

1

Energy resources can be renewable or non-renewable.

(a) Coal is a non-renewable energy resource.

Name **two** other non-renewable energy resources.

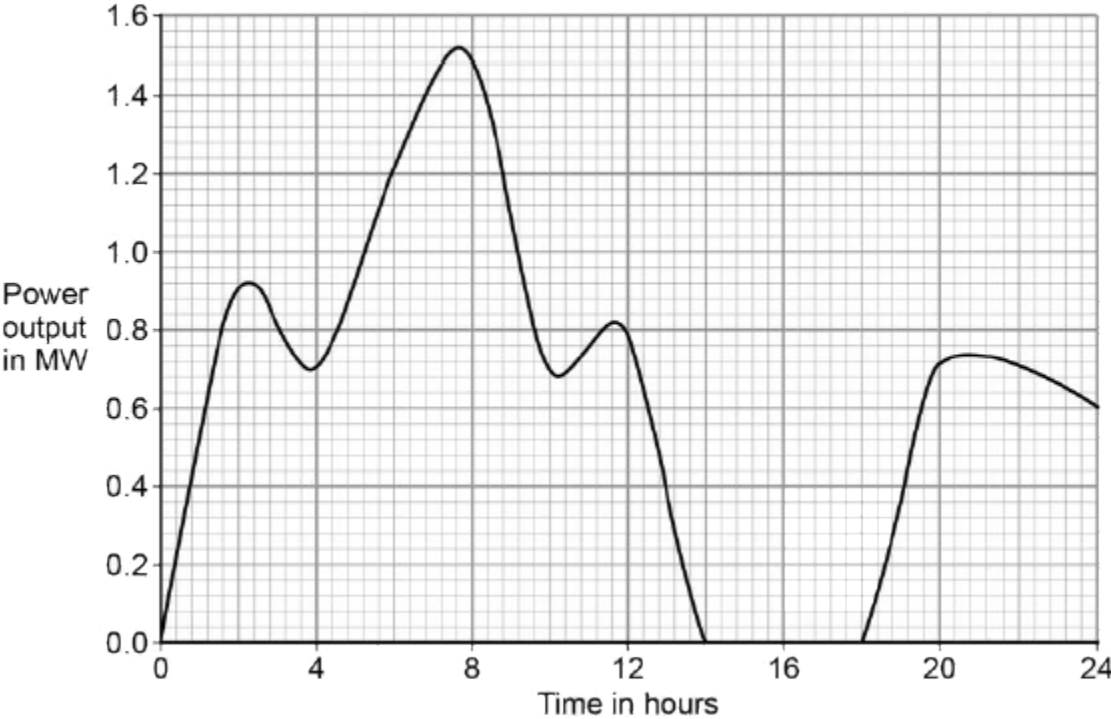
1

2

(2)

(b) Wind turbines are used to generate electricity.

The graph below shows how the power output of a wind turbine changes over one day.



A wind turbine does not generate electricity constantly.

For how many hours did the wind turbine generate no electricity?

.....

Time = hours

(1)

(c) Electrical power is transferred from power stations to the National Grid.

What is the National Grid?

Tick **one** box.

a system of cables and pylons

a system of cables and transformers

a system of cables, transformers and power stations

(1)

(d) An island has a large number of wind turbines and a coal-fired power station.

The island needs to use the electricity generated by the coal-fired power station at certain times.

Choose **one** reason why.

Tick **one** box.

Wind is a renewable energy resource.

Wind turbine power output is constant.

The power output of wind turbines is unpredictable.

The fuel cost for wind turbines is very high.

(1)

(e) A wind turbine has an average power output of 0.60 MW.

A coal-fired power station has a continuous power output of 1500 MW.

Calculate how many wind turbines would be needed to generate the same power output as one coal-fired power station.

.....
.....

Number of wind turbines =

(2)

(f) It is important that scientists develop new energy resources.

Choose **one** reason why.

Tick **one** box.

All energy resources are running out.

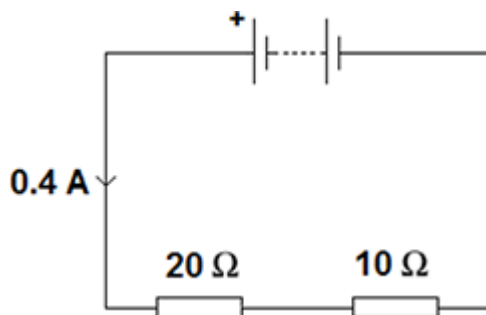
All energy resources are used to generate electricity.

Most energy resources have negative environmental effects.

(1)
(Total 8 marks)

2

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:

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

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

.....
.....

$$\text{Potential difference} = \text{..... V}$$

(3)

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

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

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

Give your answer to one significant figure.

.....

$$\text{Power} = \text{..... W}$$

(2)

(Total 6 marks)

3

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.

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.....

(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)

4

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.

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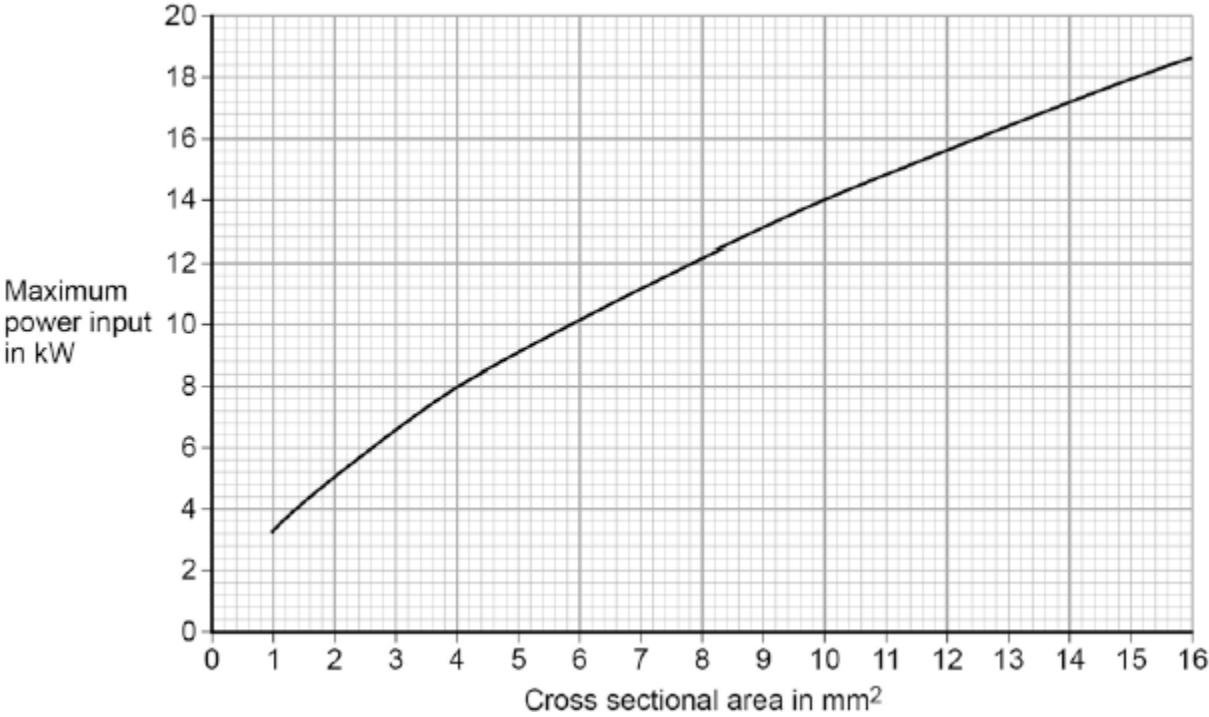
.....

(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.

