

**1**

Energy resources can be renewable or non-renewable.

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

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

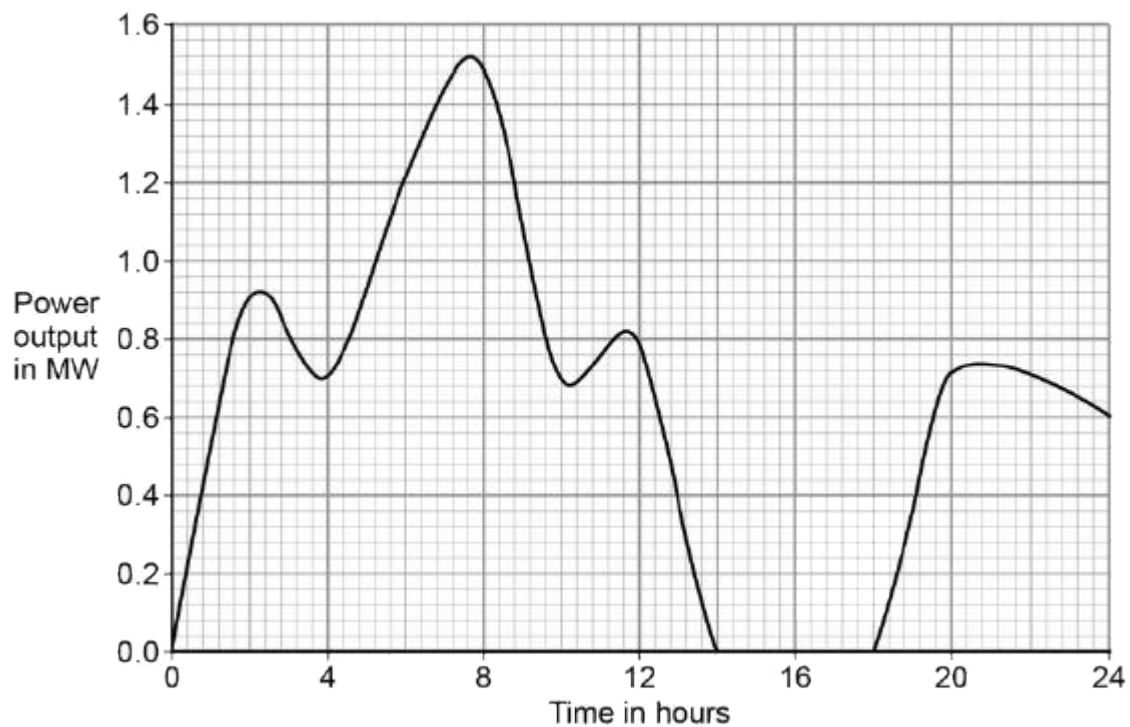
1 .....

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.

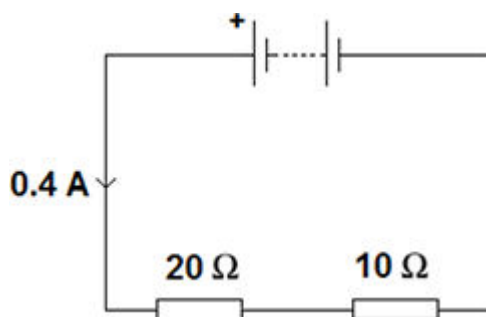
☐

(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  $\times$  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  $\times$  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**



© Michael Priest

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

Explain why.

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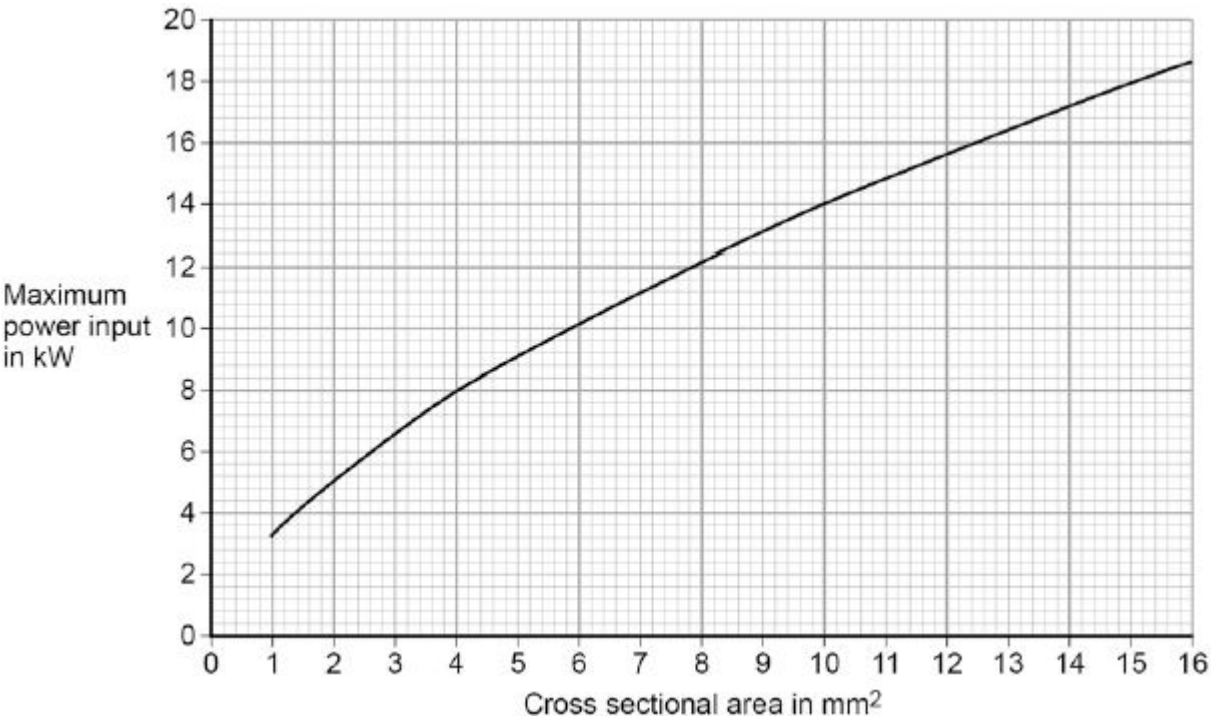
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**(4)**

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

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

**Figure 2**



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

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

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

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

$A$  is the cross-sectional area of the wire.

.....  
 .....

Minimum diameter = ..... mm

(2)



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

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

Write down any equations you use.

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Resistance = .....  $\Omega$

(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 £
<b>Filament bulb</b>	60	1250	2.00
<b>LED bulb</b>	12	50 000	16.00

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

.....

(1)

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

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

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

Use the information given in the table.

.....  
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(2)

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

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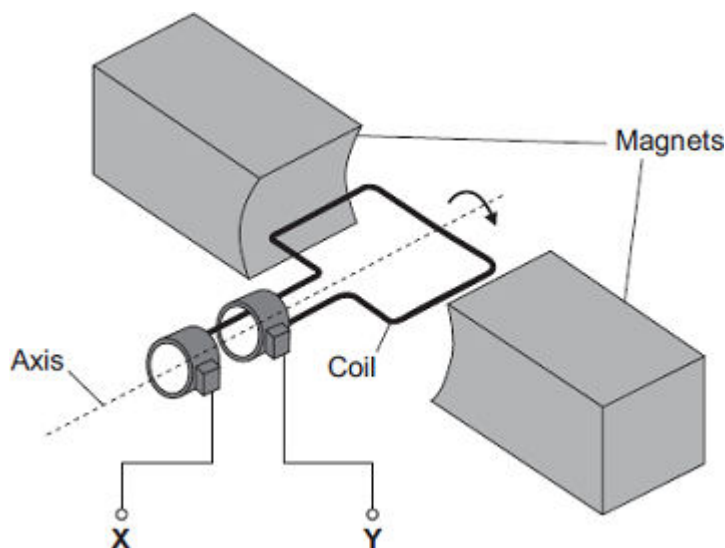
(1)

(Total 10 marks)

**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.

<b>electric</b>	<b>generator</b>	<b>motor</b>	<b>transformer</b>
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This effect is called the ..... effect.

(1)

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

.....

(1)

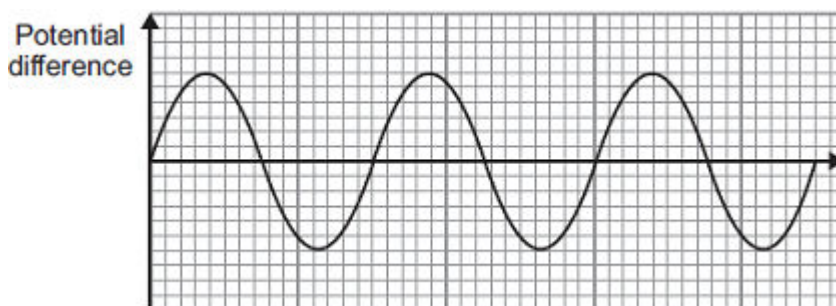
- (iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

.....

(1)

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

**Graph 1**



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

What should the other axis be labelled?

.....

(1)

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

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

(2)

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

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

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2 .....

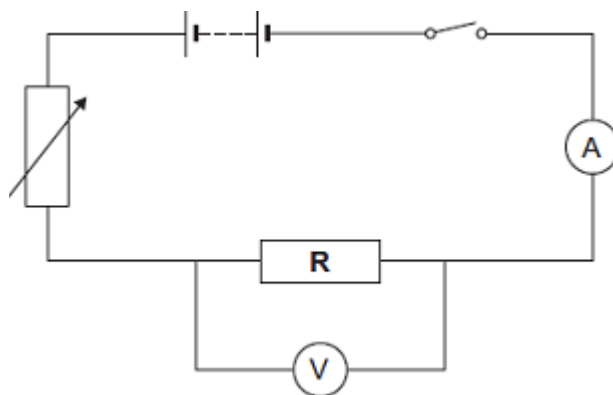
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(2)

(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**.

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**(6)**

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

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(2)

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

What is the voltmeter reading?

.....

.....

Voltmeter reading = ..... V

(2)

- (iv) The student told his teacher that the resistance of resistor **R** was 16  $\Omega$ .

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

**10  $\Omega$** **12  $\Omega$** **15  $\Omega$** **18  $\Omega$** **22  $\Omega$** 

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

Give a reason for your answer.

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(2)

- (b) The diagram shows a fuse.



Describe the action of the fuse in a circuit.

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(3)  
(Total 15 marks)

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.

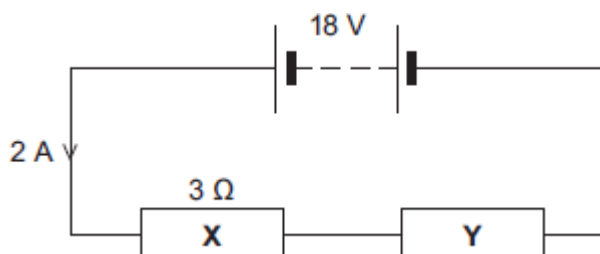
(2)

- (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  $3\ \Omega$ .
- 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**.

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 .....  
 .....

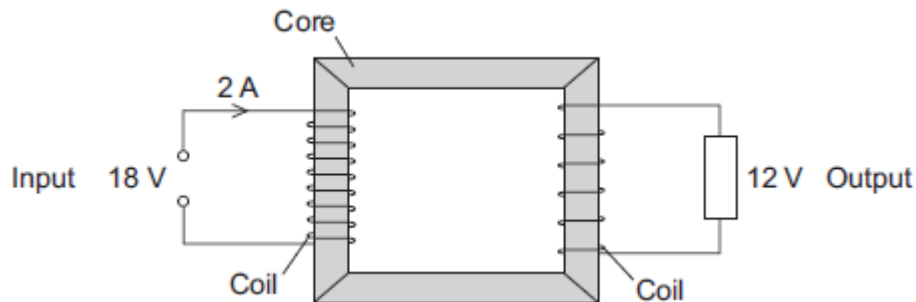
Total resistance of **X** and **Y** = .....  $\Omega$

**(2)**



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

**Figure 2**



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

Explain why.

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(2)

- (ii) The transformer is 100% efficient.

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

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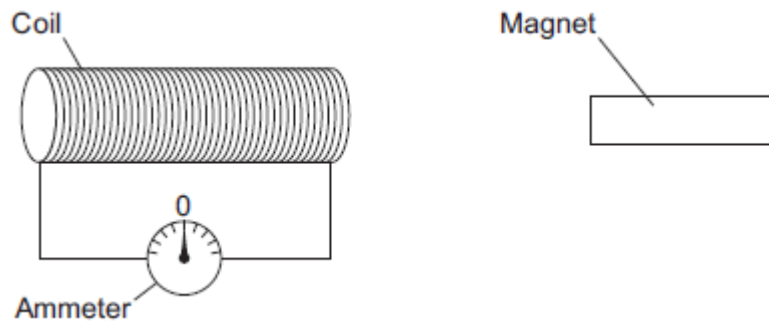
Output current = ..... A

(2)

(Total 12 marks)

**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.

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**(6)**

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

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

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

(4)

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

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

Give the unit.

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

Charge = .....

