1 Energy resources can be renewable or non-renewable.

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

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

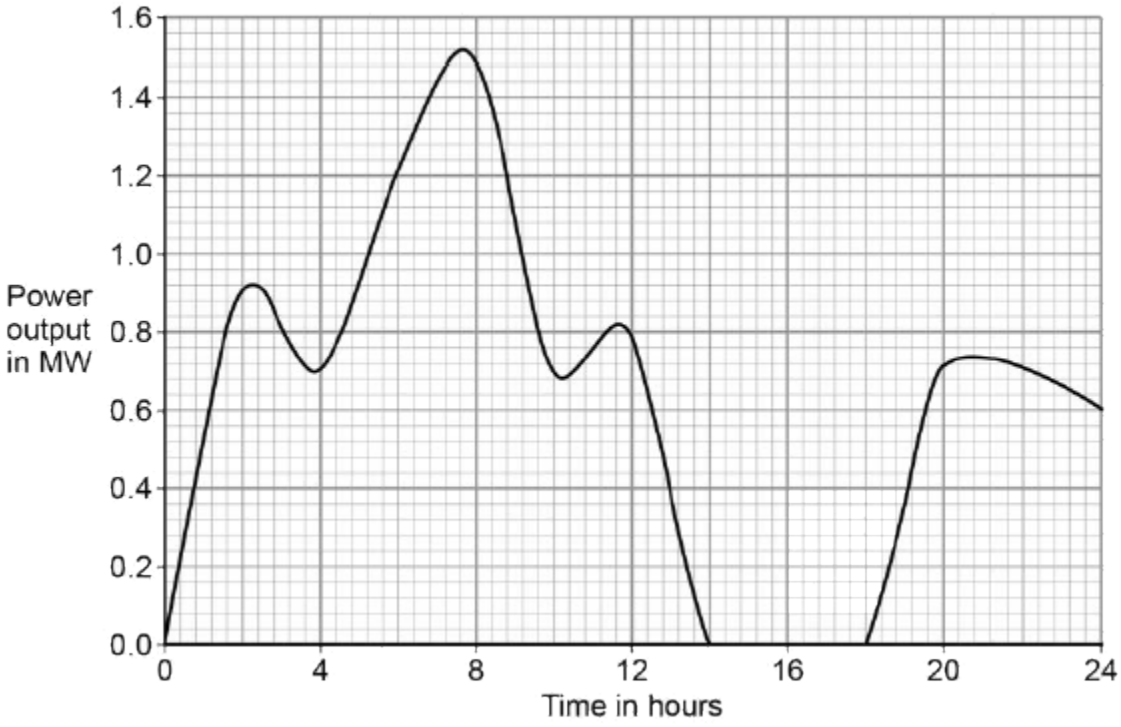
1 .....

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. ☐

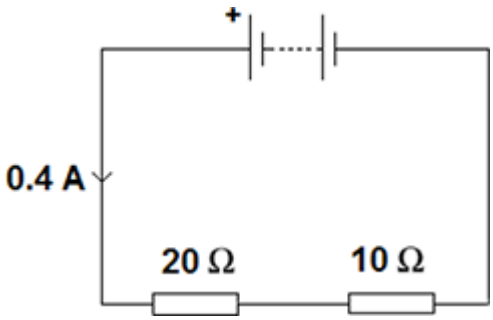
All energy resources are used to generate electricity. ☐

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:

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)

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.

.....

.....

.....

.....

(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

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

Explain why.

.....

.....

.....

.....

.....

.....

.....

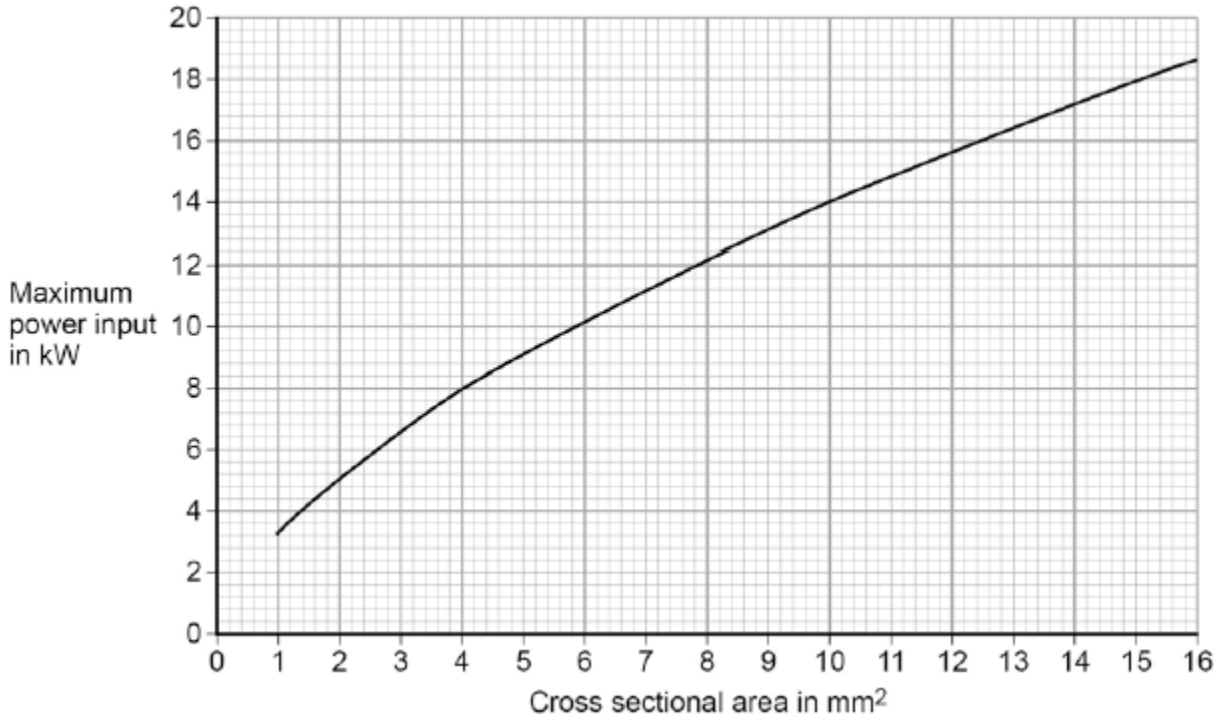
.....

(4)

(b) Different electrical wires need to have a cross-sectional area that is suitable for the power output.

Figure 2 shows the recommended maximum power input to wires of different cross-sectional areas.

Figure 2



The new electric shower has a power input of 13.8 kW.

Determine the minimum **diameter** of wire that should be used for the new shower.

The diameter, d, can be calculated using the equation:

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

A is the cross-sectional area of the wire.

.....

.....

Minimum diameter = ... mm

(2)

(c) The charge that flows through the new shower in 300 seconds is 18 000 C.
The new electric shower has a power of 13.8 kW.

Calculate the resistance of the heating element in the new shower.

Write down any equations you use.

.....

.....

.....

.....

.....

.....

.....

Resistance = ... Ω

(5)
(Total 11 marks)

5 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.

.....

.....

.....

.....

(2)

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

.....

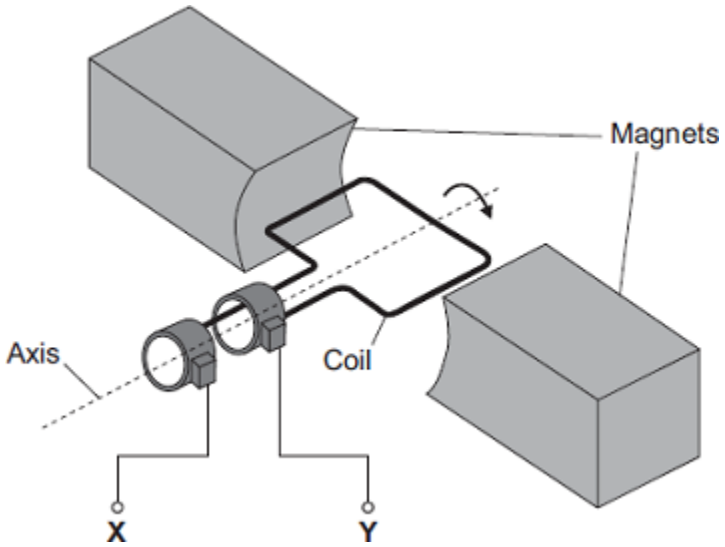
.....

(1)

(Total 10 marks)

6 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**

This effect is called the ..... effect.

(1)

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

.....

(1)

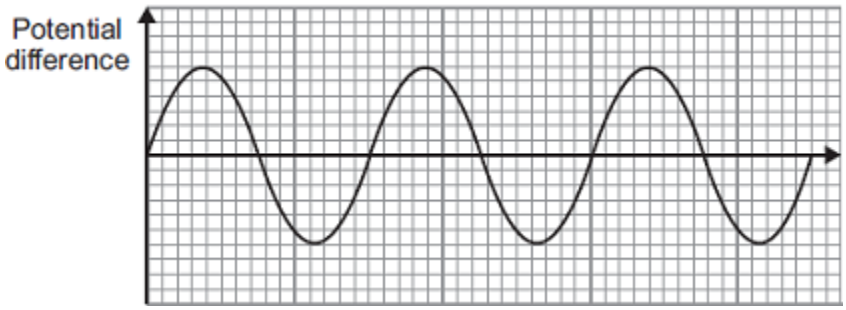
(iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

.....

(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 .....

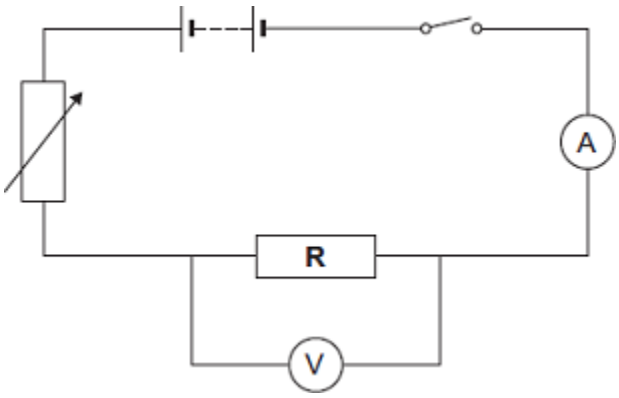
.....

2 .....

.....

(2)
(Total 8 marks)

7 (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**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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)

(b) The diagram shows a fuse.

Describe the action of the fuse in a circuit.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 15 marks)

8 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.

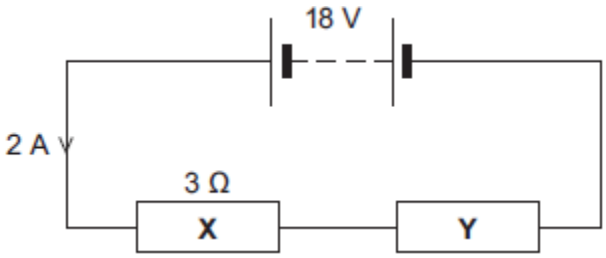
(2)

(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**.

.....

.....

.....

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

(2)

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

.....

.....

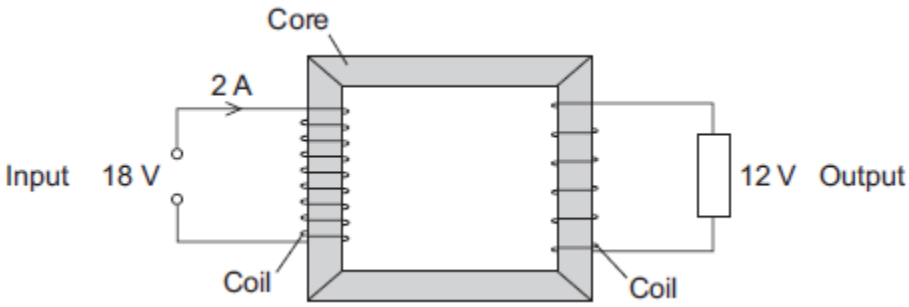
.....

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**.

.....

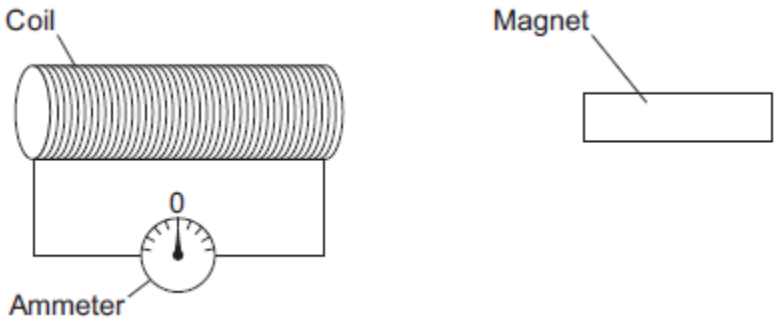
.....

.....

Output current = ... A

(2)
(Total 12 marks)

9 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)

(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)

10 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**

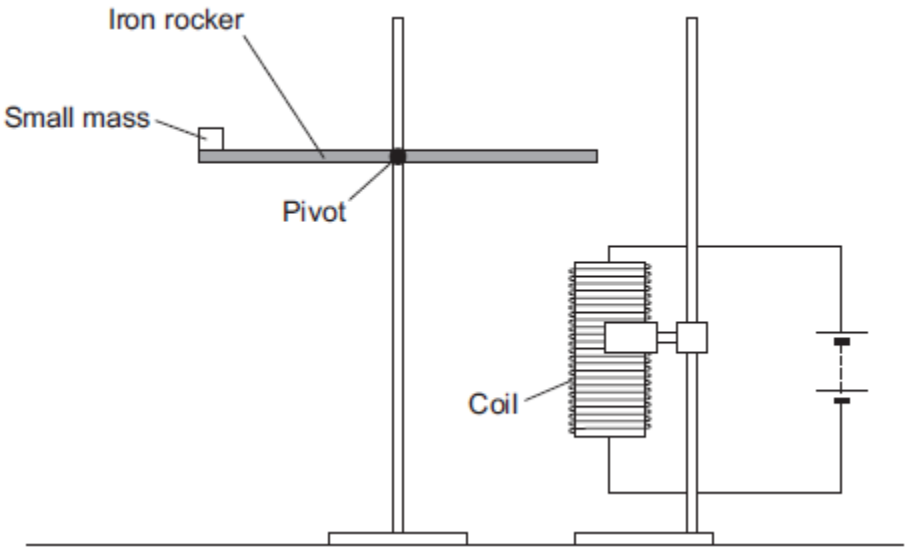
The two wires are the ..... wires.

(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 .



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)

(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)

11 (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.

.....

.....

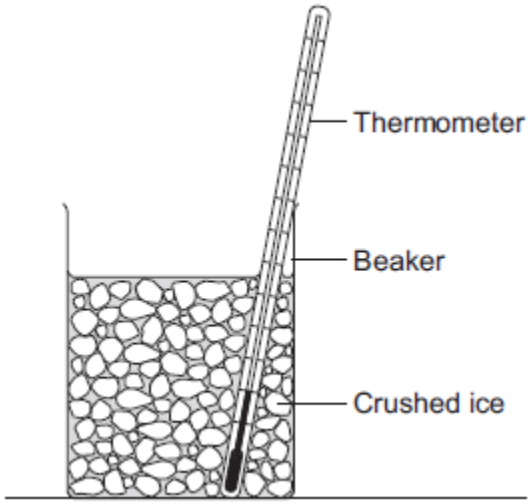
Energy = ... J

(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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Extra space .....

.....

.....

.....

.....

.....

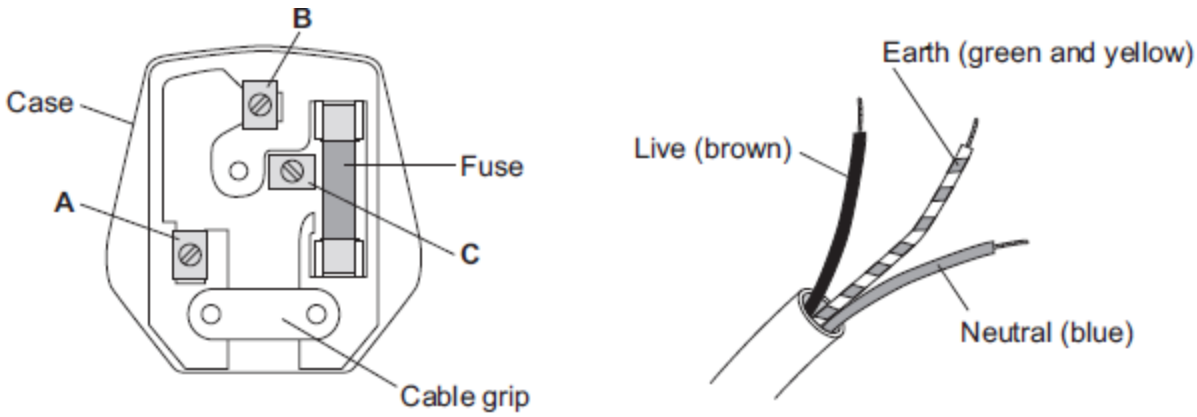
.....

(6)
(Total 18 marks)

12 (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

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
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)

13 Solar panels are often seen on the roofs of houses.

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

.....

.....

.....

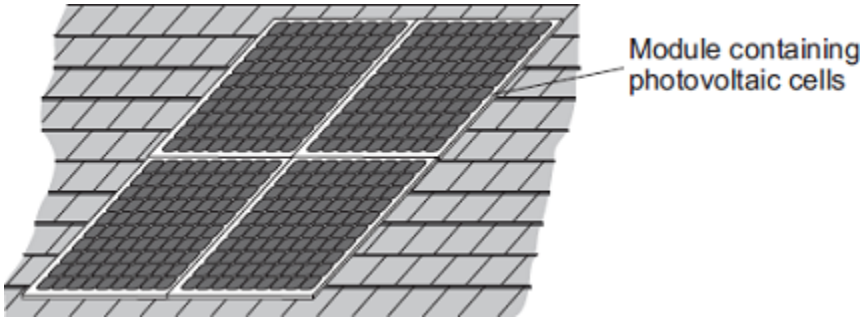
.....

(2)

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

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

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

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

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

.....

.....

.....

.....

.....

..... Time = ... minutes

(3)

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

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

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

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

.....

Energy transferred = ... kWh

(1)

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

Calculate the money the electricity company would pay the householder.

.....

.....

Money paid = ...

(2)

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

Calculate the payback time in years for the modules.

.....

.....

Payback time = ... years

(3)

(iv) State an assumption you have made in your calculation in part **(iii)**.

.....

.....

(1)

(d) In the northern hemisphere, the modules should always face south for the maximum transfer of energy.

State **one** other factor that would affect the amount of energy transferred during daylight hours.

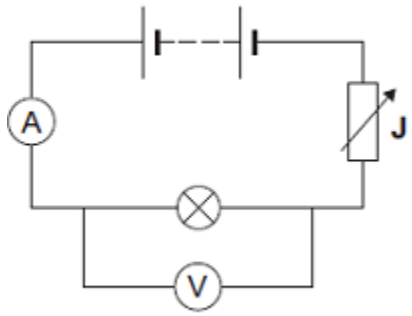
.....

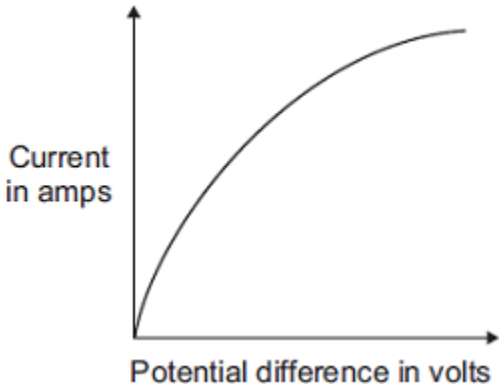
.....

(1)

(Total 13 marks)

14 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





(i) Why is the component labelled '**J** included in the circuit?

.....

.....

(1)

(ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1)

(iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

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

.....

.....

.....

Power = ...

(3)

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

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

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

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

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

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

.....

.....

.....

.....

.....

.....