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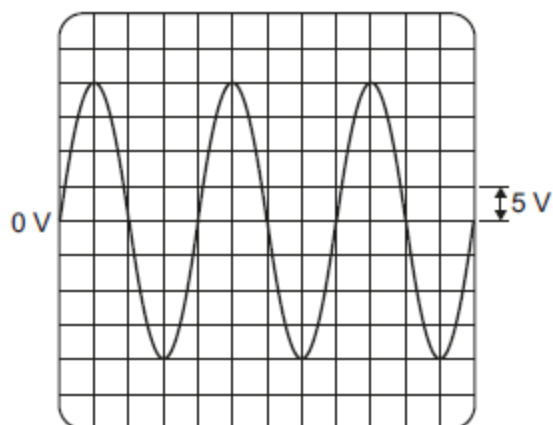
Resistance = Ω

(5)
(Total 11 marks)

5

- (a) **Figure 1** shows the oscilloscope trace an alternating current (a.c.) electricity supply produces.

Figure 1



One vertical division on the oscilloscope screen represents 5 volts.

Calculate the peak potential difference of the electricity supply.

.....

Peak potential difference = V

(1)

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

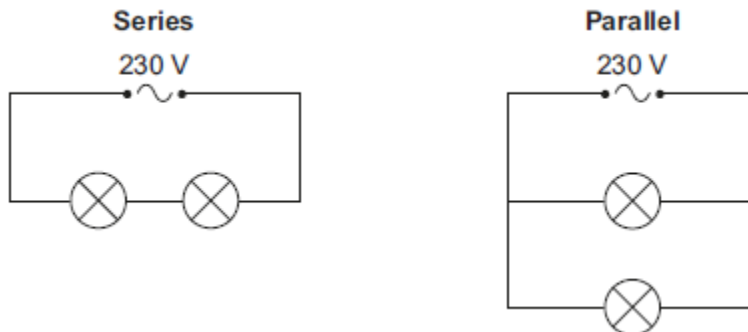
40	50	60
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In the UK, the frequency of the a.c. mains electricity supply is hertz.

(1)

(c) **Figure 2** shows how two lamps may be connected in series or in parallel to the 230 volt mains electricity supply.

Figure 2



(i) Calculate the potential difference across each lamp when the lamps are connected in **series**.

The lamps are identical.

.....

Potential difference when in series = V

(1)

(ii) What is the potential difference across each lamp when the lamps are connected in **parallel**?

Tick (✓) **one** box.

115 V

230 V

460 V

(1)

(iii) Give **one** advantage of connecting the lamps in parallel instead of in series.

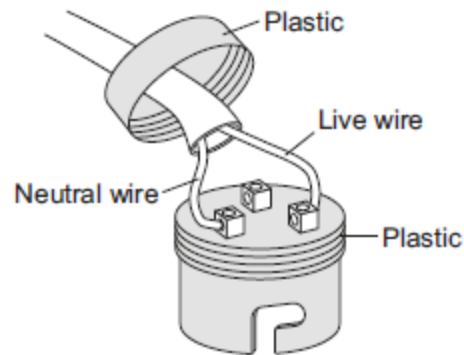
.....

.....

(1)

- (d) **Figure 3** shows the light fitting used to connect a filament light bulb to the mains electricity supply.

Figure 3



The light fitting does **not** have an earth wire connected.

Explain why the light fitting is safe to use.

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.....

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(2)

- (e) A fuse can be used to protect an electrical circuit.

Name a different device that can also be used to protect an electrical circuit.

.....

(1)

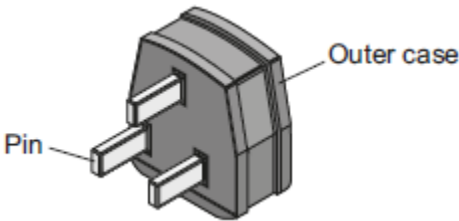
(Total 8 marks)

6

(a) A washing machine is connected to the mains electricity supply using a cable and three-pin plug.

Figure 1 shows a three-pin plug.

Figure 1



Name the materials used in the structure of a plug. Give the reason why each material is used.

Pin

.....

Outer case

.....

(1)

(b) The three-pin plug contains a fuse. The fuse is connected to one of the wires inside the cable.

(i) Which **one** of the wires inside the cable is the fuse connected to?

.....

(1)

(ii) The fuse is a thin wire inside a closed glass tube. The wire acts as a resistor.

What effect does a current through a wire have on the wire?

.....

(1)

- (iii) The power of the washing machine varies between 0.7 kW and 2 kW depending on which part of the wash cycle is operating.

Calculate the maximum current drawn from the mains electricity supply by the washing machine.

The mains electricity supply is at a potential difference of 230 V.

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.....
.....

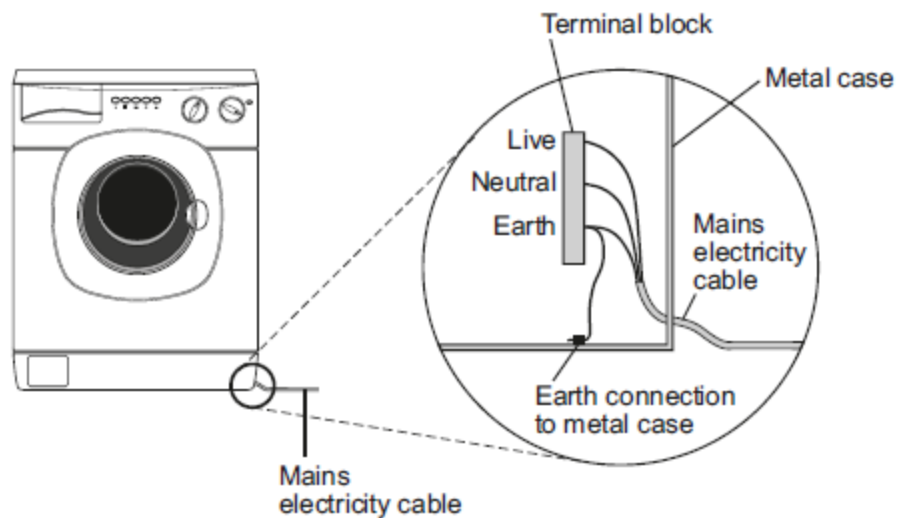
Current = A

(2)

- (c) **Figure 2** shows how the mains electricity cable is connected to the washing machine.

The earth wire is connected to the metal case of the washing machine.

Figure 2



If a fault makes the metal case live, the earth wire and fuse inside the plug prevent the mains cable from overheating and causing a fire.

Explain how.

.....
.....
.....
.....

(2)

- (d) New research has shown that many people underestimate the hazards of using mains electricity.

It is important that people do understand the hazards of using mains electricity.

Suggest why.

.....

.....

.....

(1)
(Total 9 marks)

7

Many electrical appliances are connected to the mains supply using a three-core cable and a three-pin plug.

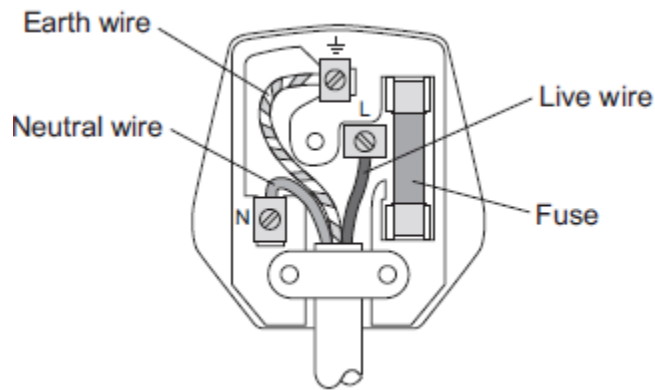
- (a) Use the correct answer from the box to complete the sentence.

charge	energy	power
---------------	---------------	--------------

Electric current is the rate of flow of

(1)

- (b) The diagram shows a three-pin plug connected to a three-core cable.



