

1

(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.

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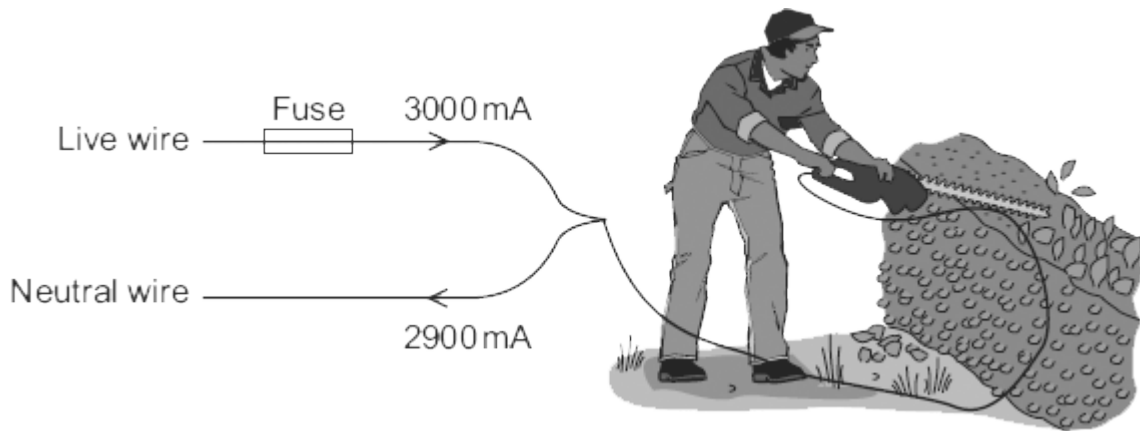
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(2)

- (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.

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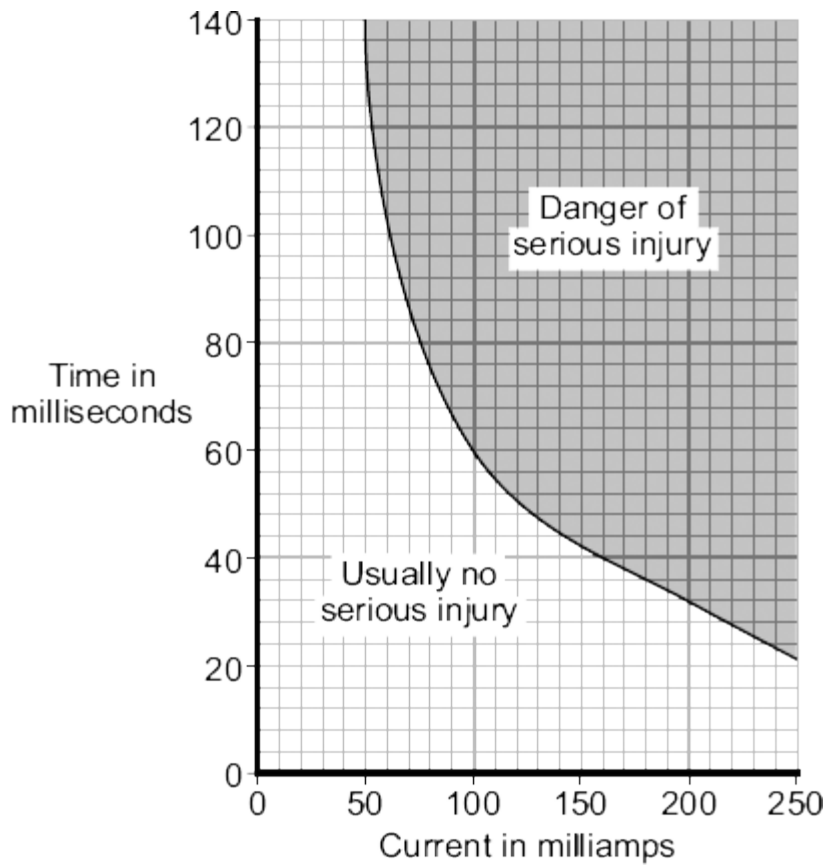
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(2)

- (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.

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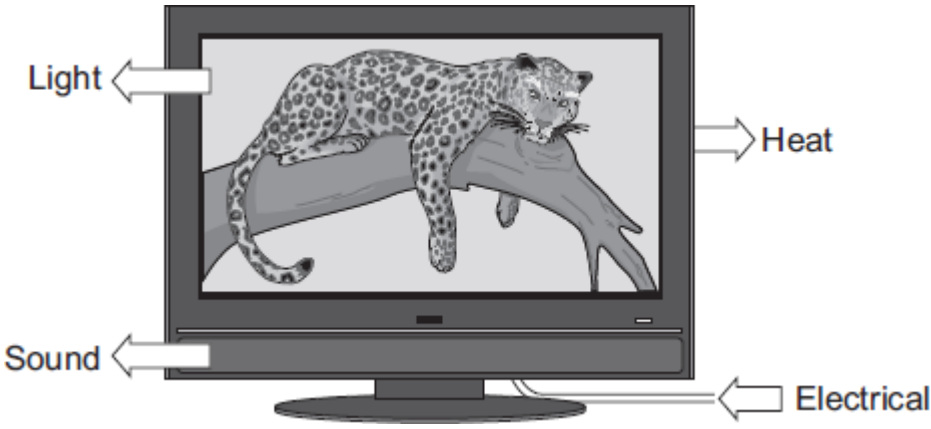
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(2)
(Total 10 marks)

2

(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.

$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$
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Show clearly how you work out your answer and give the unit.

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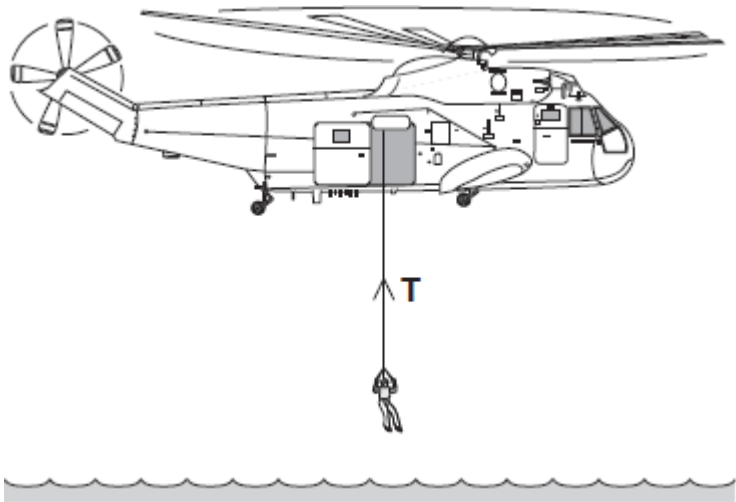
.....