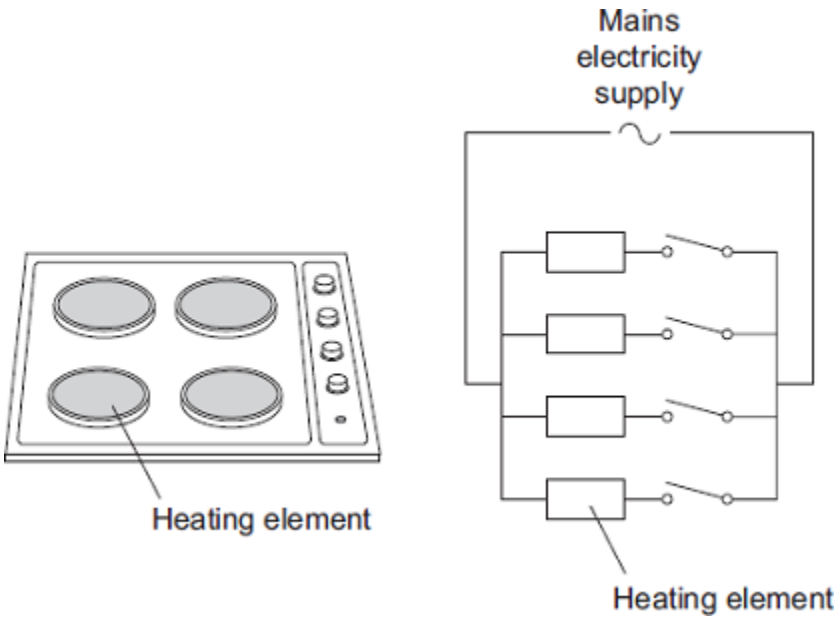
.....

.....

.....

(6)
(Total 11 marks)

15 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 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)

16 (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**

.....

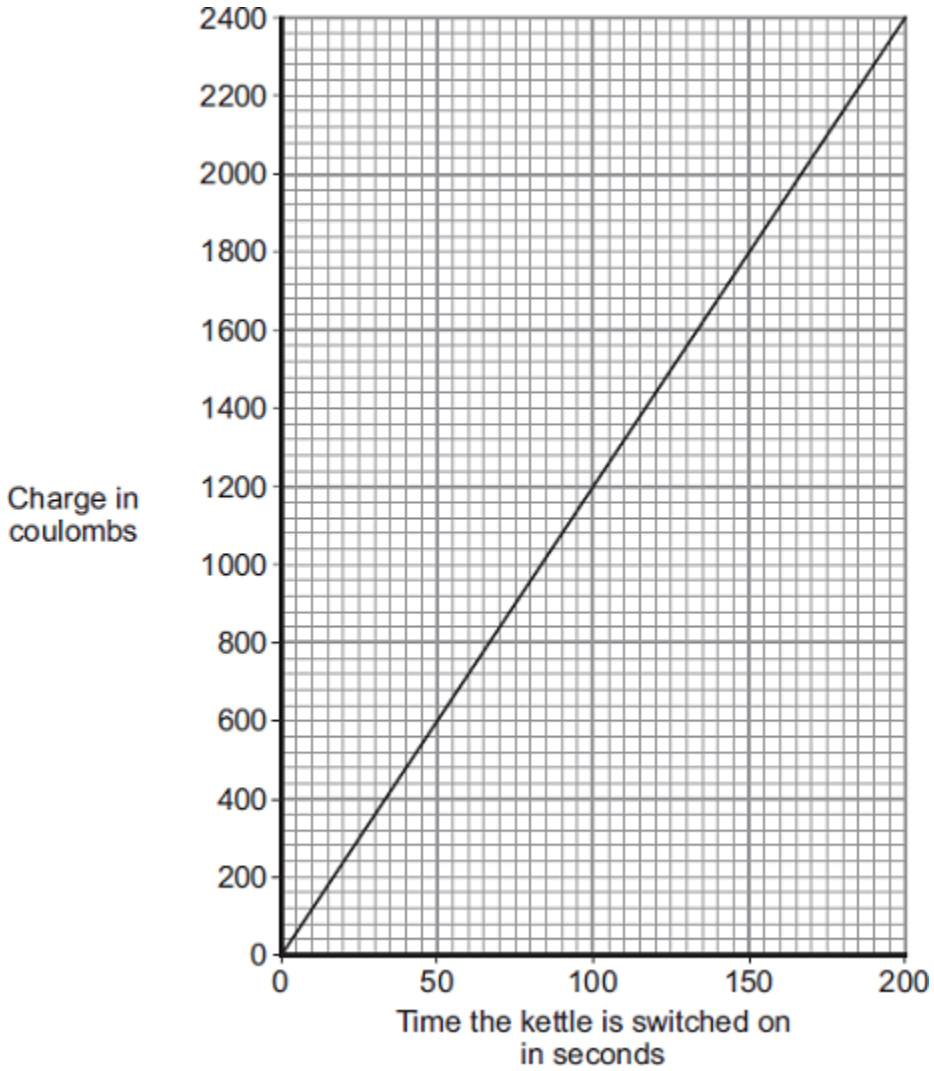
.....

.....

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.



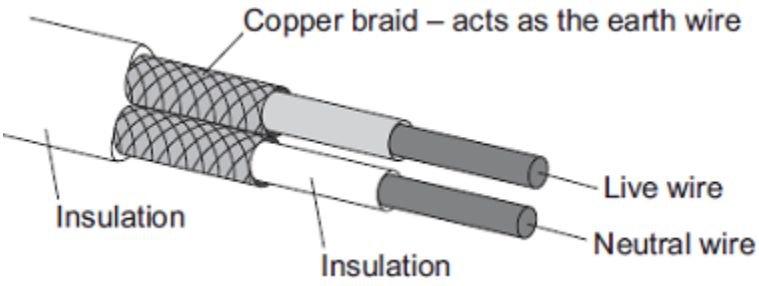
What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

.....

(2)
(Total 7 marks)

17 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.

.....

.....

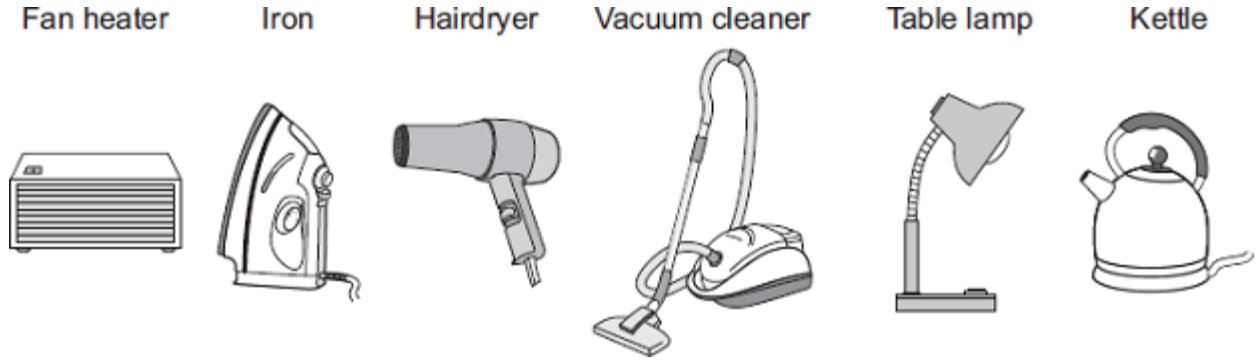
.....

.....

(2)

(Total 11 marks)

18 The pictures show six different household appliances.



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

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

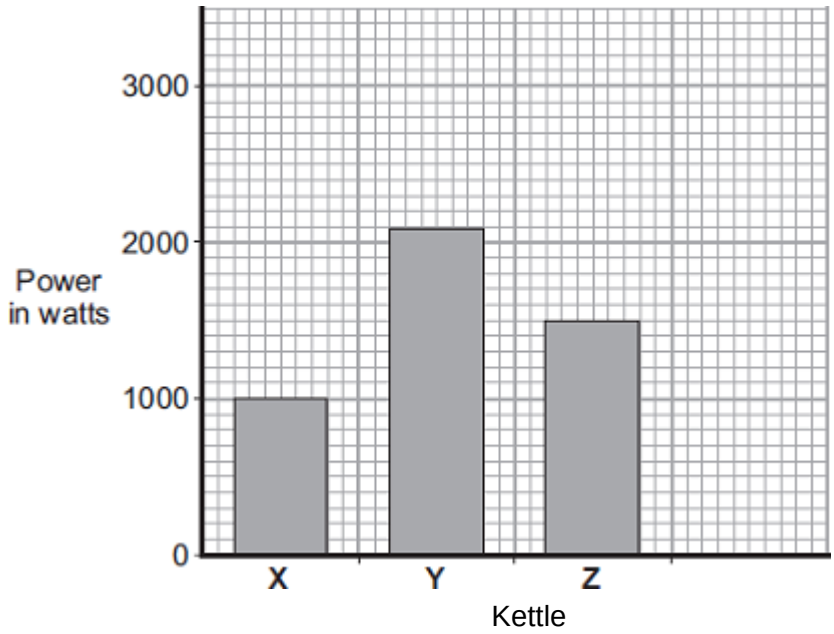
1 .....

2 .....

3 .....

(3)

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



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

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

X ☐

Y ☐

Y ☐

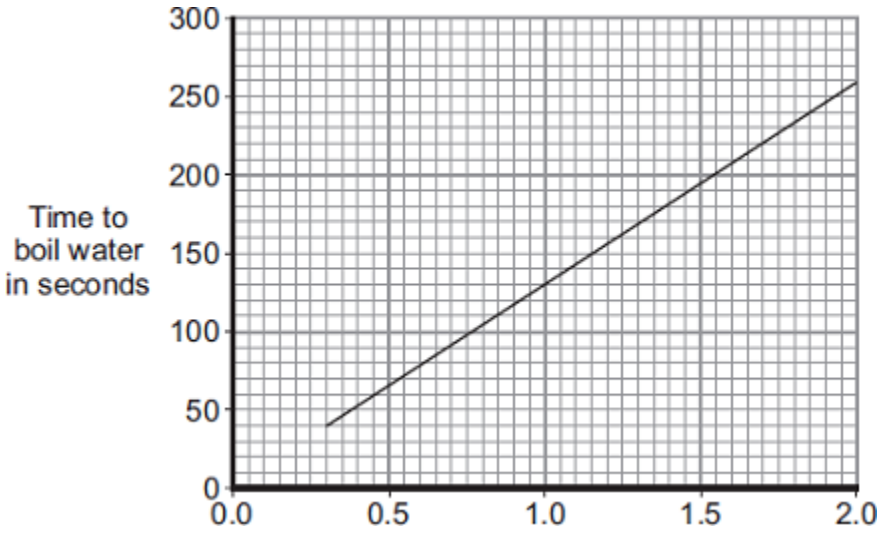
(1)

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

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

(1)

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



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

Explain how the householder is wasting money.

.....

.....

.....

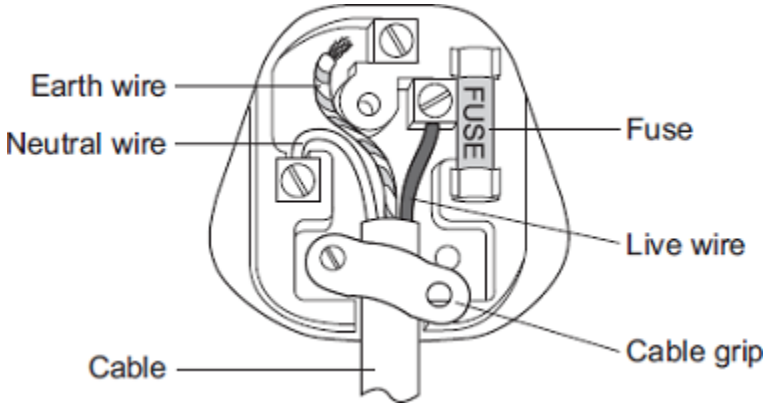
.....

.....

.....

(3)
(Total 8 marks)

19 (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.

.....

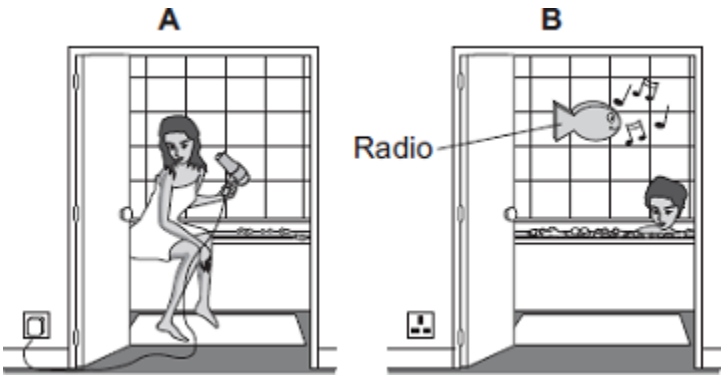
.....

.....

.....

(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)

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

.....

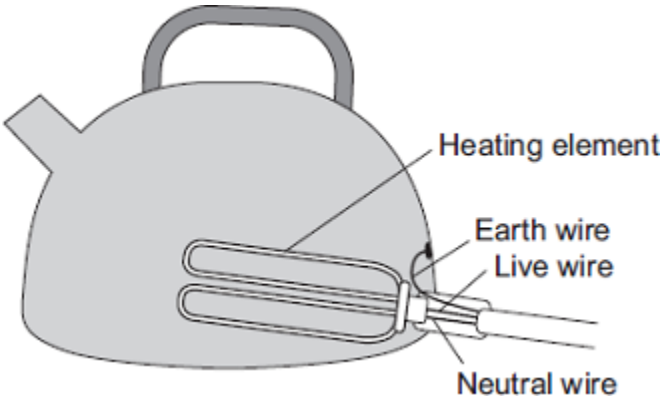
.....

.....

.....

(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.

.....

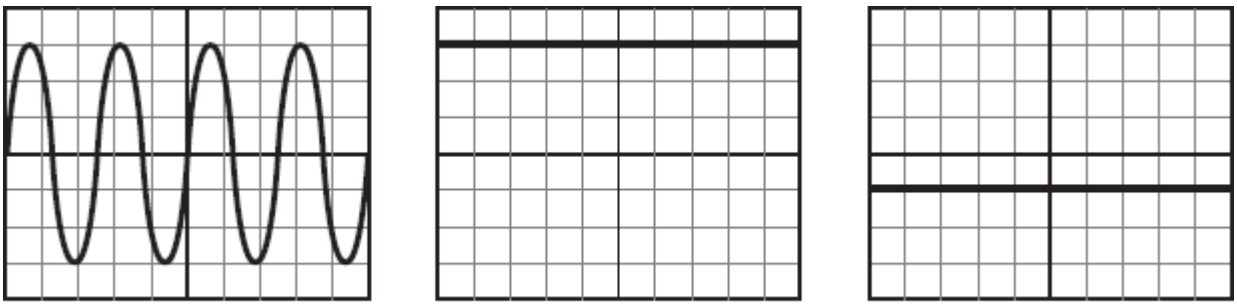
.....

.....

.....

(2)
(Total 4 marks)

21 (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?

.....

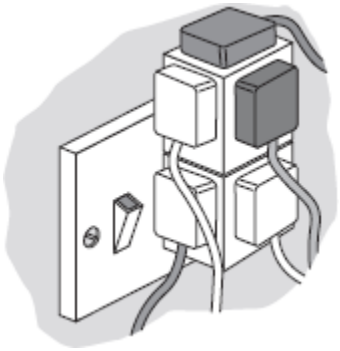
Give a reason for your answer.

.....

.....

(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.

.....

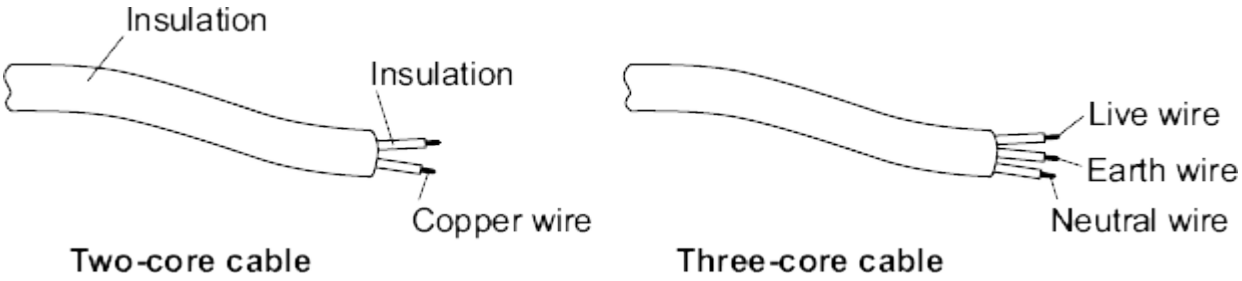
.....

.....

.....

(2)
(Total 4 marks)

22 (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.

.....

.....

.....

.....

.....

.....

.....

(3)
(Total 5 marks)

23 (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.

.....

.....

.....

(1)

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

Suggest why.

.....

.....

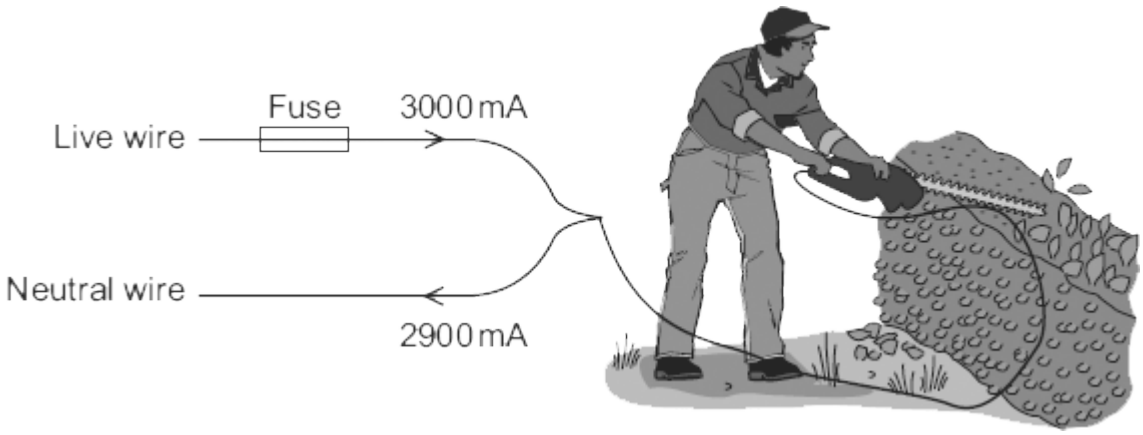
.....

.....

.....

(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.

.....

.....

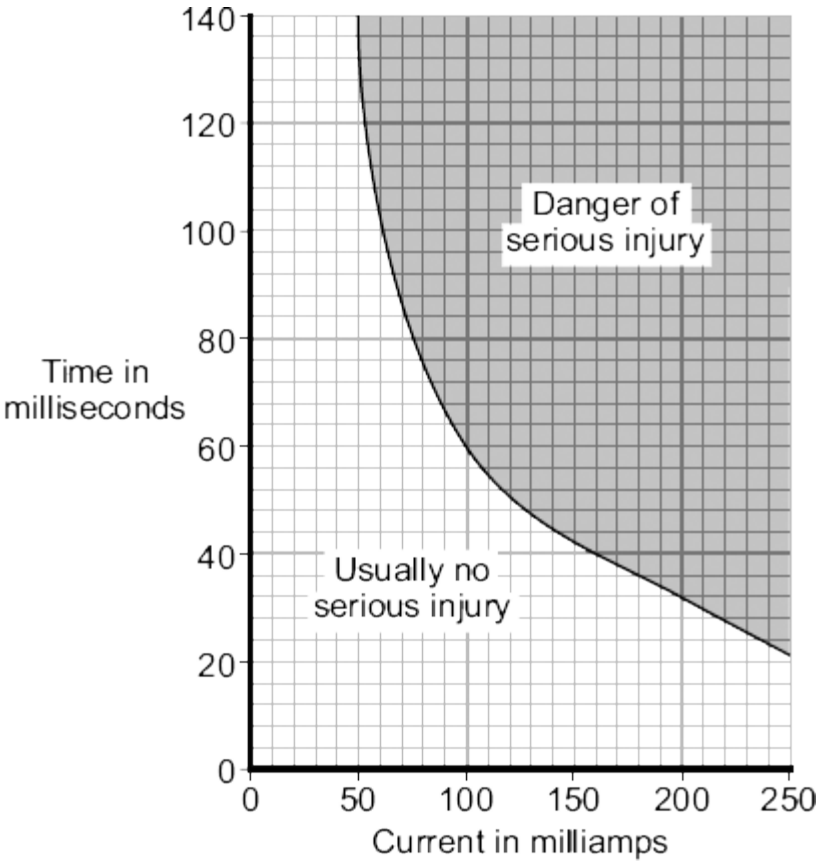
.....

.....

.....

(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.



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.

.....

.....