- (i) The three wires of the three-core cable have different coloured coverings.

State the colour of the covering of the neutral wire.

.....

(1)

(ii) Which **two** parts of the plug shown above protect the wiring of a circuit?

Tick (✓) **two** boxes.

	Tick (✓)
Earth wire	
Fuse	
Live wire	
Neutral wire	

(2)

(c) Some electrical appliances are connected to the mains supply using a two-core cable and a three-pin plug. Appliances that are double insulated do not require all three wires.

(i) What does 'double insulated' mean?

.....
.....

(1)

(ii) State which of the three wires is **not** required.

.....

(1)

(d) (i) An electrical appliance is connected to a 20 V supply.

The current in the appliance is 3 A.

Calculate the power of the appliance.

.....
.....

Power = W

(2)

(ii) Another electrical appliance is connected to a 20 V supply.

The appliance transfers 300 J of energy.

Calculate the charge.

Give the unit.

.....
.....

Charge =

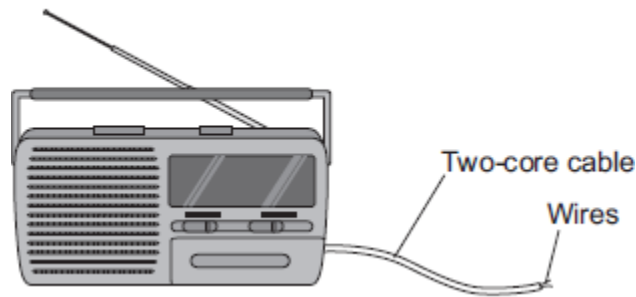
Unit

(3)
(Total 11 marks)

8

Figure 1 shows a radio. The radio can be powered by connecting the two-core cable to the mains electricity supply.

Figure 1



(a) (i) What must be fitted to the cable before it can be connected to the mains electricity supply?

.....

(1)

- (ii) There are only two wires inside the cable.
What are the names of the two wires inside the cable?

Tick (✓) **one** box.

Earth and live

Earth and neutral

Live and neutral

(1)

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

double

extra

fully

It is safe to connect the radio to the mains electricity supply using a two-core cable
because the radio is insulated.

(1)

- (b) The radio can also be powered by a battery.

What type of current does a battery supply?

Tick (✓) **one** box.

Alternating current (a.c.) only

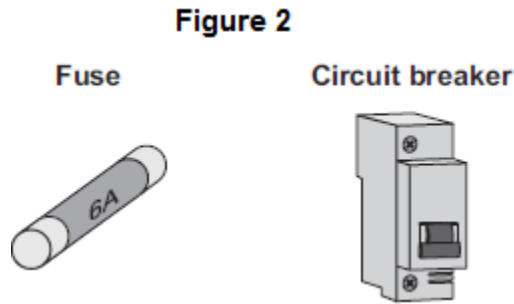
Direct current (d.c.) only

Both a.c. and d.c.

(1)

(c) **Figure 2** shows a fuse and a circuit breaker.

Fuses and circuit breakers are able to disconnect and switch off circuits.



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

earth	live	neutral
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A fuse or a circuit breaker is connected to the wire in a circuit.

(1)

(ii) What happens to cause a fuse or circuit breaker to disconnect a circuit?

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(1)

(iii) Suggest **two** advantages of using a circuit breaker to disconnect a circuit compared with using a fuse.

1.....
.....
2.....
.....

(2)

(Total 8 marks)

9

A student finds some information about energy-saving light bulbs.

(a) A 30W light bulb uses 600J of electrical energy in a certain period of time. In that time, it produces 450 J of light energy. The rest of the energy is wasted.

(i) Calculate the energy wasted by the light bulb in this period of time.

.....

Wasted energy = J

(1)

(ii) What happens to the energy wasted by the light bulb?

.....
.....

(1)

(iii) Calculate the efficiency of this light bulb.

.....
.....

Efficiency =

(2)

(iv) Calculate the period of time, in seconds, during which the 600 J is provided to the 30 W light bulb.

.....
.....

Time = s

(2)

(b) A company that makes light bulbs provides information about some of their products.

The table shows some of this information.

	Power in watts	Lifetime in hours	Cost of bulb in £
Filament bulb	60	1250	2.00
LED bulb	12	50 000	16.00

(i) Suggest why it is important to confirm this information independently.

.....

(1)

(ii) A homeowner is thinking about replacing his filament bulbs with LED bulbs.

A 12 W LED bulb gives the same light output as a 60 W filament bulb.

Suggest reasons why the homeowner is likely to choose LED bulbs.

Use the information given in the table.

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(2)

(iii) State **one** factor, other than efficiency, that is important when considering the choice of a bulb for lighting in the home.

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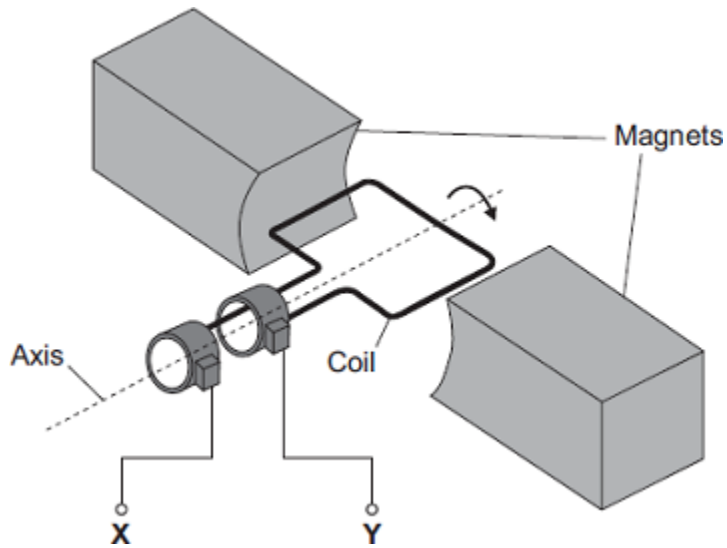
(1)

(Total 10 marks)

10

The diagram shows an a.c. generator.

The coil rotates about the axis shown and cuts through the magnetic field produced by the magnets.



(a) (i) A potential difference is induced between **X** and **Y**.

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

electric	generator	motor	transformer
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This effect is called the effect.

(1)

(ii) What do the letters a.c. stand for?

.....

(1)

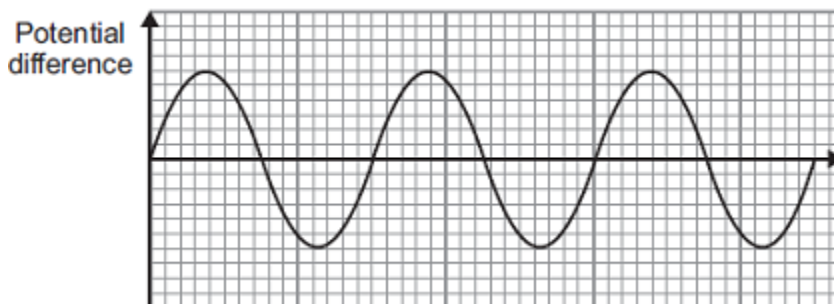
(iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

.....

(1)

(b) **Graph 1** shows the output from the a.c. generator.

Graph 1



(i) One of the axes on **Graph 1** has been labelled 'Potential difference'.

What should the other axis be labelled?

.....

(1)

(ii) The direction of the magnetic field is reversed.

On **Graph 1**, draw the output from the a.c. generator if everything else remains the same.

(2)

(c) The number of turns of wire on the coil is increased. This increases the maximum induced potential difference.

State **two** other ways in which the maximum induced potential difference could be increased.

