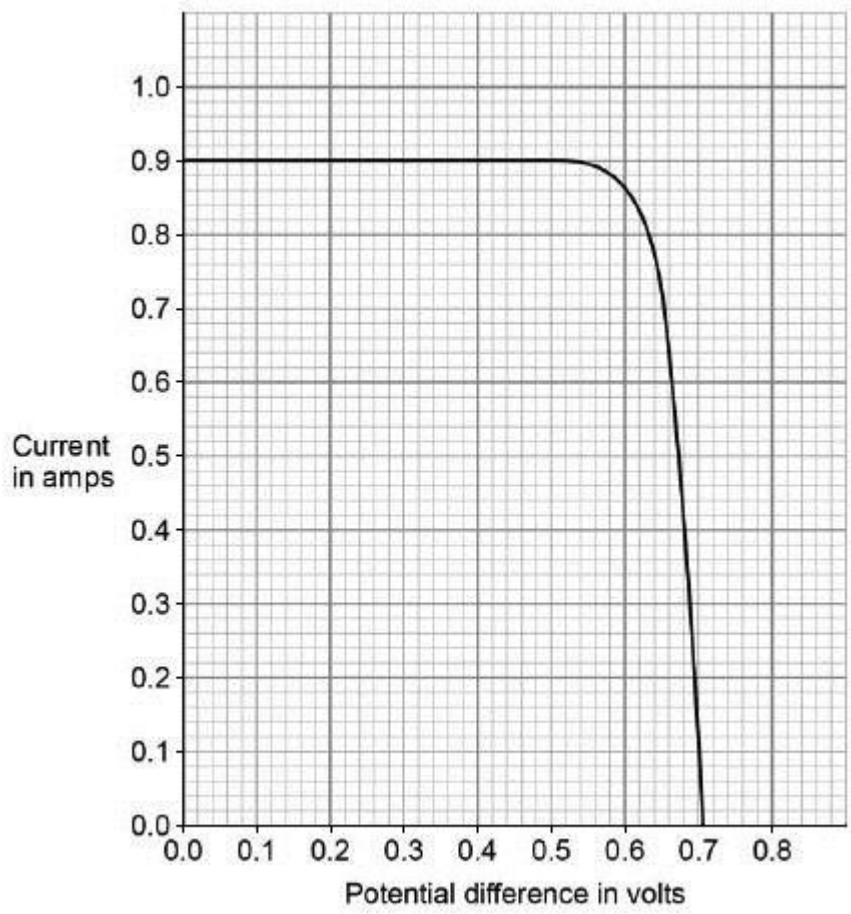
_____

_____

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.

_____

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_____

_____

(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.

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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

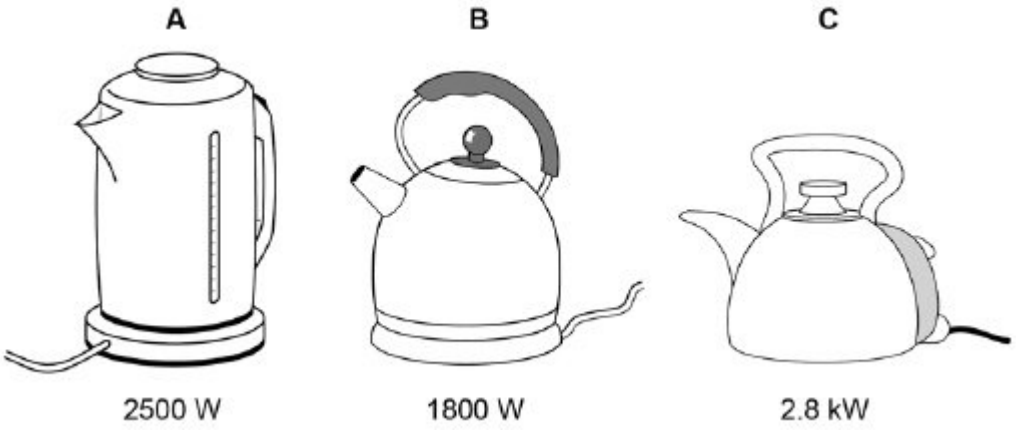
_____ polarity

(1)

Figure 1 gives the power output of three electric kettles.

Figure 1

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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 _____

_____

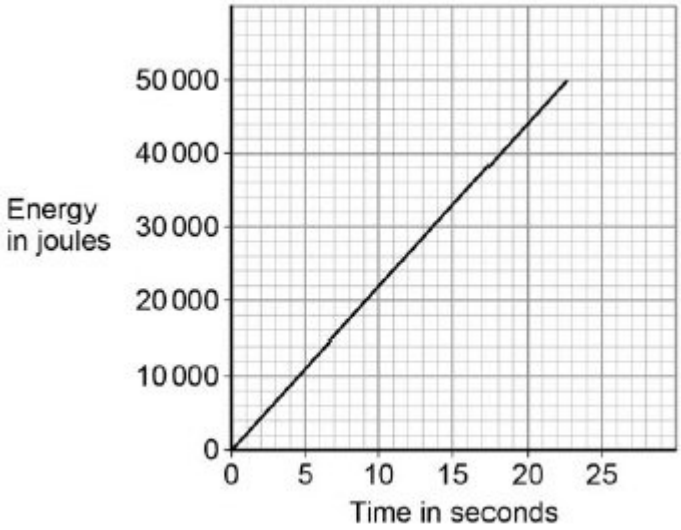
_____

(2)

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

Figure 2

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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)