Cost =

(2)
(Total 5 marks)

3

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)

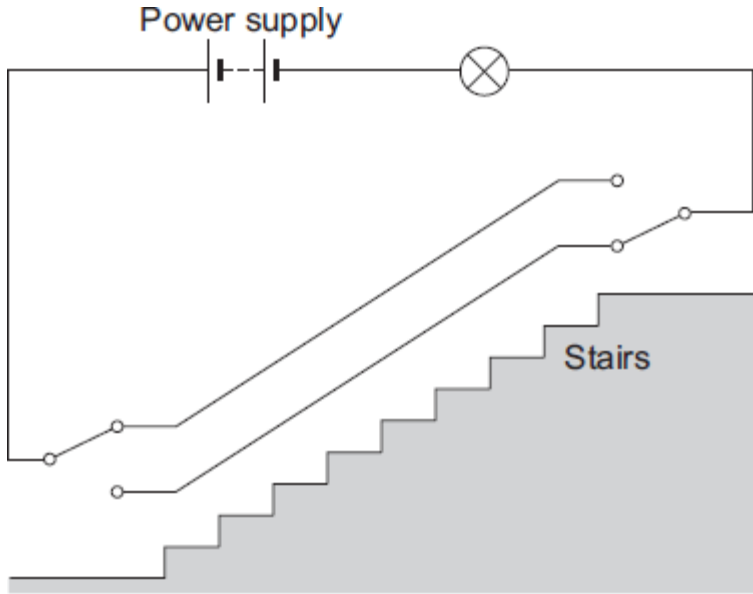
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Power =

(3)
(Total 7 marks)

4

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 18Ω 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 \times 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.

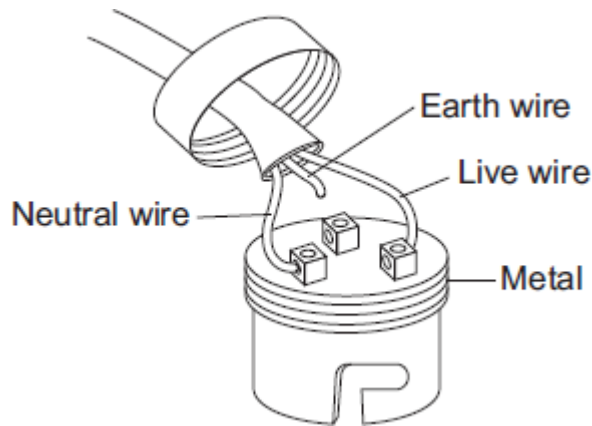
What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

.....

.....

(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?

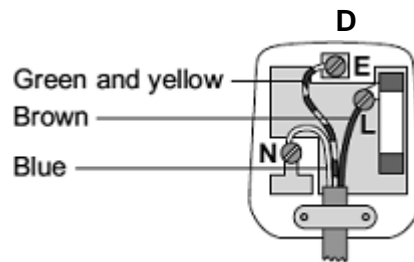
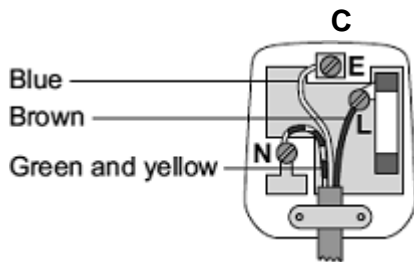
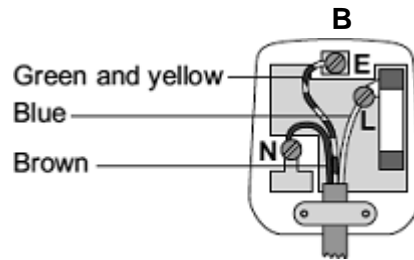
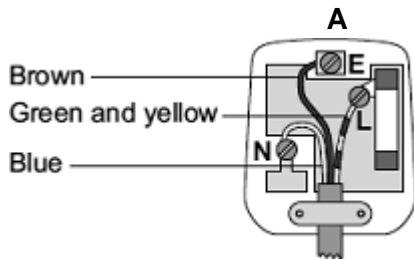
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(1)
(Total 7 marks)

5 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.

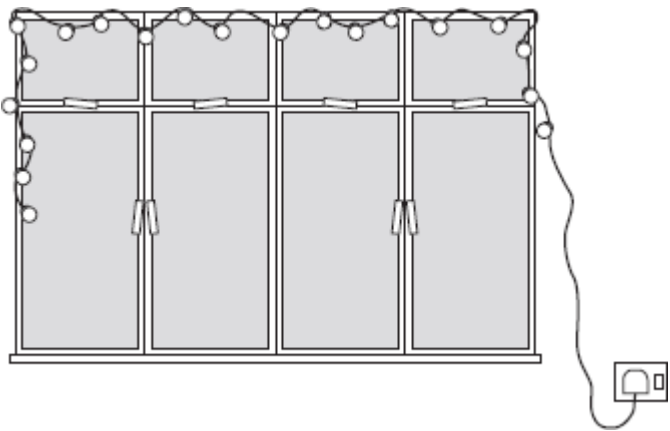
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(2)

(Total 6 marks)

6

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)

7

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.