1

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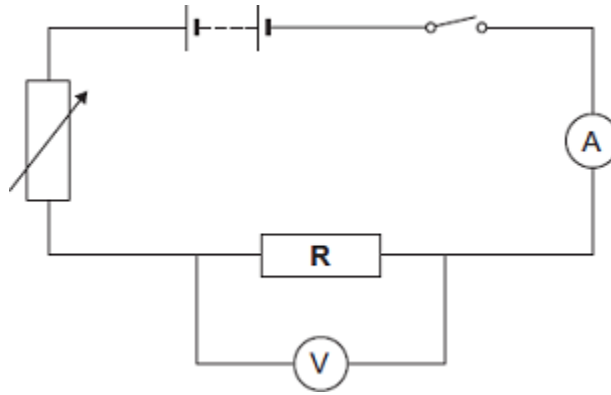
2

.....

(2)
(Total 8 marks)

11

(a) A resistor is a component that is used in an electric circuit.



(i) Describe how a student would use the circuit to take the readings necessary to determine the resistance of resistor **R**.

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(6)

(ii) Explain why the student should open the switch after each reading.

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(2)

(iii) In an experiment using this circuit, an ammeter reading was 0.75 A.
The calculated value of the resistance of resistor **R** was 16 Ω.

What is the voltmeter reading?

.....
.....

Voltmeter reading = V

(2)

(iv) The student told his teacher that the resistance of resistor **R** was 16 Ω.

The teacher explained that the resistors used could only have one of the following values of resistance.

10 Ω 12 Ω 15 Ω 18 Ω 22 Ω

Suggest which of these resistors the student had used in his experiment.

Give a reason for your answer.

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(2)

(b) The diagram shows a fuse.



Describe the action of the fuse in a circuit.

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(3)
(Total 15 marks)

12

The current in a circuit depends on the potential difference (p.d.) provided by the cells and the total resistance of the circuit.

(a) Using the correct circuit symbols, draw a diagram to show how you would connect 1.5 V cells together to give a p.d. of 6 V.

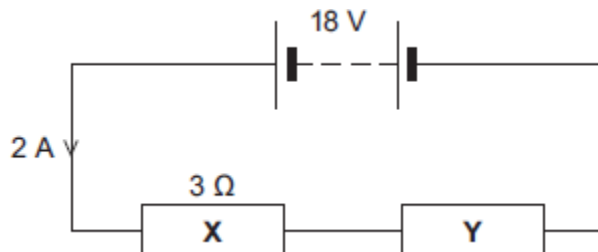
(2)

(b) **Figure 1** shows a circuit containing an 18 V battery.

Two resistors, **X** and **Y**, are connected in series.

- **X** has a resistance of 3 Ω .
- There is a current of 2 A in **X**.

Figure 1



(i) Calculate the p.d. across **X**.

.....
.....

P.d. across **X** = V

(2)

(ii) Calculate the p.d. across **Y**.

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.....

P.d. across **Y** = V

(2)

(iii) Calculate the total resistance of **X** and **Y**.

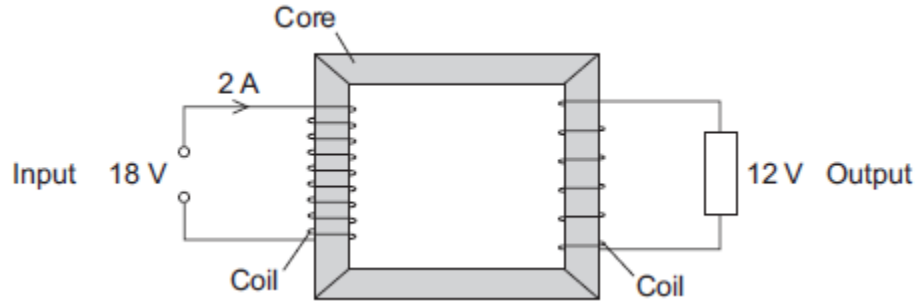
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Total resistance of **X** and **Y** = Ω

(2)

(c) **Figure 2** shows a transformer.

Figure 2



(i) An 18 V battery could **not** be used as the input of a transformer.

Explain why.

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.....
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(2)

(ii) The transformer is 100% efficient.

Calculate the output current for the transformer shown in **Figure 2**.

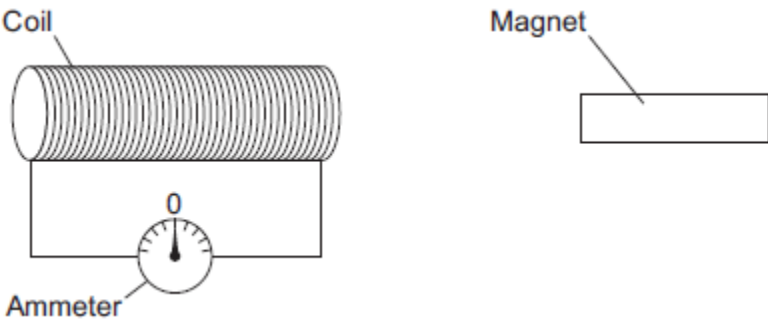
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Output current = A

(2)
(Total 12 marks)

13

The figure below shows a coil and a magnet. An ammeter is connected to the coil.



The ammeter has a centre zero scale, so that values of current going in either direction through the coil can be measured.

- (a) A teacher moves the magnet slowly towards the coil.

Explain why there is a reading on the ammeter.

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(6)

(b) The table below shows some other actions taken by the teacher.

Complete the table to show the effect of each action on the ammeter reading.

Action taken by teacher	What happens to the ammeter reading?
Holds the magnet stationary and moves the coil slowly towards the magnet	
Holds the magnet stationary within the coil	
Moves the magnet quickly towards the coil	
Reverses the magnet and moves it slowly towards the coil	

(4)

(c) The magnet moves so that there is a steady reading of 0.05 A on the ammeter for 6 seconds.

Calculate the charge that flows through the coil during the 6 seconds.

Give the unit.

.....
.....
.....

Charge =

(3)
(Total 13 marks)

14

If a fault develops in an electrical circuit, the current may become too great. The circuit needs to be protected by being disconnected.

A fuse or a circuit breaker may be used to protect the circuit.
One type of circuit breaker is a Residual Current Circuit Breaker (RCCB).

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

earth	live	neutral
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A fuse is connected in the wire.

(1)

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

are bigger	are cheaper	react faster
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RCCBs are sometimes preferred to fuses because they

(1)

(iii) RCCBs operate by detecting a difference in the current between two wires.

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

earth and live	earth and neutral	live and neutral
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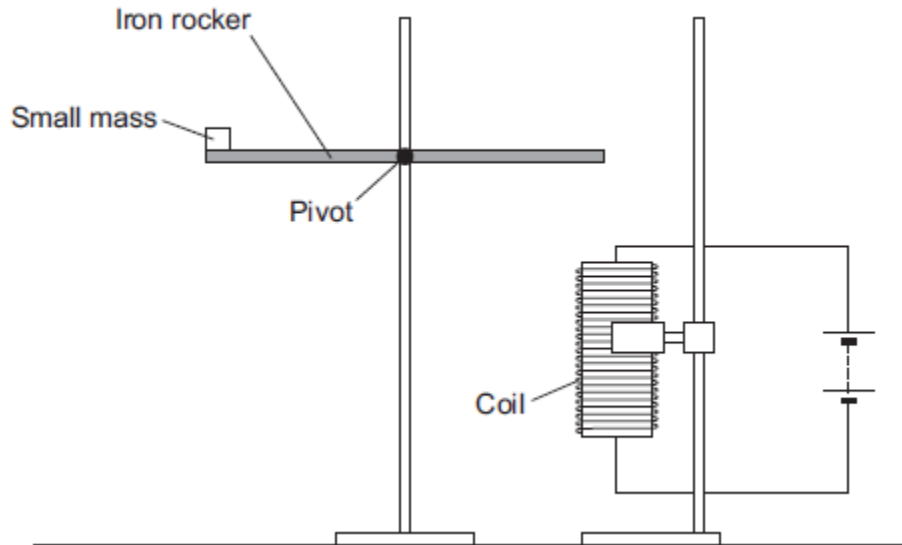
The two wires are the wires.

