AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.2.3 DOMESTIC USES AND SAFETY (PACK 1)

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/308	%

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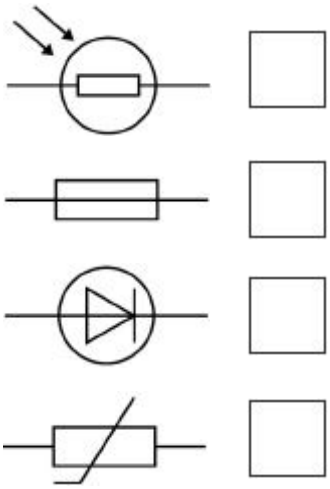
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Q1.

The plug of an electrical appliance contains a fuse.

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

Tick **one** box.



(1)

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

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

Use the equation:

energy transferred = charge flow × potential difference

_____

_____

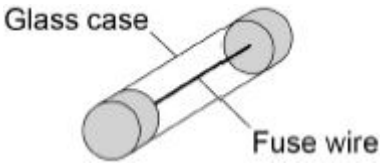
_____

_____

Energy transferred = _____ J

(2)

The diagram below shows the structure of a fuse.



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

_____

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(1)

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

Calculate the current at which the fuse wire melts.

_____

_____

_____

_____

Current = _____ A

(3)

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

Calculate the energy needed to melt the fuse wire.

Use the Physics Equations Sheet.

_____

_____

_____

_____

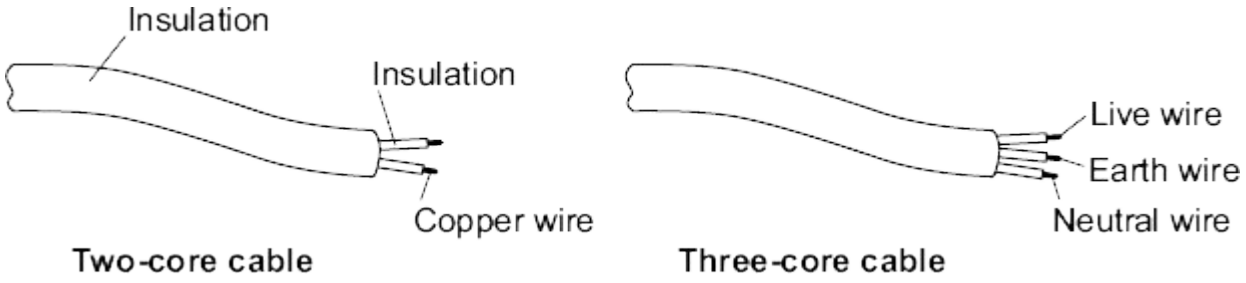
Energy = _____ J

(2)

(Total 9 marks)

Q2.

(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**

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(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.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

Q3.

Most electric kettles use the ac mains electricity supply.

(a) Complete the sentence.

The ac mains supply has a potential difference that continuously

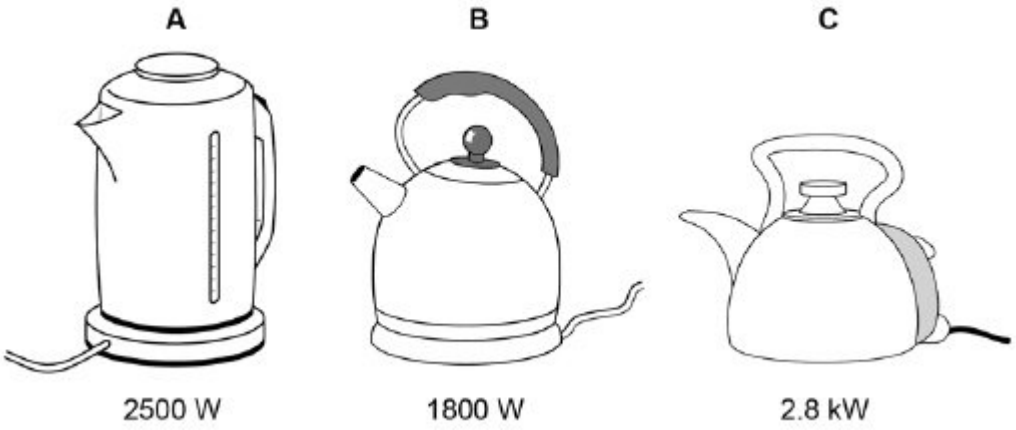
_____ polarity

(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 _____

_____

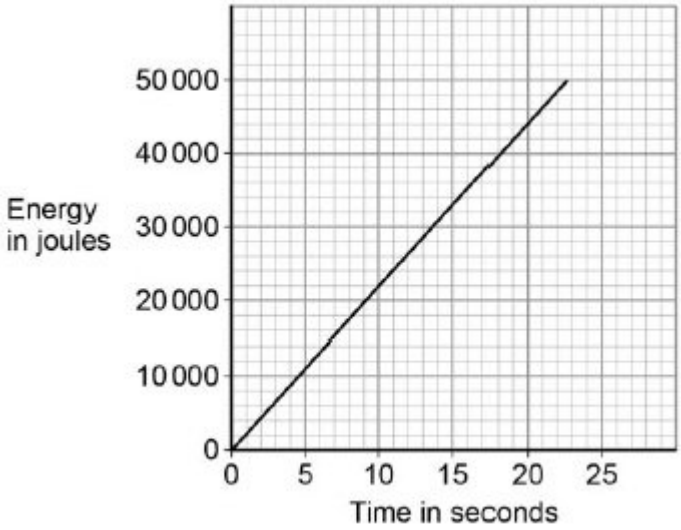
_____

(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

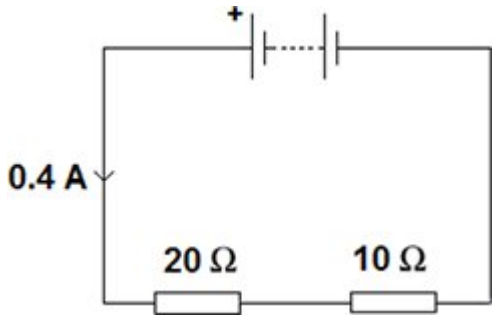
(3)

(Total 10 marks)

Q4.

An electrical circuit is shown in the figure below.

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

What is meant by direct current?

Tick **one** box.

Current that continuously changes direction.	☐
Current that travels directly to the component.	☐
Current that is always in the same direction.	☐

(1)

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

potential difference = current × resistance

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

_____

_____

Potential difference = _____ V

(3)

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

power = current × potential difference

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

Give your answer to one significant figure.

_____

Power = _____ W

(2)

(Total 6 marks)

Q5.

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

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



© Michael Priest

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

Explain why.

_____

_____

_____

_____

(2)

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

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

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

Calculate the current passing through the new shower.

Give your answer to two significant figures.

_____

_____

_____

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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)

Q6.

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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_____