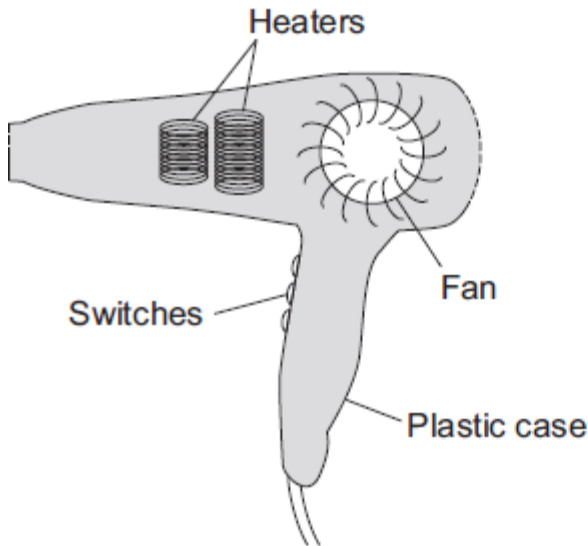


Diagram 1

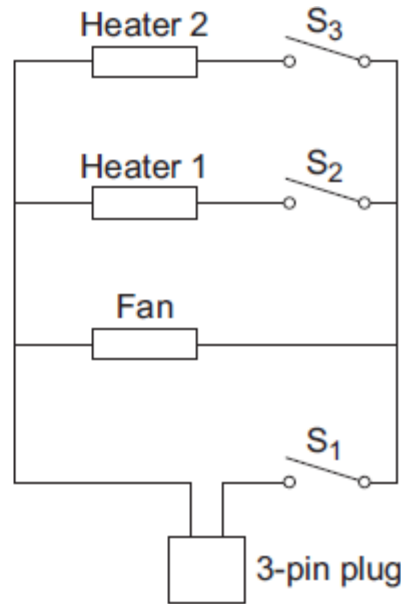


Diagram 2

- (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.

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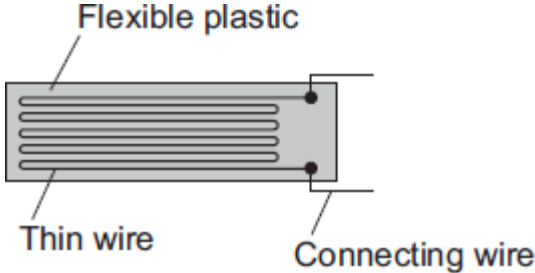
Maximum power =

(3)
(Total 9 marks)

8

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?

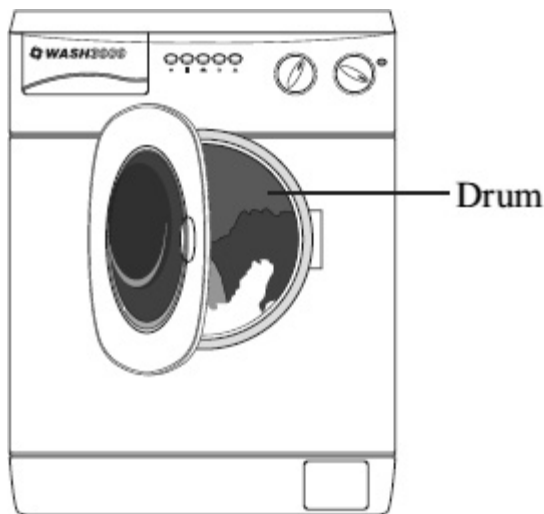
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(1)

(Total 7 marks)

9

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.

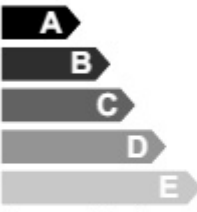



(a) What happens to the energy wasted by the electric motor?

.....
.....

(1)

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

Model – Wash 3000 Energy A	
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.

.....

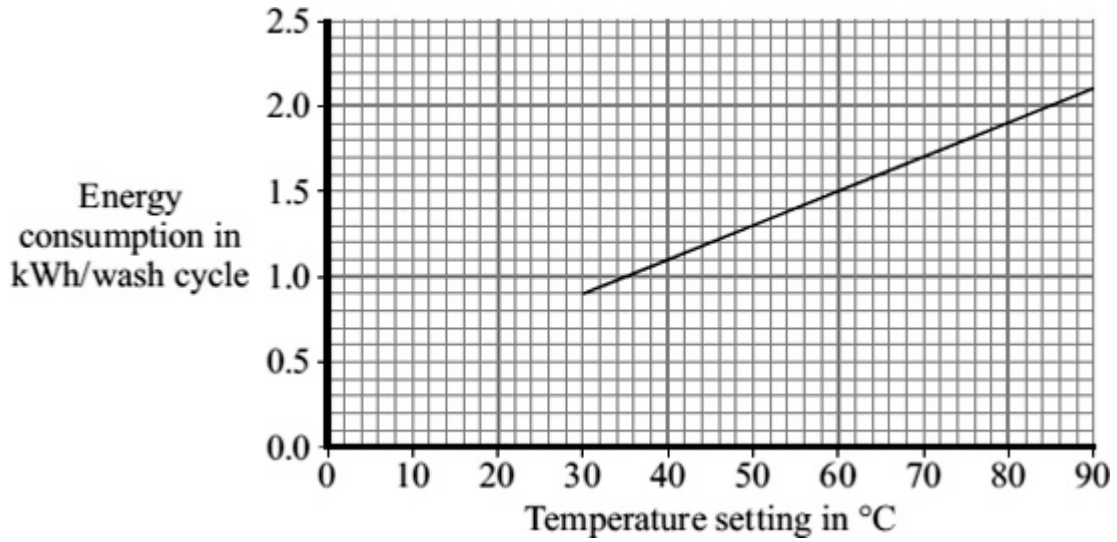
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(2)

- (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.

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

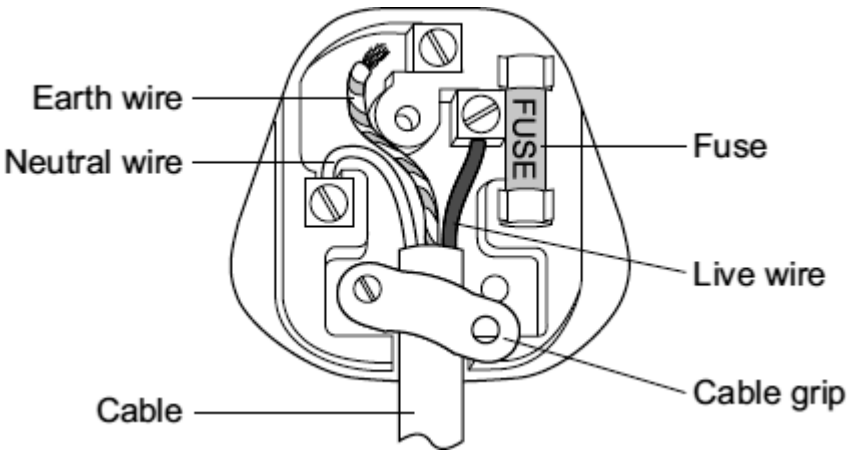
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(1)

(Total 6 marks)

10

(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.