(3)  
 (Total 13 marks)

**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**

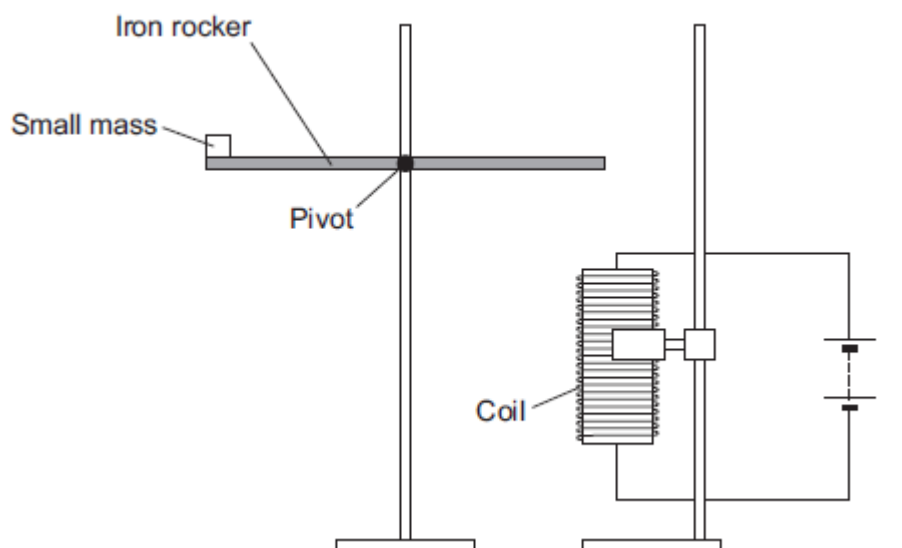
The two wires are the ..... wires.

**(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.

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**(4)**

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

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

Change 1 .....

.....

Change 2 .....

.....

**(2)****(Total 9 marks)****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 =  $3.4 \times 10^5$  J/kg.

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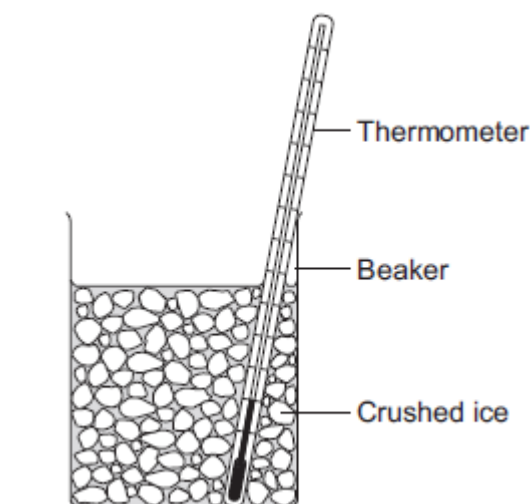
Energy = ..... J

(2)

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

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

The figure below shows the equipment that she used.



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

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

.....  
 .....

(1)

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

Suggest **two** reasons why.

Tick (✓) **two** boxes.

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

(2)

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

<b>Mass of salt added in grams</b>	0	10	20
<b>Melting point of ice in °C</b>	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)



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

- 
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[illegible]

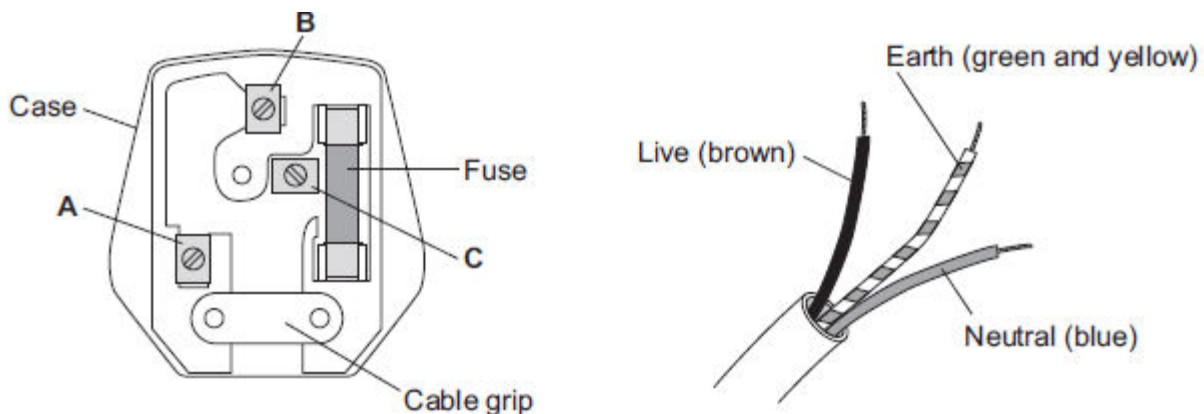
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**12**

- (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)

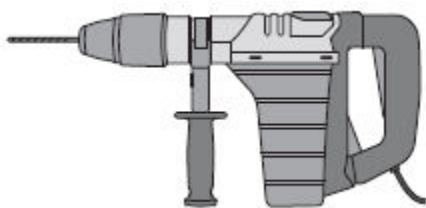
- (ii) Name a material that could be used to make the case of the plug.

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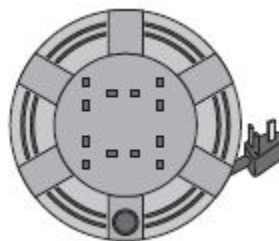
(1)

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

**Figure 2**



Electric drill



Extension lead

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

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

Calculate the power of the drill.

.....

.....

.....

Power = ..... W

**(2)**

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

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

**When in use the lead may get hot:**

**DO NOT go over the maximum power**

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

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

Explain why.

.....

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.....

(3)

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

**Table 2**

Drill	Power input in watts	Power output in watts
<b>X</b>	640	500
<b>Y</b>	710	500
<b>Z</b>	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.

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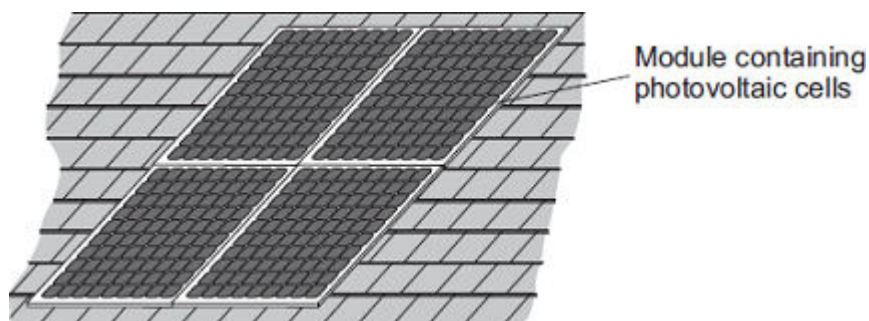
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(2)

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

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

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

The maximum power available from the photovoltaic cells shown in the diagram is  $1.4 \times 10^3 \text{ W}$ .

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

.....  
.....  
.....  
.....  
.....  
.....  
..... Time = ..... minutes

(3)

- (c) When the modules are fitted on a roof, the householder gets an extra electricity meter to measure the amount of energy transferred by the photovoltaic cells.
- (i) The diagram shows two readings of this electricity meter taken three months apart. The readings are in kilowatt-hours (kWh).

21 November

0	0	0	4	4
---	---	---	---	---

21 February

0	0	1	9	4
---	---	---	---	---

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

.....

Energy transferred = ..... kWh

**(1)**

- (ii) The electricity company pays 40p for each kWh of energy transferred.
- Calculate the money the electricity company would pay the householder.

.....

.....

Money paid = .....

**(2)**

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

Calculate the payback time in years for the modules.

.....

.....

Payback time = ..... years

**(3)**

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

.....

.....

**(1)**

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

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

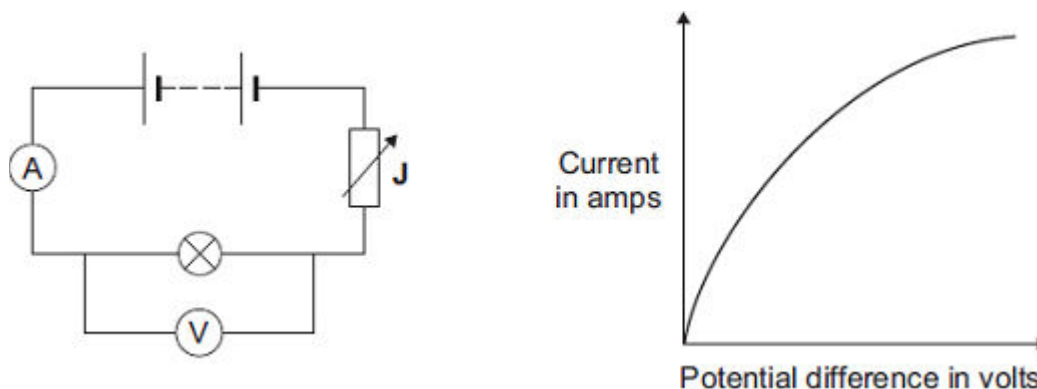
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(1)

(Total 13 marks)

**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.

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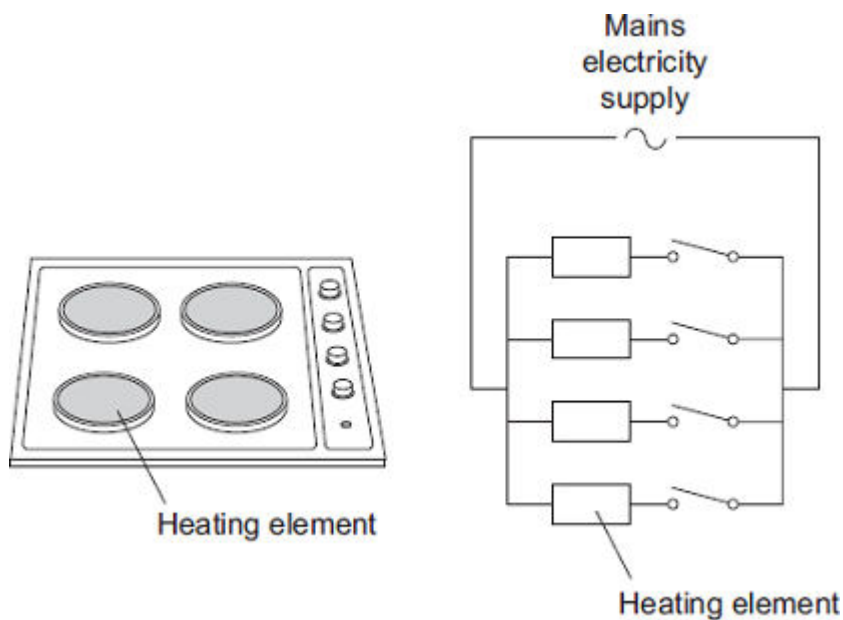
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(6)  
(Total 11 marks)

**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 = .....  $\Omega$

**(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 <sup>2</sup>	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<sup>2</sup> 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?

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.....

(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.

<b>230 V</b>	<b>2760 W</b>
<b>50 Hz</b>	

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**

.....

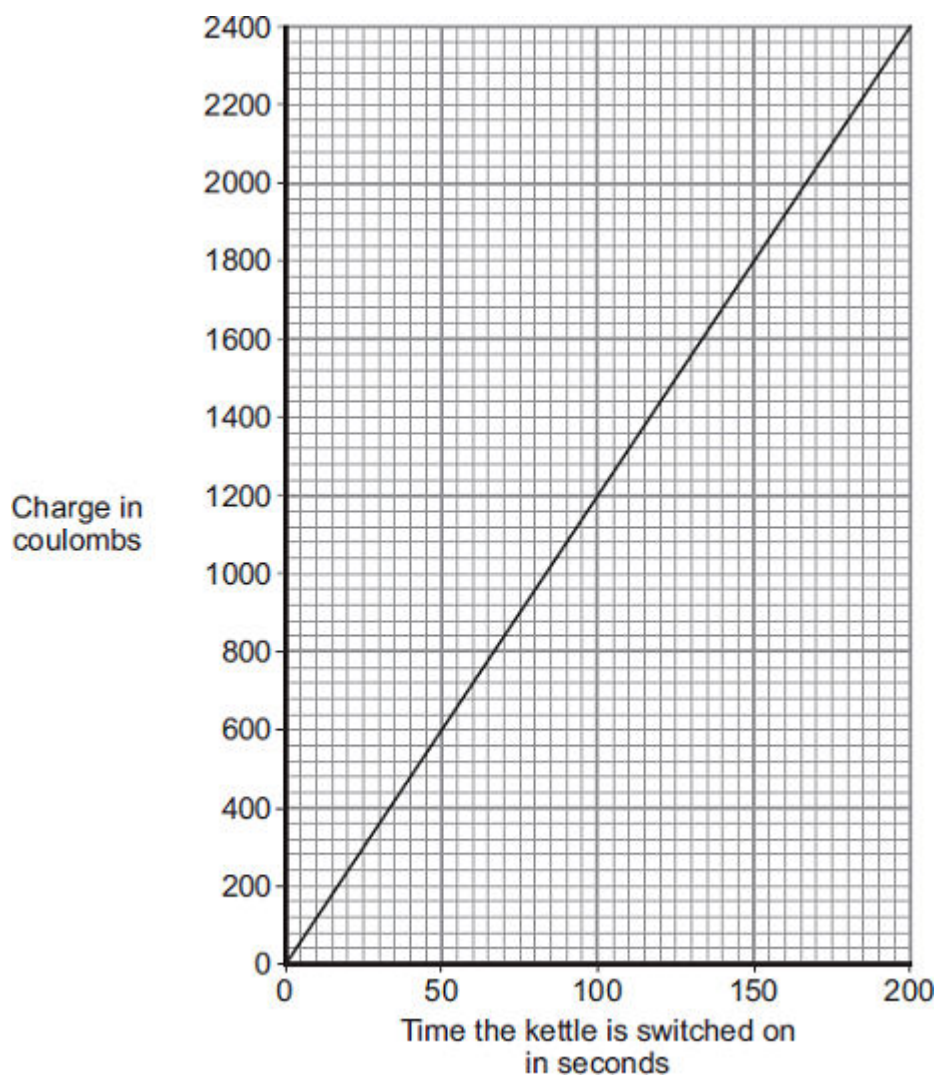
.....