_____

_____

_____

_____

_____

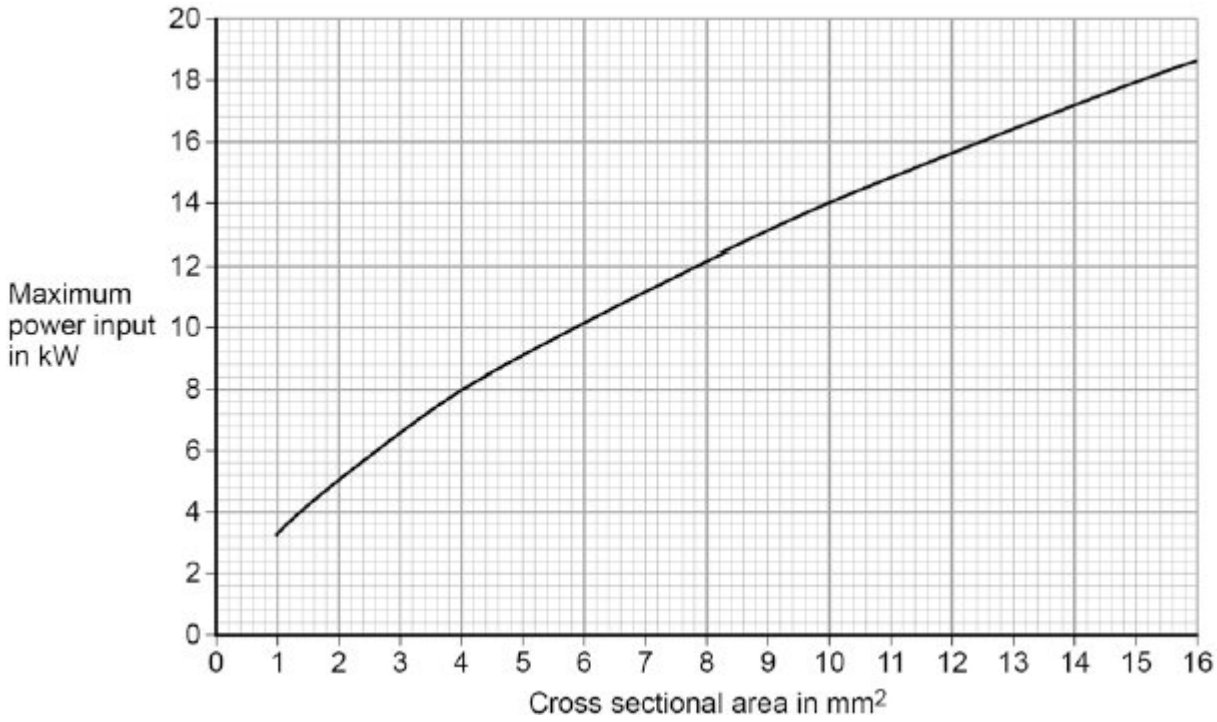
_____

(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.

_____

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_____

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

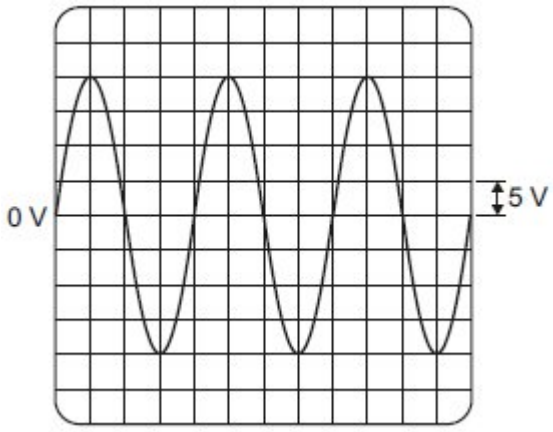
(5)

(Total 11 marks)

Q7.

(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

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(1)

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

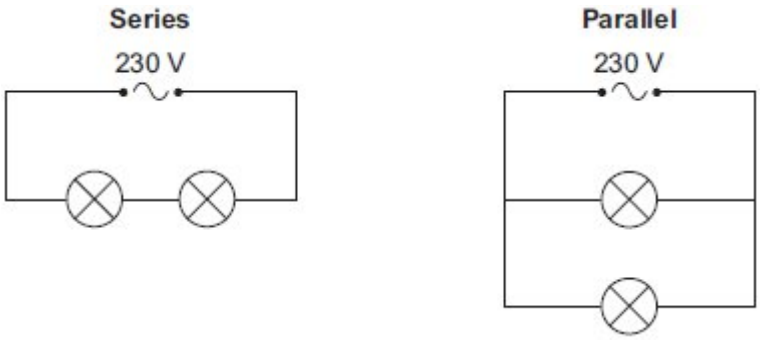
40	50	60

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.

_____

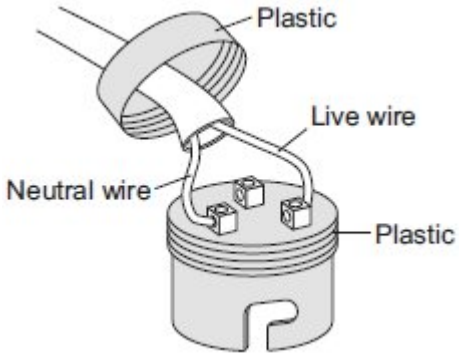
_____

(1)

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

Figure 3

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

Explain why the light fitting is safe to use.

_____

_____

_____

_____

(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)

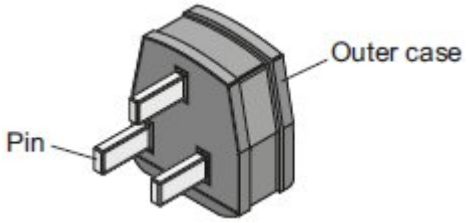
(Total 8 marks)

Q8.

(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 _____

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_____

(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.

_____

_____

_____

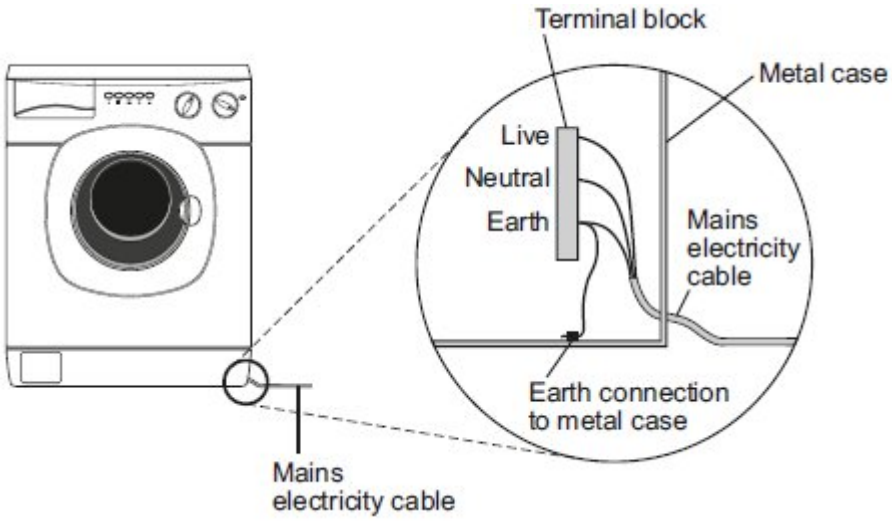
Current = _____ A

(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



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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)

Q9.

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

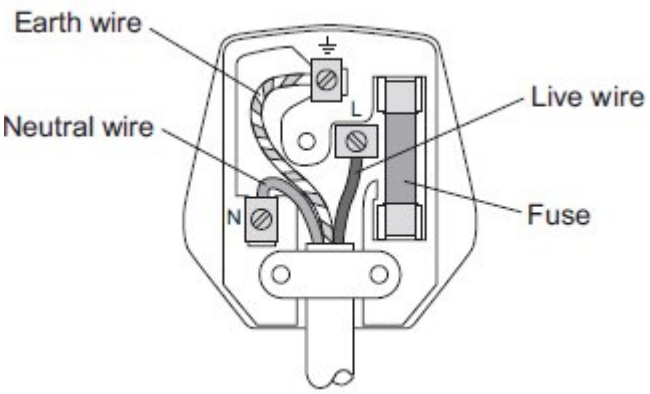
(a) Use the correct answer from the box to complete the sentence.

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.



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(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.

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Give the unit.

_____

_____

Charge = _____

Unit _____

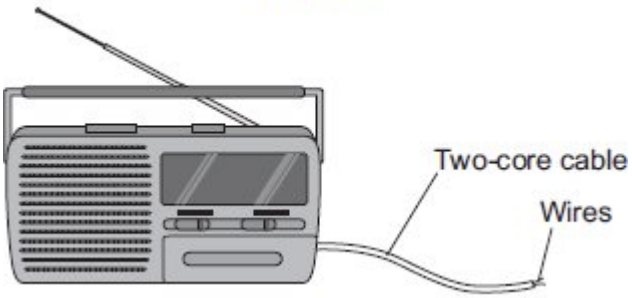
(3)

(Total 11 marks)

Q10.

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**

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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 ☐

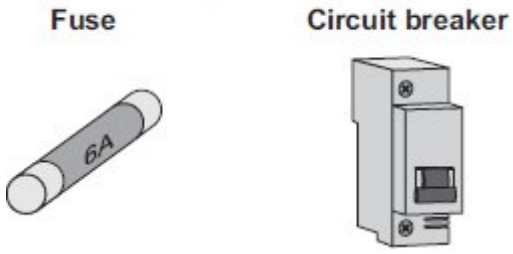
Both a.c. and d.c. ☐

(1)

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

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

Figure 2



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

earth	**live**	**neutral**

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?

_____

_____

(1)

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

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1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q11.

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 £

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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.