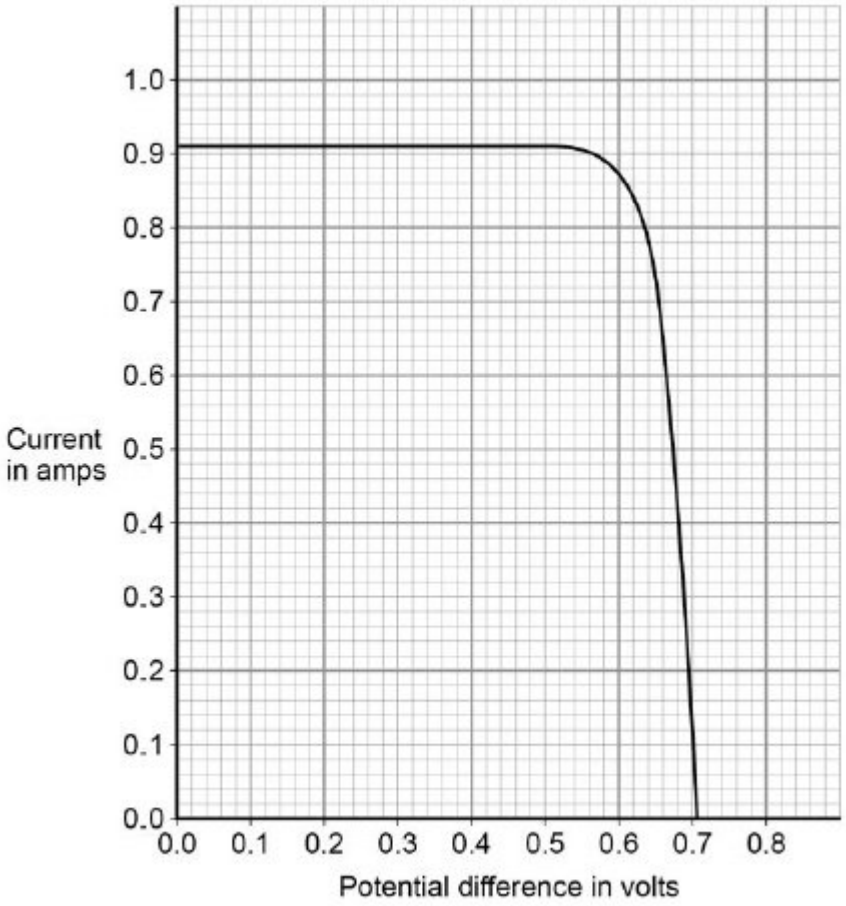
(Total 10 marks)

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

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

Use data from **Figure 1**.

_____

_____

_____

_____

_____

Power = _____ W

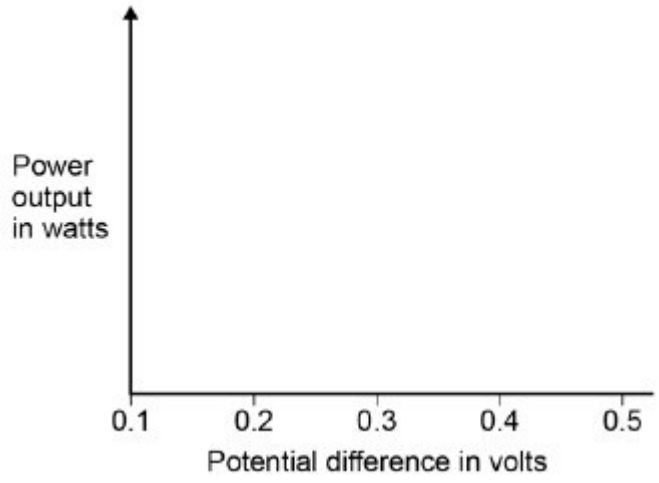
(3)

(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

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(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.

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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.

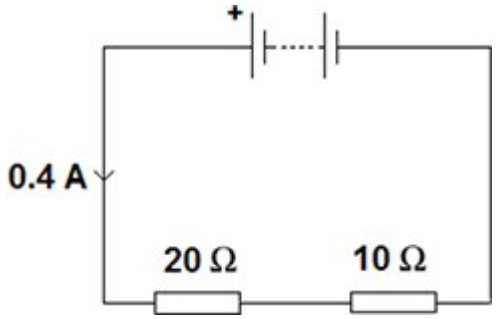
Current = _____ A

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(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.

_____

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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.

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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



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© Michael Priest

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

Explain why.

_____

_____

_____

_____

_____

_____

_____

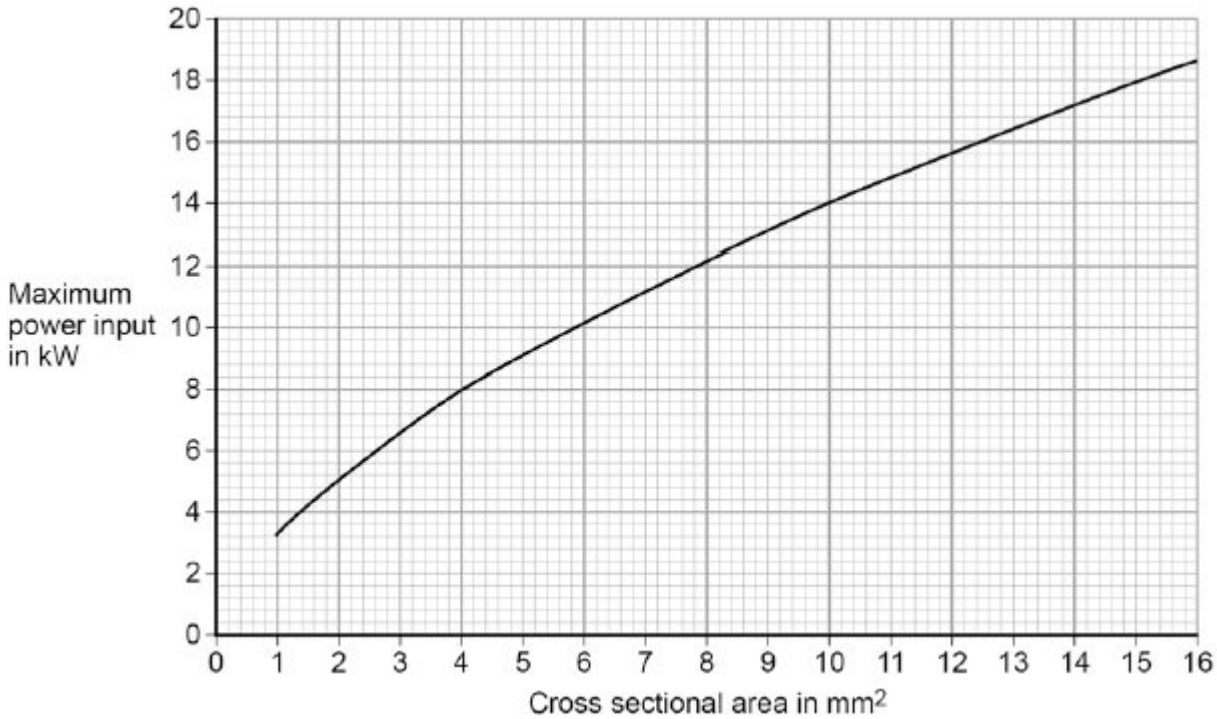
_____

(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:

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

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

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© 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.