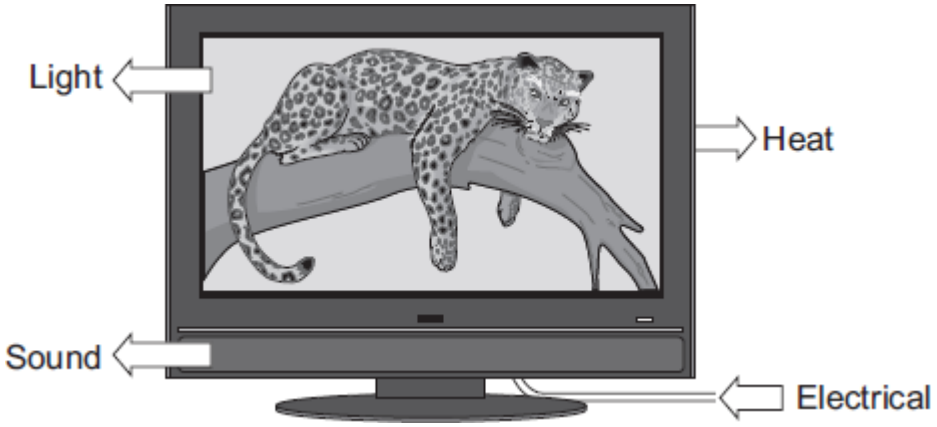
.....

.....

.....

(2)
(Total 10 marks)

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



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

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

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

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

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

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

..... .

(1)

(b) 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.

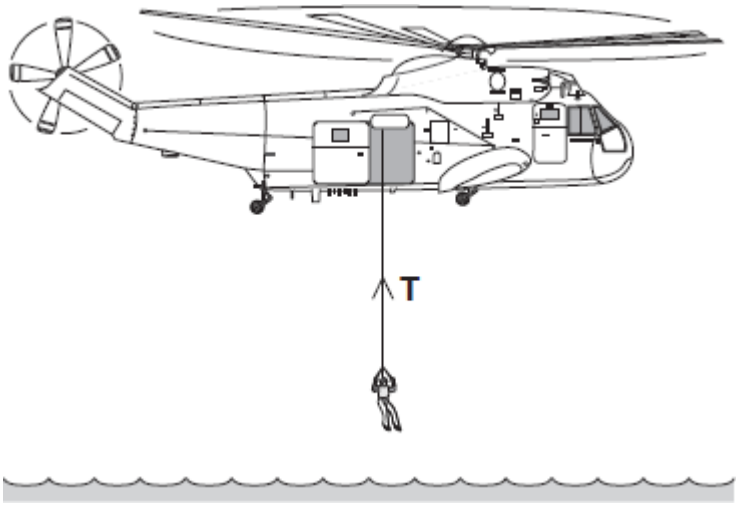
.....

.....

Cost = ...

(2)
(Total 5 marks)

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



(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.

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)**

.....

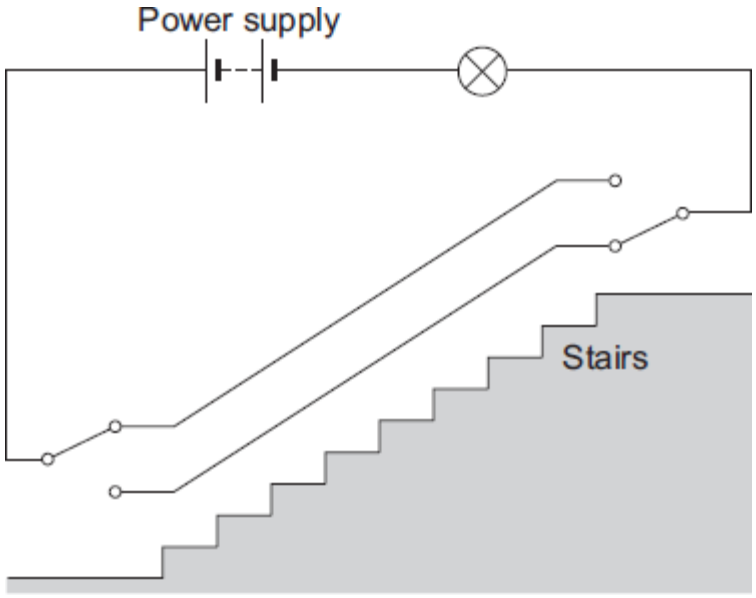
.....

Power = ...

(3)

(Total 7 marks)

26 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?

.....

.....

(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.

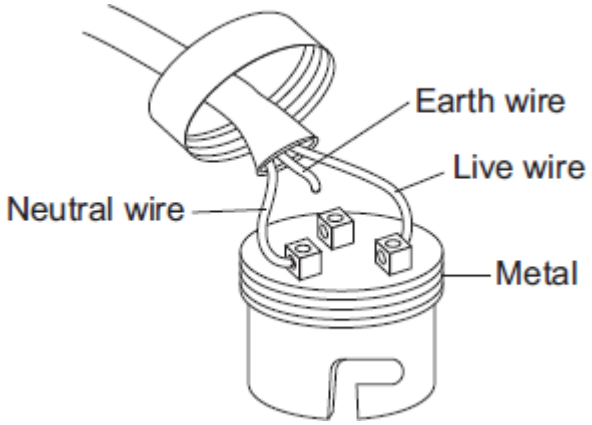
What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

.....

.....

(1)

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



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?

.....

.....

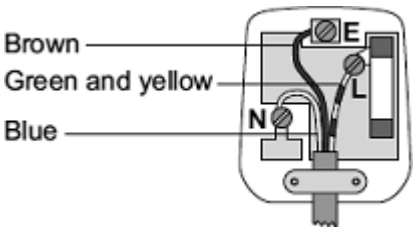
(1)
(Total 7 marks)

27 The diagrams show the inside of a 13 amp plug.

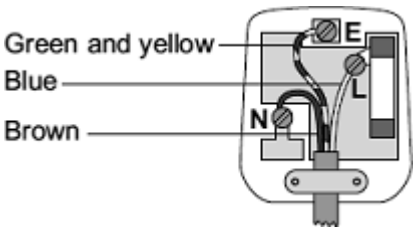
(a) (i) Which **one** of the plugs, **A**, **B**, **C** or **D**, is correctly wired?

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

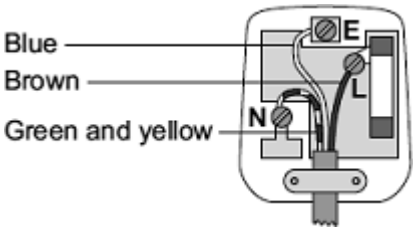
A



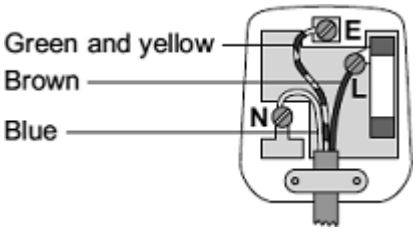
B



C



D



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.

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.

.....

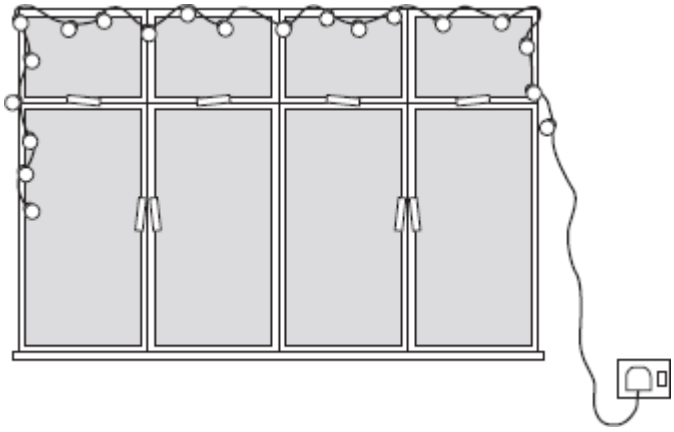
.....

.....

.....

(2)
(Total 6 marks)

28 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?

.....

(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)

29 **Diagram 1** shows a hairdryer.
Diagram 2 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.
The hairdryer does not have an earth wire.

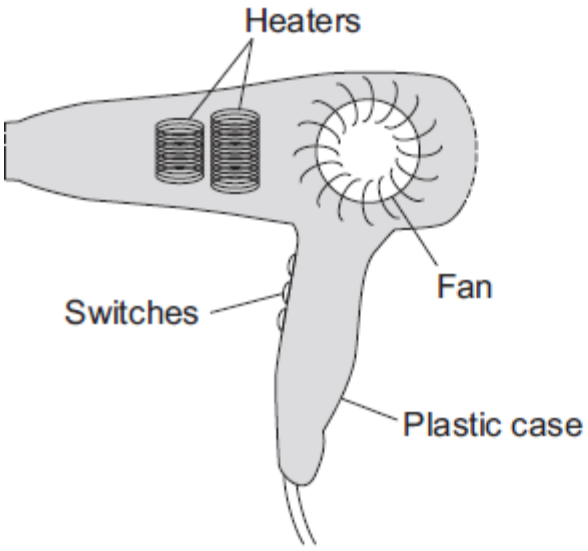


Diagram 1

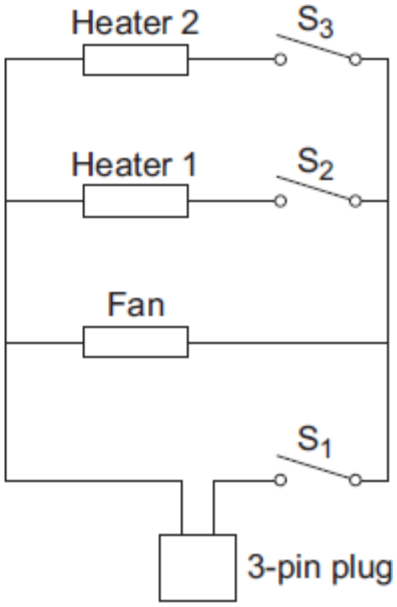


Diagram 2

(a) What colour is the insulation around the wire connected to the live pin inside the plug?

.....

(1)

(b) Why does the hairdryer **not** need an earth wire?

.....

.....

(1)

(c) All the switches are shown in the OFF position.

(i) Which switch or switches have to be ON to make:

(1) only the fan work; .....

(2) heater 2 work? .....

(2)

(ii) The heaters can only be switched on when the fan is also switched on.

Explain why.

.....

.....

.....

.....

.....

(2)

(d) The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

	Current in amps
Fan only	1.0
Fan and heater 1	4.4
Fan and both heaters	6.5

Calculate the maximum power of the hairdryer.

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

.....

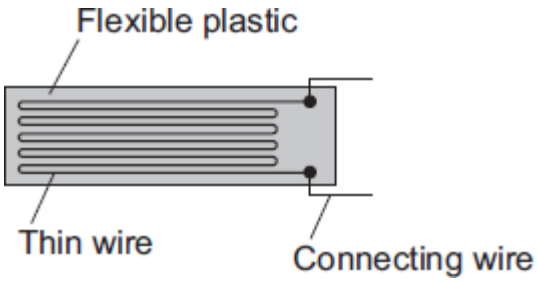
.....

Maximum power = ...

(3)
(Total 9 marks)

30 The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



(a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2)

(ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

.....

.....

.....

(1)

(b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

(i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

.....

.....

Resistance = ... Ω

(2)

(ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

.....

.....

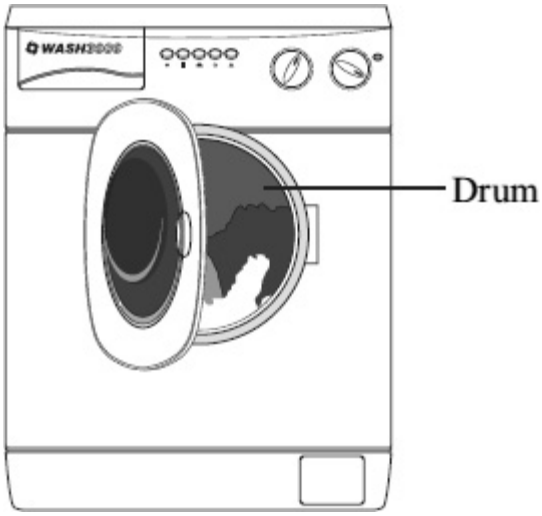
(1)

(iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

.....

(1)
(Total 7 marks)

31 The picture shows a new washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



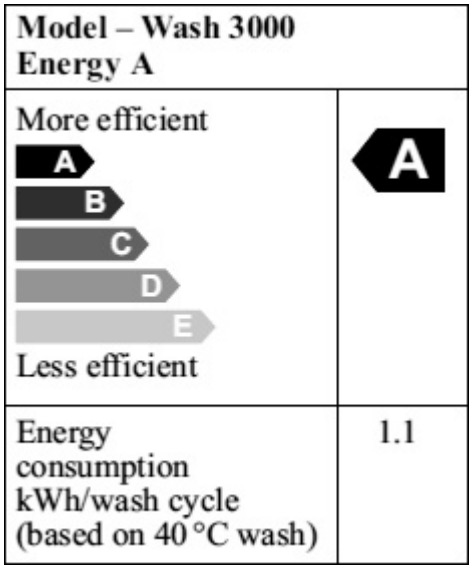
(a) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(b) The diagram shows the label from the new washing machine.



An 'A' rated washing machine is *more energy efficient* than a 'C' rated washing machine.

Explain what being *more energy efficient* means.

.....

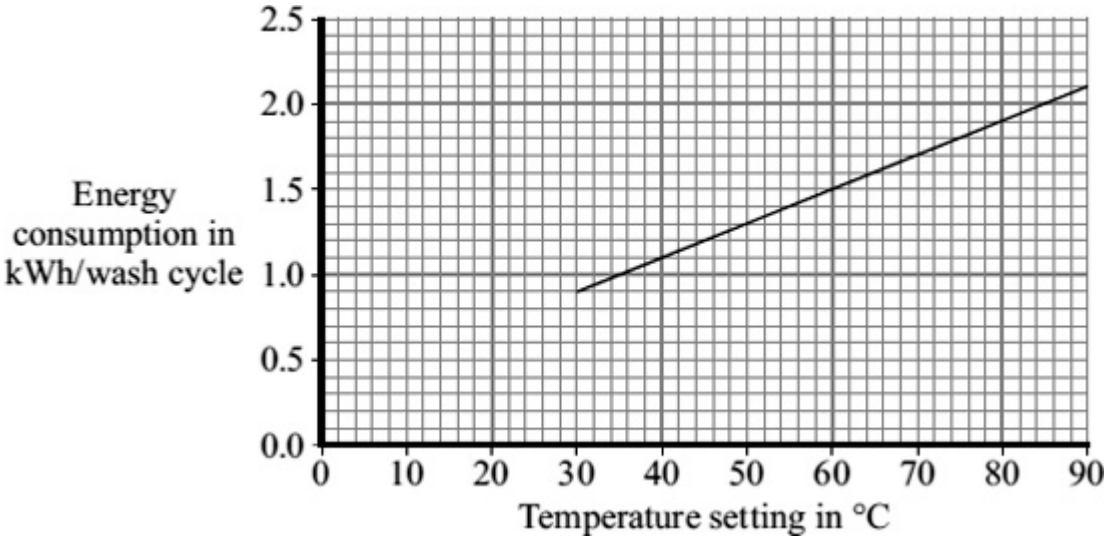
.....

.....

.....

(2)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 12 p per kilowatt-hour (kWh).
The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

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

Show clearly how you work out your answer.

.....

.....

Money saved = ... p

(2)

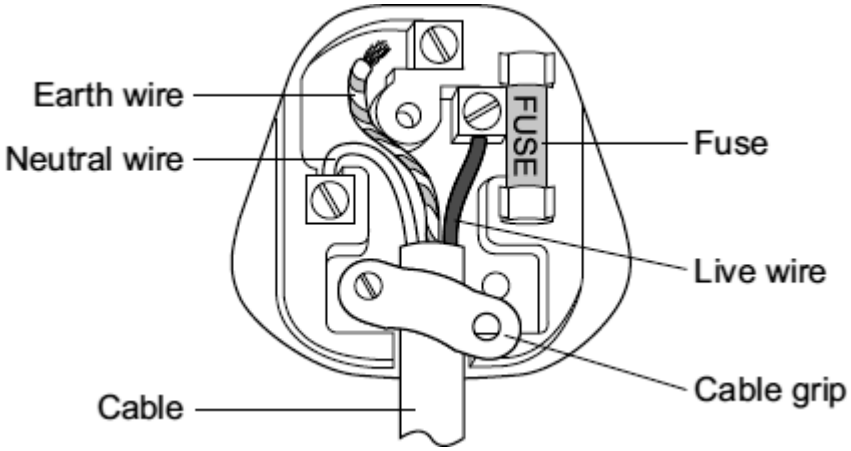
(ii) Suggest why reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

.....

.....

(1)
(Total 6 marks)

32 (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) Which one of the wires inside a plug is there to make an appliance with a metal case safer to use?

.....

(1)

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

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

.....

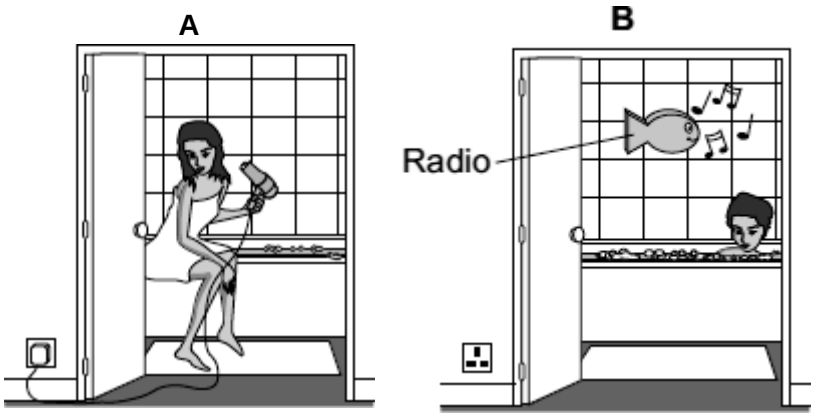
.....

.....

.....

(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.

.....

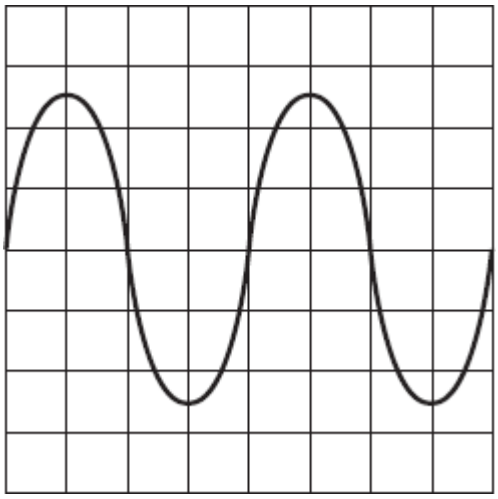
.....

.....

.....

(2)
(Total 7 marks)

33 An oscilloscope is connected to an alternating current (a.c.) supply.
The diagram shows the trace produced on the oscilloscope screen.



Each horizontal division on the oscilloscope screen represents 0.002 s.

(a) Calculate the frequency of the alternating current supply.

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

.....

.....

.....

Frequency = ...

(3)

(b) What is the frequency of the a.c. mains electricity supply in the UK?

.....