_____

_____

_____

_____

(2)

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

_____

_____

(1)

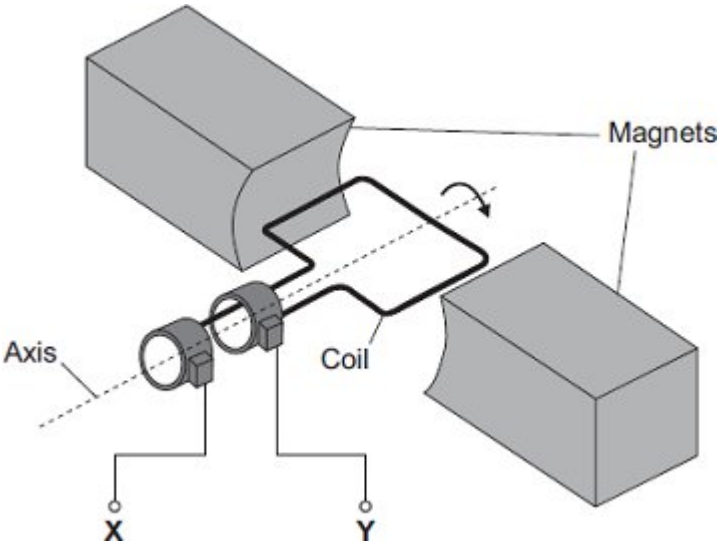
(Total 10 marks)

Q12.

The diagram shows an a.c. generator.

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

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(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**

This effect is called the _____ effect.

(1)

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

_____

(1)

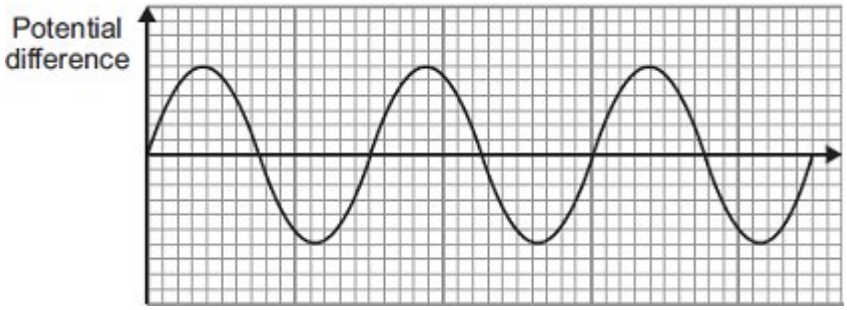
(iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

_____

(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?

_____

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(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. _____

_____

2. _____

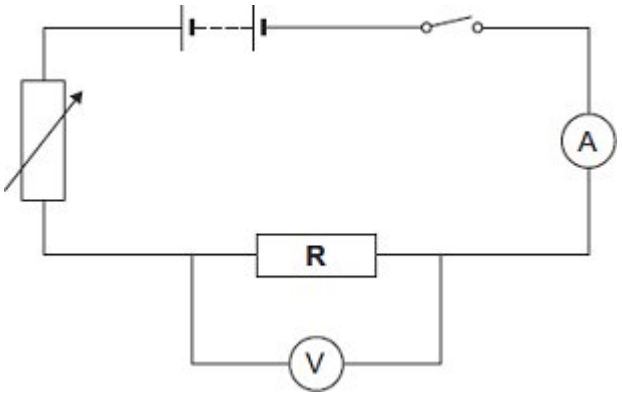
_____

(2)

(Total 8 marks)

Q13.

(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.

_____

_____

_____

_____

(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.

_____

_____

_____

_____

(2)

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(b) The diagram shows a fuse.



Describe the action of the fuse in a circuit.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)

Q14.

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.

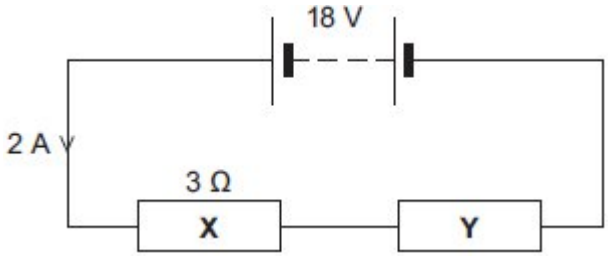
(2)

(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**.

_____

_____

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

(2)

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

_____

_____

_____

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

(2)

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

_____

_____

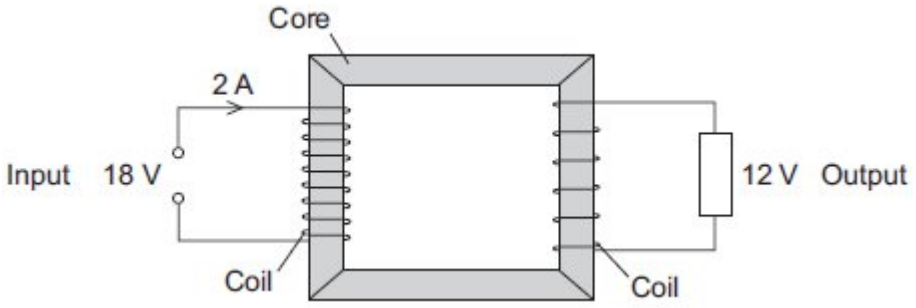
_____

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.

_____

_____

_____

_____

(2)

(ii) The transformer is 100% efficient.

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

_____

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_____

_____

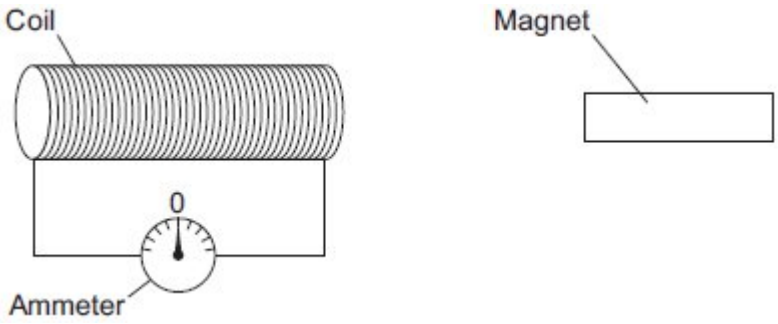
Output current = _____ A

(2)

(Total 12 marks)

Q15.

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

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(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)

Q16.

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)

Q17.

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**

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**

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**

The two wires are the _____ wires.

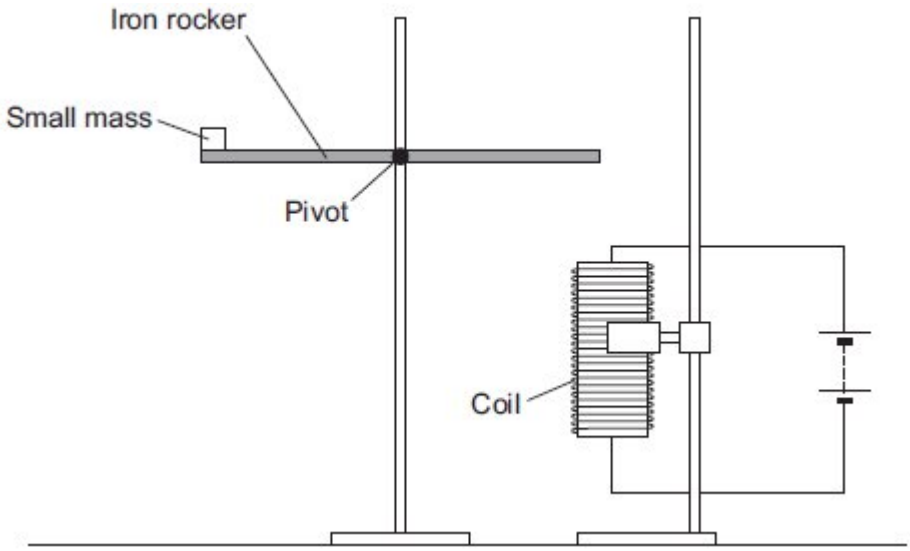
(1)

(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 .

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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.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

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(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)

Q18.

Energy resources can be renewable or non-renewable.