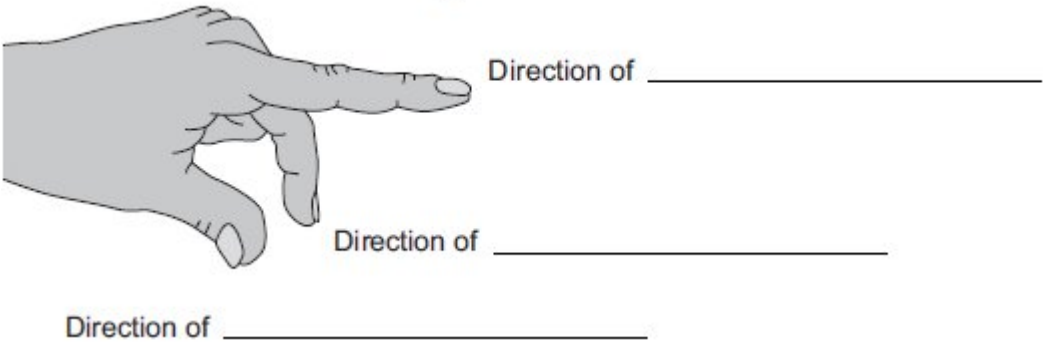
The left-hand rule can be used to identify the direction of the force acting on a current-carrying conductor in a magnetic field.

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

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

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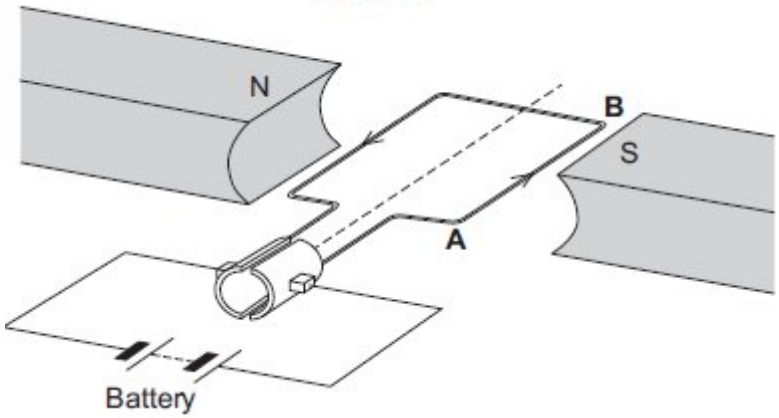
Figure 1



(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. _____

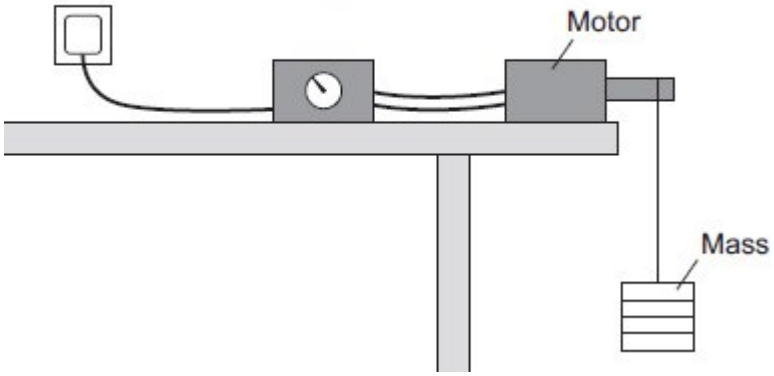
2. _____

(2)

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

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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.

_____

_____

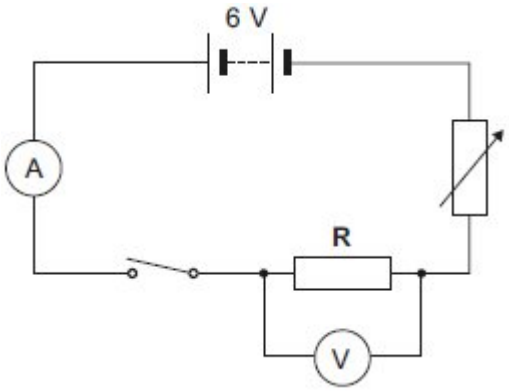
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(1)

(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

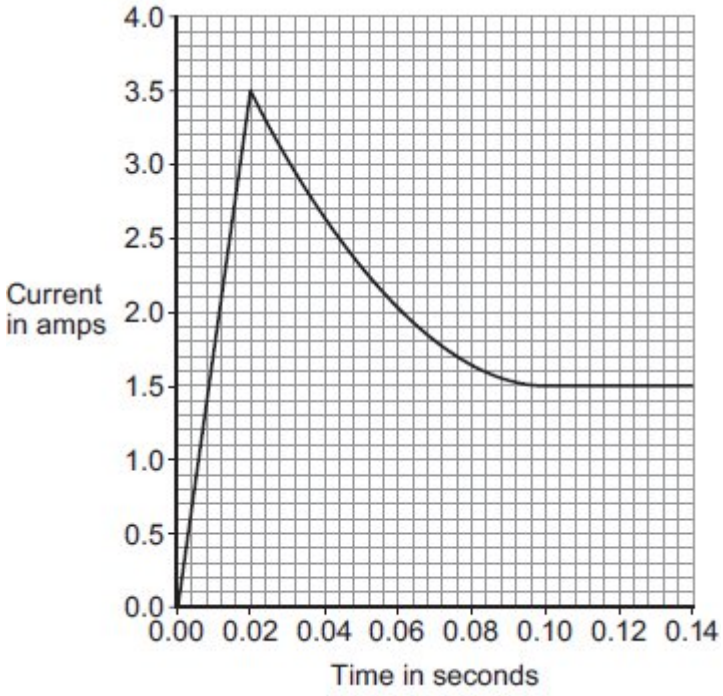
(2)

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(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.