(1)
(Total 4 marks)

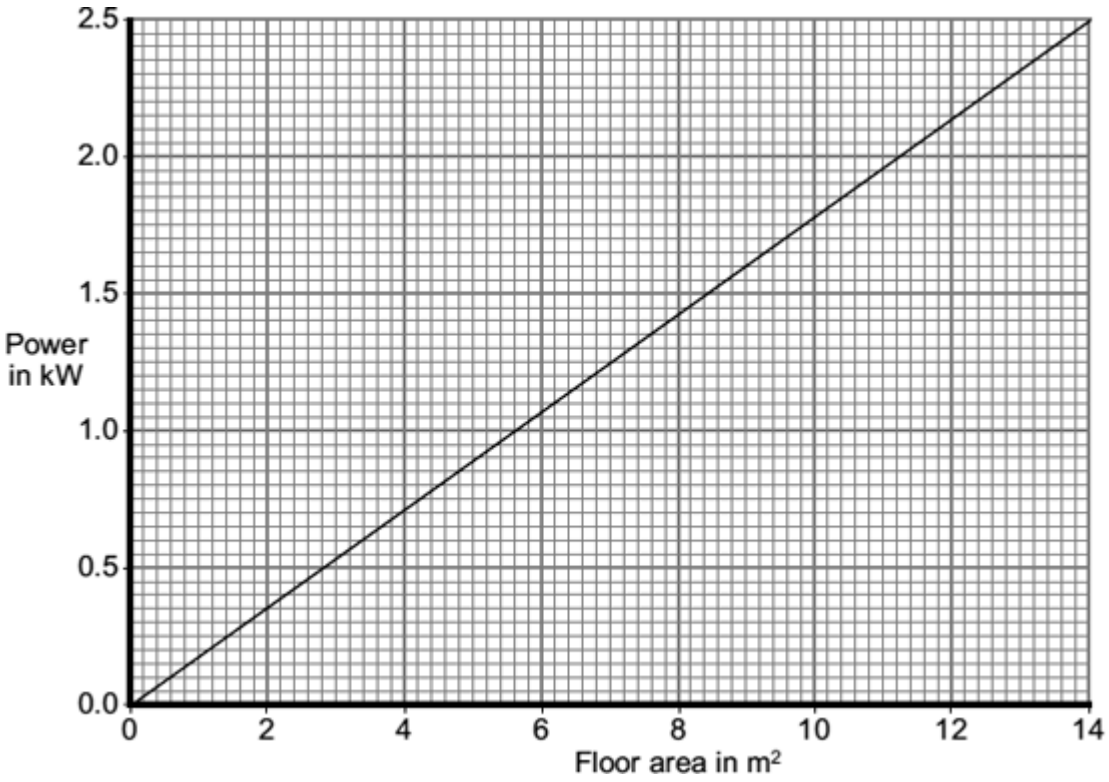
34 A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

(a) What is an electric current?

.....

(1)

(b) The graph shows how the power output of an underfloor heating system depends on the area of the floor that is heated.



The area of the homeowner's kitchen floor is 9.0 m $^{2.}$

Calculate, using the graph, the current drawn from the 230 V mains supply by the heating system.

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

.....

.....

.....

.....

Current = ...

(4)
(Total 5 marks)

35 (a) Use numbers given in the box to complete the following sentences.

12	**50**	**110**	**230**

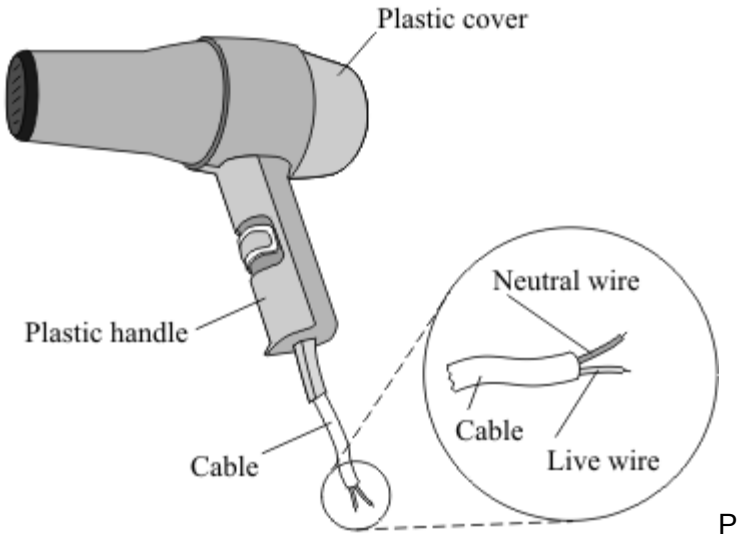
In the UK, the mains electricity supply is ..... volts.

The frequency of the UK mains electricity supply is ..... hertz.

(2)

(b) The diagram shows a hairdryer designed to be used with the UK mains supply.

The cable connecting the hairdryer to the plug does not have an earth wire.



(i) Why does the hairdryer **not** need a cable with an earth wire?

.....

.....

(1)

(ii) Which **one** of the following materials are the two wires inside the cable made from?

Draw a ring around your answer.

aluminium **copper** **steel**

(1)

(Total 4 marks)

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

.....

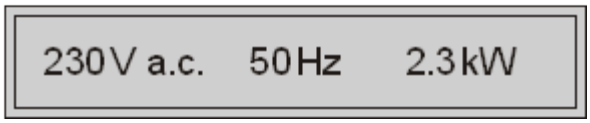
.....

.....

.....

(2)

(b) The diagram shows the information plate on the bottom of an electric wallpaper steamer.



(i) Calculate the current used by the steamer.

Show clearly how you work out your answer.

.....

.....

Current ..... A

(2)

(ii) Which **one** of the following fuses should be used inside the plug of the steamer?

Draw a ring around your answer.

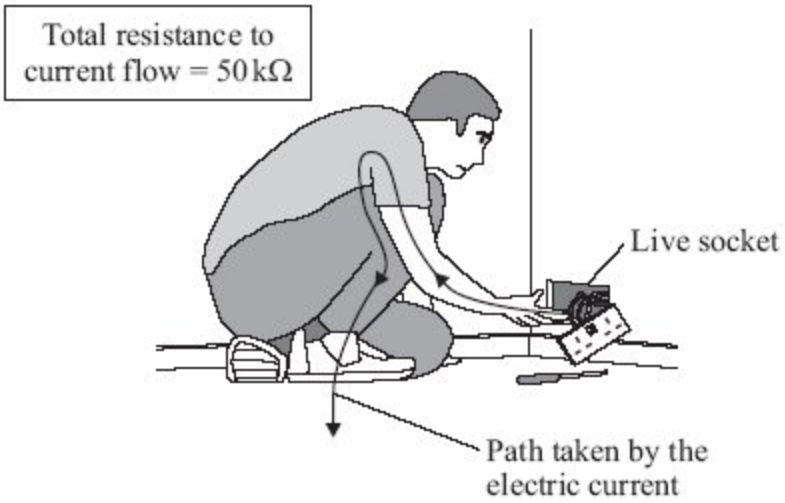
1 A **3 A** **5 A** **10 A** **13 A**

(1)

(Total 5 marks)

37 The diagram shows someone accidentally touching the live wire inside a dismantled 230 volt mains electricity socket.

A current flows through the person giving him an electric shock.



(a) (i) Calculate the current that will flow through the person.

Show clearly how you work out your answer.

.....

.....

Current = ... A

(2)

(ii) Rubber is a good insulator.

Explain why it is a good idea for electricians to wear rubber soled boots when working.

.....

.....

.....

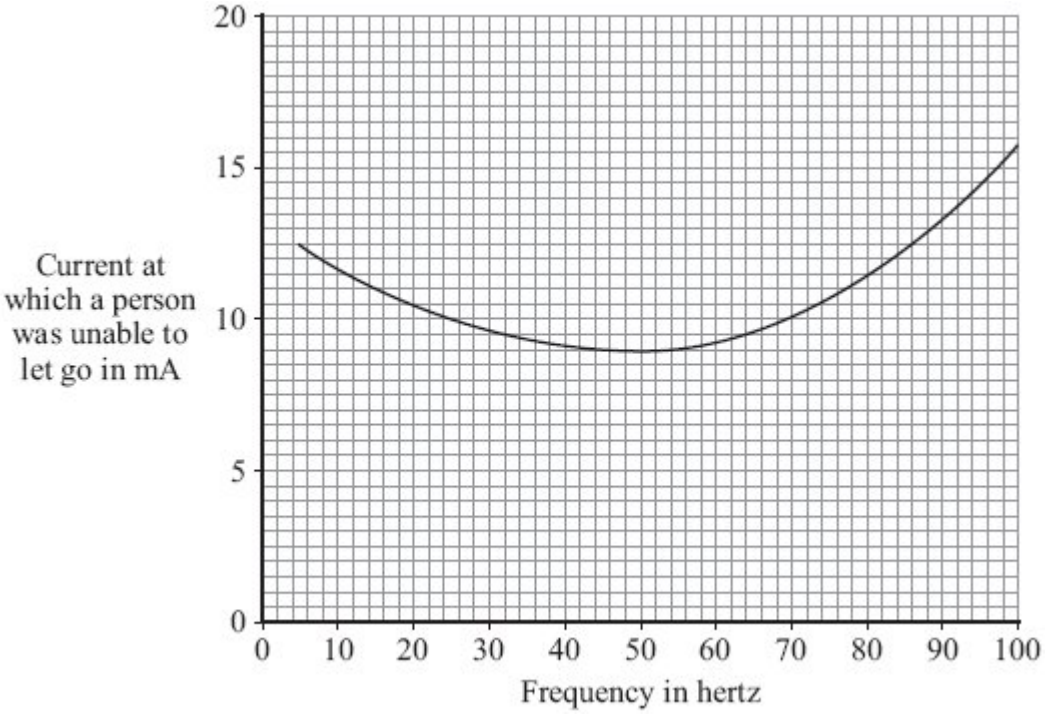
.....

(2)

(b) If the current flowing through a person is too high, the person cannot let go of the electrical source.

Different people were tested to see whether the ability to let go of an electrical source depended on the frequency of the current.

The results of the test are shown in the graph.



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

.....

(1)

(ii) From a safety point of view, is the frequency of the UK mains electricity supply suitable?

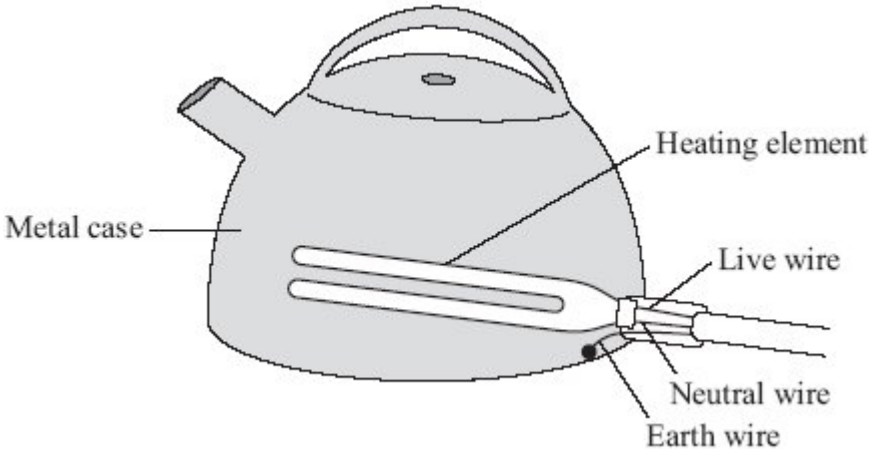
Give a reason for your answer.

.....

.....

(1)

(c) 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 8 marks)

38 (a) Each letter **A, B, C, D** and **E** represents an energy transformation.

A electrical to gravitational potential

B electrical to heat

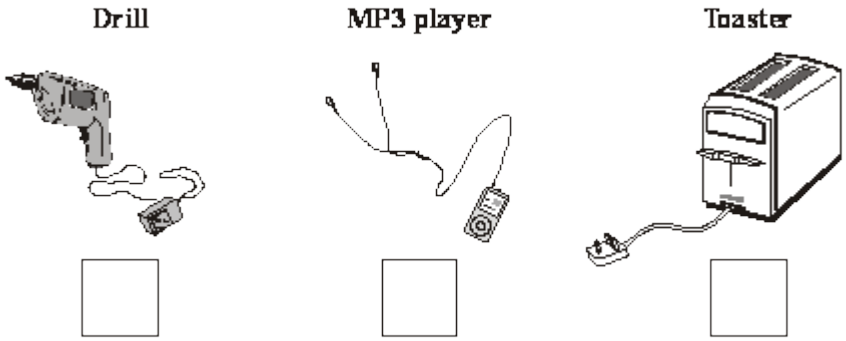
C electrical to kinetic

D electrical to light

E electrical to sound

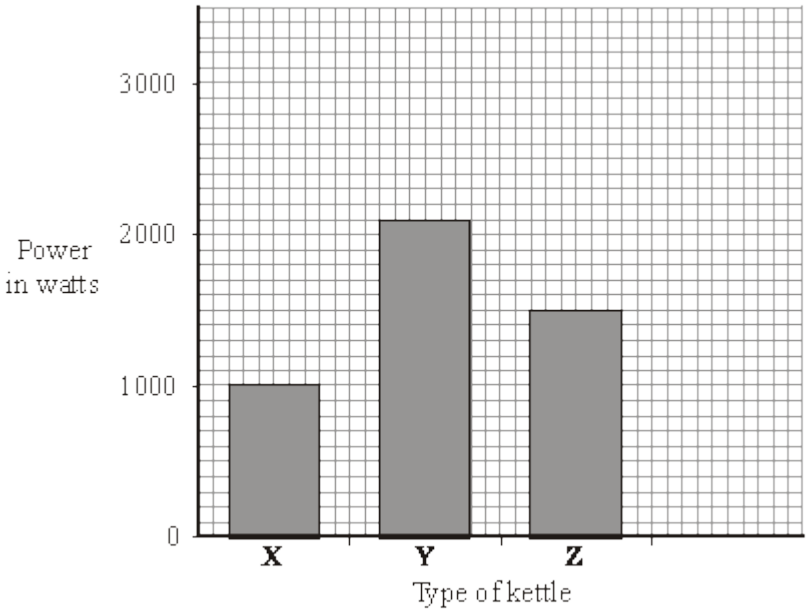
Match each of the following devices to the useful energy transformation that it is designed to make.

Write the correct letter, **A, B, C, D** or **E**, in the box below the device. Use each letter once or not at all.



(3)

(b) The bar chart shows the power of three electric kettles.



(i) What is the power of kettle **Y**?

.....

(1)

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

Which kettle costs the most to use?

.....

(1)

(iii) 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) Some friends are going on holiday. They want to be able to boil water to make their own hot drinks. They cannot decide which to take, a travel kettle or a small portable immersion heater that can be placed in a mug.

Travel Kettle
• 1 k W element
• Holds 1 litre
• Works on 110V or 230V
• Washable water filter

Immersion heater
• 0.4 k W element
• Heates up to 0.5 litres of water
• Works on 230 V only
• Small compact size

(i) Give **one** advantage of taking the travel kettle.

.....

.....

(1)

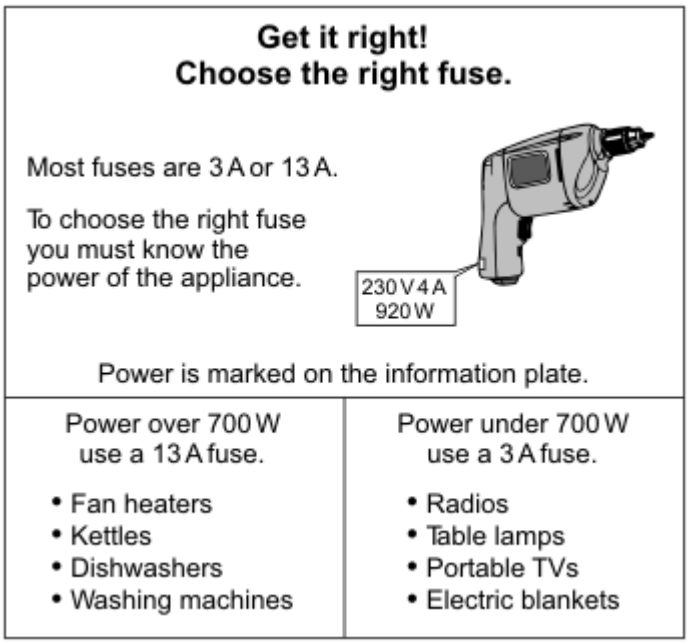
(ii) Give **one** advantage of taking the immersion heater.

.....

.....

(1)
(Total 8 marks)

39 (a) Look at this electrical safety information poster.



(i) Complete the table to show which size fuse, 3 A or 13 A, should be fitted to each of the appliances.

Appliance	Power rating	Fuse
Hairdryer	1600 W	
Electric saw	350 W	
Food mixer	1200 W	

(2)

(ii) The plug of an electric kettle has been wrongly fitted with a 3 A fuse.

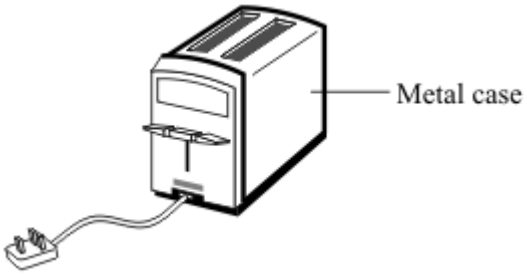
What will happen to the fuse when the kettle is switched on?

.....

.....

(1)

(b) The drawing shows a toaster, which takes a current of 4 A from the 230 V mains electricity supply.



(i) Use the equation in the box to calculate the power of the toaster.

Power (watt, W)	=	current (ampere, A)	×	potential difference (volt, V)

Show clearly how you work out your answer.

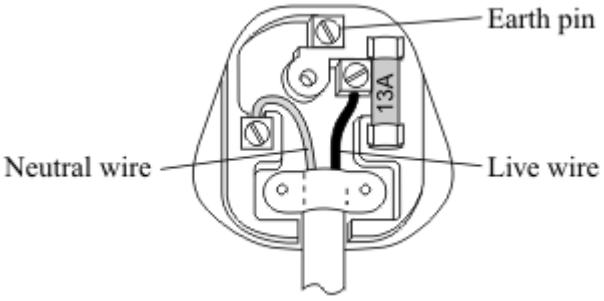
.....

.....

Power = ... W

(2)

(ii) A householder rewires the toaster with a new cable and plug. The diagram shows how the new cable has been connected to the plug.



Explain why the toaster may **not** be safe to use.

.....

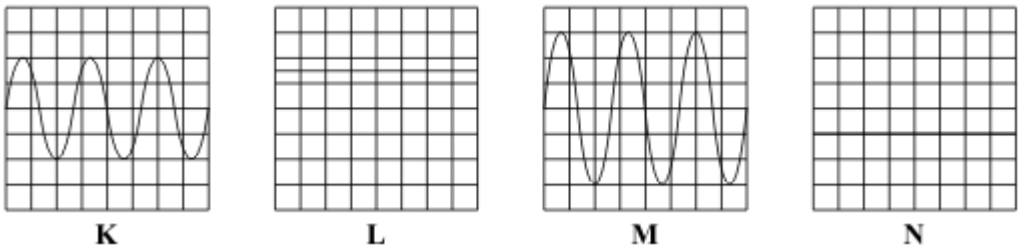
.....

.....

.....

(2)

(c) The diagram shows the oscilloscope traces produced by four different electricity supplies. The settings on the oscilloscope are the same for each electricity supply.



(i) Which **two** supplies give a direct current (d.c.)?

..... and .....

(1)

(ii) Supply **K** provides a peak potential difference of 6 V.

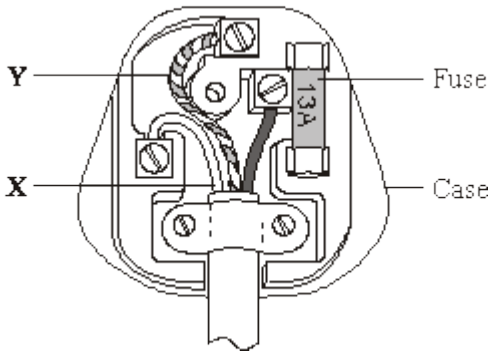
What is the peak potential difference provided by supply **M**?

.....

(1)

(Total 9 marks)

40 (a) The diagram shows the inside of a correctly wired three-pin plug.



(i) What colour is the insulation on the wire labelled **X**?

Draw a ring around your answer.

blue **brown** **green/yellow**

(1)

(ii) What name is given to the wire labelled **Y**?

Draw a ring around your answer.

earth **live** **neutral**

(1)

(iii) What material would be suitable for the case of the plug?

.....

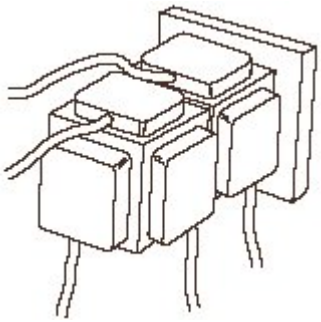
(1)

(iv) Which **one** of the following is the correct circuit symbol for a fuse?

Draw a ring around your answer.

(1)

(b) A householder does not have enough electric sockets in the kitchen. To overcome the problem, the householder uses two adaptors to plug five appliances into a single electric socket.



Explain why this is dangerous.

.....

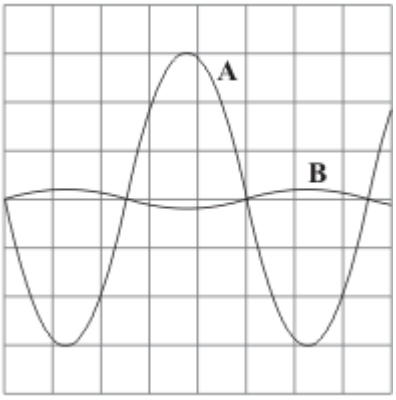
.....