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

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

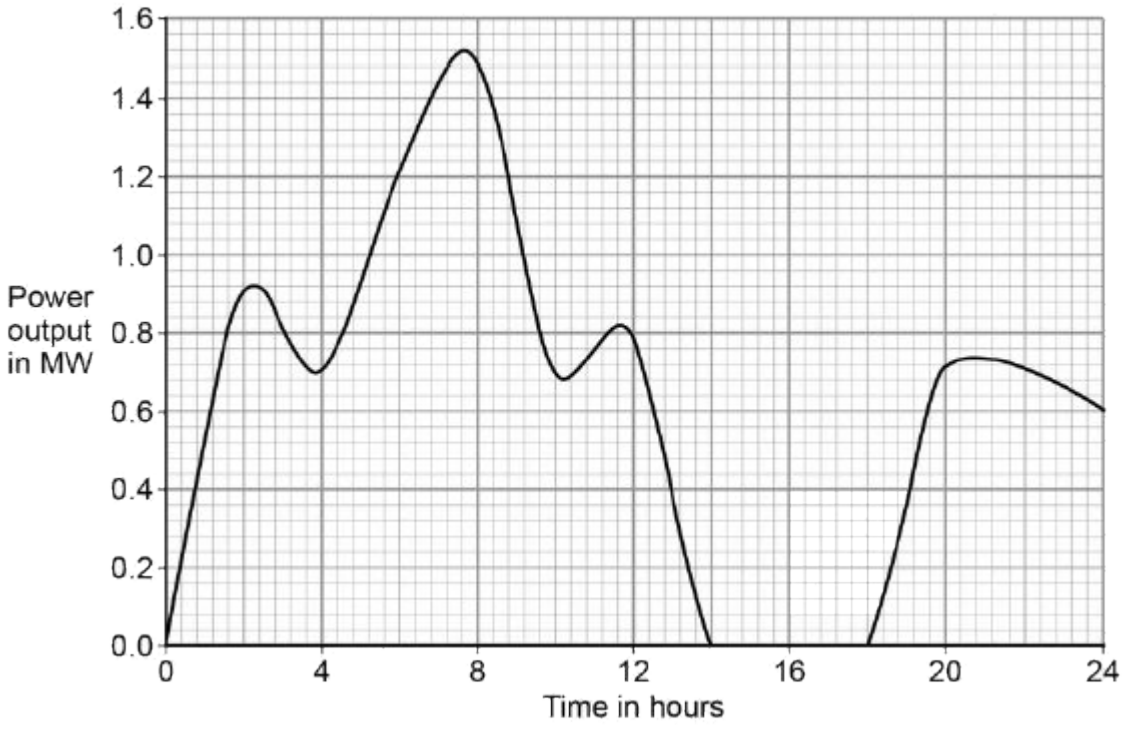
1. _____

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.



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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.

_____

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_____

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)

Q19.

(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?

_____

_____

_____

_____

(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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_____

_____

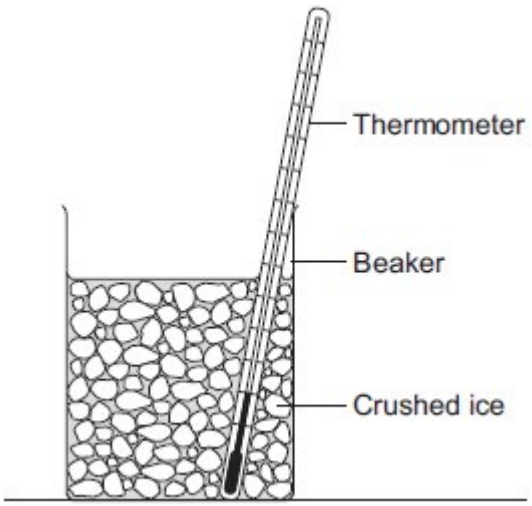
Energy = _____ J

(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	

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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 _____

(6)

(Total 18 marks)

Q20.

(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.

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

Choose the unit from the list below.

amps **volts** **watts**

_____

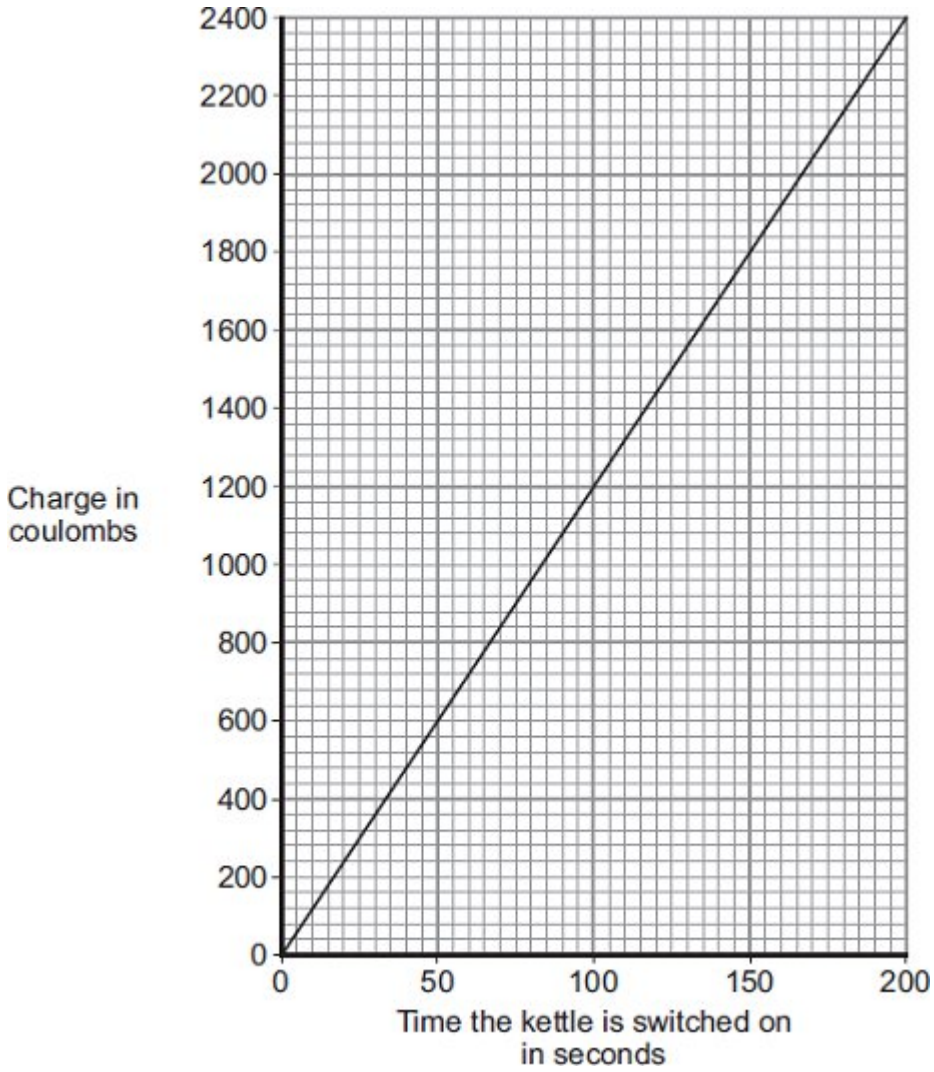
_____

_____

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?

_____

_____

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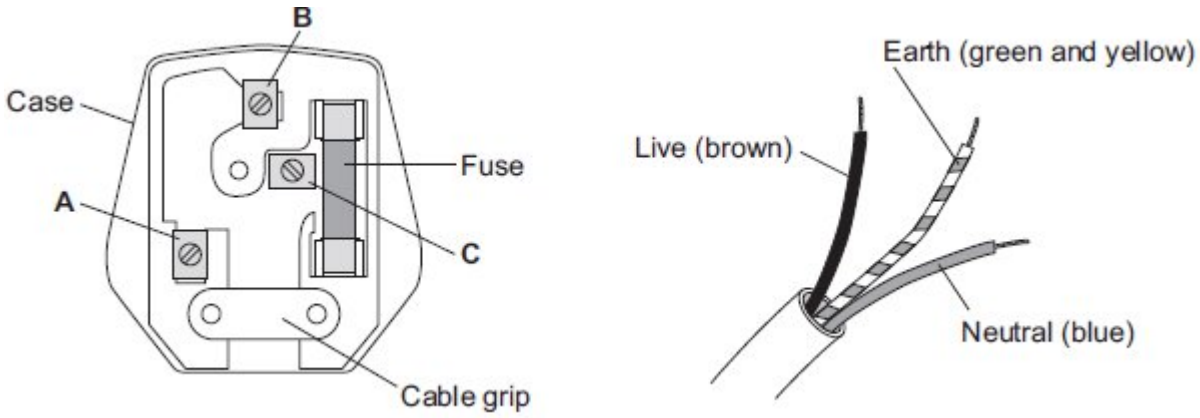
(2)
(Total 7 marks)

Q21.