(1)

(b) An RCCB contains an iron rocker and a coil.

A student investigated how the force of attraction, between a coil and an iron rocker, varies with the current in the coil.

She supported a coil vertically and connected it in an electrical circuit, part of which is shown in the figure below .



She put a small mass on the end of the rocker and increased the current in the coil until the rocker balanced. She repeated the procedure for different masses.

Some of her results are shown in the table below.

Mass in grams	Current needed for the rocker to balance in amps
5	0.5
10	1.0
15	1.5
20	2.0

(i) State **two** extra components that must have been included in the circuit in the figure above to allow the data in the above table to be collected.

Give reasons for your answers.

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.....

(4)

(ii) A teacher said that the values of current were too high to be safe.

Suggest **two** changes that would allow lower values of current to be used in this investigation.

Change 1
.....

Change 2
.....

(2)
(Total 9 marks)

15

(a) A company is developing a system which can heat up and melt ice on roads in the winter. This system is called 'energy storage'.

During the summer, the black surface of the road will heat up in the sunshine.

This energy will be stored in a large amount of soil deep under the road surface. Pipes will run through the soil. In winter, cold water entering the pipes will be warmed and brought to the surface to melt ice.

The system could work well because the road surface is black.

Suggest why.

.....
.....

(1)

(b) (i) What is meant by specific latent heat of fusion?

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.....
.....

(2)

(ii) Calculate the amount of energy required to melt 15 kg of ice at 0 °C.

Specific latent heat of fusion of ice = 3.4×10^5 J/kg.

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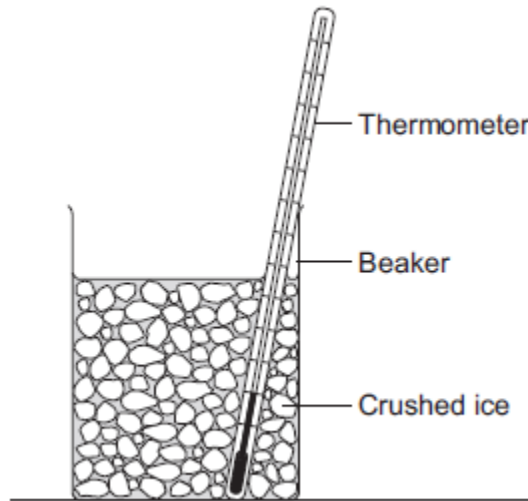
Energy = J

(2)

(c) Another way to keep roads clear of ice is to spread salt on them.
When salt is added to ice, the melting point of the ice changes.

A student investigated how the melting point of ice varies with the mass of salt added.

The figure below shows the equipment that she used.



The student added salt to crushed ice and measured the temperature at which the ice melted.

(i) State **one** variable that the student should have controlled.

.....
.....

(1)

(ii) During the investigation the student stirred the crushed ice.

Suggest **two** reasons why.

Tick (✓) **two** boxes.

	Tick (✓)
To raise the melting point of the ice	
To lower the melting point of the ice	
To distribute the salt throughout the ice	
To keep all the ice at the same temperature	
To reduce energy transfer from the surroundings to the ice	

(2)

(iii) The table below shows the data that the student obtained.

Mass of salt added in grams	0	10	20
Melting point of ice in °C	0	-6	-16

Describe the pattern shown in the table.

.....
.....

(1)

(d) Undersoil electrical heating systems are used in greenhouses. This system could also be used under a road.

A cable just below the ground carries an electric current. One greenhouse system has a power output of 0.50 kW.

Calculate the energy transferred in 2 minutes.

.....
.....
.....

Energy transferred = J

(3)

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

A local council wants to keep a particular section of a road clear of ice in the winter.

Describe the advantages and disadvantages of keeping the road clear of ice using:

- energy storage
- salt
- undersoil electrical heating.

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Extra space

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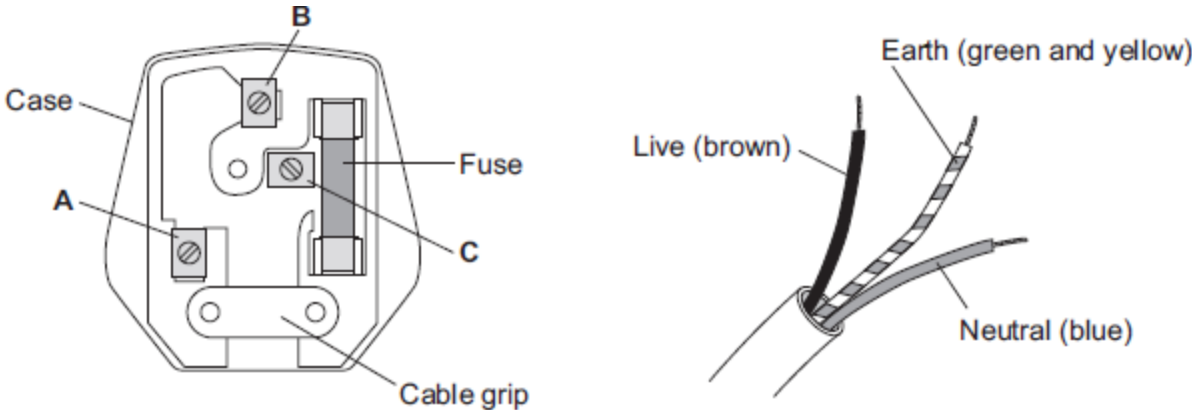
(6)
(Total 18 marks)

16

(a) **Figure 1** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

Figure 1



(i) Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

Table 1

Wire	Plug terminal
Live	
Neutral	
Earth	

(2)

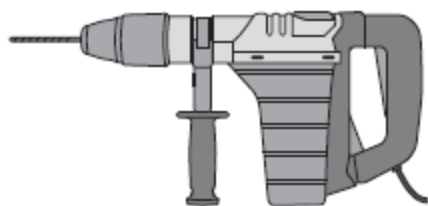
(ii) Name a material that could be used to make the case of the plug.

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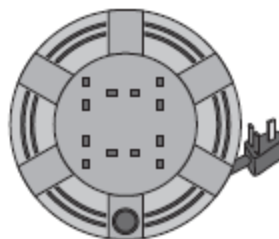
(1)

- (b) **Figure 2** shows an electric drill and an extension lead. The drill is used with the extension lead.

Figure 2



Electric drill



Extension lead

- (i) The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity supply to the drill.

Calculate the power of the drill.

.....
.....
.....

Power = W

(2)

(ii) A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

When in use the lead may get hot:

DO NOT go over the maximum power

- lead wound inside the case: 820 watts
- lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

.....

.....

.....

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.....

.....

(3)

(c) **Table 2** gives information about three different electric drills.

Table 2

Drill	Power input in watts	Power output in watts
X	640	500
Y	710	500
Z	800	500

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box.

Give a reason for your answer.

.....
.....
.....

(1)
(Total 9 marks)

17

Solar panels are often seen on the roofs of houses.

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

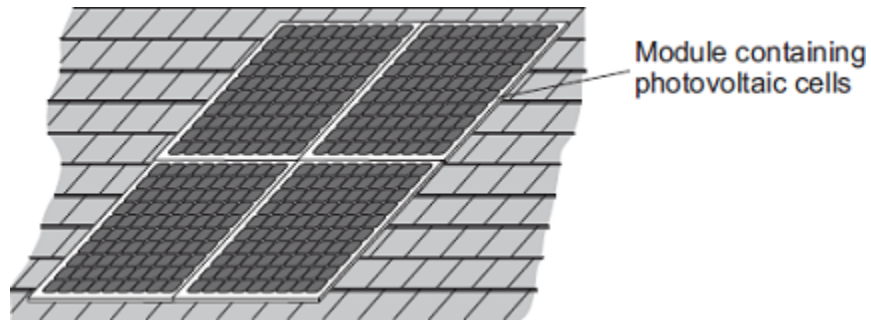
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(2)

(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 $1.4 \times 10^3 \text{ W}$.