.....

.....

(2)
(Total 6 marks)

41 The diagram shows two oscilloscope traces, **A** and **B**.



Trace **A** shows how the potential difference between the live and neutral terminals of an electricity supply changes with time.

(a) Describe how the potential of the live terminal varies with respect to the neutral terminal of the electricity supply.

.....

.....

(2)

(b) What does trace **B** show?

.....

.....

(1)

(c) Each horizontal division on the oscilloscope represents 0.005 s.

(i) What is the period of this electricity supply?

.....

Period = ... seconds

(1)

(ii) Calculate the frequency of the supply.

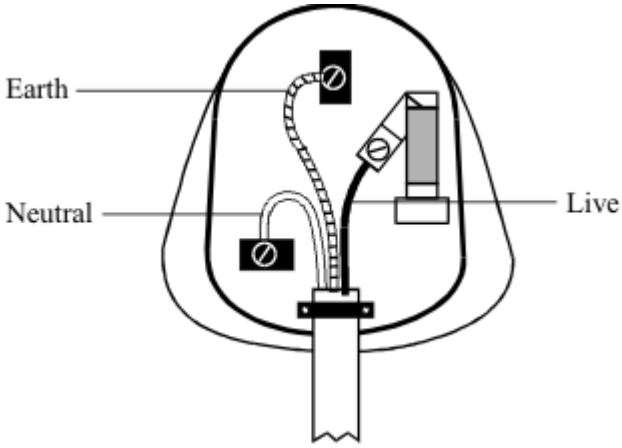
.....

Frequency = ... hertz

(1)

(Total 5 marks)

42 The diagram shows the inside of a mains plug.

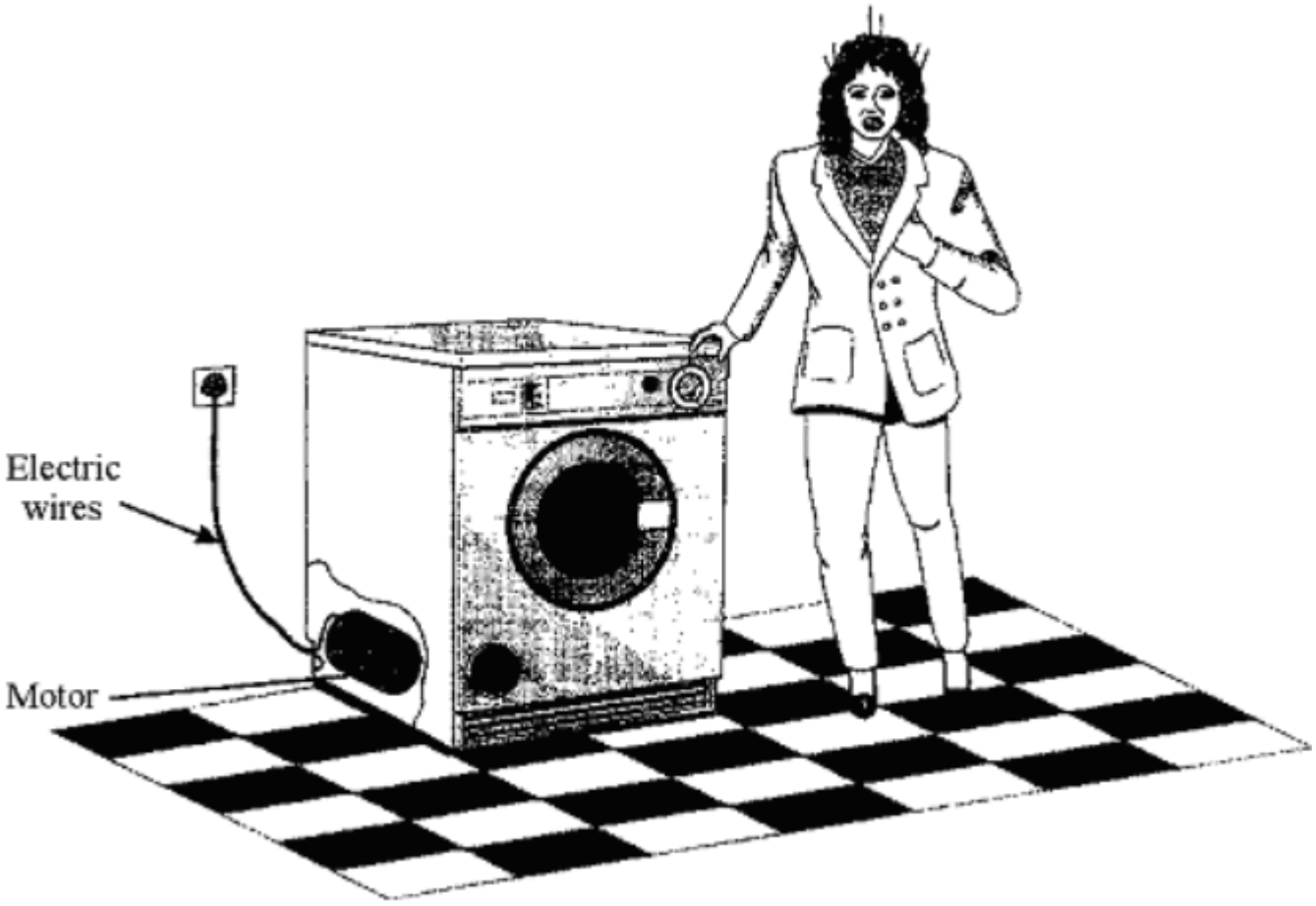


(a) Complete the table.

Wire	Colour of insulation
Earth	
Live	
Neutral	

(3)

(b) The diagram shows a washing machine without an earth connection. The live wire has become loose and is touching the metal case of the washing machine.



(i) Draw on the diagram the path taken by the electricity when the person touches the metal case of the machine.

(1)

(ii) Describe how the path of the electricity would change if the washing machine had an earth connection.

.....

.....

.....

(2)

(c) Some electrical appliances use a cable which does not have an earth wire. Which **one** of the following appliances can safely use this type of cable?

hairdrier iron refrigerator

.....

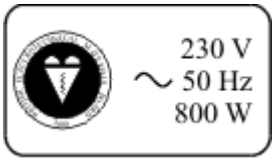
Give a reason for your answer.

.....

.....

(2)
(Total 8 marks)

43 The information plate on a hairdrier is shown.



(a) What is the power rating of the hairdrier?

.....

(1)

(b) (i) Write down the equation which links current, power and voltage.

.....

(1)

(ii) Calculate the current in amperes, when the hairdrier is being used. Show clearly how you work out your answer.

.....

.....

.....

.....

Current = ... amperes

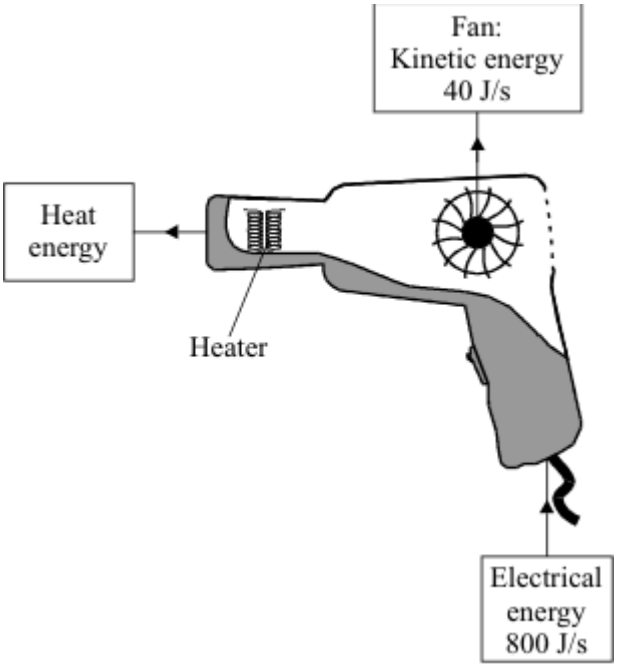
(2)

(iii) Which **one** of the following fuses, 3A, 5A or 13A, should you use with this hairdrier?

.....

(1)

(c) The hairdrier transfers electrical energy to heat energy and kinetic energy.



Calculate the efficiency of the hairdrier in transferring electrical energy into heat energy.

.....

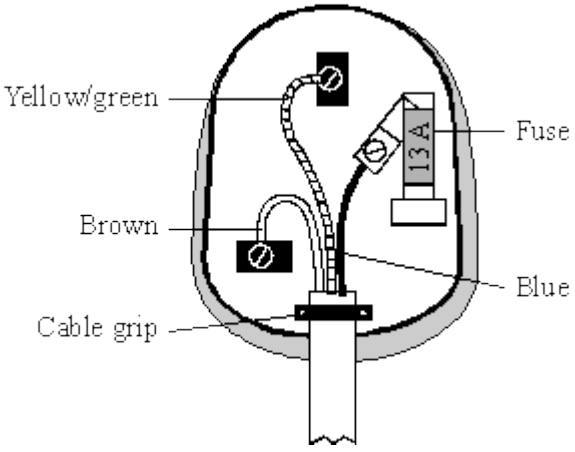
.....

.....

Efficiency = ...

(2)
(Total 7 marks)

44 (a) The diagram shows a 13 amp plug.



(i) What is wrong with the way this plug has been wired?

.....

.....

(1)

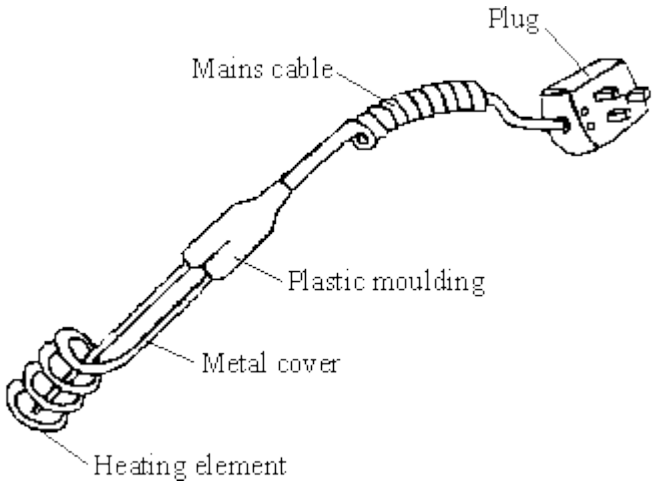
(ii) Why do plugs have a fuse?

.....

.....

(1)

(b) The diagram shows an immersion heater which can be used to boil water in a mug.

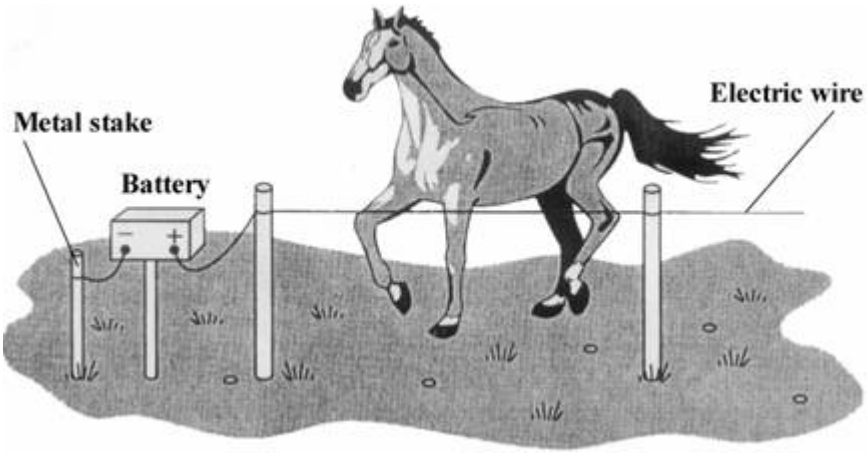


(i) Which part of the immersion heater should be connected to the earth pin of the plug?

.....

(1)
(Total 3 marks)

45 (a) The diagram shows an electric fence, designed to keep horses in a field.



When a horse touches the wire the horse receives a mild electric shock. Explain how.

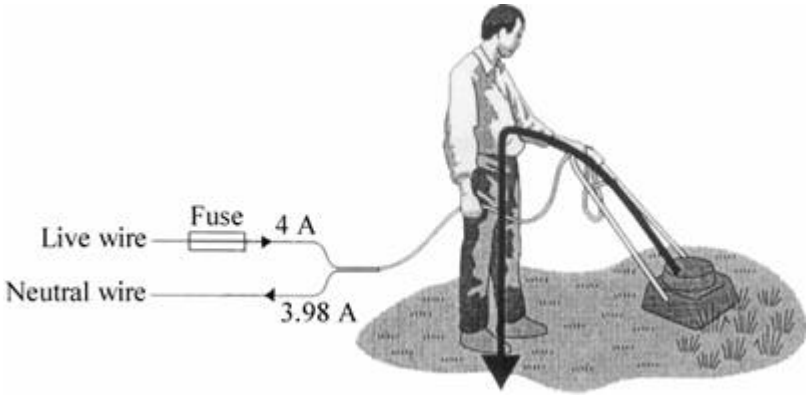
.....

.....

.....

(2)

(b) The diagram shows how a person could receive an electric shock from a faulty electrical appliance. Using a residual circuit breaker (RCB) can help to protect the person against receiving a serious shock.



(i) Compare the action of an RCB to that of a fuse.

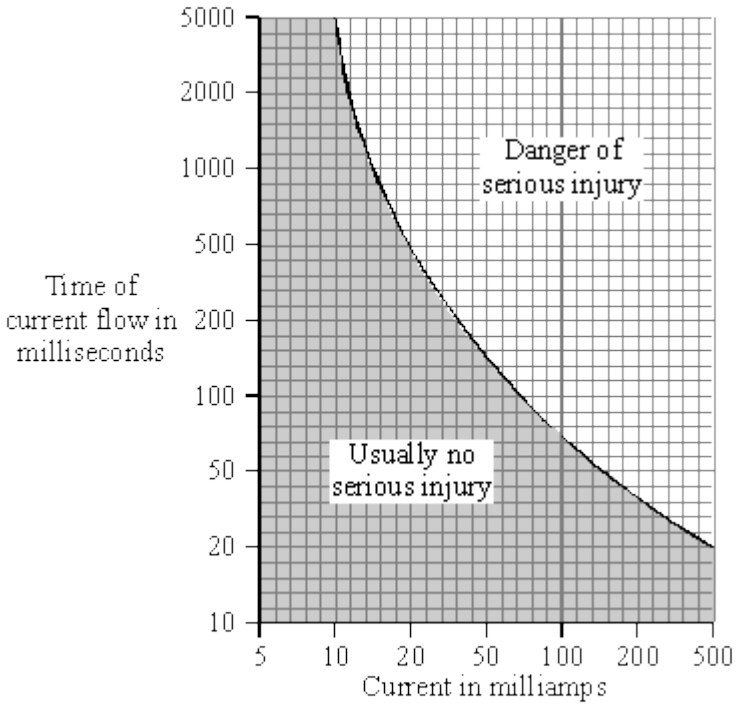
.....

.....

.....

(2)

(ii) The graph illustrates how the severity of an electric shock depends upon both the size of the current and the time for which the current flows through the body.



Within how long must the RCB cut off the current if the person using the lawnmower is to be in no danger of serious injury?

.....

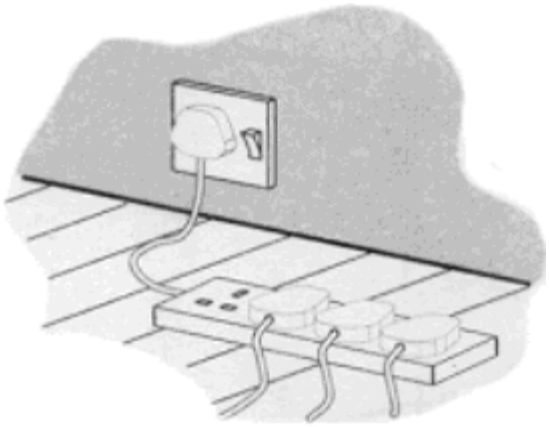
.....

Time = ... milliseconds

(2)

(Total 6 marks)

46 (a) An adaptor can be used to connect up to four appliances in parallel to one 230 V mains socket. The adaptor is fitted with a 13 A fuse. The table gives a list of appliances and the current they draw from a mains socket.



Appliance	**Current**
computer	1 A
hairdryer	4 A
heater	8 A
iron	6 A
television	2 A

(i) What current will flow to the adaptor when the television, computer and hairdryer are plugged into the adaptor?

.....

Current = ... A

(1)

(ii) Write down the equation which links current, electrical power and voltage.

.....

(1)

(iii) Calculate the electrical power used when the television, computer and hairdryer are plugged into the adaptor. Show clearly how you work out your answer and give the unit.

.....

.....

.....

Electrical power = ...

(2)

(iv) What would happen to the fuse if the heater is also plugged into the adaptor?

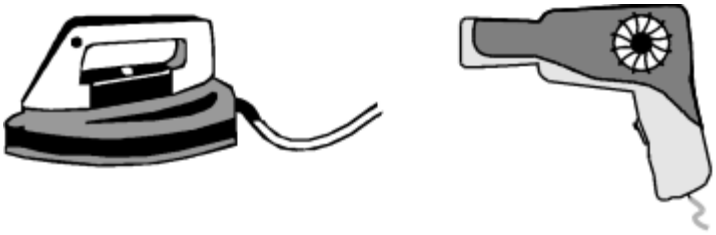
Give a reason for your answer.

.....

.....

(2)

(b) The diagram shows **two** of the appliances.



Iron Hairdryer

(i) For safety reasons, it is important that the iron has an earth wire connected to its outer metal case. Explain why.

.....

.....

.....

.....

(2)

(ii) The hairdryer does not have an earth wire. It is safe to use because it is double *insulated.* Explain what the term *double insulated* means.

.....

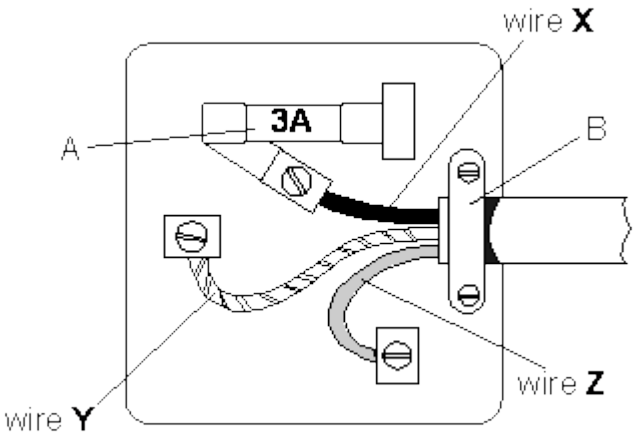
.....

.....

.....

(2)
(Total 10 marks)

47 The diagram below shows an electric mains plug.



(a) Name the parts of the plug labelled **A** and **B.**

A .....

B .....

(2)

(b) Name the colour of each of the wires **X, Y** and **Z.**

X .....

Y .....

Z .....

(3)

(c) Name a suitable material for the case of the plug.

.....

(1)

(d) Electric fires have three wires connected in the plug. One is the live wire to feed electric current in, another is the neutral (return) wire.

(i) What is the third wire called?

.....

(1)

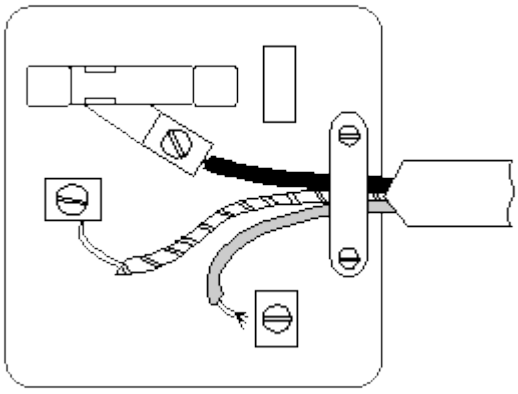
(ii) Why is it important that the third wire is also connected?

.....

.....

(1)

(e) The diagram below shows a badly wired mains plug.



Look at the plug carefully. What **four** changes should be made to make the plug safe?

1. .....

.....

2. .....

.....

3. .....

.....

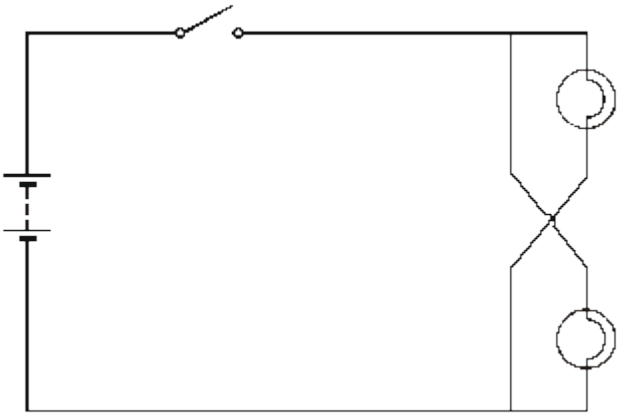
4. .....