.....

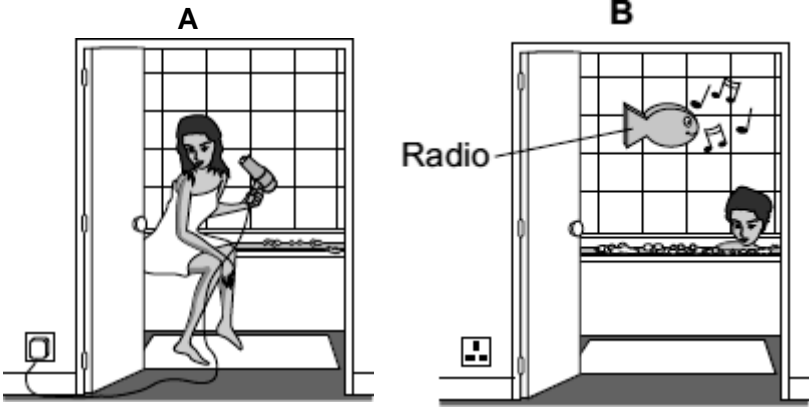
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(2)

(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.

.....

.....

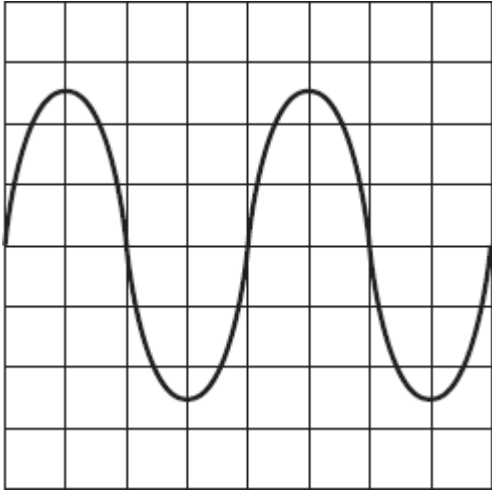
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(2)
(Total 7 marks)

11

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)

12

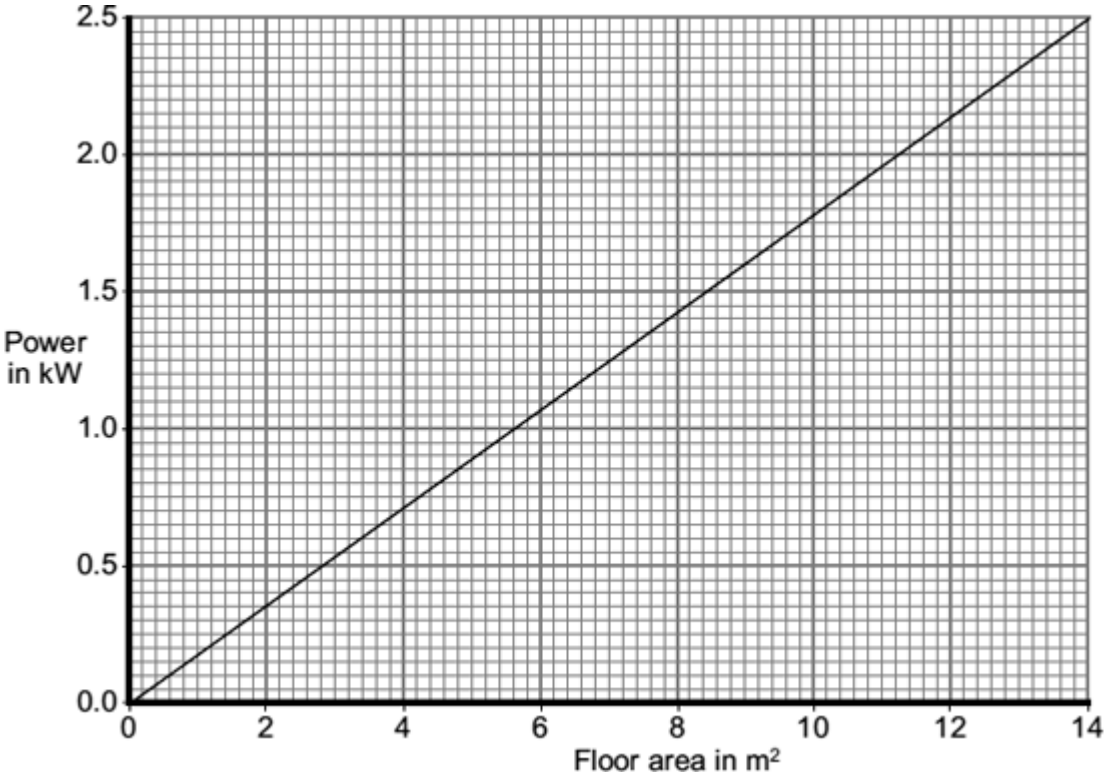
A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

(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 m².

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)

13

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

12	50	110	230
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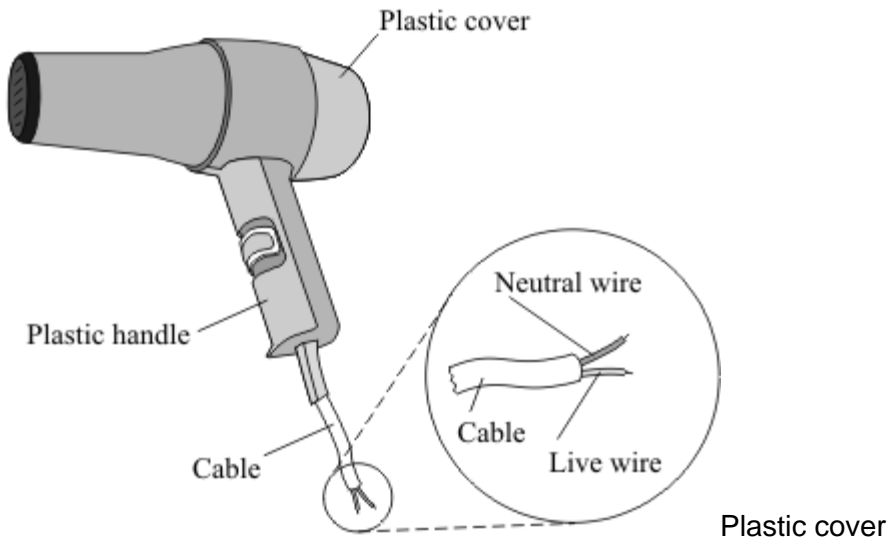
In the UK, the mains electricity supply is volts.