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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**

_____

_____

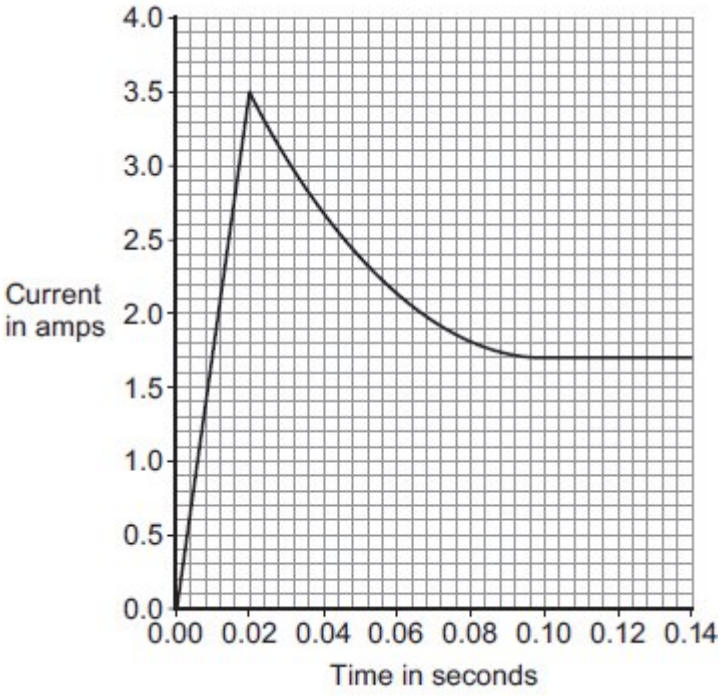
Power = _____ unit _____

(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.

_____

_____

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_____

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.

_____

_____

_____

_____

_____

_____

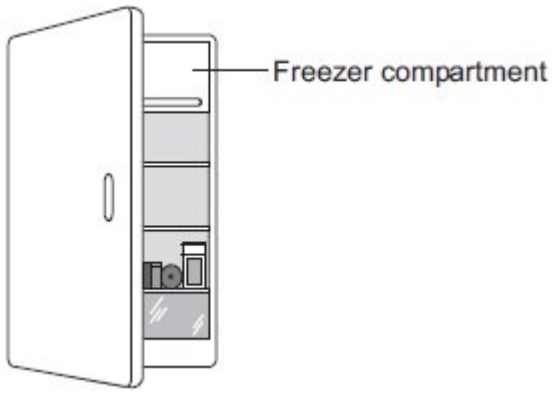
(2)

(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.

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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)

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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)

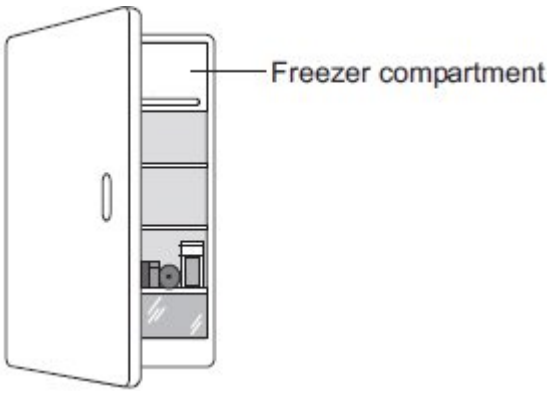
(Total 6 marks)

Q20.

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

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

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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.

_____

_____

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_____

_____

(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.

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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.

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_____

_____

_____

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.

_____

_____

_____

_____

_____

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_____

(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.

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

_____

_____

_____

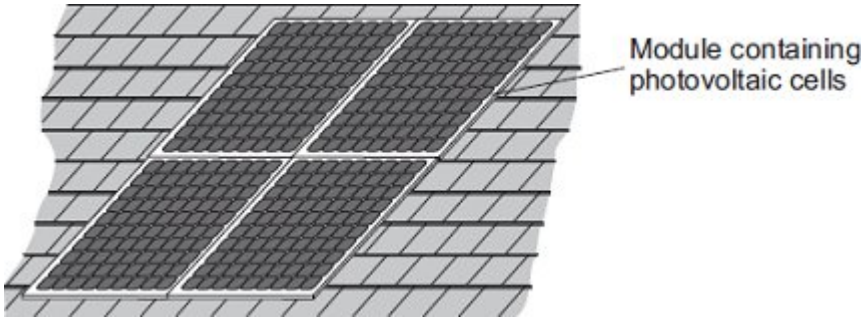
_____

(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

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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.

_____

_____

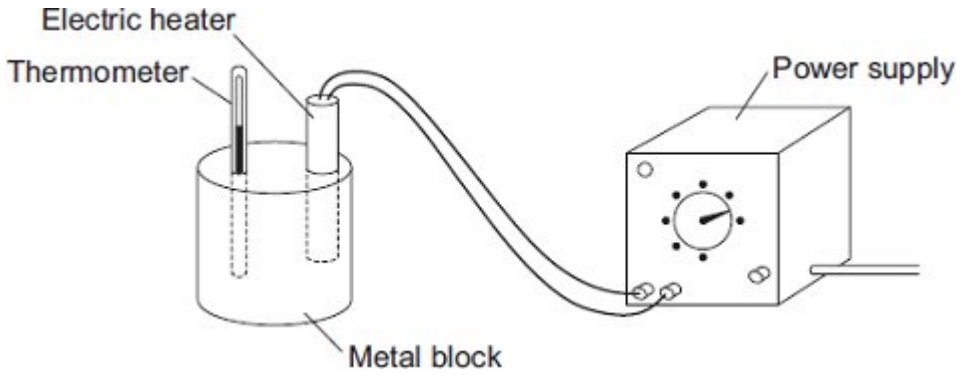
(1)

(Total 13 marks)

Q24.