.....

(4)

(Total 12 marks)

48 The circuit diagram below shows a circuit used to supply electrical energy to the two headlights of a car.



The current through the filament of one car headlight is 3.0 A. The potential difference across each of the two headlights is 12 V.

(a) Suggest a suitable fuse for the circuit. .....

(1)

(b) Calculate the resistance of the headlight filament when in use.

.....

.....

.....

.....

Answer ..... W

(2)

(c) Calculate the power supplied to the two headlights of the car.

.....

.....

.....

Answer ..... W

(2)

(d) The fully charged car battery can deliver 72 kJ of energy at 12 V. How long can the battery keep the headlights fully on?

.....

.....

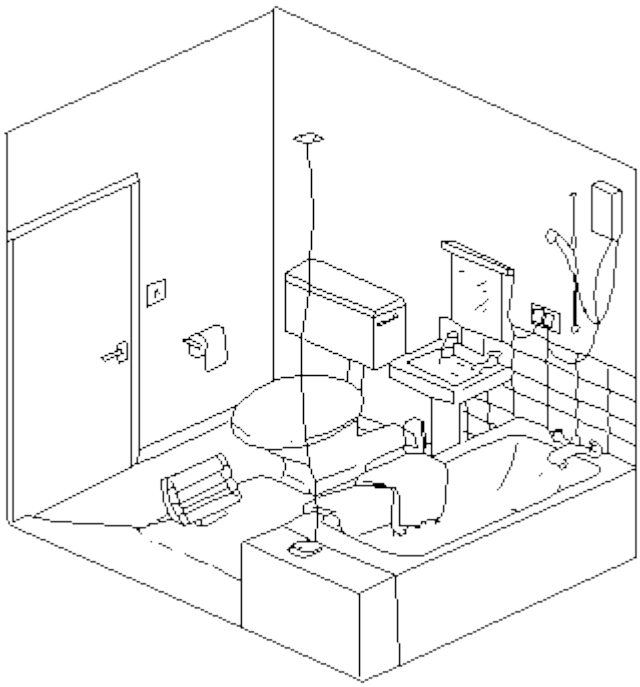
.....

Answer ..... s

(2)

(Total 7 marks)

49 (a) The picture below shows the bathroom in a house.



Describe **three** examples of dangerous practice in the use of mains electricity in this bathroom.

1. .....

.....

2. .....

.....

3. .....

.....

(3)

(b) In the table below three electrical appliances are listed with their power ratings and the number of hours they are used each week.

ELECTRICAL APPLIANCE	POWER RATINGS (W)	TIME USED EACH WEEK (h)	k Wh USED EACH WEEK
TV	200	35	
Kettle	2000	2	
Toaster	1000	1	
Cooker	11 500	7	

(i) Complete the table by inserting the number of kWh used by each appliance each week.

(ii) Which appliance would cost the least to run per week?

.....

(iii) The cost of running a toaster is 8p per week. How much does it cost to run the kettle each week?

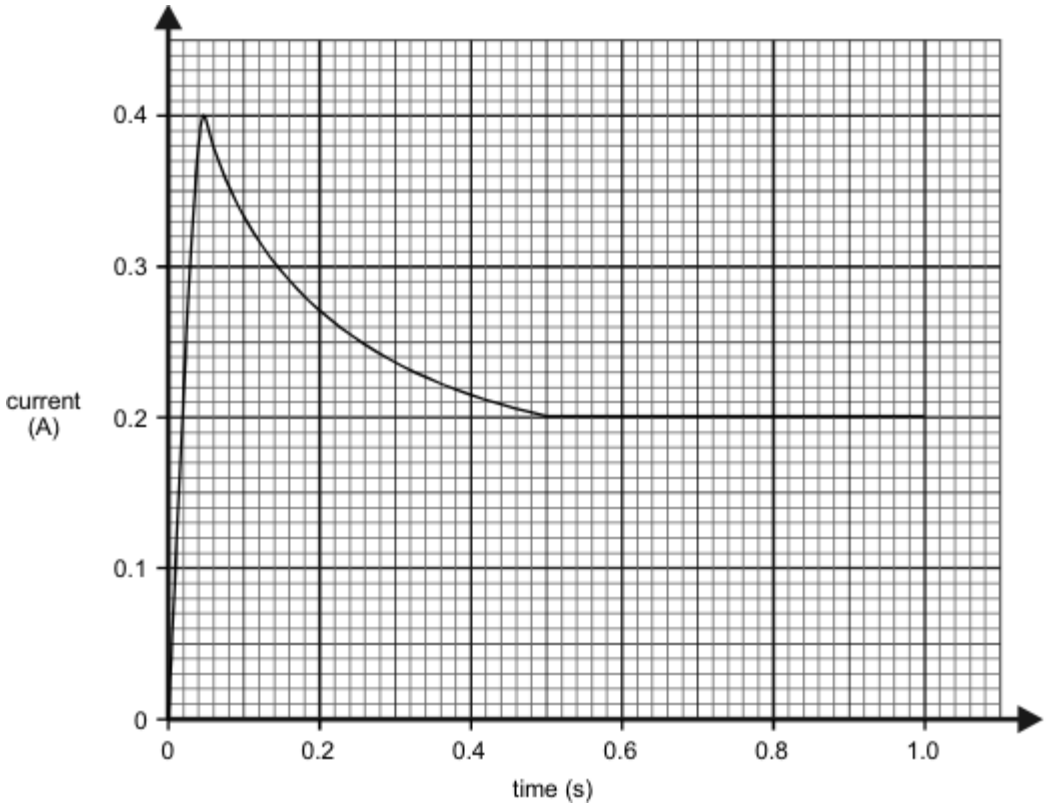
.....

.....

.....

(6)
(Total 9 marks)

50 When a mains lamp is switched on it takes 0.5 seconds for the filament to reach its normal operating temperature. The way in which the current changes during the first second after switching on is shown in the sketch graph below. Mains voltage is 240 V.



(a) Calculate the resistance of the filament whilst the lamp is drawing the **maximum** current.

.....

.....

.....

(3)

(b) Describe how the resistance of the lamp changes after the current has reached its maximum value.

.....

.....

(2)

(c) Calculate the **maximum** power taken by the lamp.

.....

.....

.....

(2)

(d) Calculate the power of the lamp in normal use.

.....

.....

.....

(2)

(e) Calculate the energy used by the lamp in six hours of normal use.

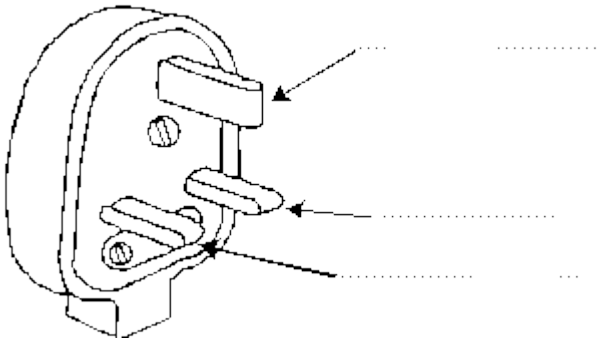
.....

.....

.....

(3)
(Total 12 marks)

51 (a) The diagram below shows the three pins in a mains plug. The pins connect with the live, neutral and earth terminals in a socket.



On the diagram, label each pin to show which is:

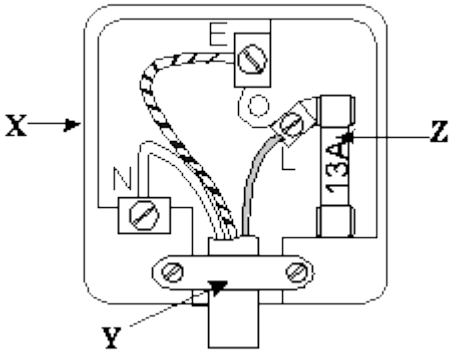
the live pin,

the neutral pin,

the earth pin.

(3)

(b) The diagram below shows the inside of a mains plug.



(i) Name **one** material which could be used for the part labelled **X**.

.....

(ii) Complete the sentences below.

The part labelled **Y** is called the ..... .

This is used to hold the ..... firmly in place.

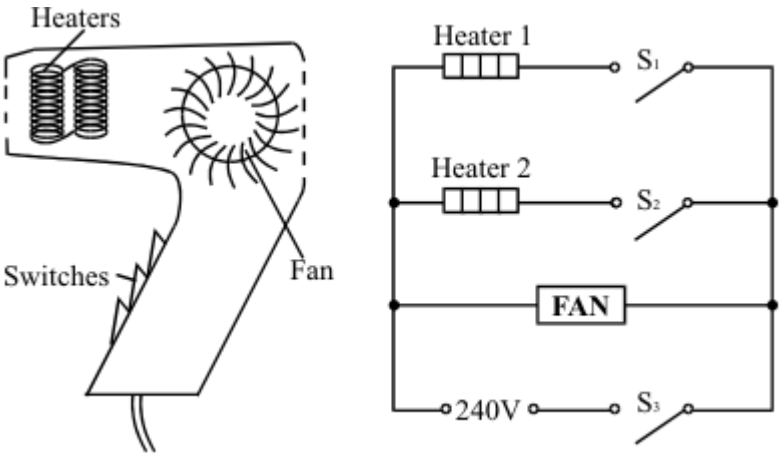
The component labelled **Z** is the ..... .

(iii) The plug is used with an electric fire.
Which part of the electric fire is connected to the earth pin?

.....

(5)
(Total 8 marks)

52 The diagrams show a hair-dryer and the circuit inside the hair-dryer.



(a) Switches S_1, S_2 and S_3 are all shown in the **OFF** position.

Which switch or switches have to be **ON** to make:

(i) only the fan work? .....

(ii) both heaters work? .....

(2)

(b) (i) What happens to the current in the circuit when the heaters are switched on?

.....

(ii) Suggest why it is important to have the fan working when the heaters are switched on.

.....

.....

.....

(3)

(c) This hair-dryer has a plastic case. It is connected to a mains socket by a 3-pin plug. The cable connecting the hair-dryer to the plug contains only two wires.

(i) Write down the colour of the insulation on the wires.

Wire 1 .....

Wire 2 .....

(ii) Which of the usual three wires is **not** needed?

.....

(iii) This hair-dryer is safe to use without the third wire. Explain why.

.....

.....

.....

(5)

(d) The following information is stamped on the hair-dryer.

(i) Which number tells us how fast the hair-dryer uses energy?

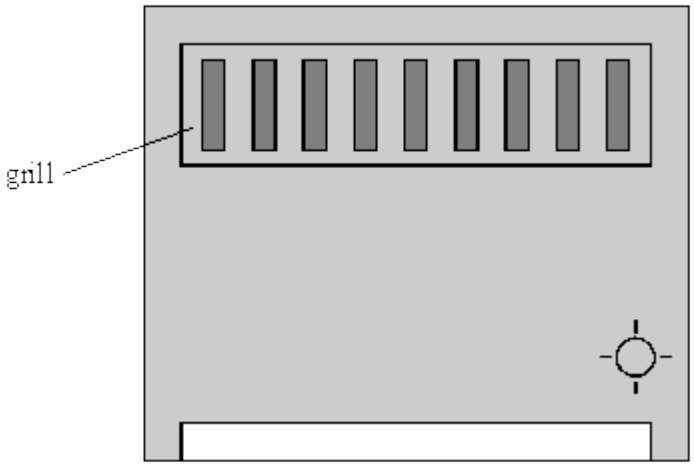
.....

(ii) On what else does the energy used by the hair-dryer depend?

.....

(2)
(Total 12 marks)

53 The diagram shows a fan heater.



(a) Complete this sentence.

The fan heater is designed to transfer electrical energy as .....

energy and ..... energy.

(2)

(b) The fan heater is connected to the mains by a three core cable.

(i) Why are the wires in the cable made out of copper?

.....

(ii) Why are the wires in the cable covered by plastic?

.....

(2)

(c)

You may find this equation useful when answering this part of the question

energy transferred (kWh) = power (kilowatt, kW) × time (hour, h)

(i) The power of the fan heater is 2.75 kW.
Calculate how many kilowatt hours (kWh) of energy are transferred when the fan heater is used for 6 hours.

.....

.....

Number of kilowatt hours .....

(2)

(ii) How much will it cost to use the fan heater for 6 hours if one Unit of electricity costs 7p?

.....

.....

Cost ..... p

(2)

(d) A fault caused a much higher than normal current to flow in the heater.
Describe what happened to the wire in the fuse.

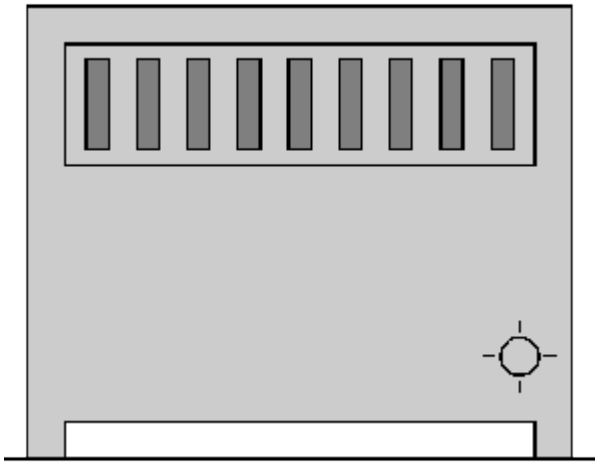
.....

.....

.....

(2)
(Total 10 marks)

54 (a) The diagram shows a fan heater.



(i) A current of 11A flows when the fan heater is working normally.
Fuses of value 3A, 5A, 10A and 13A are available.
Which one should be used in the plug of the fan heater?

.....

(1)

(ii) A fault caused a much higher than normal current to flow in the heater.
Describe what happened to the wire in the fuse.

.....

.....

.....

.....

(2)

(b)

You may find this equation useful when answering this part of the question **energy transferred (kWh) = power (kilowatt, kW) × time (hour, h)**

(i) The power of the fan heater is 2.75 kW.
Calculate how many kilowatt hours of energy are transferred when the fan heater is used for 6 hours.

.....

.....

.....

Number of kilowatt hours .....

(2)

(ii) How much will it cost to use the fan heater for 6 hours if one Unit of electricity costs 7p?

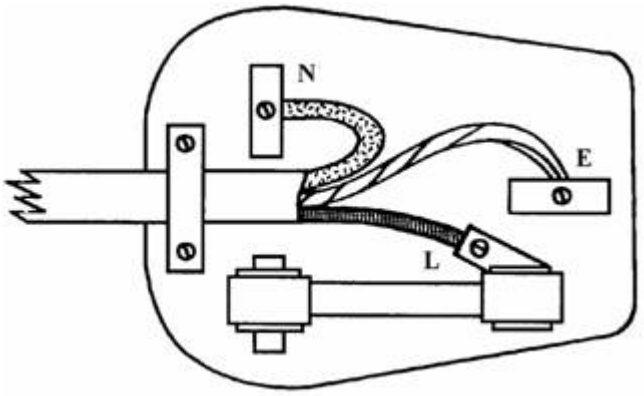
.....

.....

Cost ..... p

(2)
(Total 7 marks)

55 The diagram shows the inside of a 3-pin plug.



(a) What colour wire should be connected to each terminal?

Terminal **E** .....

Terminal **N** .....

Terminal **L** .....

(3)

(b) Name **two** parts inside the 3-pin plug which help to make it safe.

1 .....

.....

2 .....

.....

(2)
(Total 5 marks)

56 (i) Write the equation which shows the relationship between the electric *current*, the *power* and the *voltage*.

.....

.....

(1)

(ii) Calculate the power if the current is 5 A and the voltage is 400 000 V. Show clearly how you work out your answer and give the unit.

.....

.....

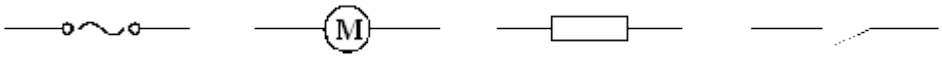
Power = ...

(2)

(Total 3 marks)

57 In a hairdryer circuit there is a heater and a motor. It is important that the motor is always running when the heater is switched on.

(a) Using the symbols shown below only **once** each, draw a circuit for a hairdryer.



(2)

(b) Modern hairdryers are described as *double insulated.*

Explain what this term means.

.....

.....

.....

(2)

(c) On a modern hairdryer handle it states:

1600 W 230 V 50 Hz

(i) [A] Write an equation which shows the relationship between current, power and voltage.

.....

(1)

[B] Calculate the current in the hairdryer when it is on full power.
Show clearly how you get your answer.

.....

.....

Current = ... A

(2)

(ii) [A] Write an equation which shows the relationship between current, resistance and voltage.

.....

(1)

[B] The resistance of the heater is 20 ohms. Calculate the resistance of the motor.

Show clearly how you get your answer.

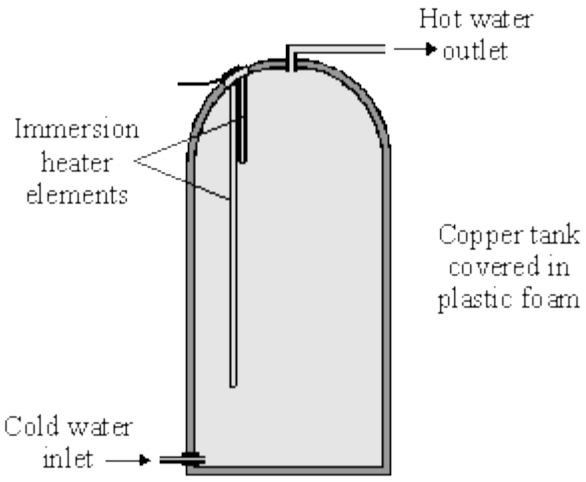
.....

.....

Resistance = ... ohms

(2)
(Total 10 marks)

58 The diagram shows a type of electric immersion heater in a hot water tank. These hot water tanks are normally found in airing cupboards.



Information on the immersion heater states:

230 V
10 A

(a) (i) What is the equation which shows the relationship between power, current and voltage?

.....

(1)

(ii) Calculate the power of the heater. Show clearly how you get to your answer and give the units.

.....

Power = ...

(2)

(b) (i) What rating of fuse should be in the immersion heater circuit?

.....

(1)

(ii) There are three wires in the cable to the immersion heater. Two of the wires are connected to the immersion heater. The third wire is connected to the copper tank.

Explain the function of this third wire and the fuse in the circuit.

.....

.....

.....

.....

(3)

(c) (i) What is the equation which shows the relationship between resistance, current and voltage?

.....

(1)

(ii) Calculate the resistance of the heater. Show clearly how you get to your answer and give the units.

.....

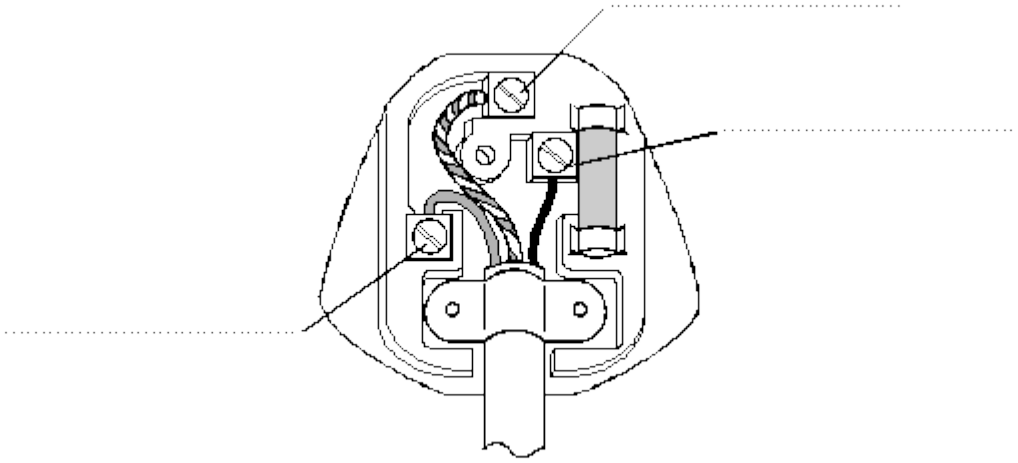
Resistance = ...

(2)

(Total 10 marks)

59 The diagram shows the inside of a mains plug.

(a) Label the earth, live and neutral pins.