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)

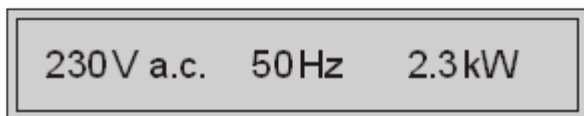
14

(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

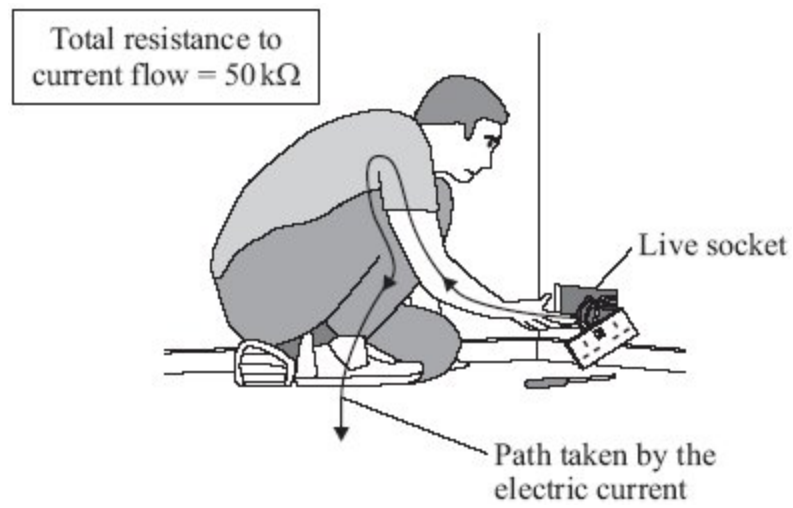
(1)

(Total 5 marks)

15

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.

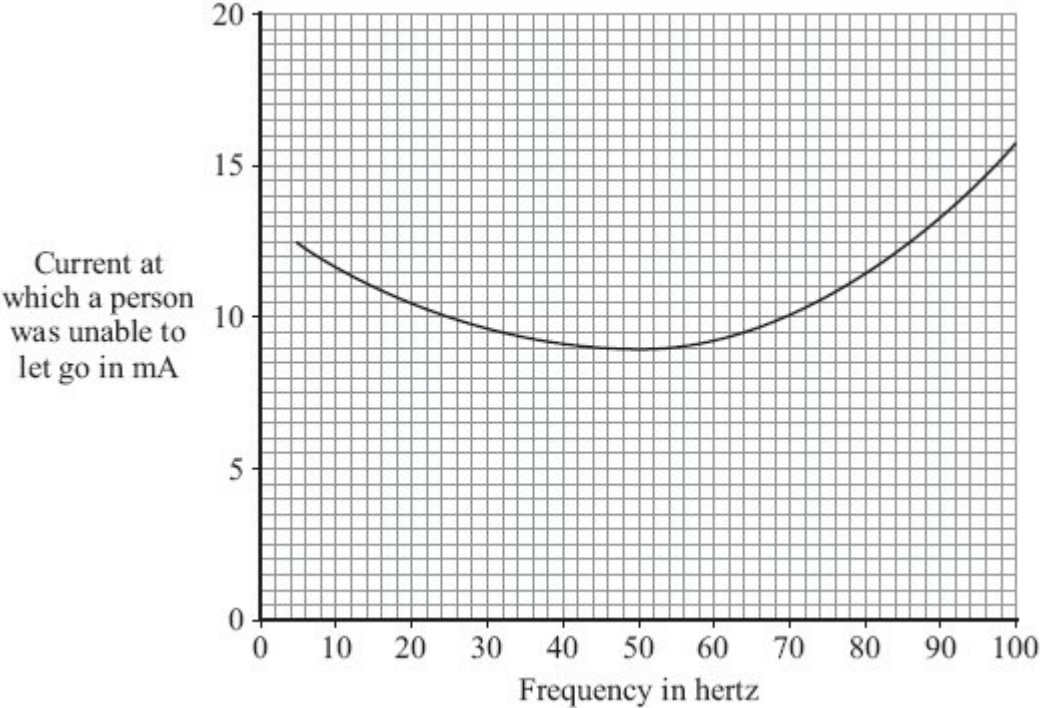
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.....

(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?

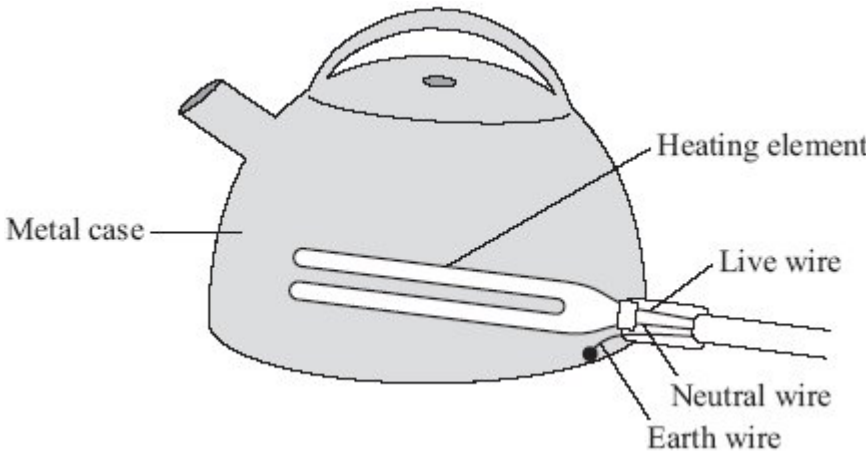
Give a reason for your answer.

.....

.....

(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.

.....

.....

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.....