(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.

_____

(1)

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

Figure 2



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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.

_____

_____

_____

_____

_____

_____

(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

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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)

Q22.

Solar panels are often seen on the roofs of houses.

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

_____

_____

_____

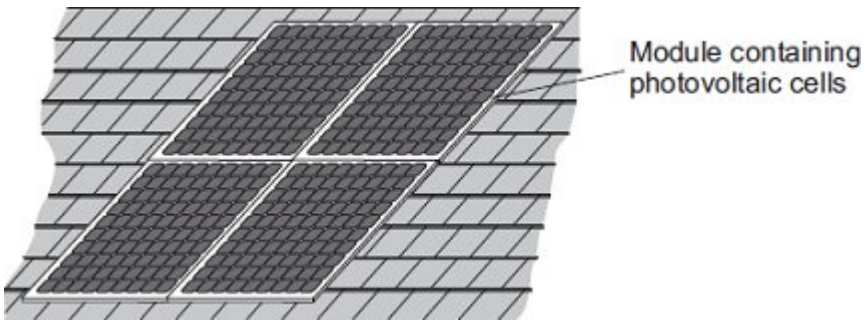
_____

(2)

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

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

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

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

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

_____

_____

_____

_____

_____

_____ Time = _____ minutes

(3)

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

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

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

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

_____

Energy transferred = _____ kWh

(1)

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

Calculate the money the electricity company would pay the householder.

_____

_____

Money paid = _____

(2)

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

Calculate the payback time in years for the modules.

_____

_____

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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.

_____

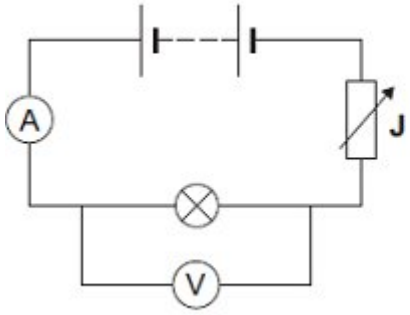
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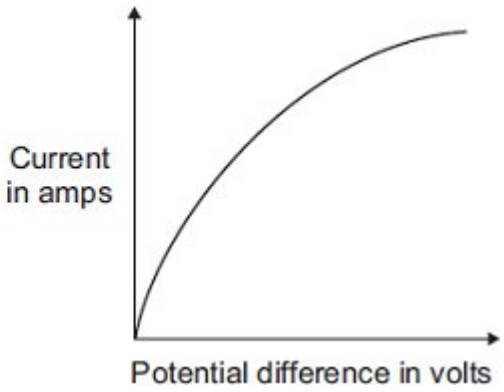
(1)

(Total 13 marks)

Q23.

(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.

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

_____

_____

_____

Power = _____

(3)

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

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

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

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

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

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

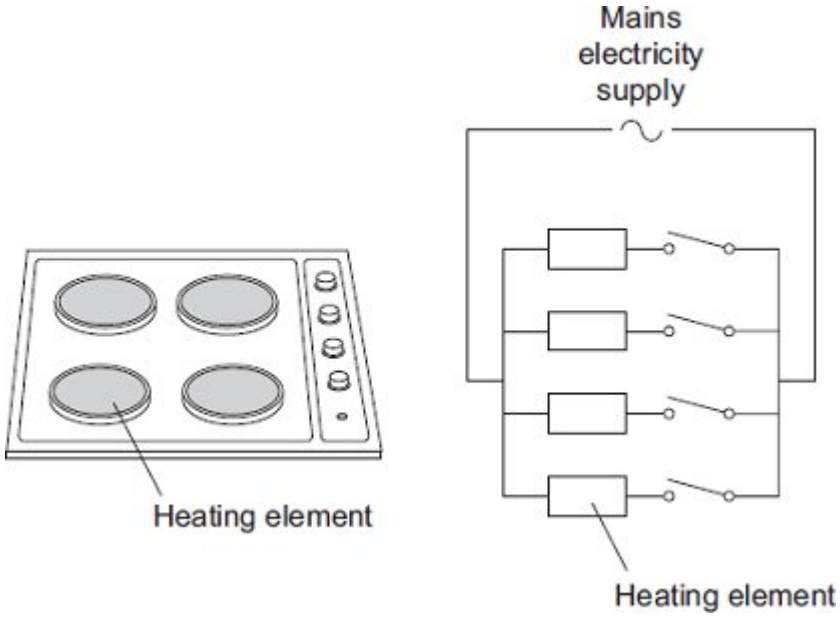
(6)

(Total 11 marks)

Q24.

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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**

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The power sockets in a home are wired to the mains electricity supply using cables containing 2.5 mm^2 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?

_____

_____

_____

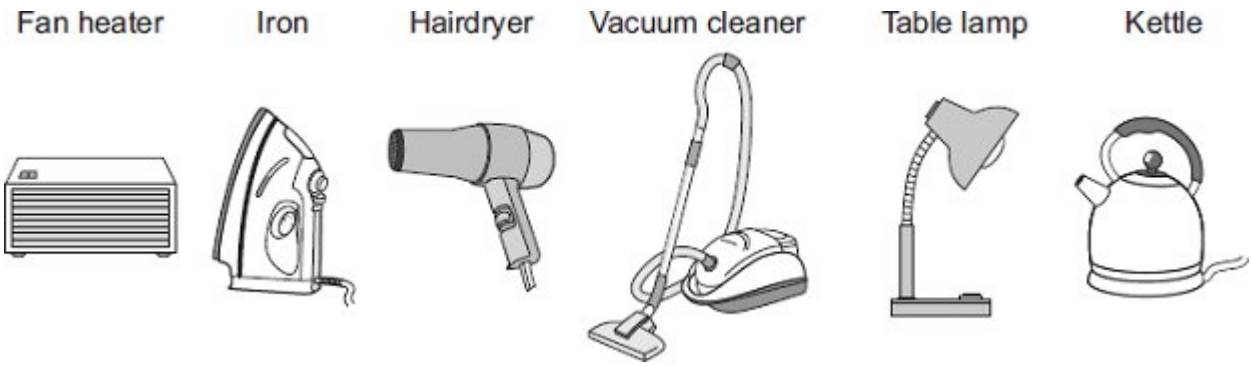
_____

(2)

(Total 7 marks)

Q25.

The pictures show six different household appliances.



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

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

1. _____

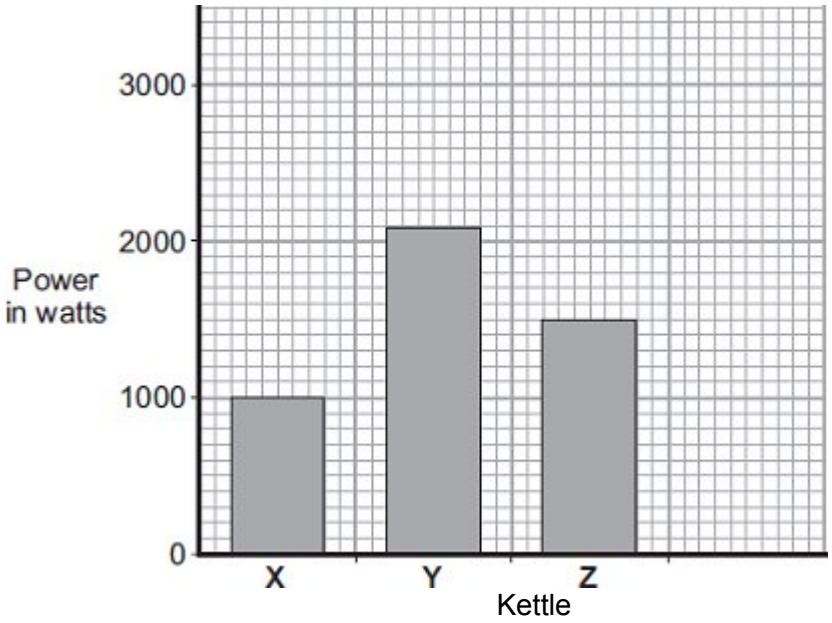
2. _____

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3 _____

(3)

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



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

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

X ☐

Y ☐

Z ☐

(1)