.....

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.



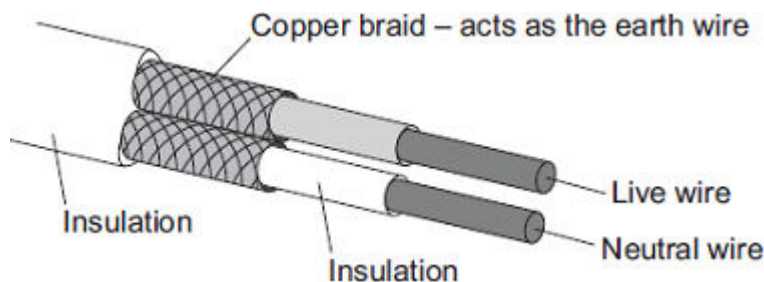
What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....  
.....

(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.

Fan heater

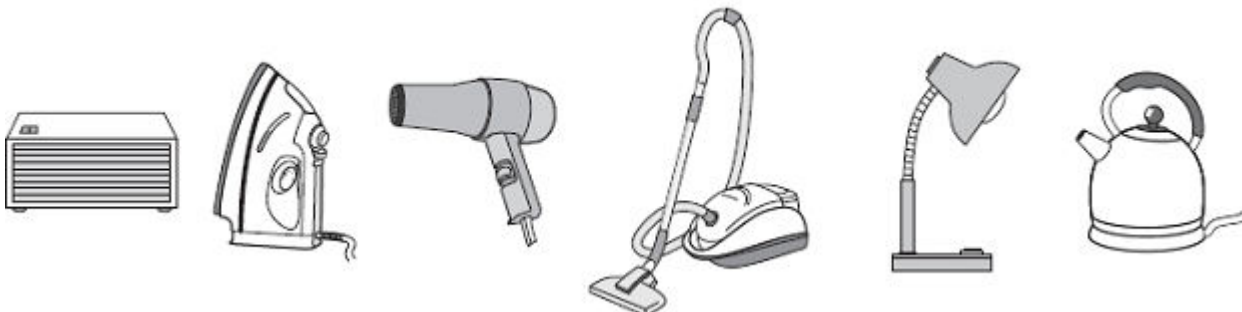
Iron

Hairdryer

Vacuum cleaner

Table lamp

Kettle



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

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

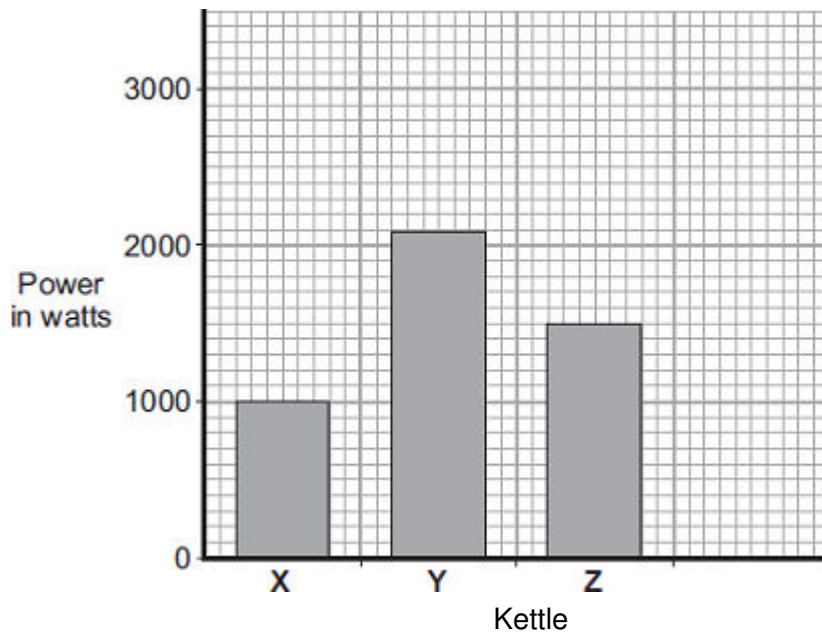
1 .....

2 .....

3 .....

(3)

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



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

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

**X**

☐

**Y**

☐

**Z**

☐

(1)

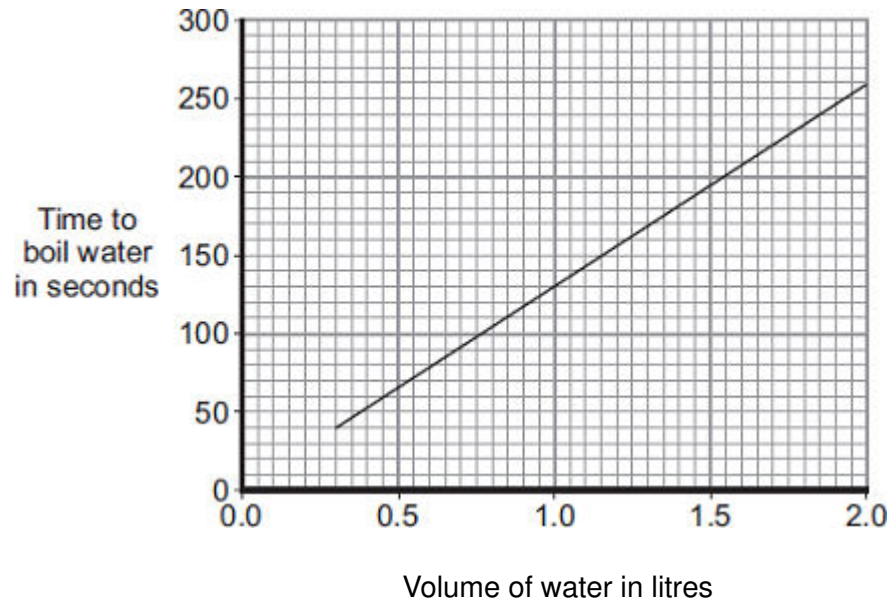
- (ii) A new 'express boil' kettle boils water faster than any other kettle.

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

(1)



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



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

Explain how the householder is wasting money.

.....

.....

.....

.....

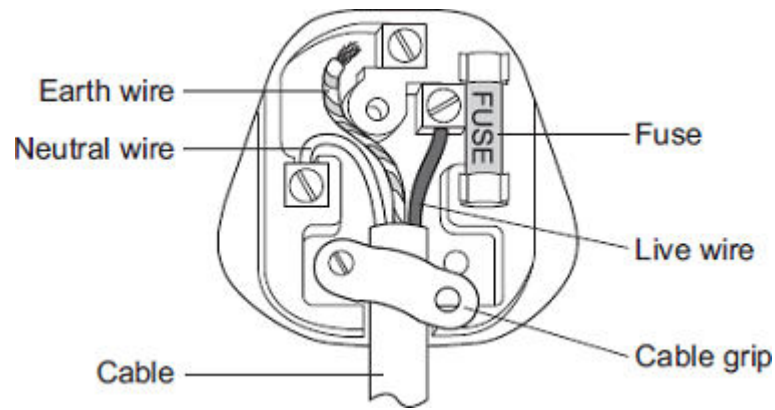
.....

.....

(3)  
(Total 8 marks)

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.

.....

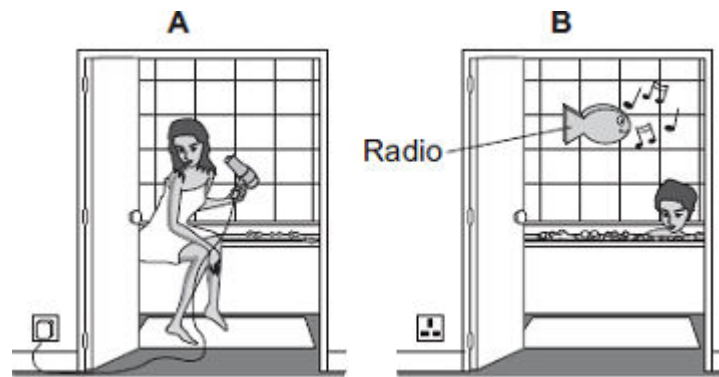
.....

.....

.....

(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.).

.....

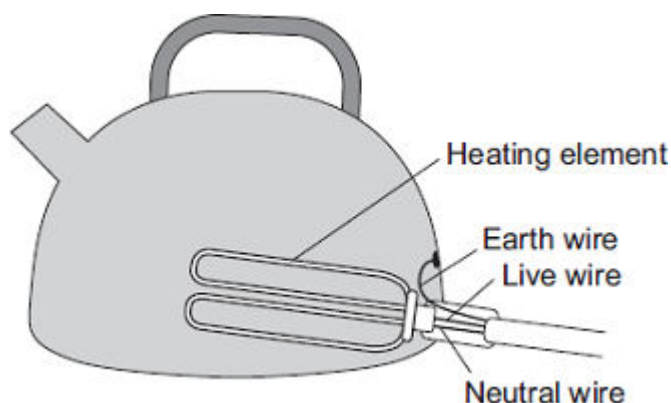
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(2)

- (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.

.....

.....

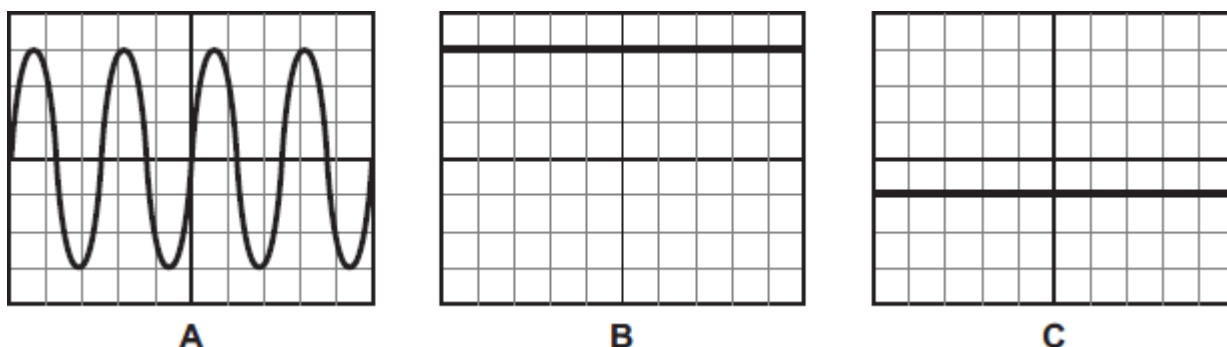
.....

.....

(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?

.....

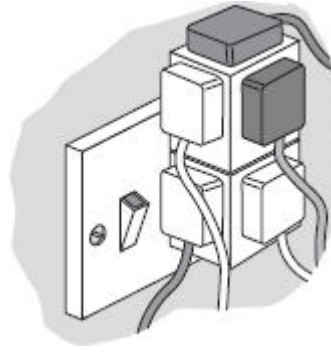
Give a reason for your answer.

.....

.....

(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.

.....

.....

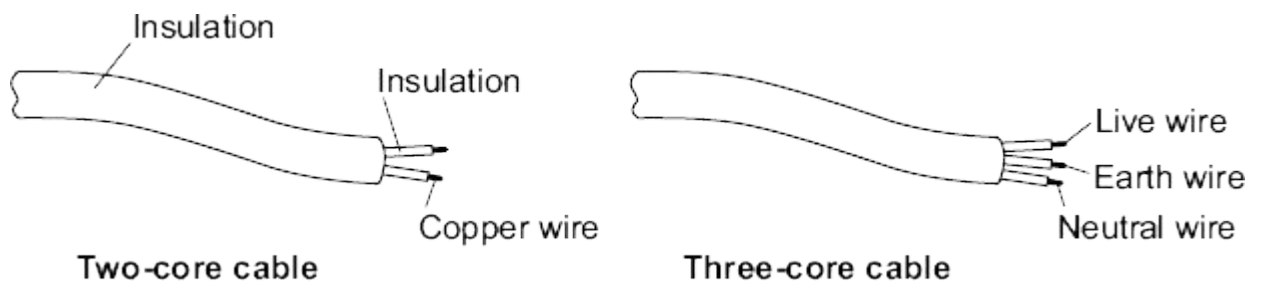
.....

.....

(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.

$$1000 \text{ mA} = 1 \text{ A}$$

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.

.....

.....