(2)
(Total 8 marks)

16

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

A electrical to gravitational potential

B electrical to heat



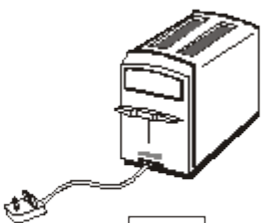
C electrical to kinetic

D electrical to light

E electrical to sound

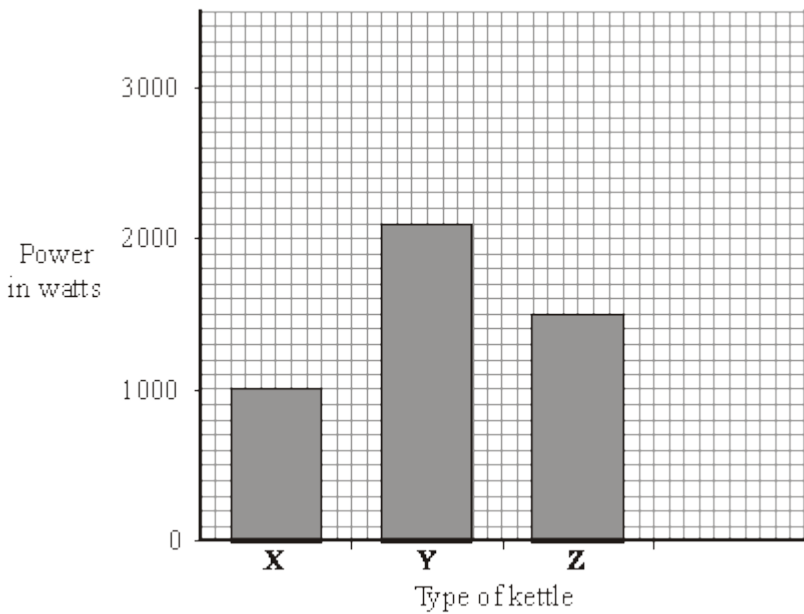
Match each of the following devices to the useful energy transformation that it is designed to make.

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

Drill	MP3 player	Toaster
		
<input type="text"/>	<input type="text"/>	<input type="text"/>

(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)

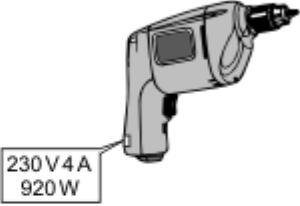
17

(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.



Power is marked on the information plate.

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

(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)

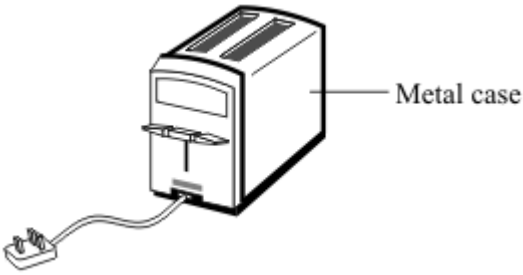
(ii) The plug of an electric kettle has been wrongly fitted with a 3 A fuse.

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)
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Show clearly how you work out your answer.

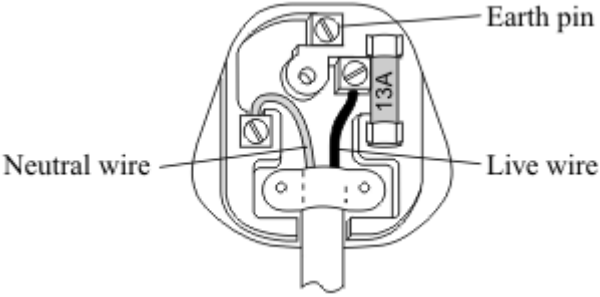
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.....

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.

.....

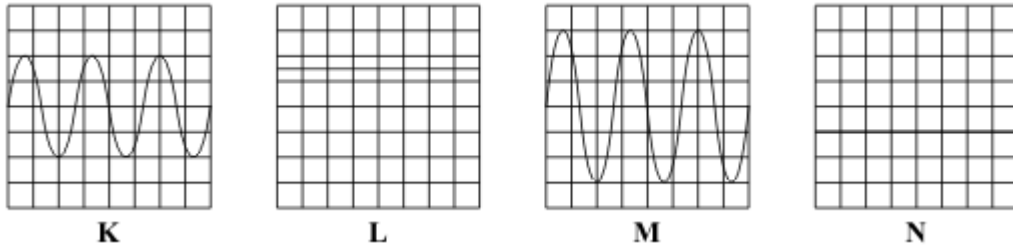
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.....

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(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**?

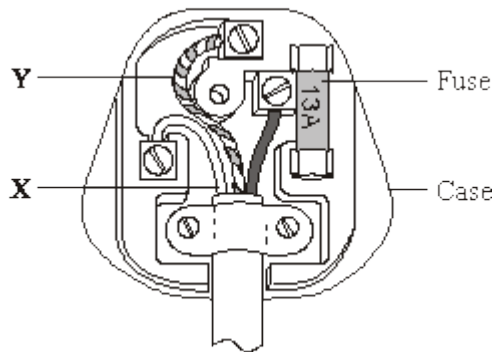
.....

(1)

(Total 9 marks)

18

- (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)

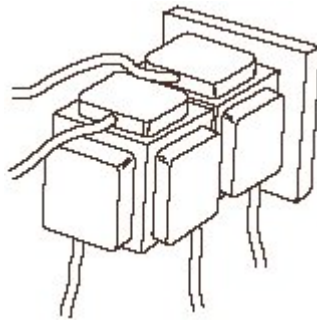
(iv) Which **one** of the following is the correct circuit symbol for a fuse?

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.



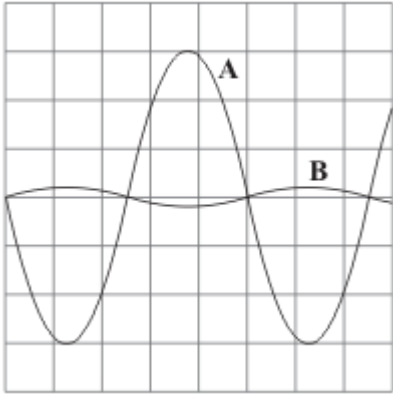
Explain why this is dangerous.

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

(2)
(Total 6 marks)

19

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.

.....