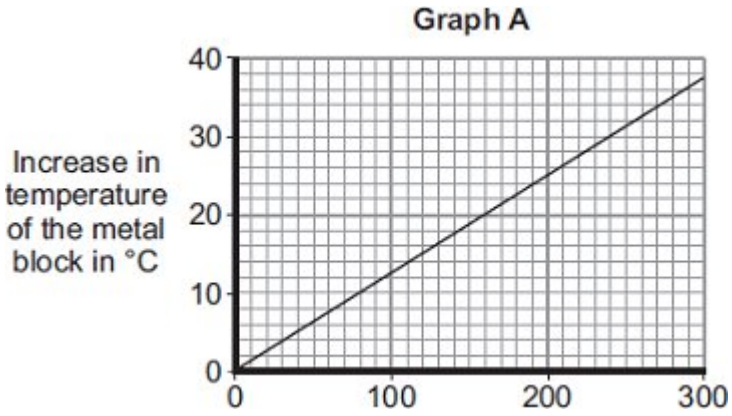
(a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.

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(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**.

_____

_____

_____

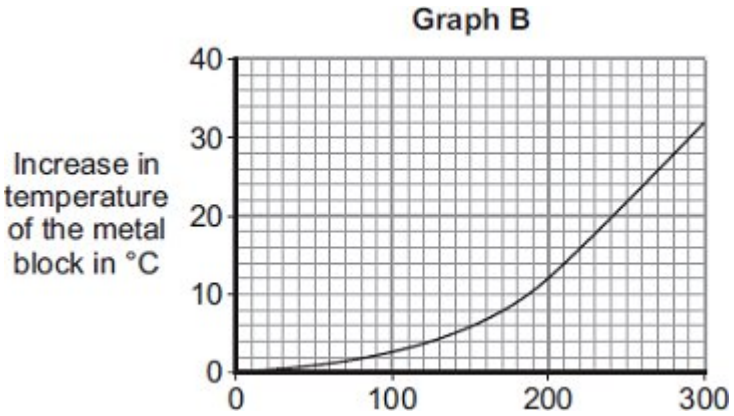
_____

(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**.

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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**

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

_____

_____

_____

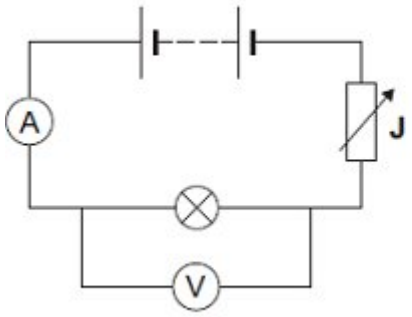
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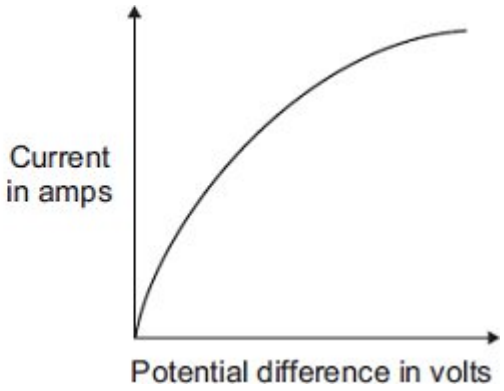
(2)

(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.

_____

_____

_____

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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.

_____

_____

_____

_____

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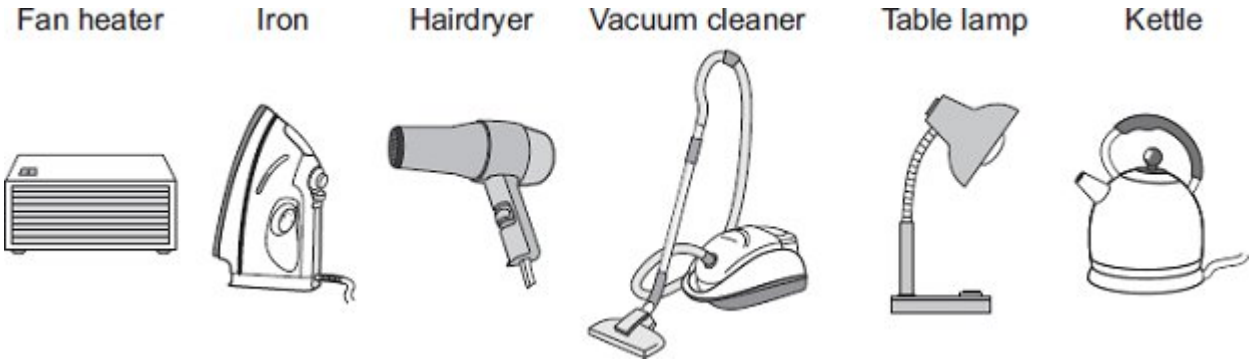
(6)

(Total 11 marks)

Q26.

The pictures show six different household appliances.

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(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.