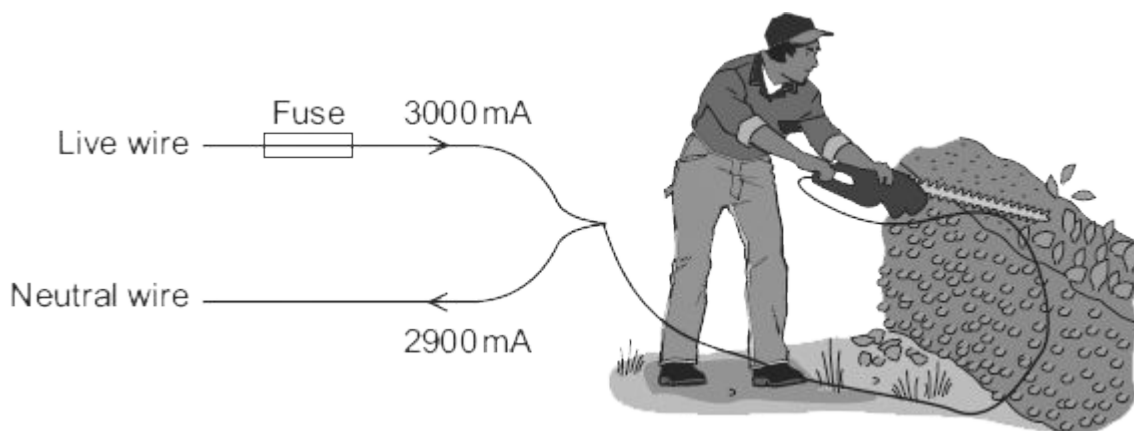
.....

.....

.....

(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.

.....

.....

.....

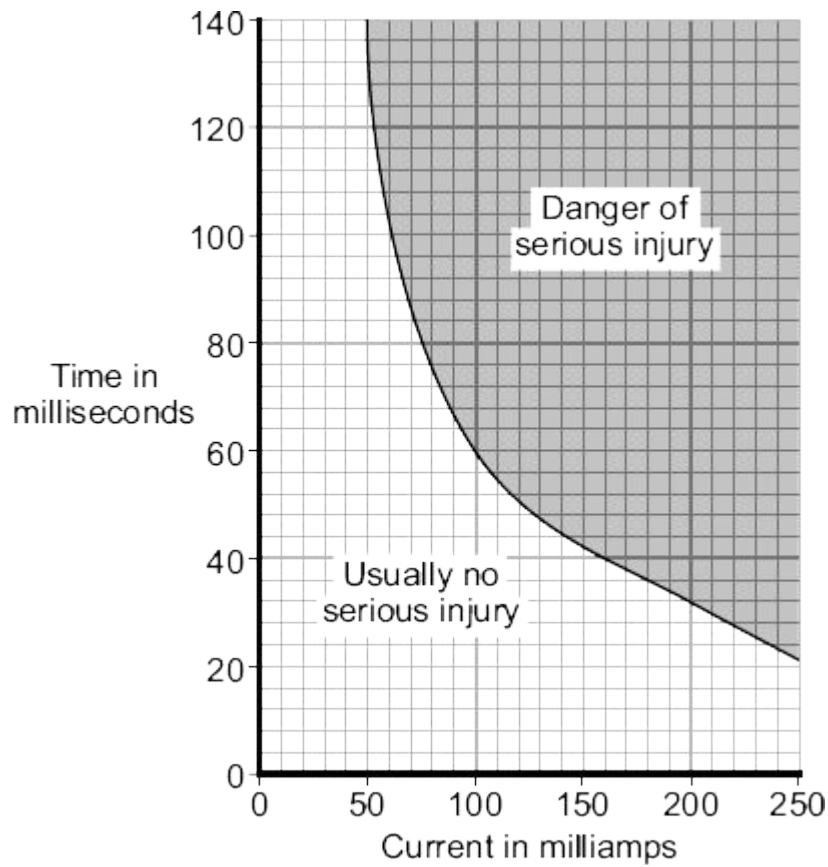
.....

.....

(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.

.....

.....

.....

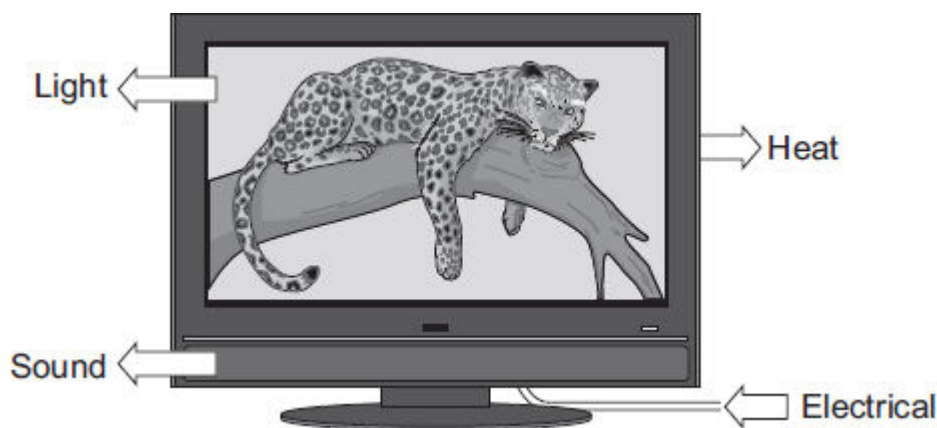
.....

.....

(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.

$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$
--

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

.....

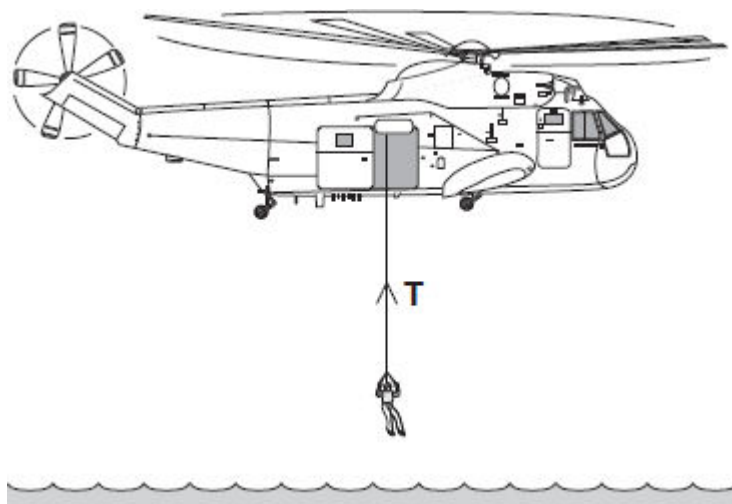
.....

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.

$\text{weight} = \text{mass} \times \text{gravitational field strength}$
--

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 = .....

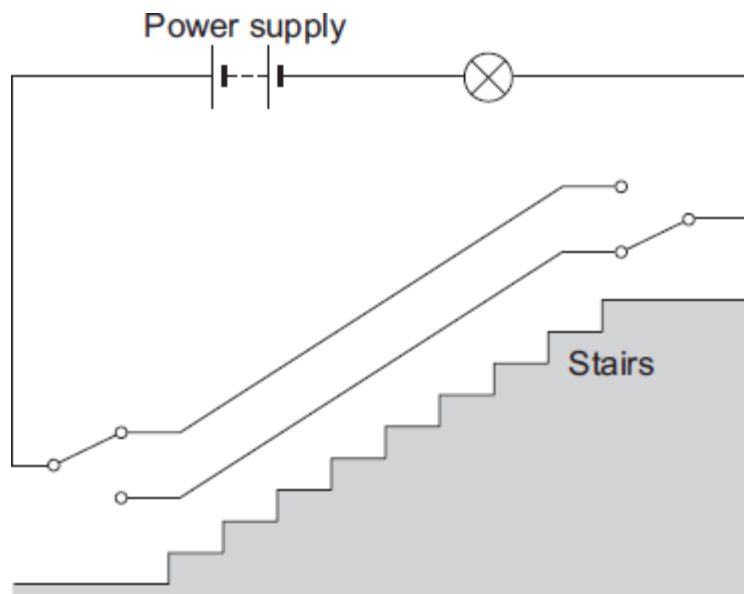
(3)

(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  $18\ \Omega$  and draws a current of  $0.5\ \text{A}$  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 = .....  $\Omega$

(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.

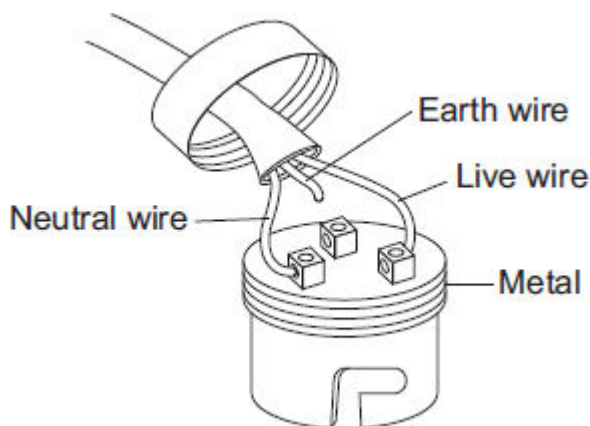
What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

.....

.....

(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?

.....

.....

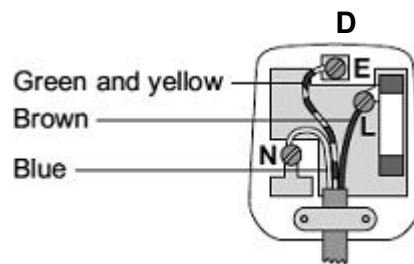
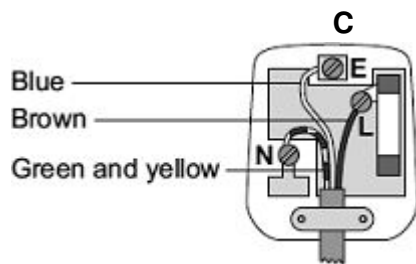
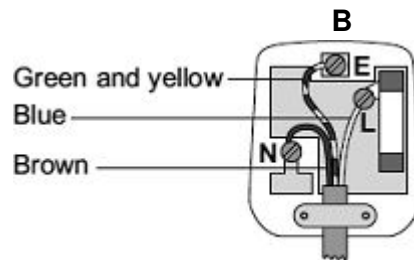
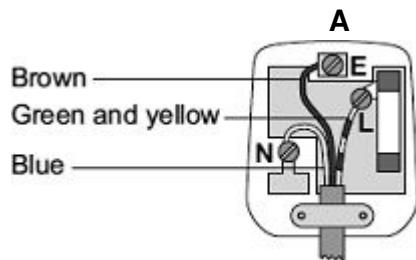
(1)  
(Total 7 marks)

**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.



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.

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

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.

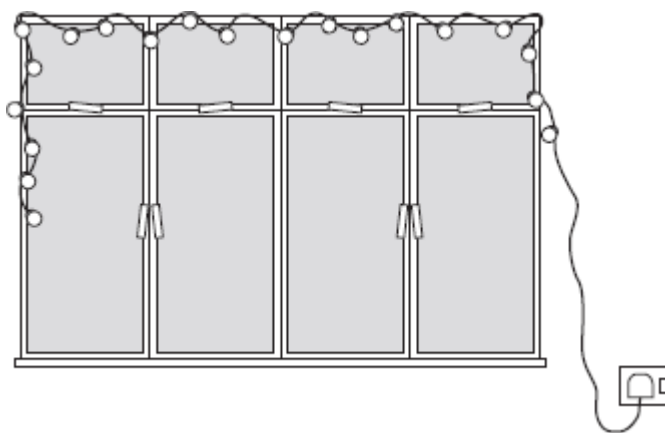
.....  
 .....  
 .....  
 .....

**(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.

.....

.....

.....

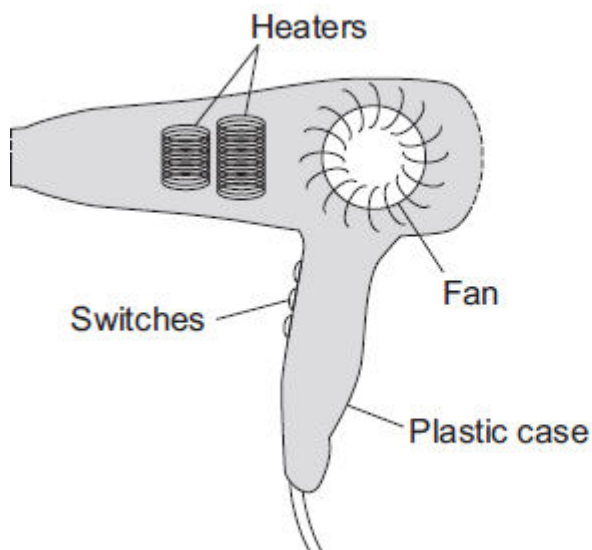
.....

(2)  
(Total 6 marks)

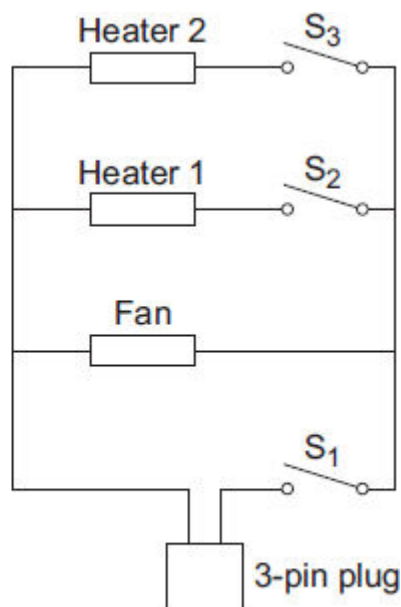
29

**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.

.....  
 .....