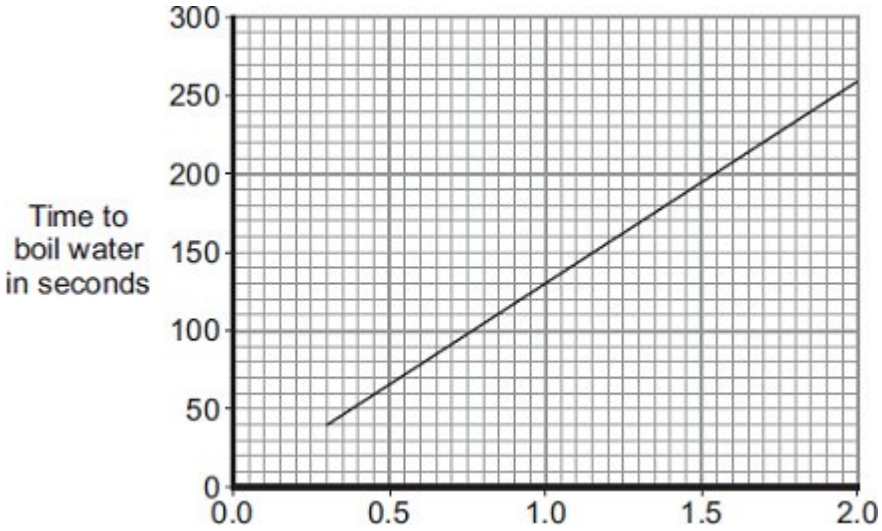
(ii) A new 'express boil' kettle boils water faster than any other kettle.

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

(1)

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

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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.

_____

_____

_____

_____

_____

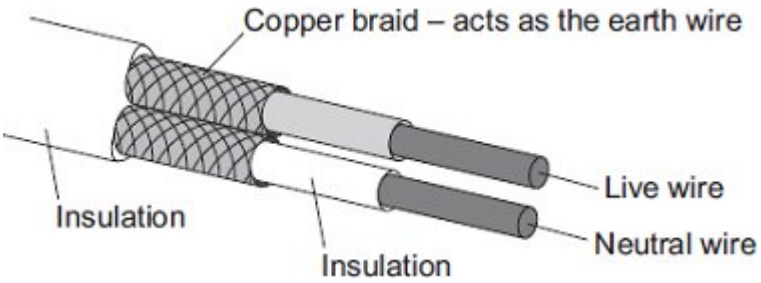
_____

(3)

(Total 8 marks)

Q26.

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?

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_____

(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.

_____

_____

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_____

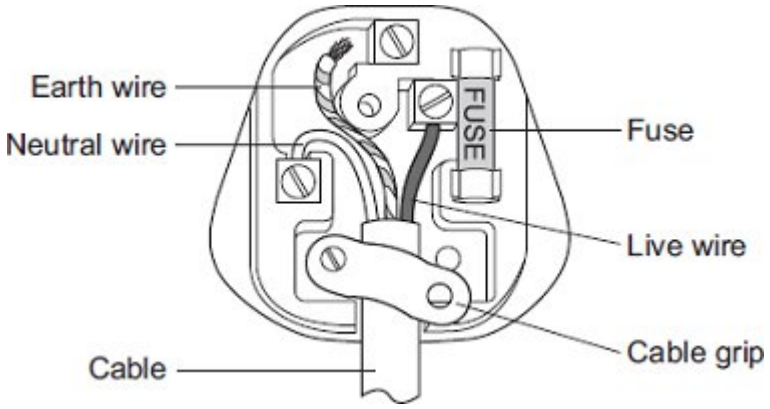
_____

(2)

(Total 11 marks)

Q27.

(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.

_____

_____

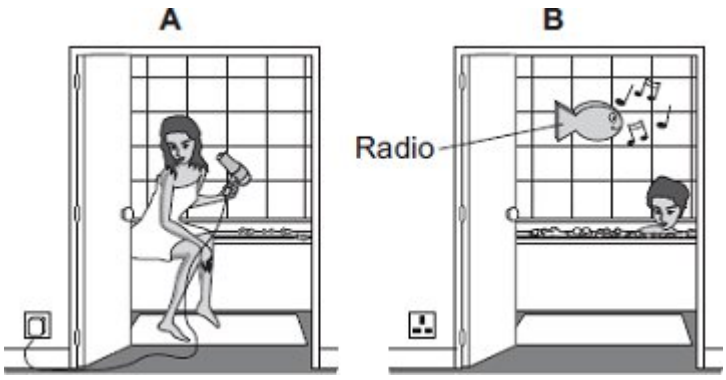
_____

_____

(2)

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

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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)

Q28.

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

_____

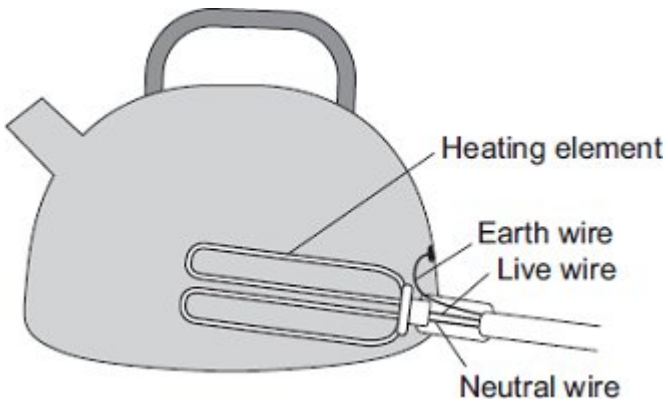
_____

_____

_____

(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.



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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.

_____

_____

_____

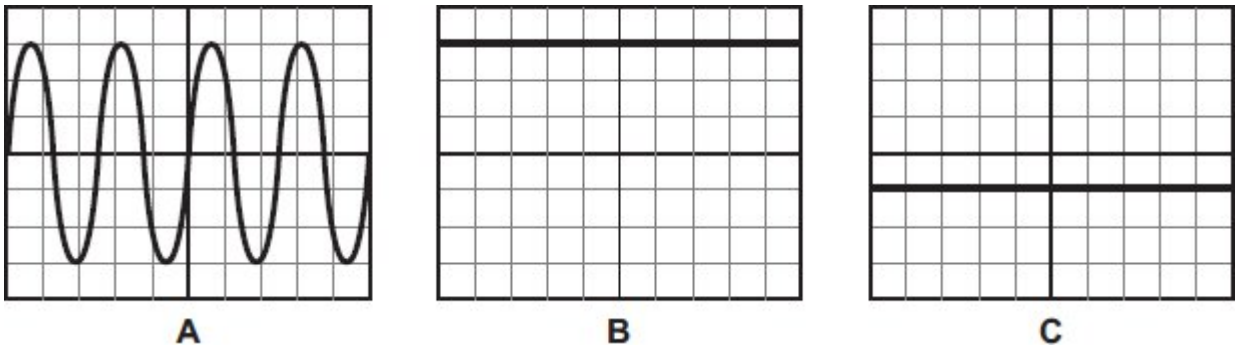
_____

(2)

(Total 4 marks)

Q29.

(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?

_____

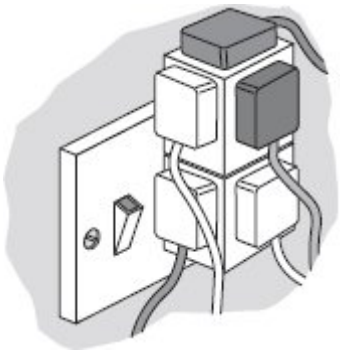
Give a reason for your answer.

_____

_____

(2)

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



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

_____

_____

_____

_____

(2)

(Total 4 marks)

Q30.

(a) The picture shows a person using a set of electronic 'Body Fat Scales'. When the person stands on the scales, a small, harmless, electric current passes through the person's body. The scales then calculate the resistance of the person's body and convert the resistance into a *prediction* of body fat content.



(i) The scales contain two 3 V cells joined in series.

Calculate the resistance of a person's body, if when he stands on the scales, a current of 0.12 mA passes through his body.

1000 mA = 1 A

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

_____

_____

_____

Resistance = _____

(3)

(ii) The scales can only produce a *prediction* of body fat content and not an accurate measurement.

Suggest why.

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_____

_____

_____

(1)

(iii) It is recommended that the scales are **not** used immediately after a person has drunk a large amount of water.

Suggest why.