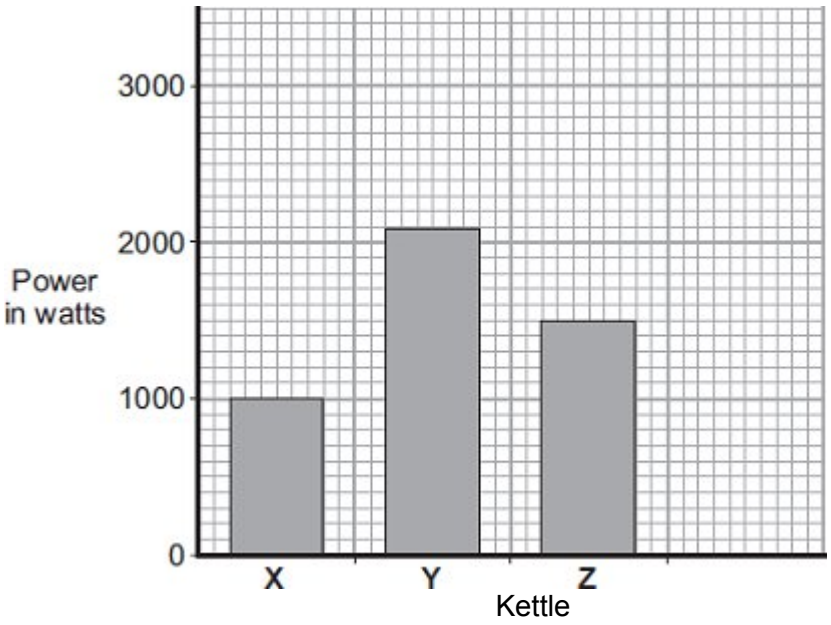
1. _____

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 ☐

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Y ☐

Z ☐

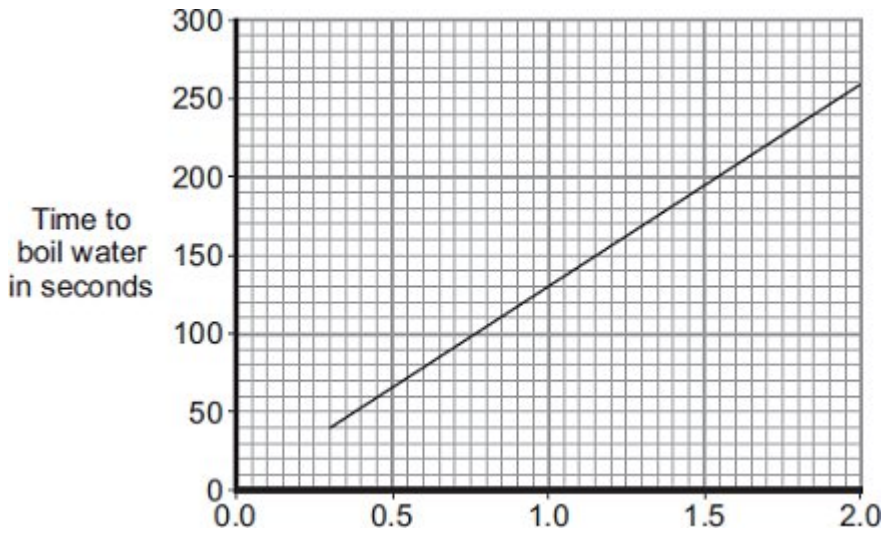
(1)

(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.

_____

_____

_____

_____

_____

_____

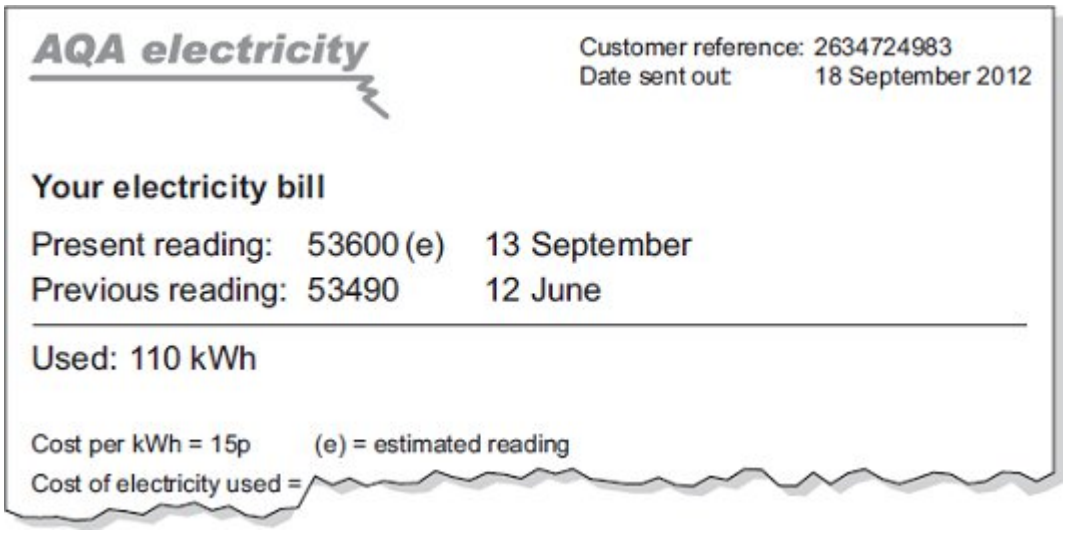
(3)

(Total 8 marks)

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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?

_____

_____

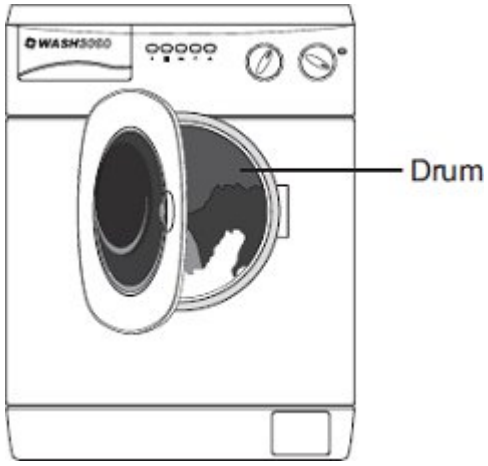
(2)

(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.