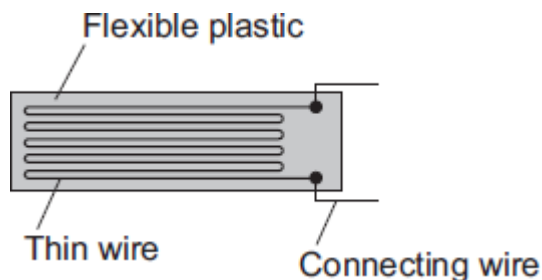
Maximum power = .....

(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 = .....  $\Omega$

**(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?

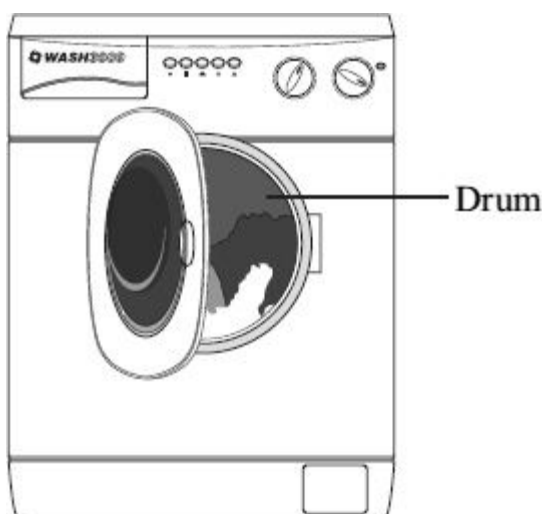
.....

(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.

<b>Model – Wash 3000</b> <b>Energy A</b>	
More efficient  Less efficient	
Energy consumption kWh/wash cycle (based on 40 °C wash)	1.1

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

Explain what being *more energy efficient* means.

.....

.....

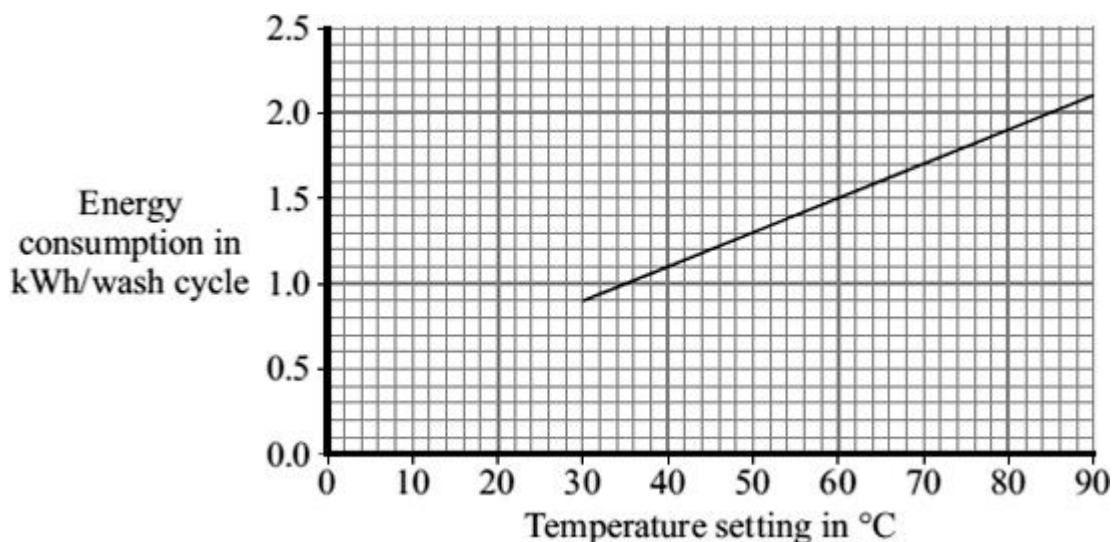
.....

.....

(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.

$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$
--

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.

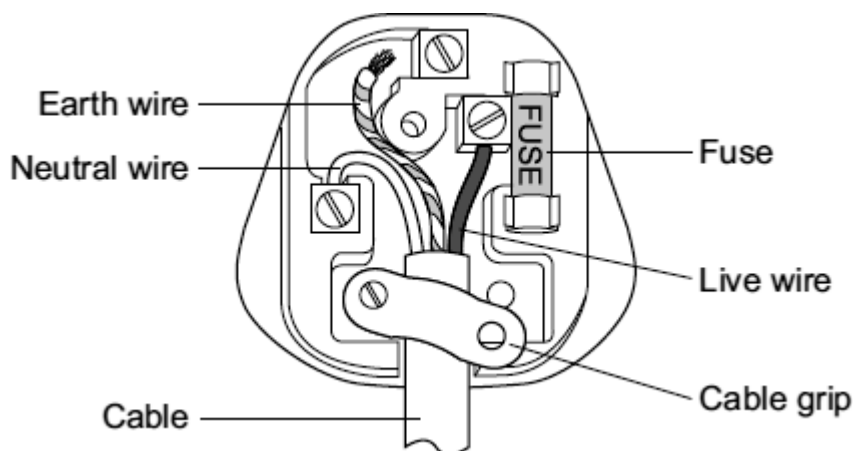
.....  
.....

(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.

.....

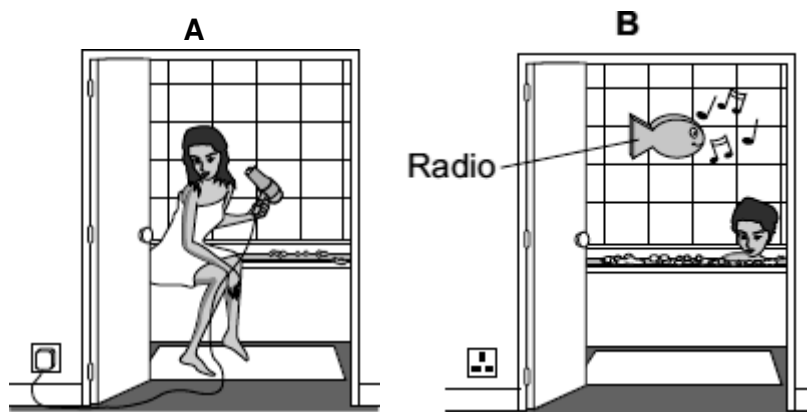
.....

.....

.....

(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.

.....

.....

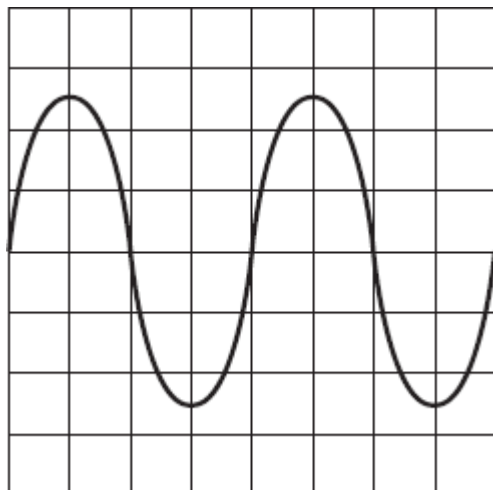
.....

.....

(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**

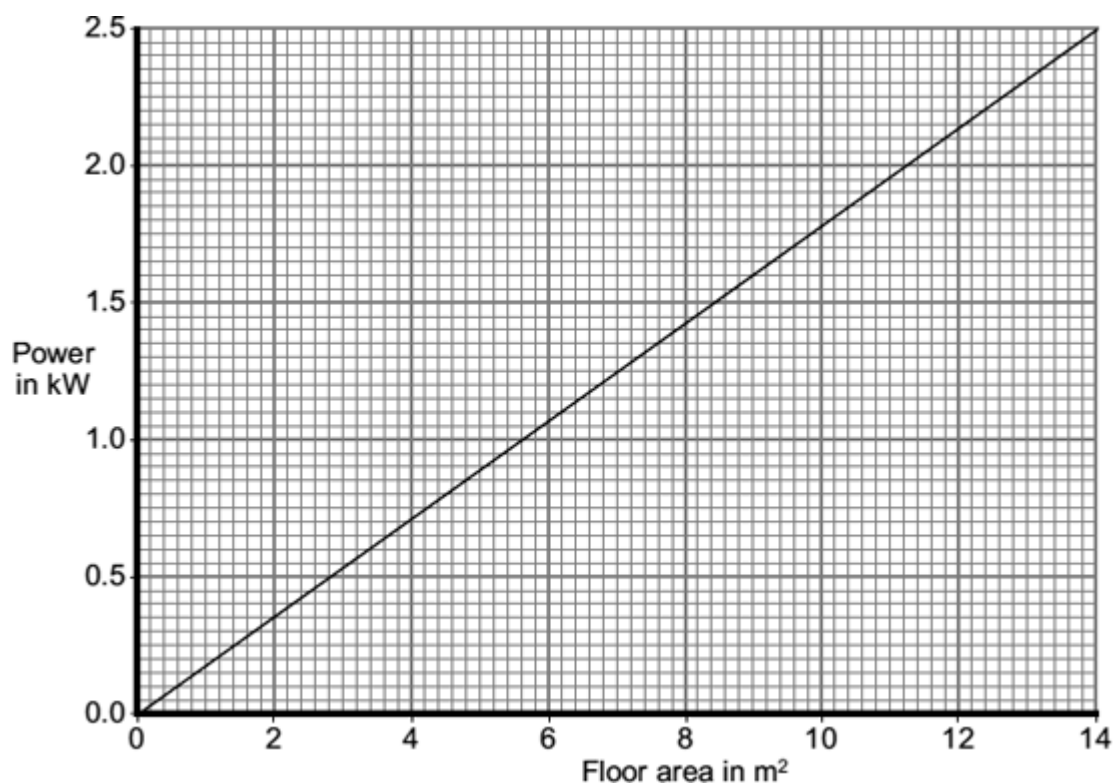
A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

- (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  $9.0 \text{ m}^2$ .

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.

<b>12</b>	<b>50</b>	<b>110</b>	<b>230</b>
-----------	-----------	------------	------------

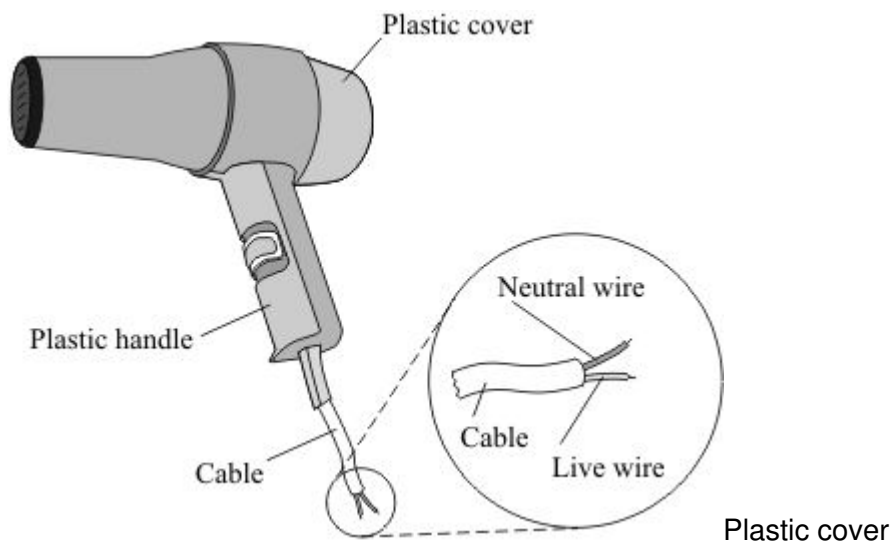
In the UK, the mains electricity supply is ..... volts.

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.).

.....

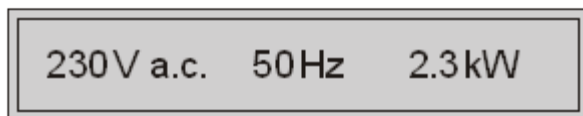
.....

.....

.....

**(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?

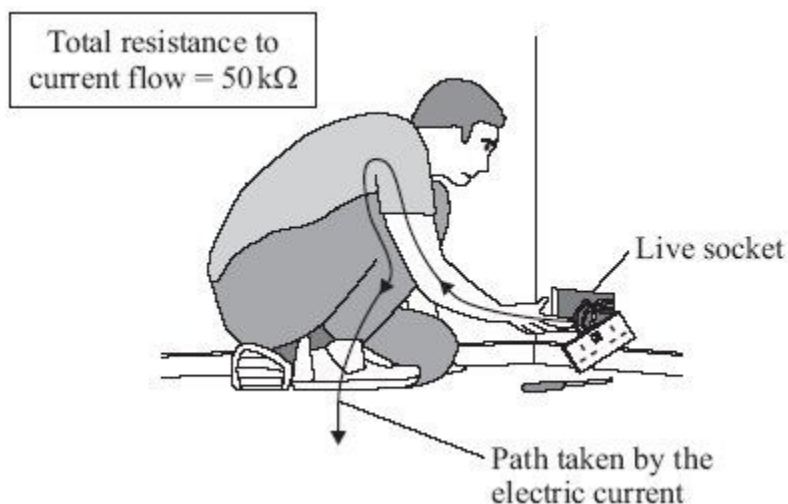
Draw a ring around your answer.