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.

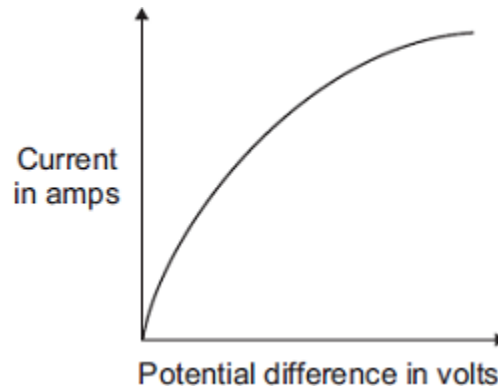
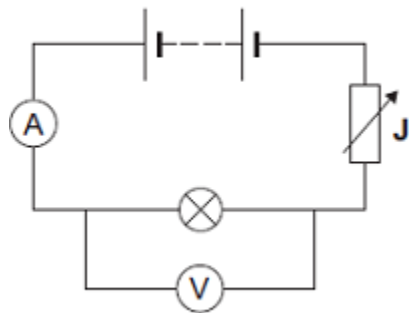
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.....

(1)
(Total 13 marks)

18

- (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.

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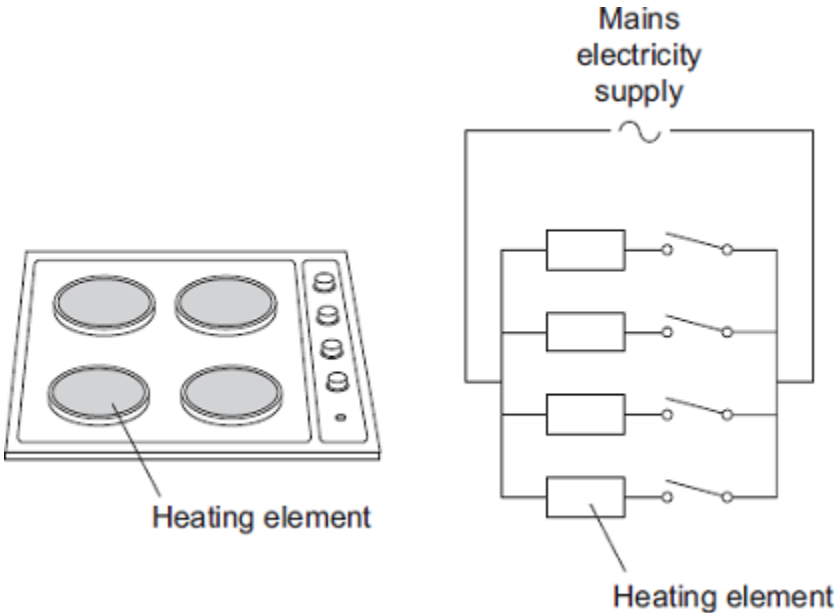
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(6)
(Total 11 marks)

19

The picture shows an electric cooker hob. The simplified circuit diagram shows how the four heating elements connect to the mains electricity supply. The heating elements are identical.



When all four heating elements are switched on at full power the hob draws a current of 26 A from the 230 V mains electricity supply.

(a) Calculate the resistance of one heating element when the hob is switched on at full power.

Give your answer to 2 significant figures.

.....
.....
.....

Resistance = Ω

(3)

(b) The table gives the maximum current that can safely pass through copper wires of different cross-sectional area.

Cross-sectional area in mm ²	Maximum safe current in amps
1.0	11.5
2.5	20.0
4.0	27.0
6.0	34.0

The power sockets in a home are wired to the mains electricity supply using cables containing 2.5 mm² copper wires. Most electrical appliances are connected to the mains electricity supply by plugging them into a standard power socket.

It would **not** be safe to connect the electric cooker hob to the mains electricity supply by plugging it into a standard power socket.

Why?

.....
.....
.....
.....

(2)

(c) Mains electricity is an alternating current supply. Batteries supply a direct current.

What is the difference between an alternating current and a direct current?

.....
.....
.....
.....

(2)
(Total 7 marks)

20

(a) The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

230 V	2760 W
50 Hz	

Use the information from the plate to answer the following questions.

(i) What is the frequency of the a.c. mains electricity supply?

.....

(1)

(ii) What is the power of the electric kettle?

.....

(1)

(b) To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Choose the unit from the list below.

amps

volts

watts

.....

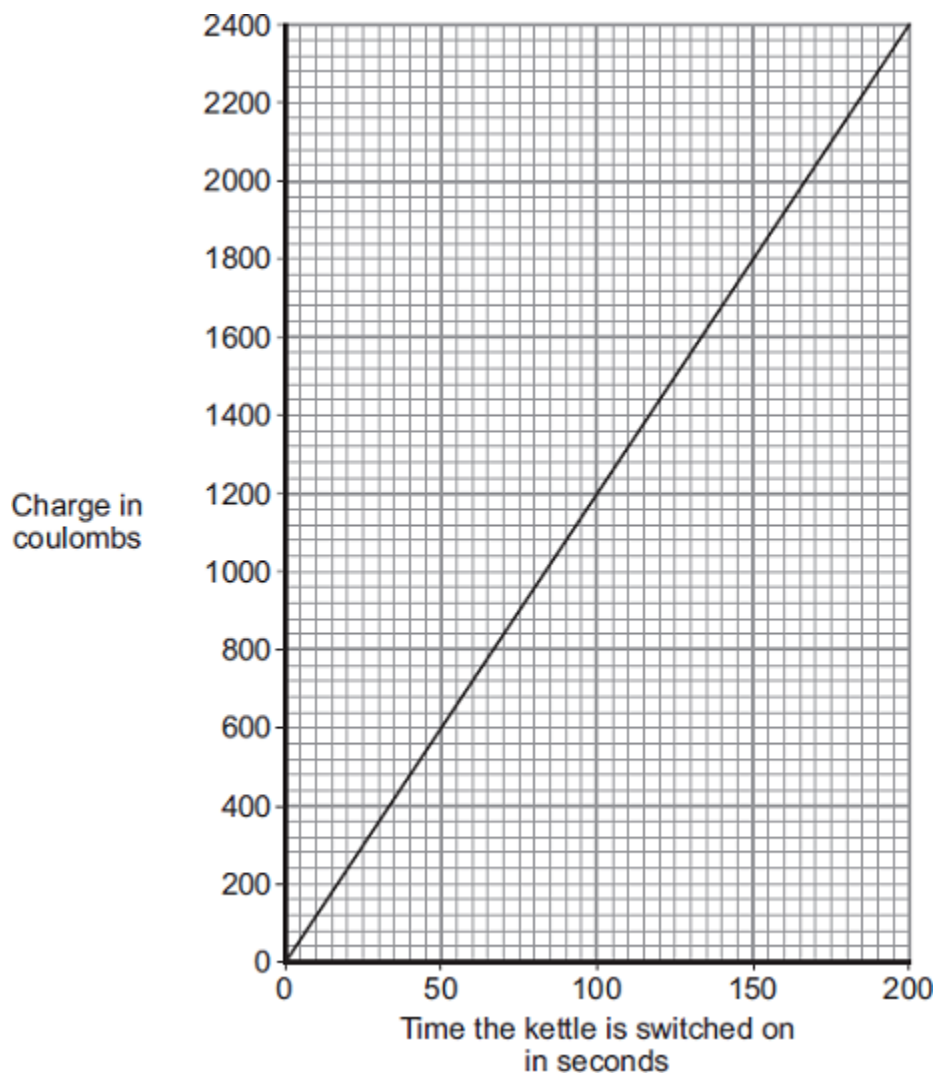
.....