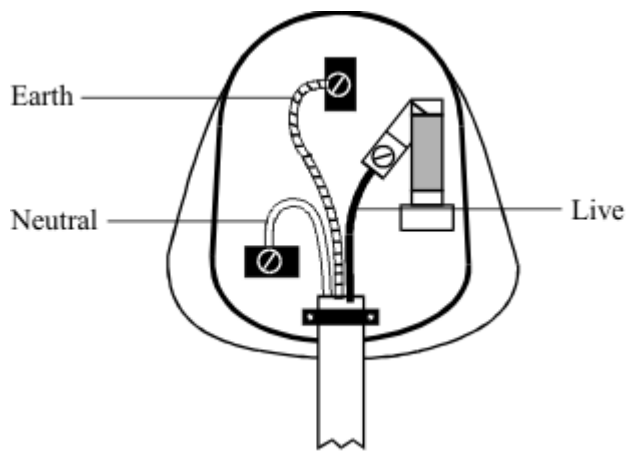
Frequency = hertz

(1)

(Total 5 marks)

20

The diagram shows the inside of a mains plug.

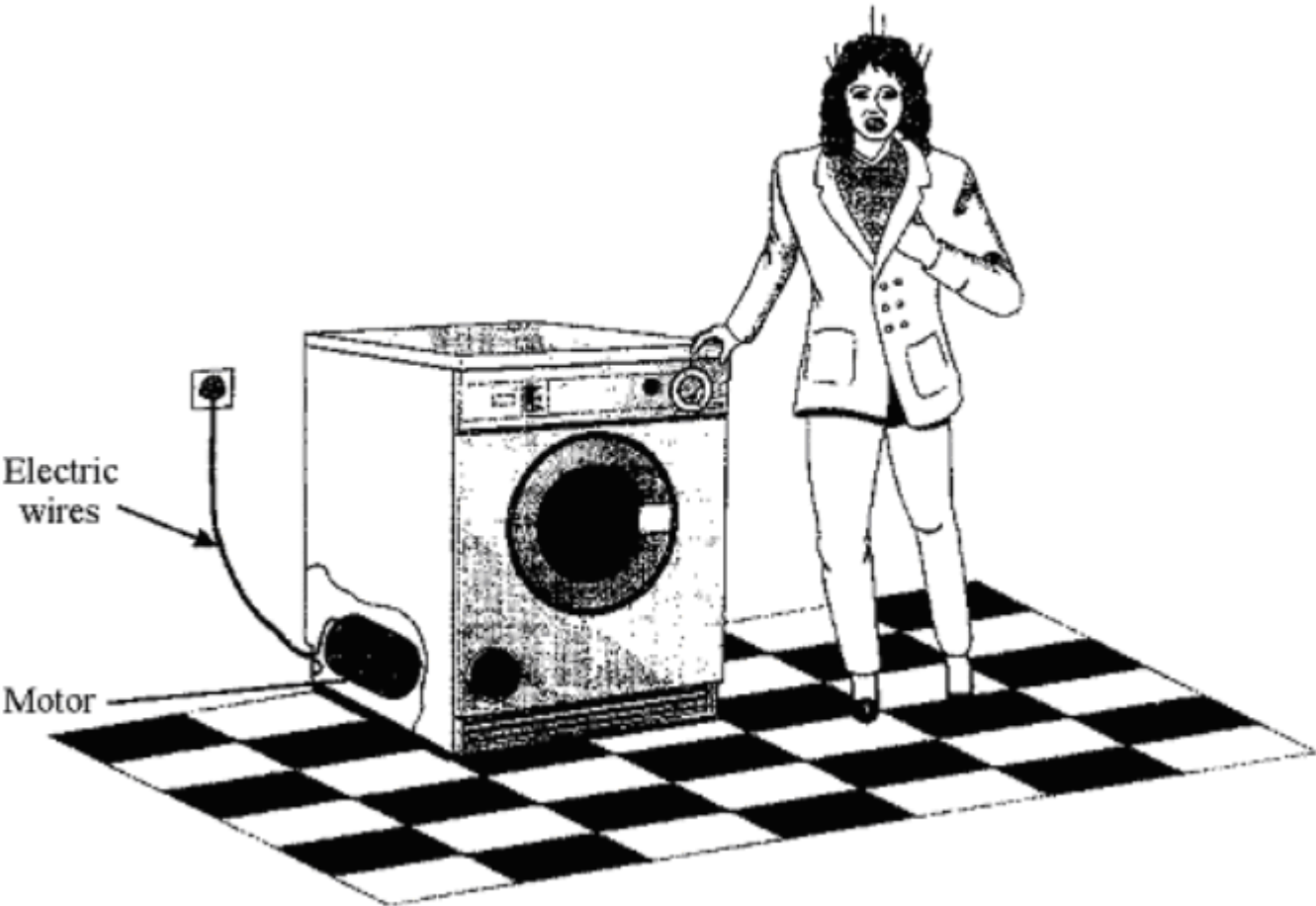


(a) Complete the table.

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)

21

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

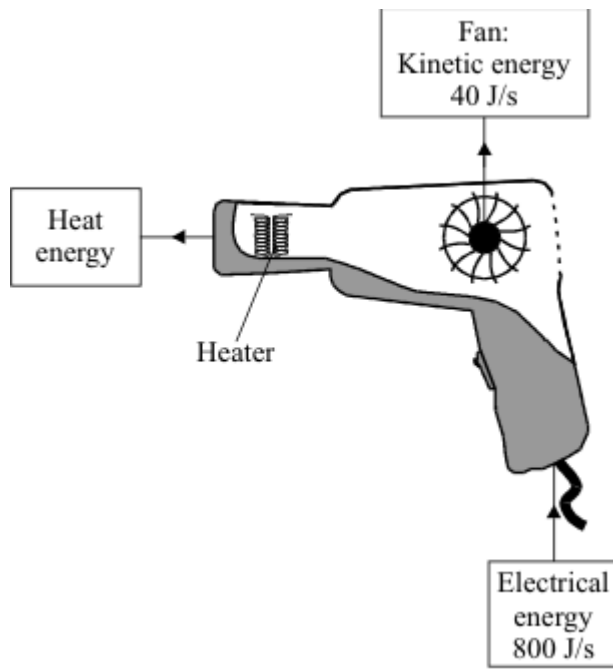
(2)

(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.

.....

.....