**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.

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

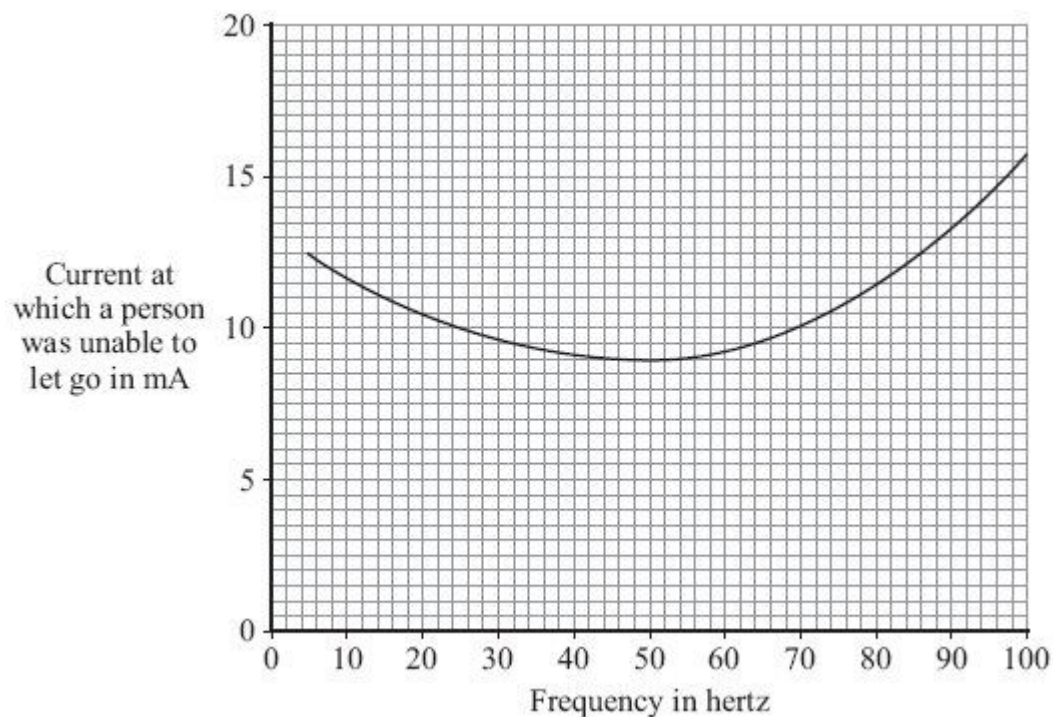
(2)



- (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?

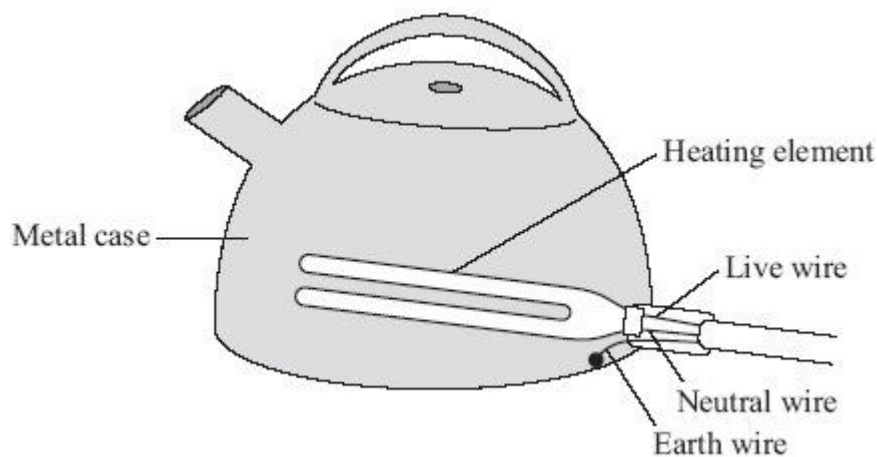
Give a reason for your answer.

.....

.....

(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

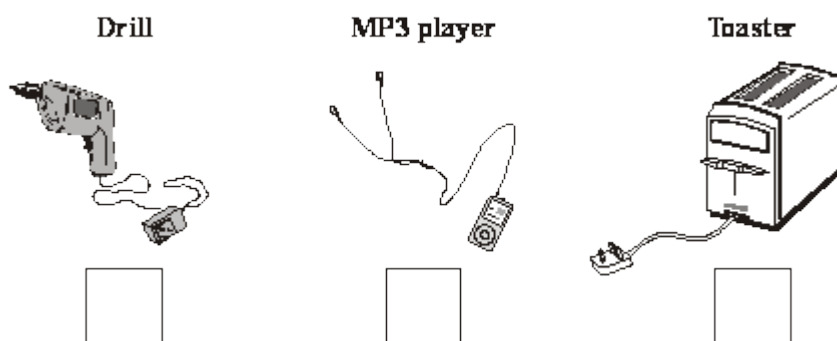
**C** electrical to kinetic

**D** electrical to light

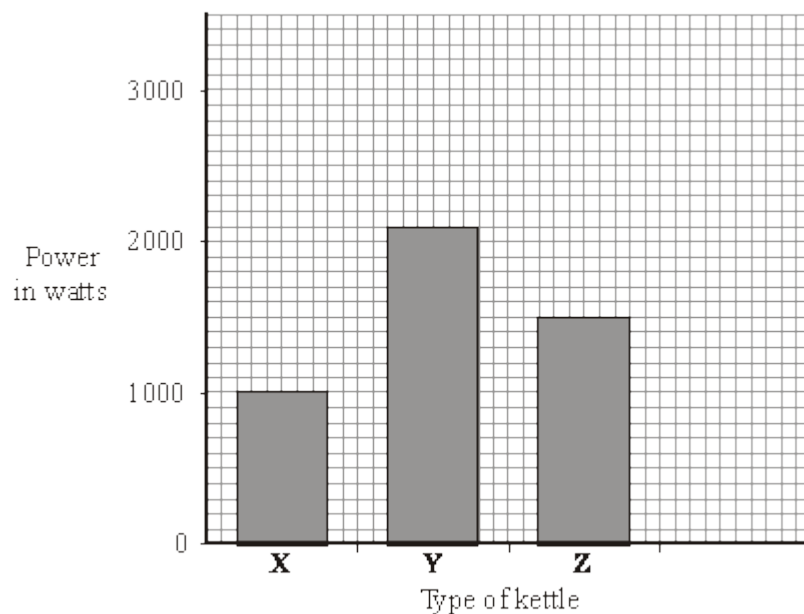
**E** electrical to sound

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.

**Get it right!  
Choose the right fuse.**

Most fuses are 3 A or 13 A.

To choose the right fuse you must know the power of the appliance.



230 V 4 A  
920 W

Power is marked on the information plate.

<p>Power over 700 W use a 13 A fuse.</p> <ul style="list-style-type: none"> <li>Fan heaters</li> <li>Kettles</li> <li>Dishwashers</li> <li>Washing machines</li> </ul>	<p>Power under 700 W use a 3 A fuse.</p> <ul style="list-style-type: none"> <li>Radios</li> <li>Table lamps</li> <li>Portable TVs</li> <li>Electric blankets</li> </ul>
--	---

- (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.

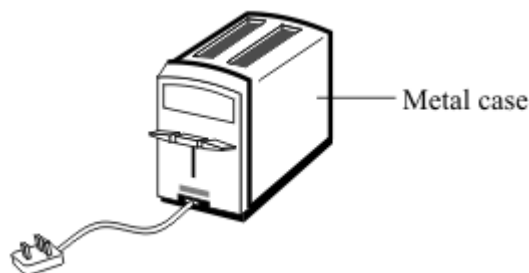
What will happen to the fuse when the kettle is switched on?

.....

.....

(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.

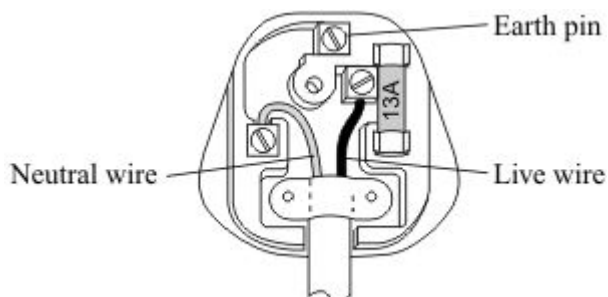
.....

.....

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.

.....

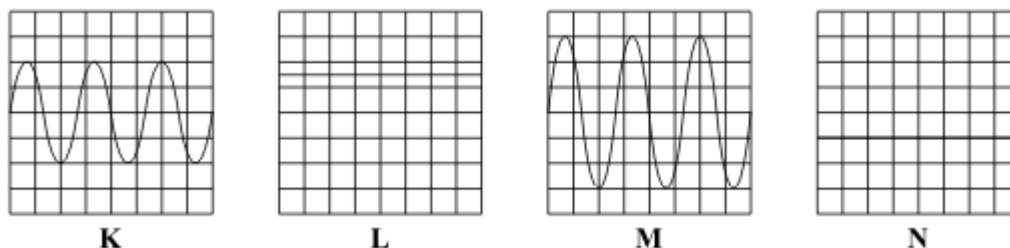
.....

.....

.....

(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**?

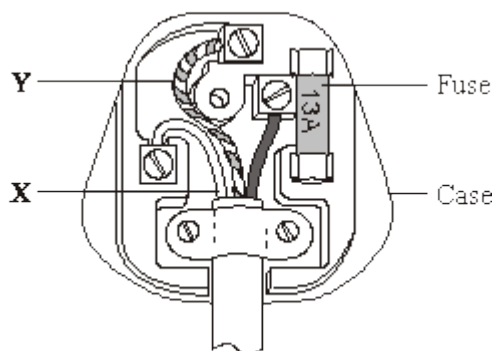
.....

(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)

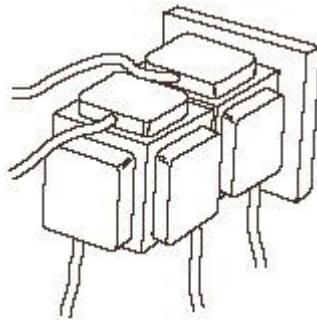
(iv) Which **one** of the following is the correct circuit symbol for a fuse?

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.

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

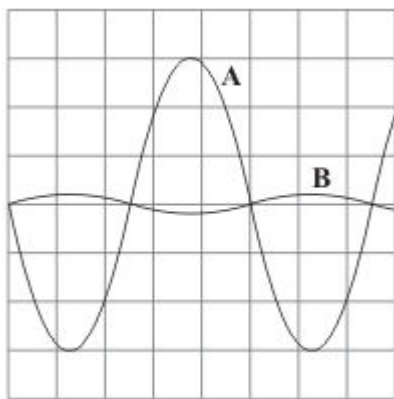
(2)

(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.

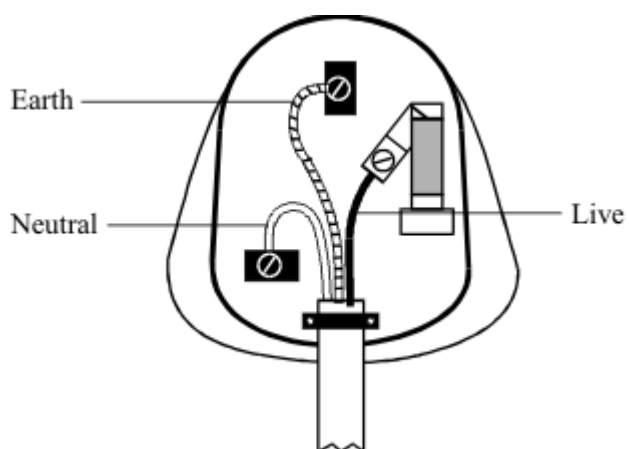
.....

Frequency = ..... hertz

**(1)****(Total 5 marks)**

42

The diagram shows the inside of a mains plug.