_____

_____

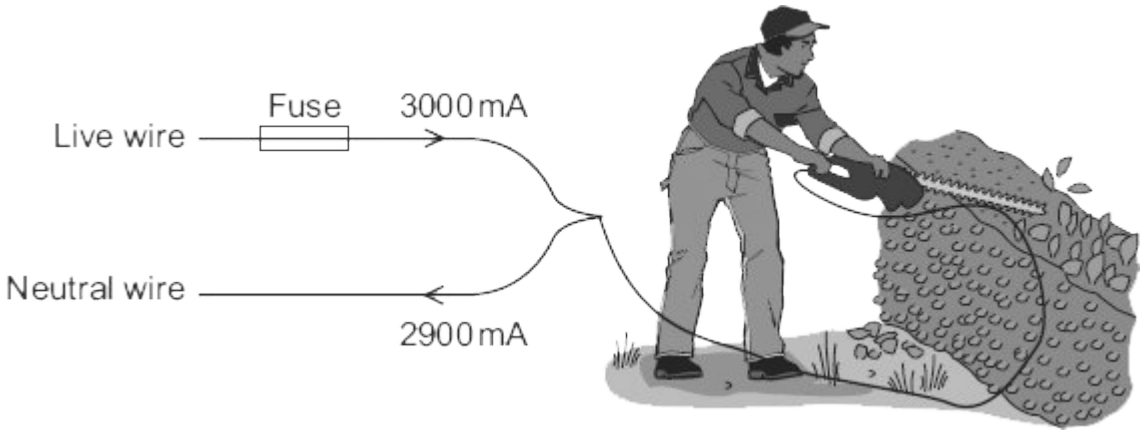
_____

_____

_____

(2)

(b) The diagram shows how someone could get an electric shock from accidentally cutting into an electric cable. If this happens, and a Residual Current Circuit Breaker (RCCB) is being used, the circuit will switch off automatically.



(i) A faulty appliance or circuit can be switched off by a RCCB or a fuse.

Compare the action of a RCCB with the action of a fuse.

_____

_____

_____

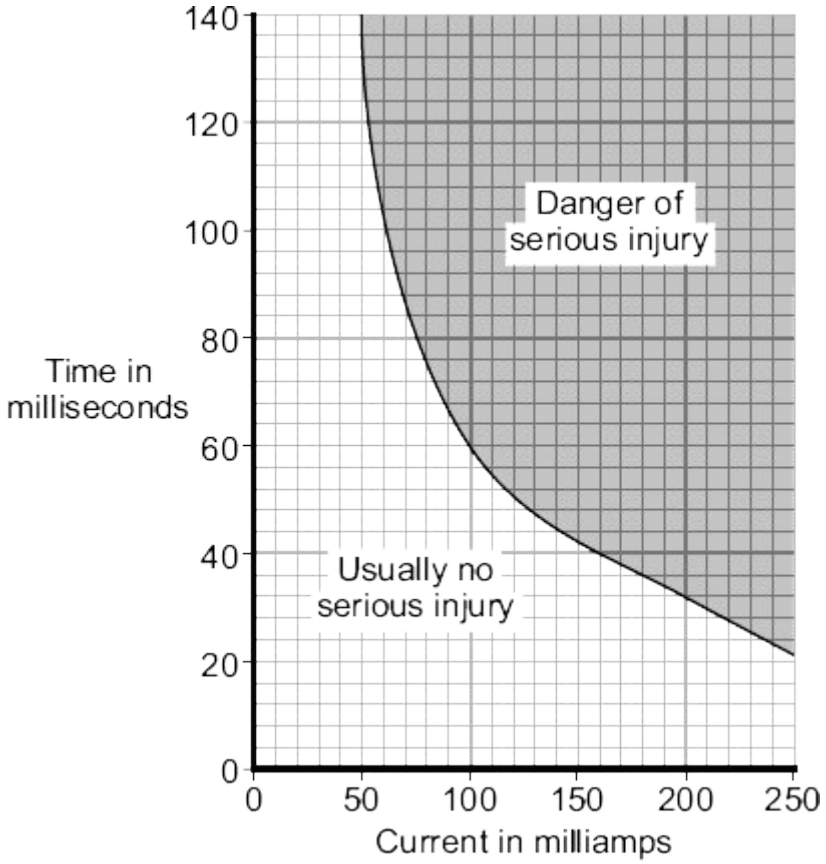
_____

_____

(2)

(ii) The graph shows how the severity of an electric shock depends on the size of the current and the time that the current flows through the body.

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Using the RCCB helps prevent an electric shock seriously injuring the person using the hedge trimmers.

Using information from both the diagram and the graph explain how.

_____

_____

_____

_____

_____

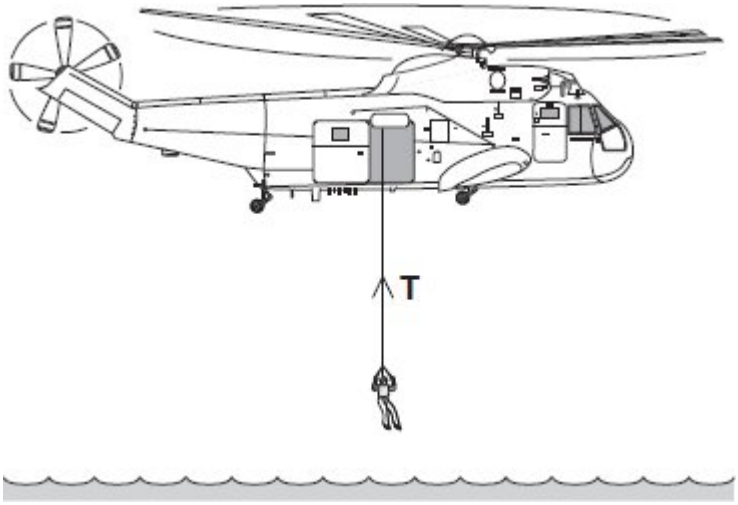
(2)

(Total 10 marks)

Q31.

The diagram shows a helicopter being used to rescue a person from the sea.

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(a) (i) The mass of the rescued person is 72 kg.

Use the equation in the box to calculate the weight of the rescued person.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Weight = _____ N

(2)

(ii) An electric motor is used to lift the person up to the helicopter.
The motor lifts the person at a constant speed.

State the size of the force, **T**, in the cable.

Force **T** = _____ N

(1)

(b) To lift the person up to the helicopter, the electric motor transformed 21 600 joules of energy usefully.

(i) Use a form of energy from the box to complete the following sentence.

gravitational potential	heat	sound

The electric motor transforms electrical energy to kinetic energy. The kinetic energy is then transformed into useful _____ energy.

(1)

(ii) It takes 50 seconds for the electric motor to lift the person up to the helicopter.

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Use the equation in the box to calculate the power of the electric motor.

$$\text{power} = \frac{\text{energy transformed}}{\text{time}}$$

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

Choose the unit from the list below.

coulomb (C) **hertz (Hz)** **watt (W)**

_____

_____

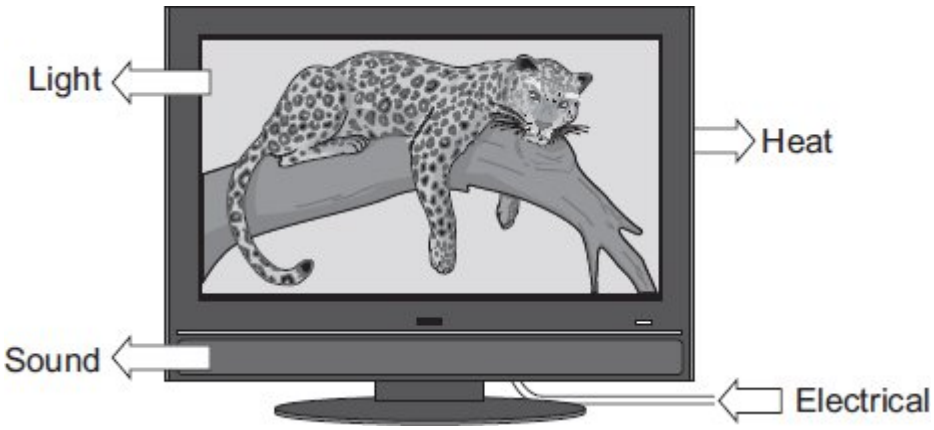
Power = _____

(3)

(Total 7 marks)

Q32.