(3)

(b) (i) Explain how the earth wire and the fuse protect a person from an electric shock when there is a short circuit to the metal case of an appliance.

.....

.....

.....

.....

.....

.....

(4)

(ii) What is the most appropriate size fuse rating for a fuse in a television?

Circle the correct answer.

3 A 5 A 13 A

(1)

(Total 8 marks)

60 A combination oven can cook food by using three methods; a microwave generator, a grill and a heating element.

voltage	230 V
microwave power (max)	900 W
grill power	1300 W
convection heater power	1200 W

(a) What is the current when the oven is operating using full microwave power? Give the equation and show your working.

.....

.....

.....

Current = ... A

(3)

(b) It is possible to cook using infrared radiation, from the grill, and microwaves. What is the maximum current in the oven when using both together?

.....

.....

.....

Current = ... A

(2)

(c) For baking and roasting, the microwave is used at 450 W and the convection heating element is on fully at 1200 W. A thawed or fresh medium-sized chicken takes 30 minutes to cook.

Calculate the energy transferred in kilowatt-hours.

Use:

units (kWh) = power (kW) × time (h)

.....

.....

.....

Energy = ... kWh

(2)

(d) Why is a combination oven of this sort more economical than a convection-only oven?

.....

.....

(1)
(Total 8 marks)

Mark schemes

1

(a) any **two** from:

- nuclear
- oil
- (natural) gas

2

(b) 4 (hours)

1

(c) a system of cables and transformers

1

(d) The power output of wind turbines is unpredictable

1

(e) 1500 / 0.6

1

2500 (wind turbines)

1

*allow 2500 with no working shown for **2** marks*

(f) Most energy resources have negative environmental effects.

1

[8]

2

(a) current that is always in the same direction

1

(b) total resistance = 30 (Ω)

1

V = 0.4 × 30

1

12 (V)

1

*allow 12 (V) with no working shown for **3** marks*
*an answer of 8 (V) or 4 (V) gains **2** marks only*

(c) P = 0.4 × 12 = 4.8

1

5 (W)

1

*allow 5 (W) with no working shown for **2** marks*
*allow 4.8 (W) with no working shown for **1** mark*

[6]

3 (a) he may receive an electric shock

or

he may be electrocuted

1

if he touches the live wire

1

(b) 10 690 = I × 230

1

I = 10 690 / 230

1

46.478(260) (A)

1

46

1

*allow 46 (A) with no working shown for **4** marks*

(c) cost is higher

1

more energy is used (per second)

1

[8]

4 (a) (because the) potential of the live wire is 230 V

1

(and the) potential of the electrician is 0 V

1

(so there is a) large potential difference between live wire and electrician

1

charge / current passes through his body

allow voltage for potential difference

1

(b) diameter between 3.50 and 3.55 (mm)

*allow correct use of value of cross-sectional area of 9.5 to 9.9 (mm^2) with no final answer given for **1** mark*

2

(c) 18000 = I × 300

1

I = 18000 / 300 = 60

1

13 800 = (60^2) × R

1

$R = 13\,800 / 60^2$

1

3.83 (Ω)

1

*allow 3.83(Ω) with no working shown for **5** marks*

answer may also be correctly calculated using P = IV and V = IR if 230 V is used.

[11]

5 (a) (i) 150

1

(ii) transferred to the surroundings by heating

reference to sound negates mark

1

(iii) 0.75

*450 / 600 gains **1** mark*

*accept 75% for **2** marks*

*maximum of **1** mark awarded if a unit is given*

2

(iv) 20 (s)

*correct answer with or without working gains **2** marks*

*correct substitution of 600 / 30 gains **1** mark*

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

1

[10]

6 (a) (i) generator

1

(ii) alternating current

1

(iii) voltmeter / CRO / oscilloscope / cathode ray oscilloscope

1

(b) (i) time

1

(ii) peaks and troughs in opposite directions

1

amplitude remains constant

dependent on first marking point

1

(c) any **two** from:

- increase speed of coil
- strengthen magnetic field
- increase area of coil

*do **not** accept larger*

2

[8]

7 (a) (i) any **six** from:

- switch on
- read both ammeter and voltmeter

allow read the meters

- adjust variable resistor to change the current
- take further readings
- draw graph
- (of) V against I

allow take mean

- R = V / I

allow take the gradient of the graph

6

(ii) resistor would get hot if current left on

1

so its resistance would increase

1

(iii) 12 (V)

*0.75 × 16 gains **1** mark*

2

(iv) 15 (Ω)

1

16 is nearer to that value than any other

1

(b) if current is above 5 A / value of fuse

1

fuse melts

allow blows / breaks

*do **not** accept exploded*

1

breaks circuit

1

[15]

8 (a) *attempt to draw four cells in series*

1

correct circuit symbols

circuit symbol should show a long line and a short line, correctly joined together

example of correct circuit symbol:

1

(b) (i) 6 (V)

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

*V = 3 × 2 scores **1** mark*

provided no subsequent step

2

(ii) 12 (V)

ecf from part (b)(i)

18 – 6

or

*18 – their part (b)(i) scores **1** mark*

2

(iii) 9 (Ω)

ecf from part (b)(ii) correctly calculated

3 + their part (b)(ii) / 2

or

*18 / 2 scores **1** mark*

provided no subsequent step

2

(c) (i) need a.c.

1

battery is d.c.

1

(ii) 3 (A)

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

*18 × 2 = 12 × I_s scores **1** mark*

2

[12]

9

(a) *there is a* magnetic field *(around the magnet)*

1

(this magnetic field) changes / moves

1

and cuts through coil

accept links with coil

1

so a p.d. *induced* across coil

1

the coil forms *a* complete circuit

1

so a current (*is* induced)

1

(b) ammeter reading does not change

must be in this order

accept ammeter has a small reading / shows a current

1

zero

1

greater than before

accept a large(r) reading

1

same as originally but in the opposite direction

accept a small reading in the opposite direction

1

(c) 0.30

*allow **1** mark for correct substitution, ie 0.05 = Q / 6*

2

C / coulomb

allow A s

1

[13]

10

(a) (i) live

1

(ii) react faster

1

(iii) live and neutral

1

(b) (i) ammeter

1

to measure current

accept to measure amps

1

plus any **one** from:

- *variable resistor* (1)
  to vary current (1)
  accept variable power supply
  accept change or control

- *switch* (1)
  to stop apparatus getting hot / protect battery
  or
  to reset equipment (1)

- fuse (1)
  to break circuit if current is too big (1)

2

(ii) any **two** from:

- use smaller mass(es)
- move mass closer to pivot
- reduce gap between coil and rocker
- more turns (on coil) *coil / loop*
- iron core in coil

accept use smaller weight(s)

2

[9]

11 (a) (black) is a good absorber of (infrared) radiation

1

(b) (i) amount of energy required to change (the state of a substance) from solid to liquid (with no change in temperature)

melt is insufficient

1

unit mass / 1kg

1

(ii) 5.1×10^6 (J)

accept 5×10^6

*allow **1** mark for correct substitution ie* $E = 15 \times 3.4 \times 10^5$

2

(c) (i) mass of *ice*

allow volume / weight / amount / quantity of ice

1

(ii) to distribute the salt throughout the ice

1

to keep all the ice at the same temperature

1

(iii) melting point decreases as the mass of salt is increased

allow concentration for mass

accept negative correlation

*do **not** accept inversely proportional*

1

(d) 60 000 (J)

accept 60 KJ

*allow **2** marks for correct substitution ie E = 500 × 2.0 × 60*

*allow **2** marks for an answer of 1000 **or** 60*

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

*E = 500 × 2.0 **or** 0.50 × 2.0 × 60*

*allow **1** mark for an answer of 1*

3

(e) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1–2 marks)
There is *an attempt at a description of some advantages or disadvantages.*

Level 2 (3–4 marks)
There is a basic description of *some advantages* ***and / or*** *disadvantages for some of the methods*

Level 3 (5–6 marks)
There is a clear description of the advantages and disadvantages of all the methods.

examples of the points made in the response

extra information

energy storage

advantages:

- no fuel costs
- no environmental effects

disadvantages:

- expensive to set up and maintain
- need to dig deep under road
- dependent on (summer) weather
- digging up earth and disrupting habitats

salt spreading

advantages:

- easily available
- cheap

disadvantages:

- can damage trees / plants / drinking water / cars
- needs to be cleaned away

undersoil heating

advantages:

- not dependent on weather
- can be switched on and off

disadvantages:

- costly
- bad for environment

6

[18]

12 (a) (i)

Wire	Plug terminal
Live	C
Neutral	A
Earth	B

*all 3 correct for **2** marks*

*allow **1** mark for 1 correct*

2

(ii) plastic
or
rubber

accept:

ABS
UF / urea formaldehyde
nylon
PVC

1

(b) (i) 600

*allow **1** mark for correct substitution,*

ie $P = \frac{30\,000}{50}$
provided no subsequent step

2

(ii) power is greater than 820 (W)

power is 1200 W is insufficient

1

the lead /cable / wire will overheat / get (too) hot

accept lead / cable will melt
may overheat / get hot is insufficient

1

so there is a risk of fire

accept causing a fire

1

(c) X

any **one** from:

- most / more efficient
- smallest energy input (per second)
- cheapest to operate

mark only scores if X is chosen

mark is for the reason

accept smallest input (power) for same output (power)

accept wastes least energy

smallest (power) input is insufficient

uses least electricity is insufficient

1

[9]

13 (a) water heated by radiation (from the Sun)

accept IR / energy for radiation

1

water used to heat buildings / provide hot water

*allow for **1** mark heat from the Sun heats water if no other marks given*

*references to photovoltaic cells / electricity scores **0** marks*

1

(b) 2 (minutes)

$1.4 \times 10^3 = \frac{168 \times 10^3}{t}$

*gains **1** mark*

*calculation of time of 120 (seconds) scores **2** marks*

3

(c) (i) 150 (kWh)

1

(ii) £60(.00) or 6000 (p)

*an answer of £6000 gains **1** mark*

*allow **1** mark for 150 × 0.4(0) 150 × 40*

*allow ecf from **(c)(i)***

2

(iii) 25 (years)

an answer of 6000 / 240

or

*6000 / their **(c)(ii)** × 4*

*gains **2** marks*

an answer of 6000 / 60

or

*6000 / their **(c)(ii)** gains **1** mark, ignore any other multiplier of **(c)(ii)***

3

(iv) any **one** from:

- will get £240 per year

  *accept value consistent with calculated value in **(c)(iii)***
- amount of light is constant throughout the year
- price per unit stays the same
- condition of cells does not deteriorate

1

(d) any **one** from:

- angle of tilt of cells
- cloud cover
- season / shade by trees
- amount of dirt

1

[13]

14 (a) (i) to obtain a range of p.d. values

accept increase / decrease current / p.d. / voltage / resistance

accept to change / control the current / p.d. / voltage / resistance

to provide resistance is insufficient

a variable resistor is insufficient

*do **not** accept electricity for current*

1

(ii) temperature of the bulb increases

accept bulb gets hot(ter)

accept answers correctly

expressed in terms of collisions between (free) electrons and ions / atoms

bulb gets brighter is insufficient

1

(iii) 36

*allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown*

2

watt(s) / W

accept joules per second / J/s

*do **not** accept w*

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)
There is a clear comparison of either the cost aspect or energy efficiency aspect
OR
a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)
There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy
  simply giving cost figures is insufficient
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency

- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

6

[11]

15 (a) 35

*an answer with more than 2 sig figs that rounds to 35 gains **2** marks*
*allow **2** marks for correct method, ie* $\frac{230}{6.5}$
*allow **1** mark for I = 6.5 (A) **or** R =* $\frac{230}{26}$
*an answer 8.8 gains **2** marks*
*an answer with more than 2 sig figs that rounds to 8.8 gains **1** mark*

3

(b) (maximum) current exceeds maximum safe current for a 2.5 mm^2 wire

accept power exceeds maximum safe power for a 2.5 mm^2 wire

or
(maximum) current exceeds 20 (A)

(maximum) current = 26 (A) is insufficient

1

a 2.5 mm^2 wire would overheat / melt

accept socket for wire

*do **not** accept plug for wire*

1

(c) a.c. is constantly changing direction

accept a.c. flows in two directions

accept a.c. changes direction

a.c. travels in different directions is insufficient

1

d.c. flows in one direction only

1

[7]

16 (a) (i) 50 (Hz)

1

(ii) 2760 (W)

1

(b) 12

*allow **1** mark for correct substitution, ie 2400/200*

or

*allow **1** mark for 2760/230 provided no subsequent step shown*

2

amps

1

(c) the charge is directly proportional to the time switched on for

*accept for **1** mark the longer time (to boil), the greater amount of charge*

***or** positive correlation*

***or** they are proportional*

2

[7]

17 (a) (i) 50(Hz)

ignore any unit given

1

(ii) any **two** from:

- (some) current flows to Earth
  accept ground for Earth
- current flows through copper braid
  accept current flows through the earth wire
  accept electricity for current in either the first or second marking point but not both
- RCCB detects difference between current in live and neutral wire

2

(iii) can be reset
accept does not need replacing

or

faster acting
accept switches circuit off faster

1

(b) (i) 79 200
*allow **1** mark for correct substitution, ie* $11 = \frac{Q}{2 \times 3600}$
*an answer 22 gains **1** mark*

2

coulombs / C
*do **not** accept c*

1

(ii) 18 216 000
*accept for **2** marks 18 216 kJ **or** 18.216 MJ*

or

230 × their (b)(i) correctly calculated
*allow **1** mark for correct substitution, ie 230 × their (b)(i) **or***
*allow **1** mark for power calculated as 2530(W)*

2

(c) increases temperature of thermistor

1

changes resistance (of thermistor)
*do **not** accept increases resistance (of thermistor)*
*an answer decreases resistance (of thermistor) gains **2** marks*

1

[11]

18 (a) iron

1

hairdryer

1

kettle

1

answers can be in any order

(b) (i) **Y**

1

(ii) bar drawn with any height greater than **Y**

ignore width of bar

1

(c) (bigger volume) takes more time (to boil)

accept explanation using data from graph

1

(so) more energy transferred

*do **not** accept electricity for energy*

1

(and) this costs more money

ignore reference to cost of water

wasting more money because heating more water than needed is insufficient

1

[8]

19 (a) (i) connect the earth wire (to pin)

answers must be in terms of correcting the faults

1

screw cable grip (across cable)

accept tighten the cable grip

1

(ii) any **two** from:

- fuse gets (very) hot
- fuse melts

accept blows for melts

*do **not** accept break / snap fuse / blow up*

- circuit breaks / switches off

accept stops current flowing

2

(b) any **two** from:

- hairdryer is plugged into mains (electricity socket)

  it refers to hairdryer
  hairdryer works from the mains

  or
  hairdryer is using 230 V

  accept 240 for 230

- water conducts electricity

  *do **not** accept water and electricity don't mix*

- radio is low power / current / pd / voltage

  accept radio not connected to the mains
  *do **not** accept radio is waterproof*

- (the current in / pd across) hairdryer more likely to give a (fatal) electric shock

  accept the idea of electrocution if hairdryer is wet
  accept the idea of radio not causing electrocution if wet

2

[6]

20 (a) d.c. flows in (only) one direction

1

a.c. changes direction (twice every cycle)

accept a.c. constantly changing direction

ignore references to frequency

1

(b) a current flows through from the live wire / metal case to the earth wire

accept a current flows from live to earth

*do **not** accept on its own if the current is too high*

1

this current causes the fuse to melt

accept blow for melt

*do **not** accept break / snap / blow up for melt*

1

[4]

21 (a) **A**

*only scores if **A** chosen*

1

it is alternating / a.c.

accept because B and C are d.c.

or

it changes direction/p.d.

accept voltage for p.d.

it goes up and down is insufficient

it is constantly changing is insufficient

an answer B and/or C with the reason because it is <u>direct current/d.c</u> scores 1 mark

1

(b) too much current (through socket)

accept electricity for current

accept too much power

accept socket/circuit overloaded

do not accept voltage/p.d for current

1

wiring / socket gets hot

accept melts for gets hot

accept risk of fire

risk of fire in appliances is insufficient

ignore reference to sparking

overloaded plugs and plugs getting hot or fuses melting is insufficient

1

[4]

22 (a) (i) earth wire

1

(ii) double

1

(b) if too much current flows through the wire

accept power for current

*do **not** accept electricity for current*

accept if more than 20 amps flows through the wire

1

the fuse (overheats and) melts

accept 'blows' for melts

do not accept explodes / breaks / snaps etc

1

breaking the circuit

accept stopping the current flow

1

[5]

23 (a) (i) 50 000

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

6 = 0.00012 × R

***or** 6 = 0.12 × R*

***or** answers of 25 000 or 50 gain **1** mark*

***or** allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current*

2

ohm / Ω

*an answer 50kΩ gains **3** marks*

1

(ii) (body) resistance changes

or

body fat/resistance affected by (many) factors

accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat / resistance

1

(iii) gives misleading / wrong/inaccurate value

do not credit if specifically linked to a change in mass / weight

1

(because) high water content changes body resistance

accept a specific change to resistance

water changes body mass is insufficient

1

(b) (i) RCCB – detects difference between current in live and neutral (wires)

accept RCCB can be reset

1

fuse – (overheats and) melts

accept blows for melts

1

(ii) switches the circuit / hedge trimmers off within 60 milliseconds

*allow for **1** mark the RCCB / it is (very) fast.*

do not accept the bigger the current the faster the RCCB switches off

2

[10]

24 (a) (i) 0.6
or
60%

*allow **1** mark for correct substitution ie* $\frac{720}{1200}$ *provided no subsequent step shown*

*an answer of 0.6 / 60 with a unit gains **1** mark only*

*an answer of 60 gains **1** mark only*

2

(ii) heat

allow thermal

1

(b) 12 000 p
or
£120

to score both marks the unit must be consistent with the numerical answer

*answers 12 000 and 120 gain **1** mark only*

*allow **1** mark for correct substitution ie 800 × 15 **or** 800 × 0.15*

provided no subsequent step shown

2

[5]

25 (a) (i) 720

*allow **1** mark for correct substitution,*

ie 72 × 10 provided no subsequent step shown

2

(ii) 720
or
their (a)(i)

1

(b) (i) gravitational potential

allow gravitational

allow potential

1

(ii) 432

*allow **1** mark for correct substitution, ie* $\frac{21600}{50}$ *provided no subsequent step shown*

2

watt / W

1

[7]

26 (a) (i) circuit not complete

accept circuit is broken

accept switch / s are open / off

1

(ii) 9

*allow **1** mark for correct substitution, ie 0.5 × 18 provided no subsequent step shown*

2

(iii) 36

1

(b) can be switched on / off from top or bottom of stairs

1

(c) (i) (electric) shock

accept fitting becomes live

accept answers giving a possible consequence of electric shock, eg death

1

(ii) connect the earth wire

1

[7]

27 (a) (i) **D**

1

(ii) plastic or rubber

accept a specific type of plastic

accept electrical insulator

1

(b) 460

*allow **1** mark for correct substitution ie 2 × 230*

2

(c) any **two** from:

- not all appliances need a 13 A fuse

  idea that 13 A is (much) bigger than required by many appliances

  *do **not** accept some appliances require more than 13 A*

  *do **not** accept 13 A fuse will blow*

- can choose the most suitable fuse (for the appliance)

  accept install correct fuse for the appliance

- (in the event of a fault) 13 A fuse may allow too much current to flow through an appliance

  or

  fuse may not melt (before appliance is damaged)

- may already have the fuse

  idea of reusing a fuse

  *do **not** accept cheaper unless explained correctly*

2

[6]

28 (a) (i) 0.25 (A)

1

(ii) 75

*allow **1** mark for converting 5 minutes to 300 seconds*

***or** allow **1** mark for correct substitution*

ie 0.25 × 300

*allow **1** mark for an answer 1.25*

*allow **1** mark only for their (a)(i) × 300 correctly calculated*

2

coulombs or C

*do **not** accept c*

1

(b) any **two** from:

- fault not repaired
  accept if a fault was to occur
- larger current will (still) flow
- aluminium foil will not melt (if a fault)
  accept aluminium foil needs a higher current / charge to melt
- wiring will overheat / (may) cause a fire
  accept idea of fire hazard
  *do **not** accept explode etc*

2

[6]

29 (a) brown

1

(b) outside / case is plastic / an insulator
accept is double insulated
accept non-conductor for plastic
*do **not** accept it / hairdryer is plastic*

1

(c) (i) (1) S_1
and no other

1

(2) S_1 and S_3
both required, either order

1

(ii) S_1 must be ON (for either heater to work)
*do **not** accept reference to 'fan' switch*