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(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)

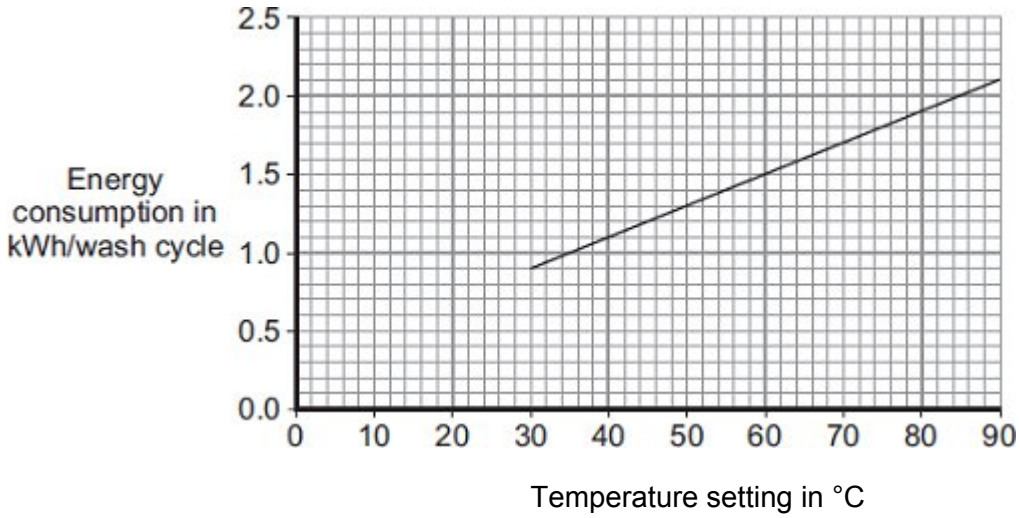
(b) What happens to the energy wasted by the electric motor?

_____

_____

(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.

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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.

_____

_____

_____

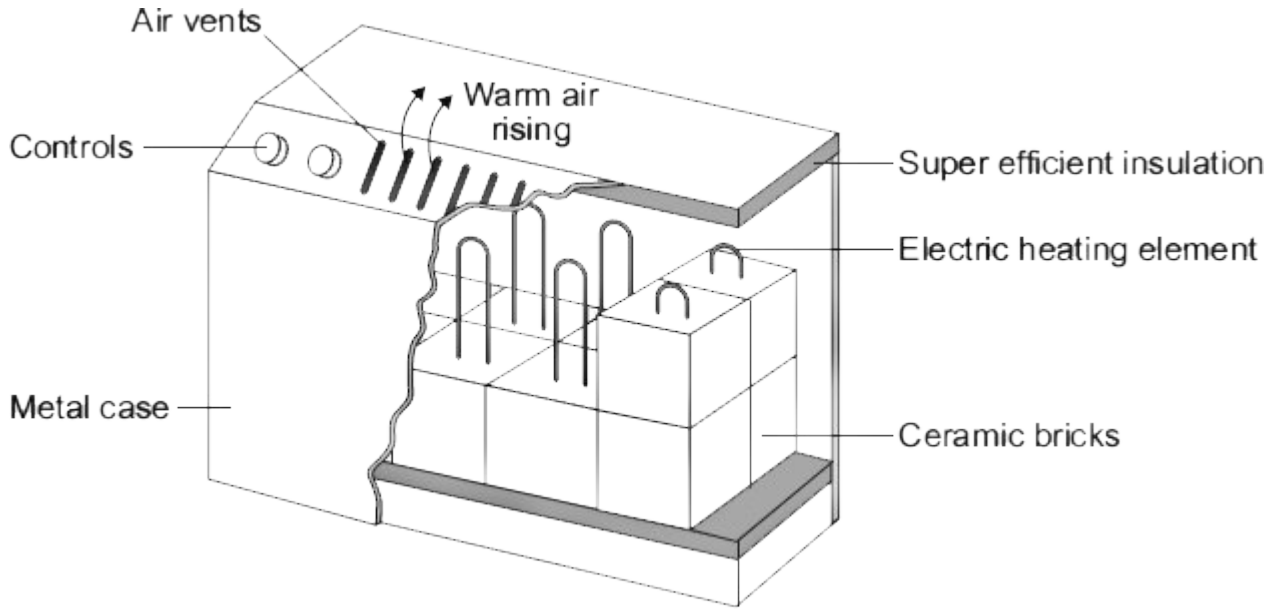
_____

(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.

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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)

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(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.

_____

_____

_____

_____

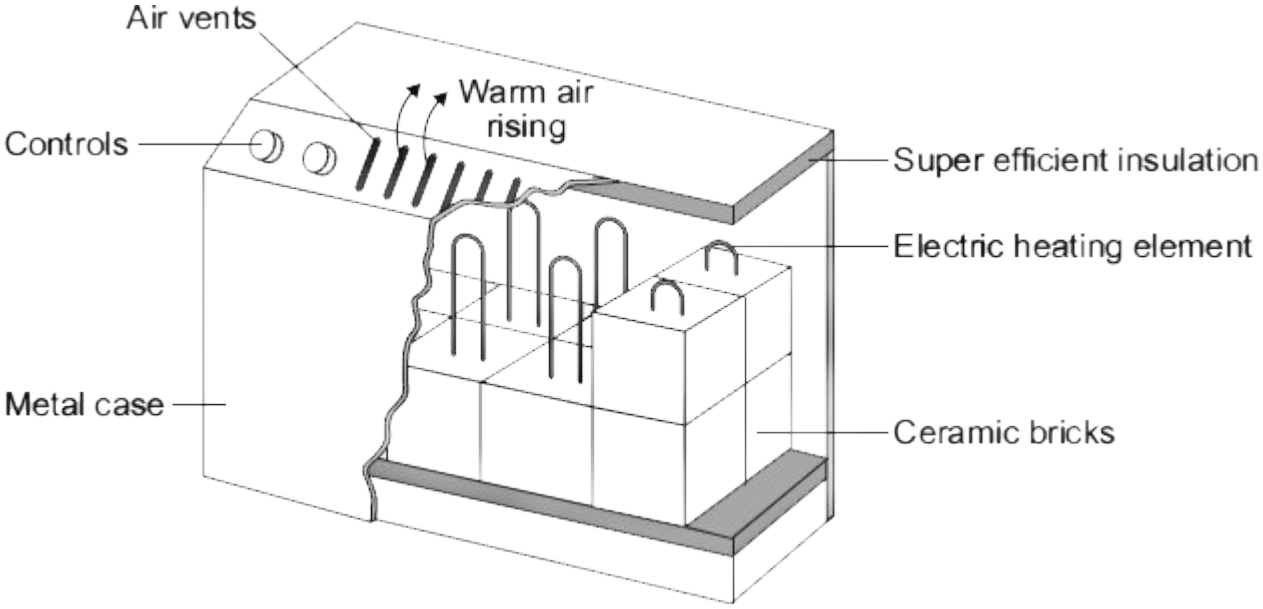
Energy transferred = _____ J

(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.