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



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

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

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

Show clearly how you work out your answer.

_____

_____

Efficiency = _____

(2)

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

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

wasted as _____ .

(1)

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

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

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

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

_____

_____

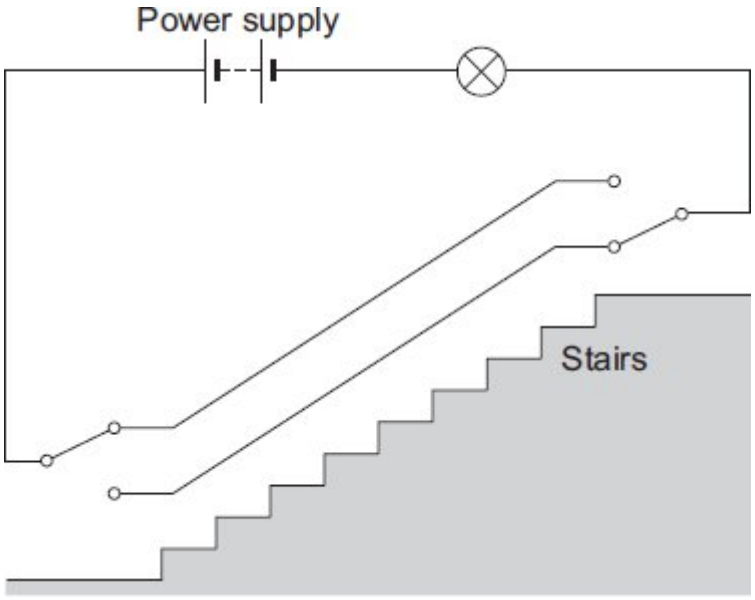
Cost = _____

(2)

(Total 5 marks)

Q33.

The diagram shows an electric circuit used in a dolls' house.
The switches are 2-way switches; this means that each switch has a connecting wire that can be in one of two positions.



(a) (i) With the connecting wire in each switch in the position shown in the diagram, the lamp is off. Why?

_____

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_____

(1)

(ii) When switched on, the lamp has a resistance of 18 Ω and draws a current of 0.5 A from the power supply.

Use the equation in the box to calculate the potential difference of the power supply used in the circuit.

potential difference = current × resistance

Show clearly how you work out your answer.

_____

_____

Potential difference = _____ V

(2)

(iii) A second, identical lamp is added to the circuit. The two lamps are joined in series.

Calculate the total resistance of the two lamps.

_____

Total resistance = _____ Ω

(1)

(b) This type of circuit is also used in real houses. One of the switches is at the top of the stairs, and the other switch is at the bottom of the stairs.

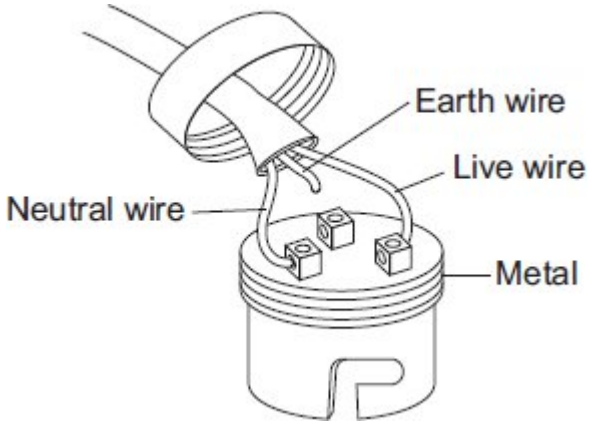
What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

_____

_____

(1)

(c) The diagram shows an old type of metal lamp fitting.



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The cable has been connected to the lamp fitting in a way that makes the lamp fitting unsafe.

(i) What is the possible risk to someone touching the lamp fitting while the lamp is switched on?

_____

_____

(1)

(ii) What should be done to make **this** lamp fitting safe to use?

_____

_____

(1)

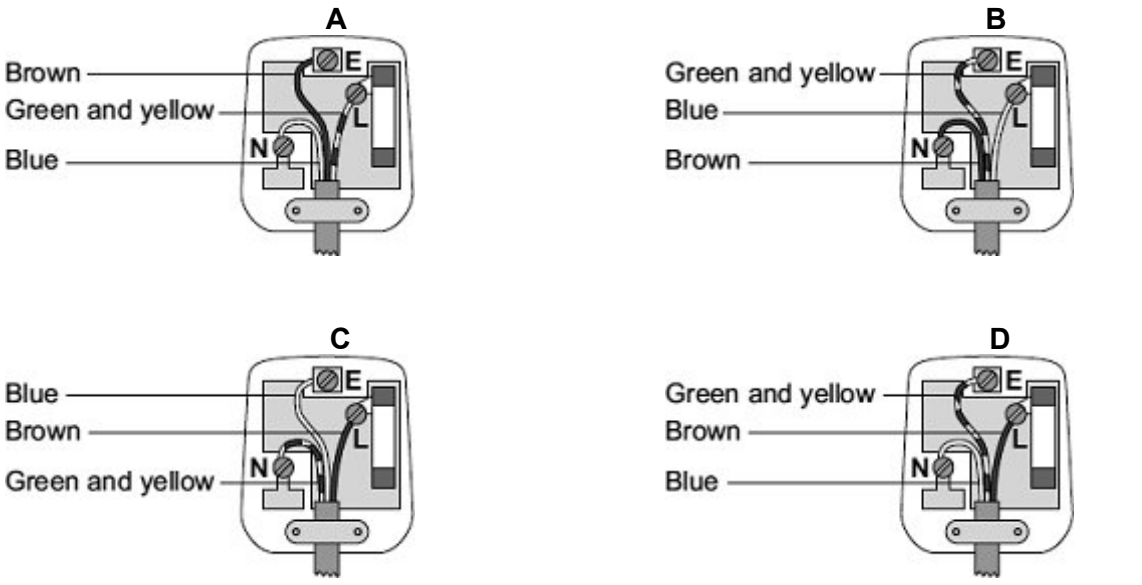
(Total 7 marks)

Q34.

The diagrams show the inside of a 13 amp plug.

(a) (i) Which **one** of the plugs, **A**, **B**, **C** or **D**, is correctly wired?

Write your answer, **A**, **B**, **C** or **D**, in the box.



The plug that is correctly wired is ☐

(1)

(ii) What material is the outside casing of a plug made from?

_____

(1)

(b) An electric drill draws a current of 2 amps from the 230 volt mains electricity supply.

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Use the equation in the box to calculate the power of the drill.

power = current × potential difference

Show clearly how you work out your answer.

_____

_____

Power _____ watts

(2)

(c) A householder needs to replace a damaged plug. Most replacement plugs are sold with a 13 amp fuse fitted inside. The householder thinks it would be better for shops to sell the plugs without a fuse. He could then buy either a 3 A, 5 A or 13 A fuse to fit inside the plug.

Explain an advantage of selling plugs without a fuse, rather than with a 13 amp fuse fitted.

_____

_____

_____

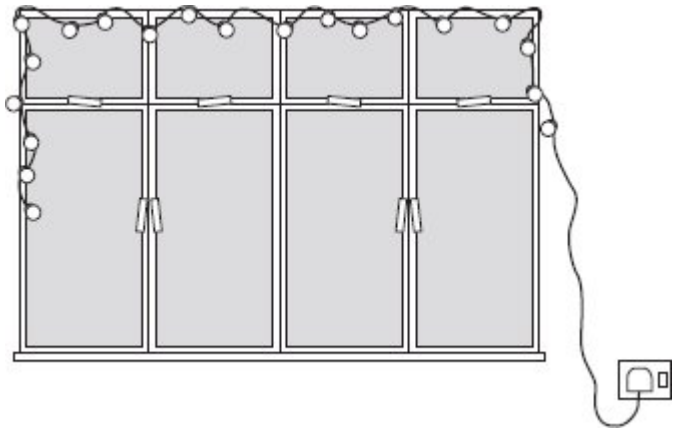
_____

(2)

(Total 6 marks)

Q35.

A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



(a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

(i) What is the total current drawn from the mains supply?

_____

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(1)

(ii) Calculate the charge passing through **one** of the lamps in 5 minutes.

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

_____

_____

_____

_____

Total charge = _____

(3)

(b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.
When switched on, the nineteen remaining lamps work.
What the householder has done is dangerous.

Explain why.

_____

_____

_____

_____

(2)

(Total 6 marks)

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