.....

Current =

(3)

- (c) The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.



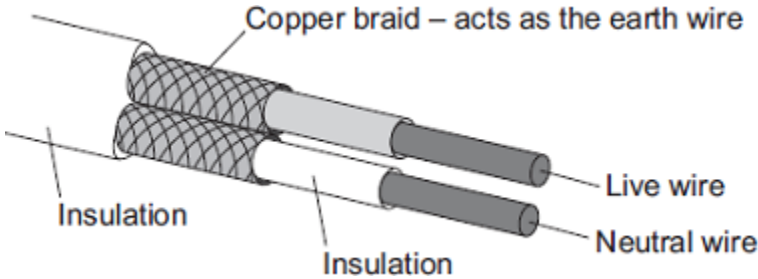
What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....
.....

(2)
(Total 7 marks)

21

The diagram shows the structure of a cable. The cable is part of an undersoil heating circuit inside a large greenhouse.



(a) The cable is connected to the mains electricity supply through a residual current circuit breaker. If the cable is accidentally cut the circuit breaker automatically switches the circuit off.

(i) What is the frequency of the mains electricity supply in the UK?

.....

(1)

(ii) What happens, as the cable is cut, to cause the circuit breaker to switch the circuit off?

.....
.....
.....
.....

(2)

(iii) A circuit can also be switched off by the action of a fuse.

Give **one** advantage of using a circuit breaker to switch off a circuit rather than a fuse.

.....
.....

(1)

(b) The 230 volt mains electricity supply causes a current of 11 amps to flow through the cable.

(i) Calculate the amount of charge that flows through the cable when the cable is switched on for 2 hours and give the unit.

.....
.....
.....

Charge =

(3)

(ii) Calculate the energy transferred from the cable to the soil in 2 hours.

.....
.....

Energy transferred = J

(2)

(c) The heating circuit includes a thermistor. The thermistor is buried in the soil and acts as a thermostat to control the increase in the temperature of the soil.

Describe how an **increase** in the temperature of the soil affects the thermistor.

.....
.....
.....
.....

(2)
(Total 11 marks)

22

The pictures show six different household appliances.

Fan heater

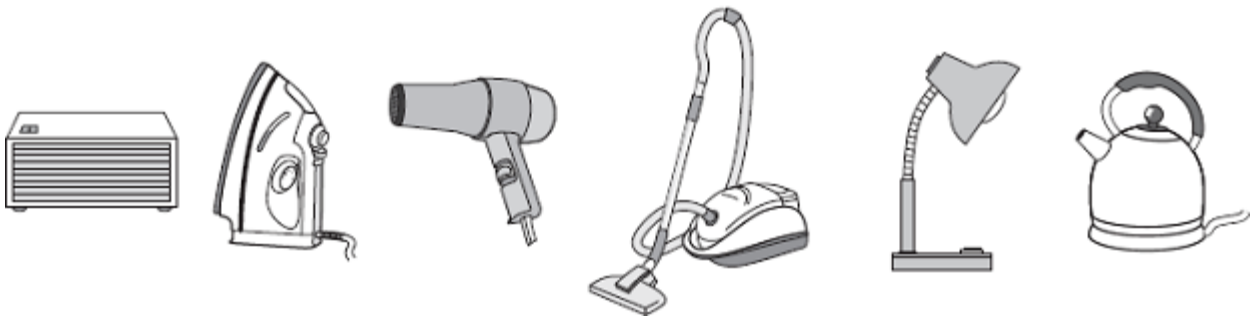
Iron

Hairdryer

Vacuum cleaner

Table lamp

Kettle



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

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

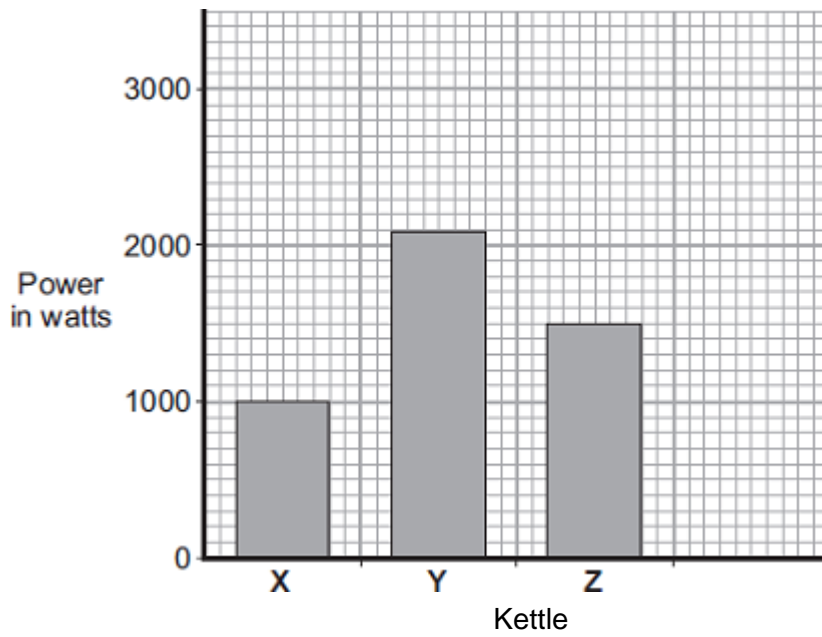
1

2

3

(3)

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



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

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

X

Y

Y

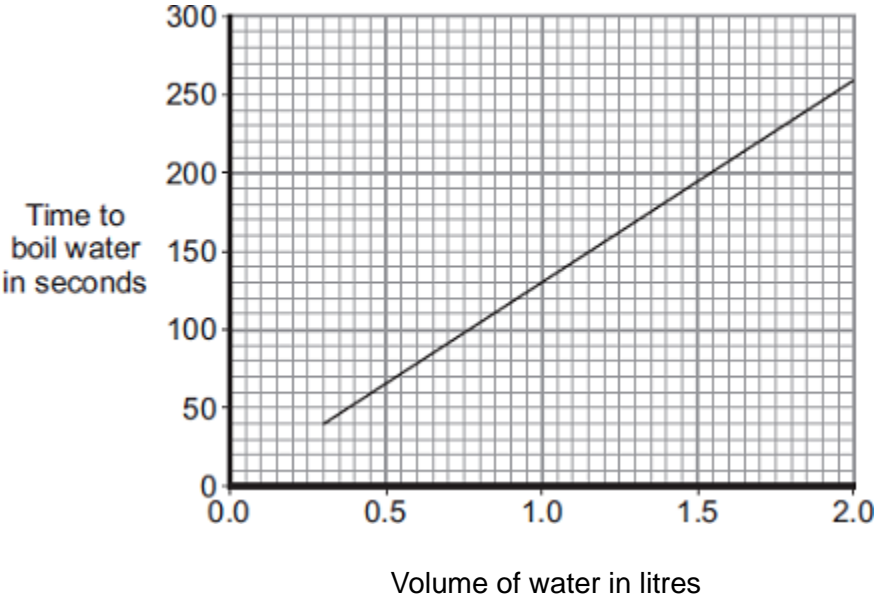
(1)

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

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

(1)

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



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

Explain how the householder is wasting money.

.....

.....

.....