1

S_1 switches the fan on

1

(d) 1495
*allow **1** mark for correct substitution*
ie, 6.5 × 230

2

watt(s) or W

*an answer of 1.495 kW gains **3** marks*

although the unit is an independent mark for full credit

the unit and numerical value must be consistent

accept joules per second or J/s

1

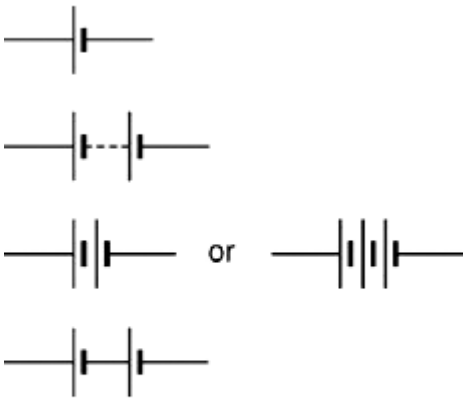
[9]

30 (a) (i) ammeter and battery **in series** with the **gauge**

symbols must be correct

ignore a voltmeter drawn in series

accept



not

or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii) d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i) 75

this answer only

*allow **1** mark for correct substitution **and** transformation,*

ie resistance = $\frac{3.0}{0.040}$

2

(ii) increases

1

(iii) elastic / strain <u>potential</u>

*do **not** accept potential*

1

[7]

31 (a) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(b) a smaller <u>proportion / percentage</u> of the energy supplied is wasted

owtte

*accept a statement such as 'less energy is wasted' for **1** mark*

*do **not** accept costs less to run*

ignore references to uses less energy

2

(c) (i) 2.4 (p)

accept 2 p if it is clear from the working out this is rounded from 2.4 p

*allow **1** mark for correct substitution of correct values*

ie 0.2 × 12

*allow **1** mark for calculating cost at 40 °C (13.2 p)*

or

cost at 30 °C (10.8 p)

2

(ii) any **one** from:

- less electricity needed

  ignore answers in terms of the washing machine releasing less energy

  an answer in terms of the washing machine releasing CO_2 negates the mark

  *do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is burned

  accept a correctly named fuel

  *do **not** accept less fuel is needed*

1

[6]

32 (a) (i) connect the earth wire (to pin)

answers must be in terms of correcting the faults

1

screw cable grip (across cable)

accept tighten the cable grip

1

(ii) earth (wire)

accept the green and yellow (wire)

1

(iii) any **two** from:

- fuse gets (very) hot

- fuse melts

  accept blows for melts

  *do **not** accept break / snap fuse / blow up*

- circuit breaks/ switches off

  accept stops current flowing

2

(b) any **two** from:

it refers to hairdryer

- hairdryer is plugged into mains (electricity socket)

  hairdryer works from the mains

  or

  hairdryer is using 230 V

  accept 240 for 230

- water conducts electricity

  *do **not** accept water and electricity don't mix*

- radio is low power / current / pd / voltage

  accept radio not connected to the mains

  *do **not** accept radio is waterproof*

- (the current in / p.d.across) hairdryer more likely to give a (fatal) electric shock

  accept the idea of electrocution if hairdryer is wet

  accept the idea of radio not causing electrocution if wet

2

[7]

33 (a) 125

*allow **1** mark for obtaining time period = 0.008 (s)*

or

frequency = 1 / time period (or their calculated time period)

2

hertz

or

Hz

*do **not** accept hz*

1

(b) 50 (hertz)

1

[4]

34 (a) (rate of) <u>flow</u> of charge / electrons / ions

accept movement for flow

*do **not** accept flow of electricity*

1

(b) 7(.0)

accept 6.96 / 6.95 or an answer that would approximate to 6.96 if rounded

*allow **1** mark for obtaining correct power and changing to watts ie 1600*

or

*allow **2** marks for correct substitution and transformation ie 1600 ÷ 230*

*an answer 0.00696 / 0.007 gains **2** marks*

*allow **1** mark for 1.6 / 230 or 1.7 / 230*

*an answer 7.39 or 7.4 gains **2** marks*

3

amp (ere)

accept A

1

[5]

35 (a) 230

1

50

1

(b) (i) has a plastic case

accept outside is plastic

accept cover / handle/ hair dryer is plastic / non-conductor

or does not have a metal case **or** plastic is an insulator

accept is double insulated

1

(ii) copper

1

[4]

36 (a) d.c. flows in (only) one direction

1

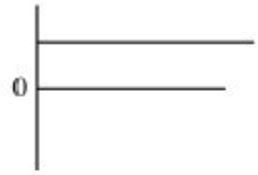
a.c. <u>changes</u> direction (twice every cycle)

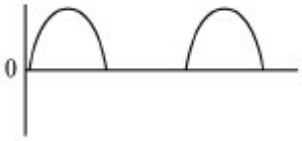
accept a.c. constantly changing direction

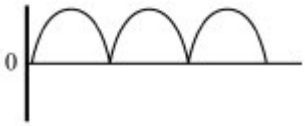
ignore references to frequency

accept answers presented as a clear diagram

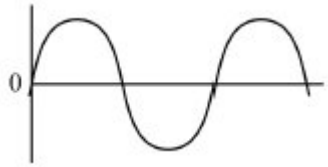
e.g.







ac:



1

(b) (i) 10

*allow **1** mark for correct transformation and substitution i.e.*

$\frac{2.3}{230}$ *or* $\frac{2300}{230}$ *an answer 0.01 gains **1** mark*

2

(ii) 13 A

e.c.f.

accept the fuse size that is the next listed value greater than answer (b)(i)

1

[5]

37 (a) (i) 0.0046

accept 4.6 mA

*allow **1** mark for correct substitution and transformation*

i.e. current $= \frac{230}{50000}$

*an answer of 4.6 gains **1** mark*

2

(ii) • increases overall resistance

1

• (in event of a shock) gives a smaller current

accept gives smaller shock
*do **not** accept no shock/current*

1

(b) (i) 50 (hertz)

ignore units

1

(ii) NO has the lowest current at which people cannot let go

answer and reason needed
accept a sensible reason in terms of their answer to (b) (i)

or YES changing the frequency changes the current by only a small amount

1

(c) a current flows through from the live wire/metal case to the earth wire

accept a current flows from live to earth
*do **not** accept on its own if the current is too high*

this current causes the fuse to melt

accept blow for melt

2

[8]

38 (a) electric drill **C**

1

MP3 player **E**

1

toaster **B**

1

(b) (i) 2100

no unit required / ignore units

accept 2.1 kW must have units for this

1

(ii) **Y**

1

(iii) bar drawn with any height greater than **Y**

ignore width of bar

1

(c) (i) any **one** from:

answers must be a comparison

- holds more water

  *do **not** accept 1 litre of water on its own*

- works in other countries

  accept a named country

  accept works at 2 voltages

- boils faster

- has a more powerful element

  *do **not** accept 1 kW element on its own*

- can filter water

1

ignore can wash filter

(ii) any **one** from:

- it weighs less

- smaller to pack

- cheaper to use

answers must be a comparison

***or** state why the chosen feature is an advantage*

accept boils enough for one drink

1

[8]

39 (a) (i) hairdryer 13

all correct

saw 3

*allow **1** mark for 2 correct*

1

mixer 13

1

(ii) fuse melts

accept blows/ breaks/ snaps for melts
*do **not** accept blows up*
*do **not** accept fuse gets hot on its own*
*do **not** accept does not work on its own*

1

(b) (i) 920

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

2

(ii) no earth (wire)

1

outside / case may become live

cause a fire insufficient

or danger of electric shock

1

(c) (i) L and N

both required

1

(ii) 9 (volts)

correct answer only

1

[9]

40 (a) (i) blue

1

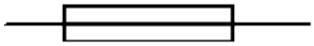
(ii) earth

1

(iii) rubber / plastic

*accept any suitable **named** non conductor eg polypropylene*
*do **not** accept bakelite*
*do **not** accept an insulator*

1

(iv) 

1

(b) any **two** from:

- draws too high a current

  accept power for current
  *do **not** accept electricity/ electric for current*
  accept too much current goes through the socket
  *do **not** accept too many currents go through the socket*

- socket overloaded

  *it = socket do **not** accept circuit for socket*

- wiring gets too hot / melts

  accept socket for wiring
  *do **not** accept fuse melts or blows*
  *do **not** accept plug/ appliances overheating*

- (may) cause a fire

- (may) cause sparking

- (possible) physical damage to the socket

  a physical reason, such as stick out from the wall is insufficient
  ignore reference to electric shocks

2

[6]

41 (a) alternates

accept switches
accept (constantly) changes
accept goes up and down

1

between positive and negative

1

(b) potential difference between the neutral and earth (terminal)

accept voltage for p.d

or potential of the neutral terminal with respect to earth

1

(c) (i) 0.025 (s)

1

(ii) 40 (Hz)

accept 1 ÷ their (a)(i)

1

[5]

42 (a) earth yellow and green

accept green and yellow

1

live brown

1

neutral blue

1

(b) (i) path shows electricity flowing from washing machine through to the person (and on to earth)

ignore direction of arrows

1

(ii) electricity flows through earth wire (to earth) **or** goes to ground

***not** escaping electricity*

***not** fuse wire blowing*

1

not through the person **or** miss the person **or** not electrocuting

***not** electric shock*

1

(c) hairdrier

*hairdrier needed for second mark **except** allow double insulated if iron or fridge **but not** plastic case*

1

double insulated **or** plastic case

accept 'It's made of plastic'
accept 'it does not conduct'

1

[8]

43 (a) 800 (W)

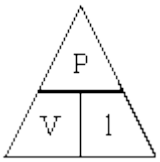
accept 0.8kW but this answer must have the unit

1

(b) (i) power = voltage × current

accept the equation rearranged

accept P = VI
do not accept C for current
do not accept P = VA
do not accept power = VA
do not accept



unless subsequent calculation shows understanding

1

(ii) 3.5 (A)

accept a larger number of d.p. but you must be able to round to 3.5

allow 1 mark for

$$\textit{current} = \frac{\textit{power}}{\textit{voltage}}$$

or $(I =) \frac{800}{230}$

2

(iii) 5 (A)

independent of (ii) unless e.c.f from part (b)(ii)

1

(c) 0.95 **or** 95 (%)

allow I mark if useful energy output is given as 760 ignore any incorrect unit

2

[7]

44 (a) (i) live and neutral wrong way around

accept blue and brown wrong way round or in the wrong place
for credit both wires must be given
*do **not** accept the wires are in the wrong holes*

1

(ii) to protect the appliance

*accept melt or blow **or** burns out if too much current **or** power or energy or electricity flows*

*accept to stop too much current **or** power **or** energy **or** electricity flowing*

*accept stop overheating **or** a fire*

*do **not** accept 'safety' unless qualified by above*

1

(b) (i) (metal) cover

accept (heating) element

*do **not** accept the mains cable*

1

[3]

45 (a) horse completes circuit between wire and earth **or** horse earths the wire

1

charge **or** electrons **or** current **or** electricity flows through the horse

1

(b) **two** from:

- RCB breaks circuit when it detects a difference between currents in live and neutral wires
- fuse breaks circuit only when fuse rating exceeded or when it melts
- RCB is resettable

2

(ii) 500 (ms)

*leakage current = 0.02A **1** mark only*

1

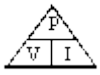
[6]

46 (a) (i) 7

1

(ii) (electrical) power = voltage x current

accept P = V × I (correct standard symbol)
accept watts = volts x amps
accept a correct rearrangement

accept 

if subsequent use of  *is correct*

1

(iii) 1610
or their (a)(i) × 230

1.61 kW = ***2*** *marks*

do ***not*** *accept 7 × 240*

2

watts

accept watt
accept W
accept .J/s

(iv) melts

accept burns out
accept blows
accept breaks
do ***not*** *accept stops working*
do ***not*** *accept burns*

2

current greater than 13(A)
or current exceeds fuse rating **or** current 15(A)

do ***not*** *accept too much current*
unless qualified

(b) (i) if live wire touches case

accept if case becomes live

accept metal for case

2

current flows to earth **or** ground
or fuse melts **or** stops iron becoming live

accept electricity flows to earth

do ***not*** *accept - you will get a shock*

accept with <u>no earth</u> (wire) you would or could get a shock for ***1****mark*

(ii) (outer) case is made of insulator

accept outside is plastic

*accept outside is not made of metal **or** conductor*

cable is (also) insulated

accept wires for cable

*do **not** accept it has two layers of insulation without explanation*

*do **not** credit answers in terms of heat*

2

[10]

47 (a) A – fuse
B – (cable) grip

for 1 mark each

2

(b) X – brown/red
Y – green + yellow/green
Z – blue/black

for 1 mark each

3

(c) any plastic/rubber

for 1 mark

1

(d) (i) earth

for 1 mark

1

(ii) metal appliance needs earthing/safety qualified

for 1 mark

1

(e) cut less insulation on earth; neutral wire needs connecting;
fit fuse properly; cable grip needs to be an outer cable **or** allow identifying faults

for 1 mark each

4

[12]

48 (a) in range 6 < I ≥ 13 A

for 1 mark
(no unit no mark)

1

(b) 4

gains 2 marks

(else working

gains 1 mark

(resistance of circuit correctly worked (2Ω))

2

(c) 72 (I^2 R) ecf

gains 2 marks

else working

gains 1 mark

an answer of 36W (ie for one lamp) – (1)

2

(d) 1000 or 16.7 min (ecf from (c))

gains 2 marks

else working

gains 1 mark
(formula with incorrect substitution – no mark (12V)

2

[7]

49

(a) Mains socket – once only
Shower cable can get wet
Trailing cable to fire (not heater unless fire clearly identified)
Use of fire
Free running cable from ceiling
Appliance on side of bath
Use of ordinary light switch
Free cable to sink light

any 3 each for1 mark

3

(b) (i) 7, 4, 1, 80.5

Four right – 2
Three right – 1
All right in W – 1

2

(ii) Toaster

1

(iii) 32p

gets 3 marks

Else 8 × 4

gets 2 marks

Else unit cost = 8p

gets 1 mark

3

[9]

50 (a) Current = 0.4A (1)
R = V/I or 240/0.4 (1)
R = 600 ohm (1)

3

(b) Doubles

gets 2 marks

OR gets bigger

gets 1 mark

2

(c) P = V.I or 240 × 0.4
P = 96W

for 1 mark each

2

(d) 1 = 0.2A
P = 48W

for 1 mark each

BUT may get equation mark here if not in (c)

2

(e) P = V.I.t (1)
P = 240 × 0.2 × 6 × 3600
OR P = 48 × 6 × 3600

gets 1 mark

P = 1036800 W

gets 1 mark

3

[12]

51 (a) Earth
return/neutral
live

for 1 mark each

3

(b) (i) rubber/plastic

for 1 mark

1

(ii) cable/wire/grip
cable/wires
fuse

for 1 mark each

3

(iii) case

for 1 mark

1

[8]

52 (a) (i) S_3

for 1 mark

1

(ii) S_1, S_2 and S_3

for 1 mark

1

(b) (i) increases/current passes through heaters/current unaffected in fan

for 1 mark

1

(ii) (fan) blows/air moving prevents dryer overheating

for 1 mark each

2

(c) (i) brown
blue

any order

for 1 mark each

2

(ii) earth/green and yellow

for 1 mark

1

(iii) (case is) plastic
plastic does not conduct (electricity)
for 1 mark each

2

(d) (i) 1300/power
for 1 mark

1

(ii) time/units of time
for 1 mark

1

[12]

53 (a) heat / thermal
kinetic / movement
each for 1 mark

2

(b) (i) its a good (electrical) conductor
for 1 mark

1

(ii) its a good (electrical) <u>insulator</u> / very <u>poor conductor</u>
for 1 mark

1

(c) (i) 2.75 × 6
gains 1 marks

but
16.5
gains 2 marks

2

(ii) (c)(i) × 7 or no. of kW h × cost/kW h
gains 1 marks

but
115.5 or e.c.f if correct
gains 2 marks

2

(d) it would heat and melts / blows / burns out / breaks circuit

any two for 1 mark each (fuse wire just breaks – gains 1)
(blows up – gets 0)
(fuse causing wire to melt gets 1)

2

[10]

54 (a) (i) 13A

for 1 mark

1

(ii) fuse heated melts owtte / blows / burns out **Not** explodes / burns circuit breaks

any 2 for 1 mark each

2

(b) (i) 2750 × 6 or 2.75 × 6

gains 1 mark

but
16.5

gains 2 marks

2

(ii) 2750 × 6 × 7 or 2.75 × 6 ×7 or (b)(i) × 7 or kW h × cost / kW h

gains 1 mark

but
115p or 116p or 115.5p or £1.16 or £1.15

gains 2 marks

2

[7]

55 (a) E – green and yellow
N – blue (*not* black **but** black / blue OK)
L – brown (*not* red **but** red / brown OK)

for 1 mark each

3

(b) fuse
screws to secure wires
cable grip (maybe described)
reference to an earth
(plastic case *wrong*)

any two for 1 mark each

2

[5]

56 (i) power = current × voltage
or any correctly transposed version

accept watts = amps × volts

accept P = IV

do not credit P = CV

accept p.d. for voltage triangle acceptable only if used correctly in (ii)

1

(ii) 2 000 000 (1)

2000 kilowatts/kW (2)

accept KW

watts/W (1)

2 megawatts/MW (2)

*do not credit mW (1) if correct method is clearly shown but answer is numerically incorrect **or** unit is absent **or** incorrect*

do not credit any working from an incorrect equation in (d)(i) but an appropriate unit should be credited

2

[3]

57 (a) series circuit

all four components must be included

if a battery included the neatness mark may still be awarded

1

circuit fully functional **or** properly connected

this is the neatness mark

do not credit a parallel circuit with one switch controlling both components

1

(b) case **or** outer parts are made of plastic **or** insulator **or** non-metallic

1

there is no electrical pathway between inner and outer insulation

accept no connection between inner and outer part

do not credit two layers of insulation

1

(c) (i) [A] power = voltage × current

*accept P = V I **or***

W = V × A

***or** any transformation*

1

[B] 1600 ÷ 230 =current

1

6.96 **or** 7

accept with no working for two marks

accept 6.95

in [A] award a mark for a triangle if calculation correctly performed

1

(ii) [A] voltage = current × resistance

*accept V = I R **or** any transformation*

1

[B] 230 ÷ 7 = overall R = 33

accept 230 ÷ 6.96 = overall R = 33

1

resistance of motor = 33 – 20 = 13

accept with no working for two marks

do not credit negative answer

accept consequential errors from c(i)

in [A] award a mark for a triangle if calculation correctly performed

1

[10]

58 (a) (i) P = V × 1

or equivalent

credit a triangle if part (ii) correctly uses the relationship

*credit power = volts × amps **or** watts V × A*

do not accept C for current

1

(ii) (P = 230 × 10 =) 2300

credit 2.3

1

W **or** J/s

kW

1

(b) (i) 15 A

*credit 13 A **or** amps*

1

(ii) any **three** from

earth

any short (to the metal tank) causes fuse to blow

fuse is in the live wire

to prevent damage to the heater

credit to stop the current

3

(c) (i) V = I × R

or equivalent

credit a triangle if part (ii) correctly uses the relationship

1

(ii) (230 = 10 × R =) 23

ohms **or** Ω

2

[10]

59 (a) earth at top

1

neutral on left

1

live on right

1

(b) (i) (when a short occurs to the metal case) electricity flows to earth

a logical sequence of events is required
which address each of the key aspects

1

electricity **or** current flows to earth

*accept flows to ground **or** down the earth wire*

1

(a surge of current) blows the fuse

this breaks the (live) circuit

do not accept a short circuit

1

stops electricity flowing (through person **or** appliance)

do not accept it stops an electric shock

1

(ii) 3 A

accept 5 A

1

[8]

60 (a) *Formula mark*
P = V × I

*accept P = VI **or** W = V 5 A **or** any transformation*

1

Substitution mark I = 900 ÷ 230

1

Calculation mark 3.9

*accept 3.9 **or** 3.91 **or** 4 for three marks with no working*

1

(b) 900 + 1300 = 2200 ÷ 230 = 9.6

*accept 9.57 to 9.6 **or** 10 for both marks with no working*

2

(c) 1.2 + 0.45 = 1.65

1

× 0.5 = 0.825

*accept 0.8 **or** 0.83 for both marks with no working*

1

(d) any **one** from

use less energy (to cook something)

*accept fewer energy losses **or** use less electricity*

cook faster

do not credit a cost argument about buying two different ovens

1

[8]