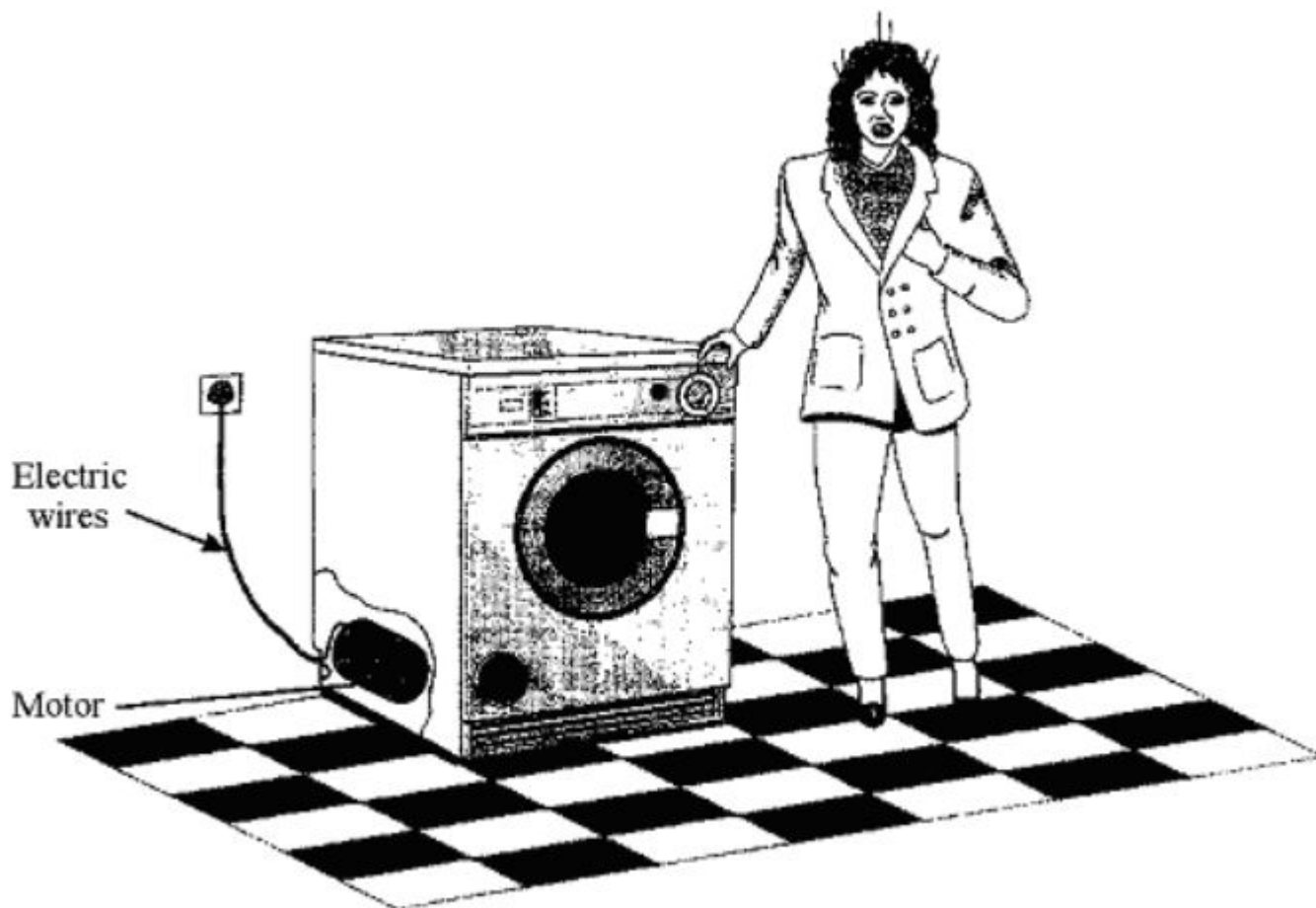


(a) Complete the table.

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

(1)

.....

.....

.....

(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.

.....

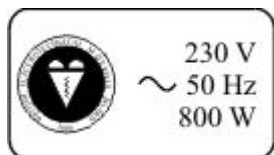
.....

(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

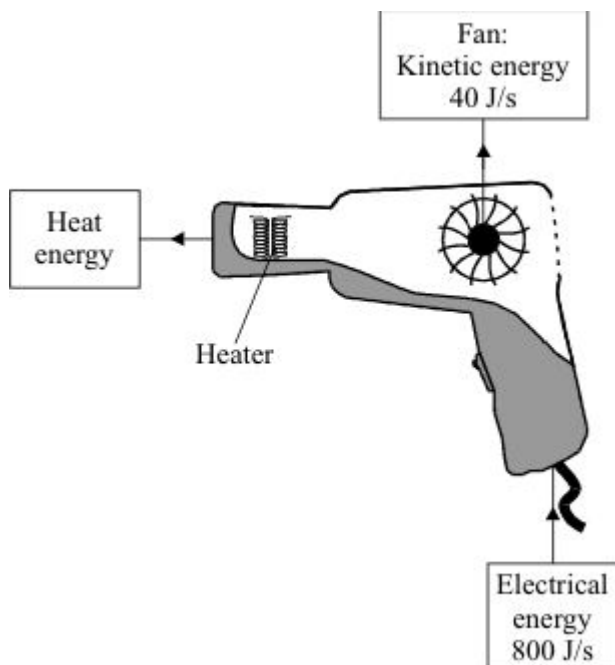
(2)

- (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.

.....

.....

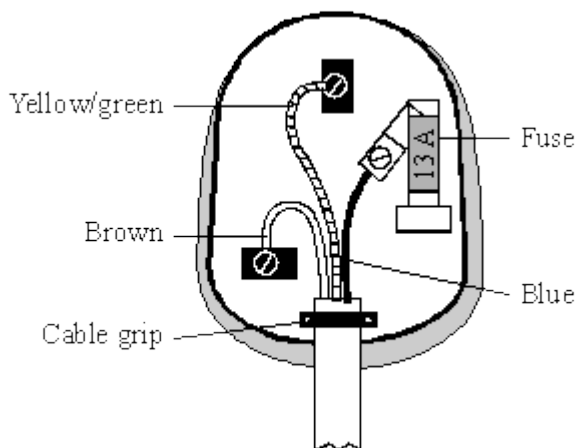
.....

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)

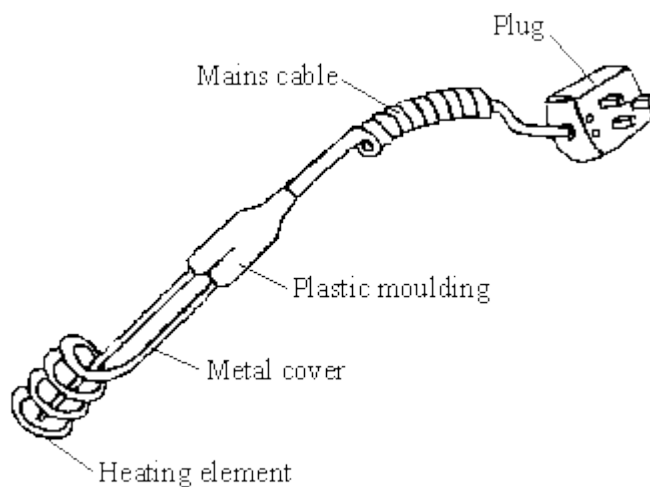
- (ii) Why do plugs have a fuse?

.....

.....

(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?

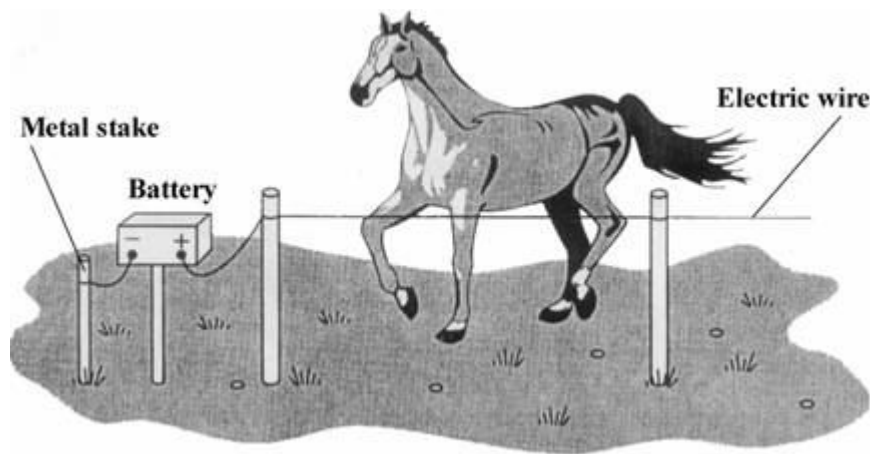
.....

(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.

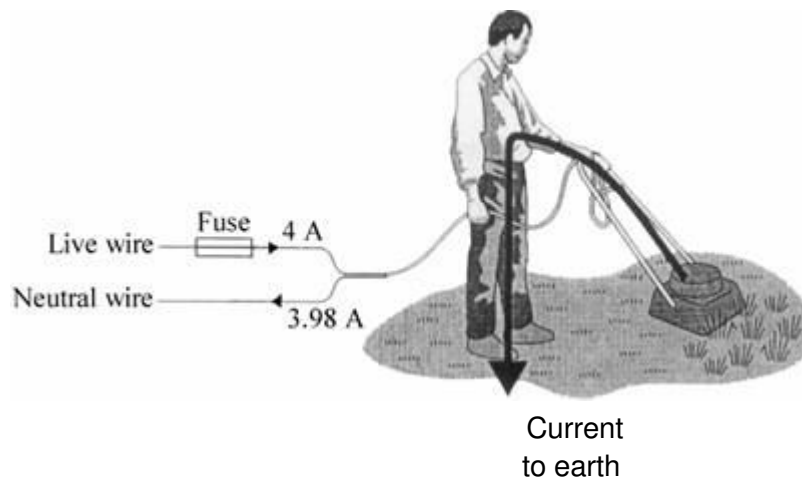
.....

.....

.....

(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.

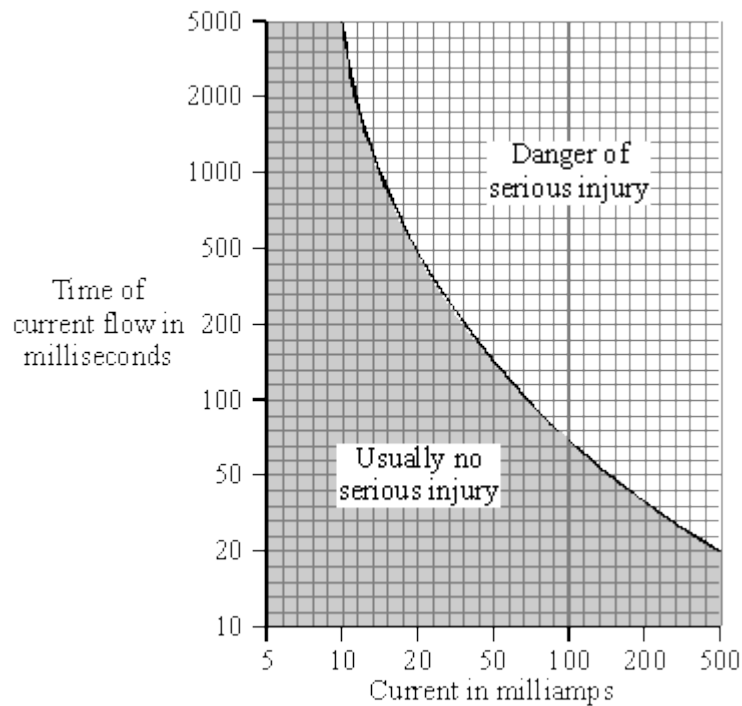
.....

.....

.....

(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?

.....  
 .....

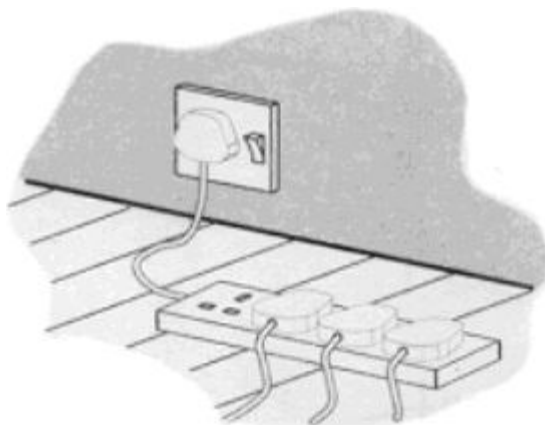
Time = ..... milliseconds

(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.

.....

.....

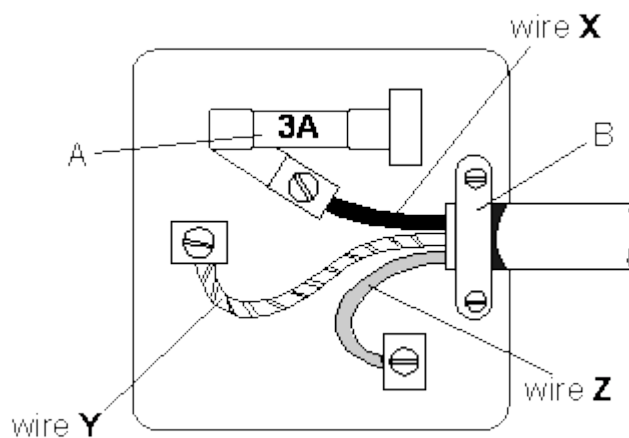
.....

.....

(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)

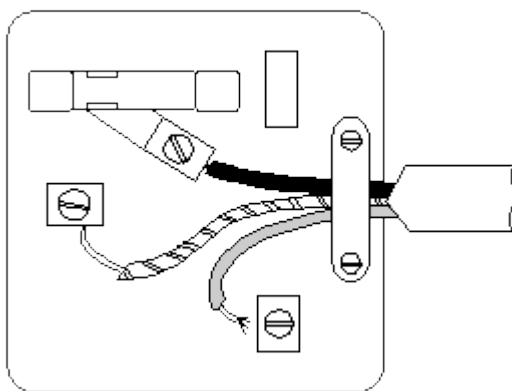
(ii) Why is it important that the third wire is also connected?

.....

.....

(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. ....