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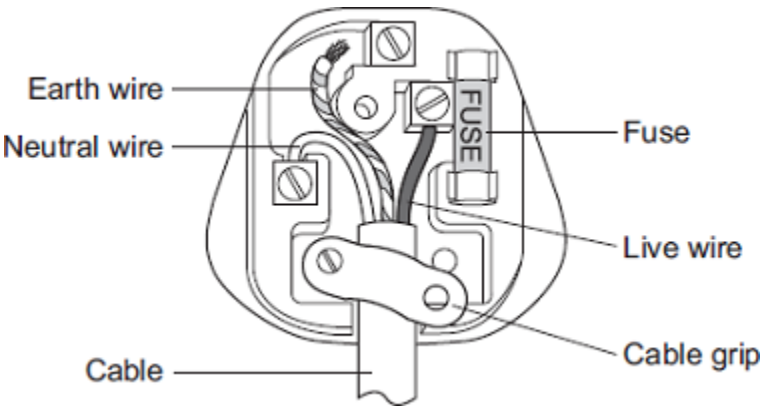
.....

.....

(3)
(Total 8 marks)

23

(a) The diagram shows the inside of an incorrectly wired three-pin plug.



(i) What **two** changes need to be made so that the plug is wired correctly?

- 1
-
- 2
-

(2)

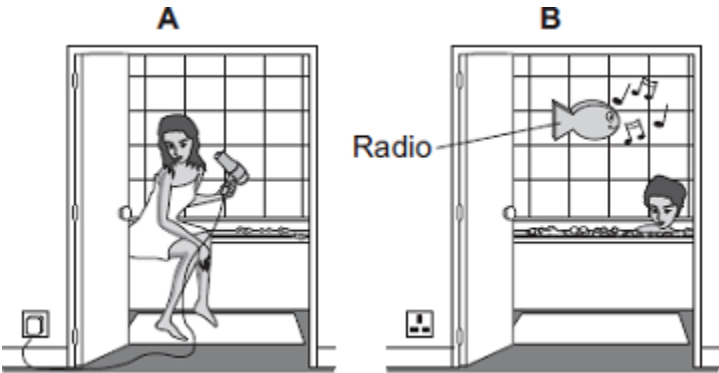
(ii) The fuse inside a plug is a safety device.

Explain what happens when too much current passes through a fuse.

-
-
-
-

(2)

(b) Each of these pictures shows an electrical appliance being used in a bathroom.



Using the hairdryer in picture **A** is dangerous. However, it is safe to use the battery-operated radio in picture **B**.

Explain why.

.....
.....
.....
.....

(2)
(Total 6 marks)

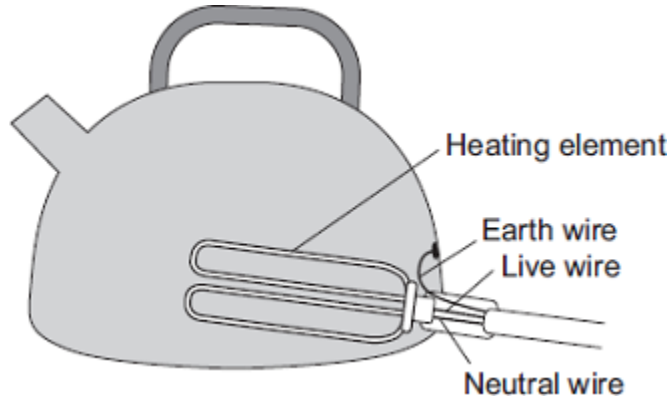
24

(a) Describe the difference between an alternating current (a.c.) and a direct current (d.c.).

.....
.....
.....
.....

(2)

- (b) The diagram shows how the electric supply cable is connected to an electric kettle. The earth wire is connected to the metal case of the kettle.



If a fault makes the metal case live, the earth wire and the fuse inside the plug protect anyone using the kettle from an electric shock.

Explain how.

.....

.....

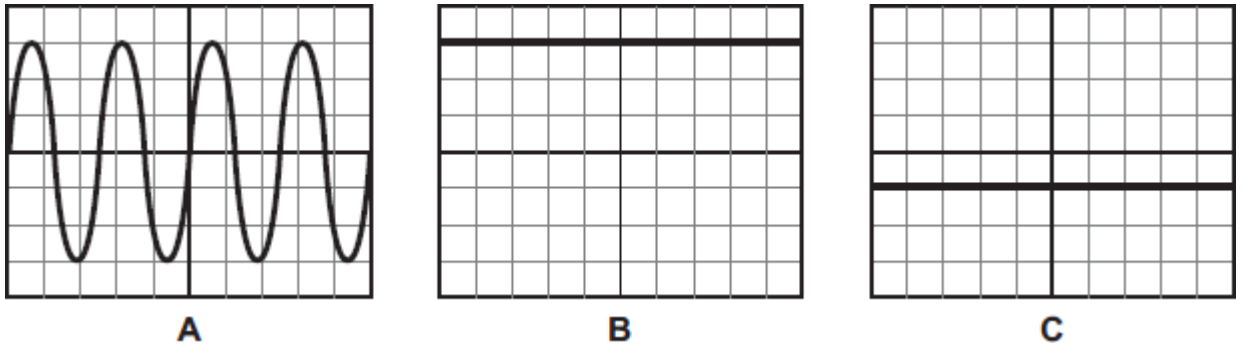
.....

.....

(2)
(Total 4 marks)

25

- (a) The diagram shows the traces produced on an oscilloscope when it is connected across different electricity supplies.



Which of the traces could have been produced by the mains electricity supply?

.....

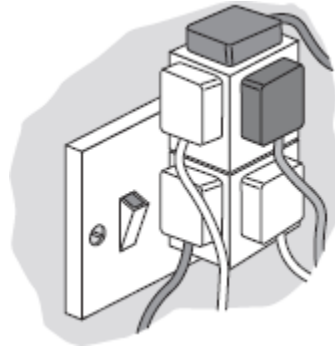
Give a reason for your answer.

.....

.....

(2)

- (b) The picture shows two adaptors being used to plug five electrical appliances into the same socket.



Explain why it is dangerous to have all five appliances switched on and working at the same time.

.....

.....

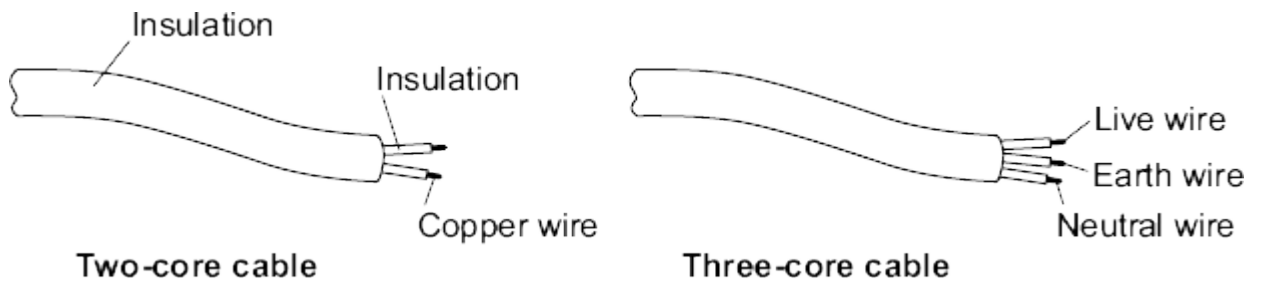
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.....

(2)
(Total 4 marks)

26

- (a) The diagram shows a piece of two-core cable and a piece of three-core cable.



- (i) Which **one** of the wires inside a three-core cable is missing from a two-core cable?

Draw a ring around your answer.

earth wire

live wire

neutral wire

(1)

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

double	extra	totally
---------------	--------------	----------------

A pottery table lamp fitted with a two-core cable is safe to use because it is
..... insulated.

(1)

(b) The cables connecting the power sockets in a building contain wires 1.8 mm thick. The maximum current that can safely pass through these wires is 20 amps. A fuse is included in the circuit to protect the wiring.

Explain how a fuse protects the wiring of a circuit.

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.....

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(3)
(Total 5 marks)