_____

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_____

_____

_____

_____

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.

_____

_____

_____

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_____

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.

_____

_____

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_____

_____

(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.

_____

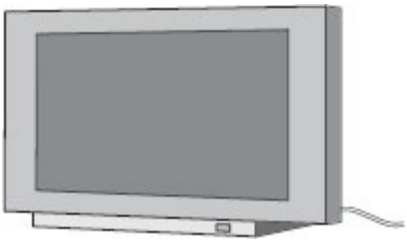
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(1)

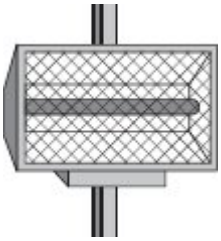
(Total 6 marks)

Q32.

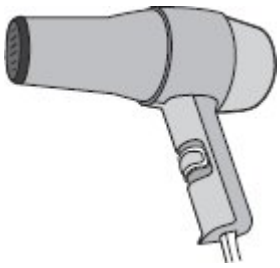
The data included in the diagrams gives the power of the electrical appliances.



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.

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(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.

_____

_____

_____

_____

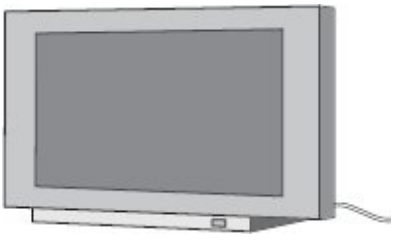
Cost = _____ pence

(2)

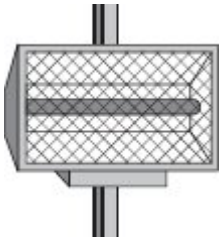
(Total 6 marks)

Q33.

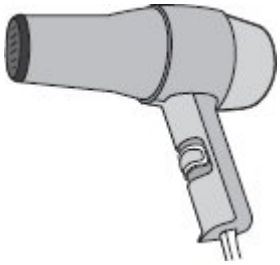
The data included in the diagrams gives the power of the electrical appliances.



TV



Radiant heater



Hairdryer

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160 W | 1.0 kW | 1100 W



Sandwich toaster
1.1 kW



Food processor
0.4 kW



Table lamp
40 W

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

_____

_____

(1)

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

_____

_____

(1)

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

Explain why.

_____

_____

_____

_____

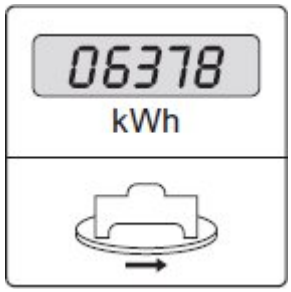
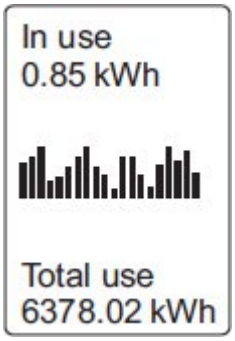
(2)

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

The table gives some information about each method.

Electricity meter	Electronic device
Records to the nearest kilowatt-hour	Records to the nearest 1/100th kilowatt-hour
Homeowner takes	Energy use recorded

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readings at regular intervals	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)

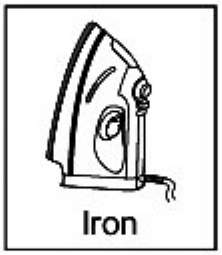
Q34.

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

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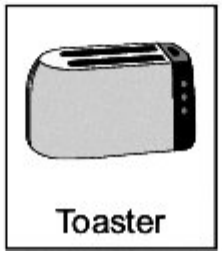














(a) The vacuum cleaner is designed to transfer electrical energy to kinetic energy.

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. ☐

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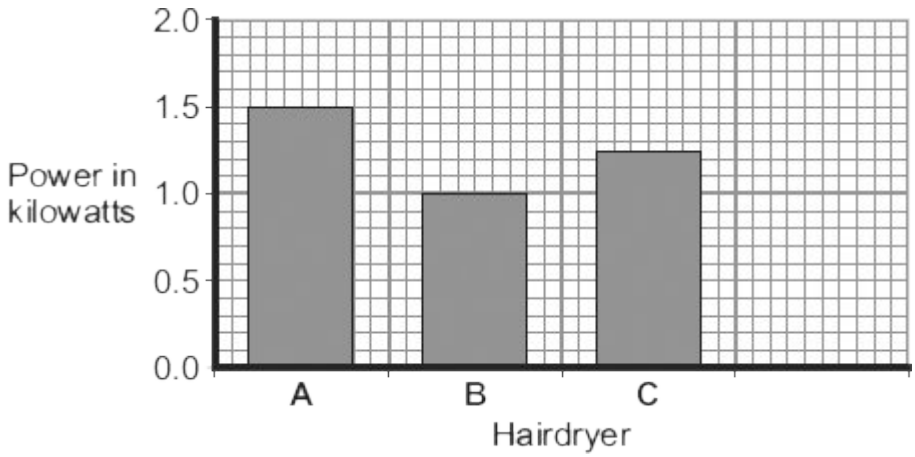
The energy output from an appliance is bigger than the energy input. ☐

(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.

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Show clearly how you work out your answer.

_____

_____

Cost = _____ pence

(2)

(Total 6 marks)

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