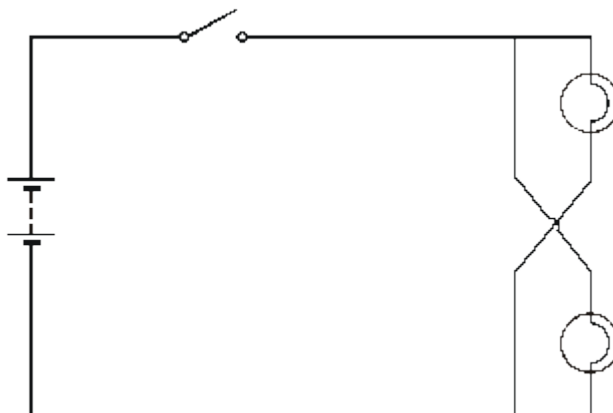
.....

(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?

.....

.....

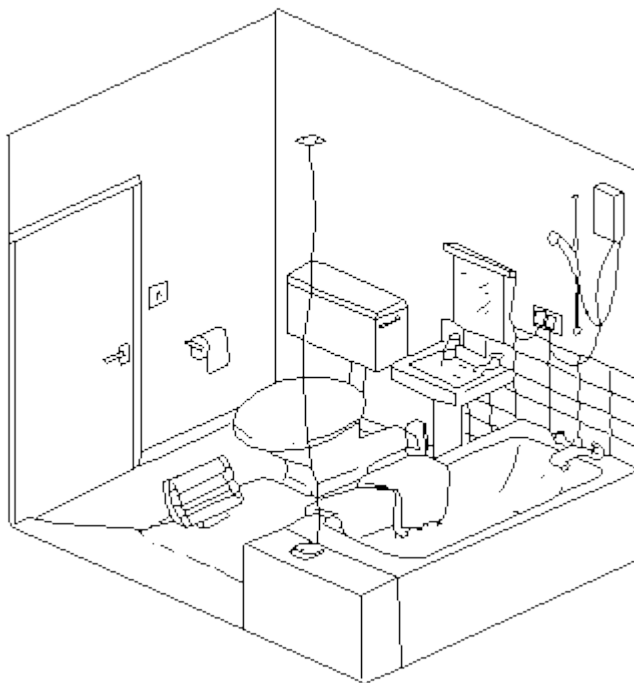
.....

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.

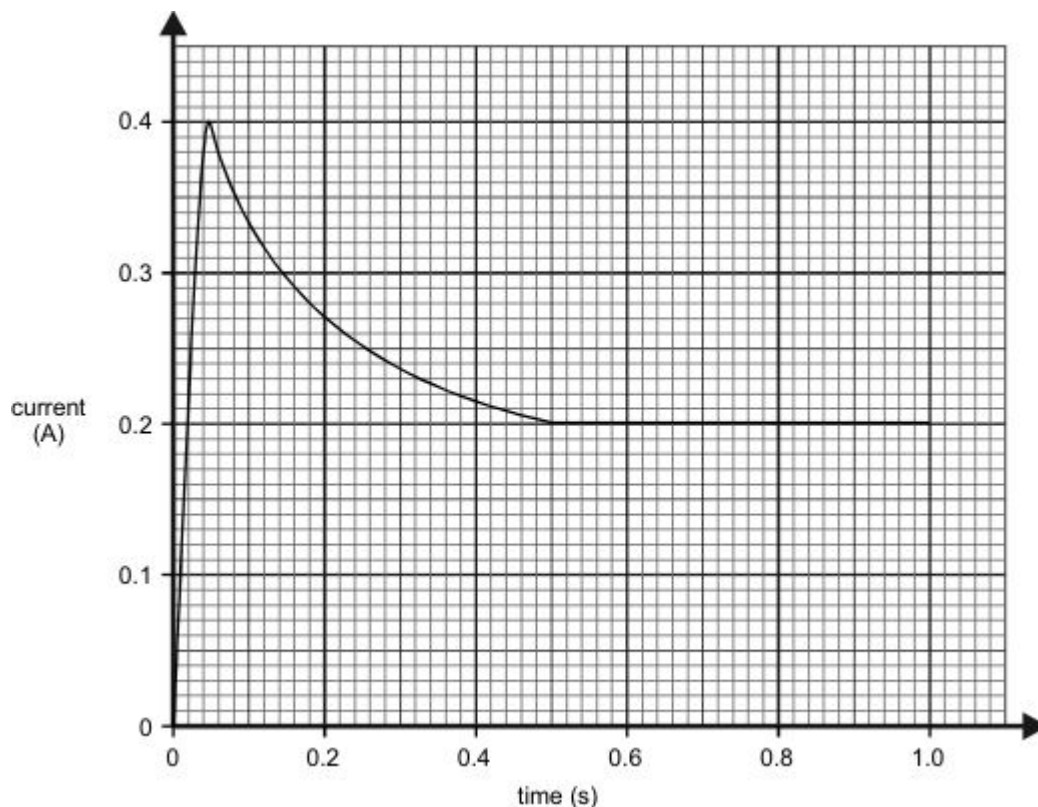
ELECTRICAL APPLIANCE	POWER RATINGS (W)	TIME USED EACH WEEK (h)	k Wh USED EACH WEEK
TV	200	35	
Kettle	2000	2	
Toaster	1000	1	
Cooker	11 500	7	

- (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.

.....

.....

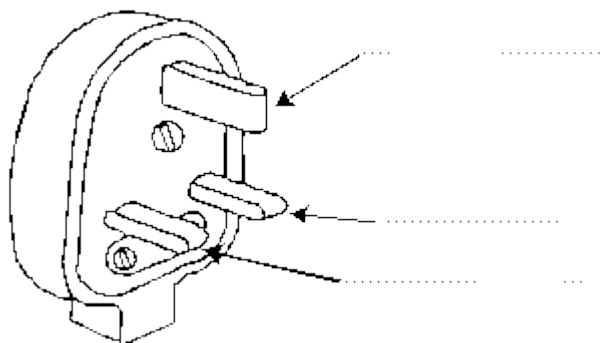
.....

(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:

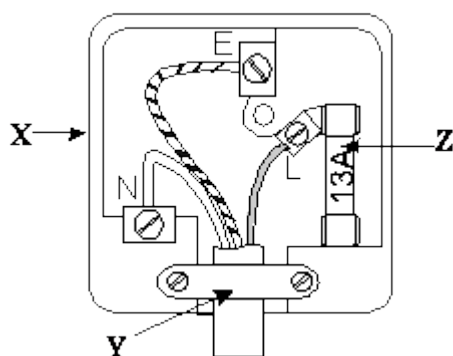
the live pin,

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.

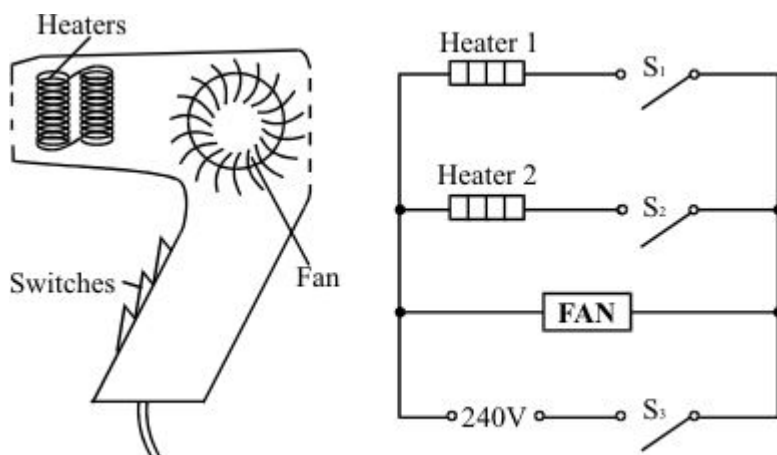
Which part of the electric fire is connected to the earth pin?

.....

(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?

.....

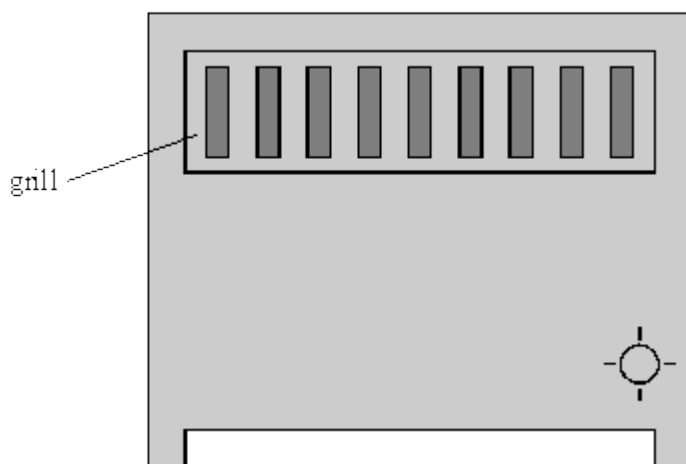
- (ii) On what else does the energy used by the hair-dryer depend?

.....

(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

$$\text{energy transferred (kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

- (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.

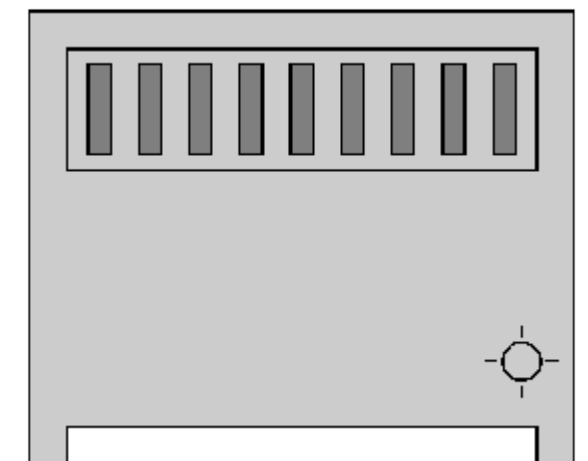
.....  
 .....  
 .....

(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

$$\text{energy transferred (kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

- (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?

.....

.....

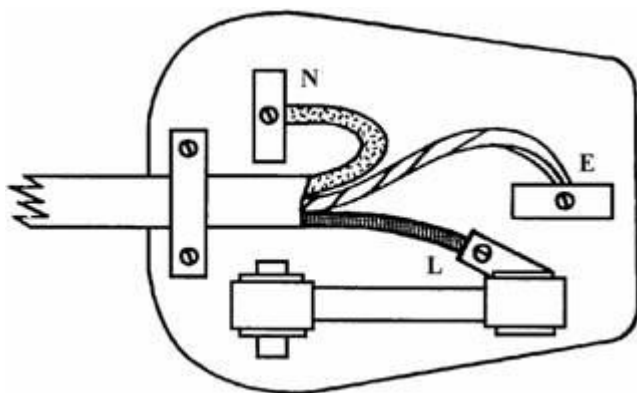
Cost ..... p

(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.

.....  
 .....

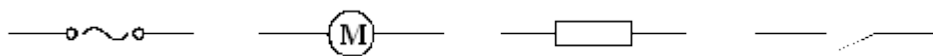
Power = .....

(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.

.....  
.....

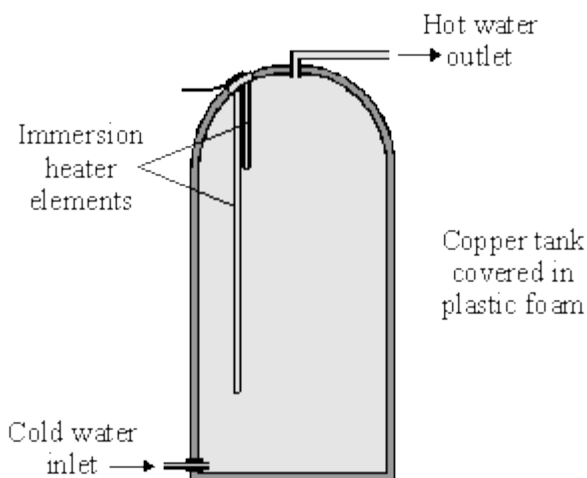
Resistance = ..... ohms

(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 = .....

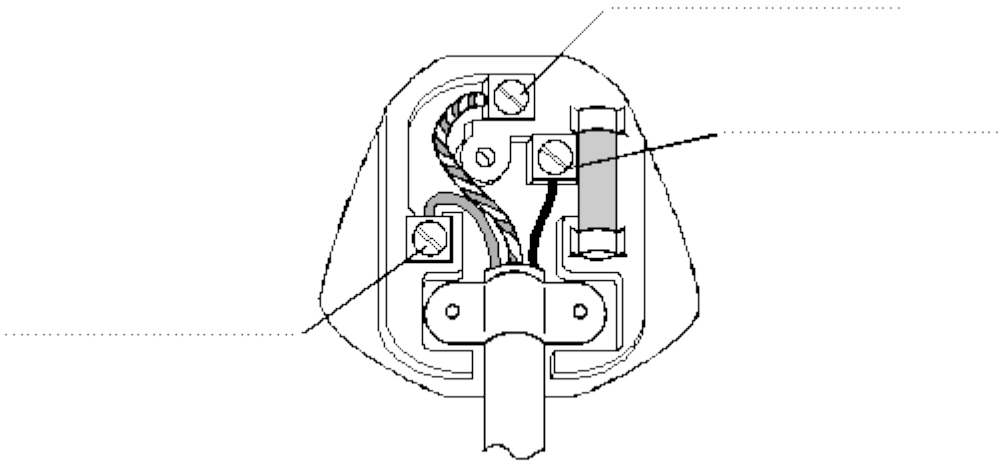
(2)

(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)