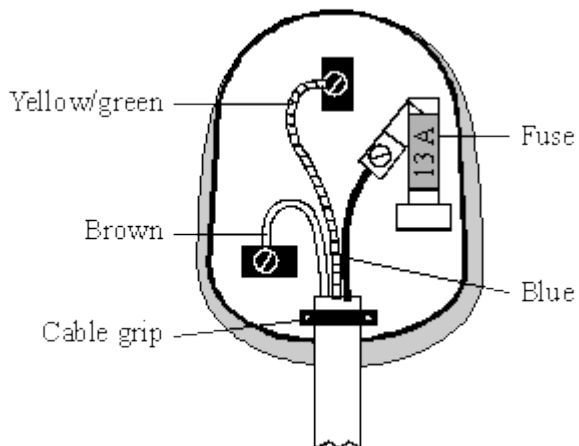
.....

Efficiency =

(2)
(Total 7 marks)

22

(a) The diagram shows a 13 amp plug.



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

.....
.....

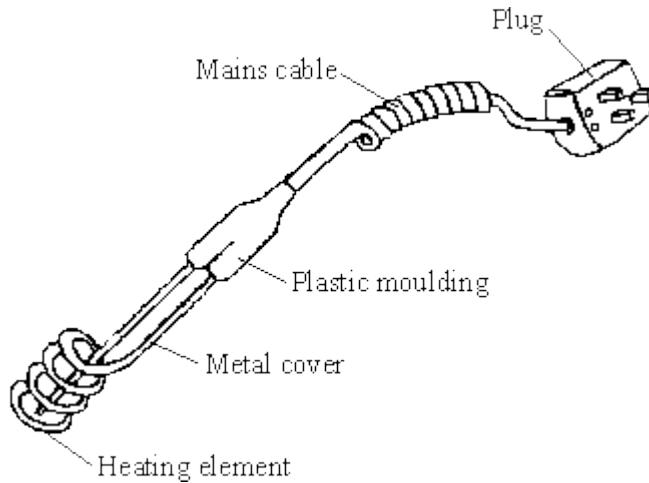
(1)

(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.

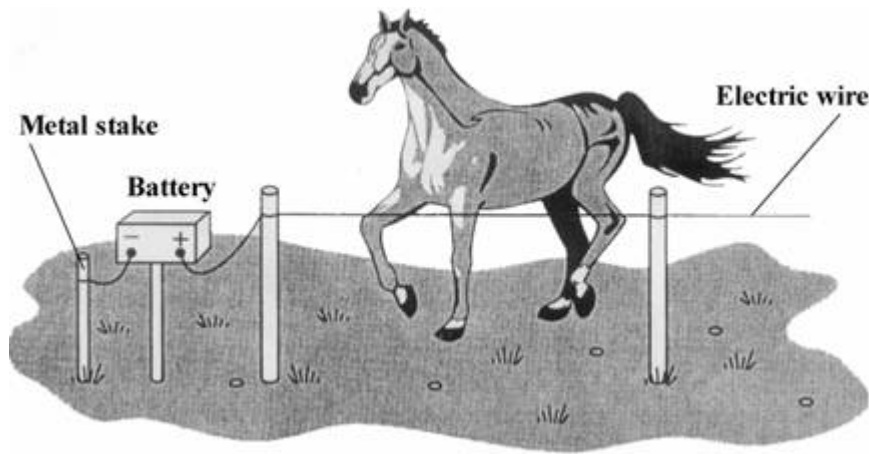


(i) Which part of the immersion heater should be connected to the earth pin of the plug?

.....

(1)
(Total 3 marks)

(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.

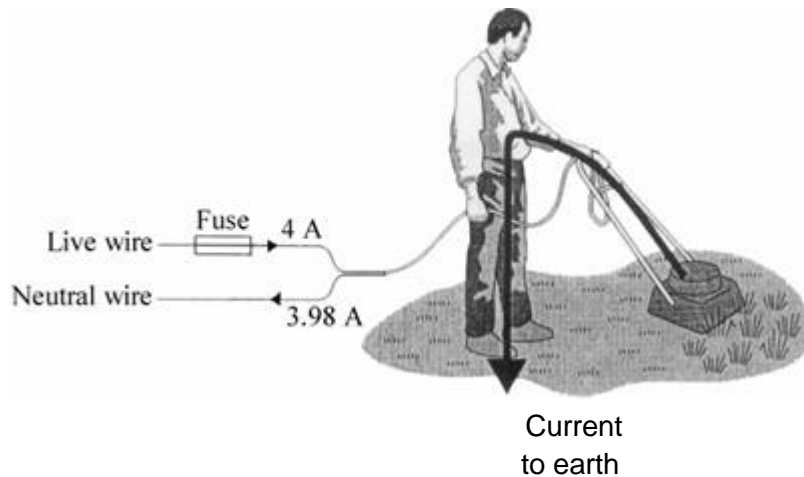
.....

.....

.....

(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.

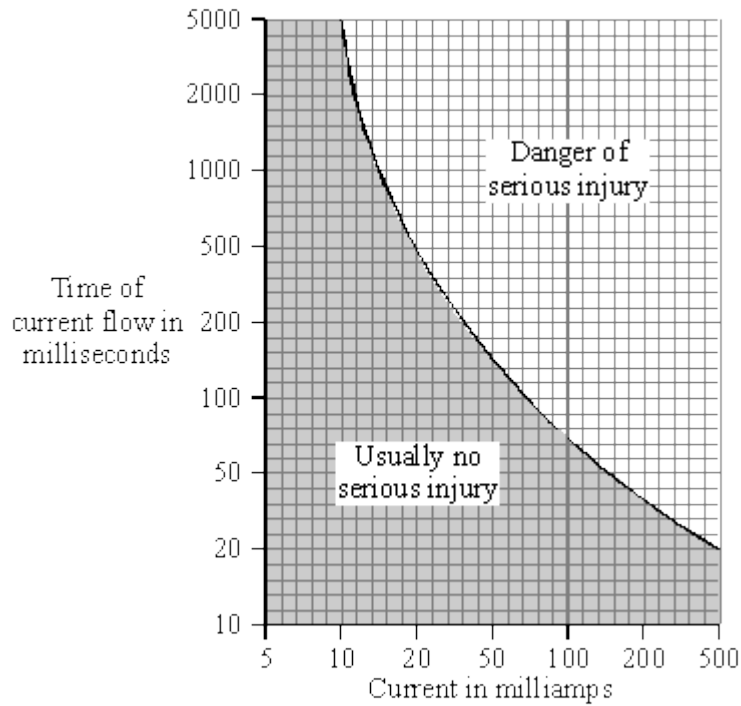
.....

.....

.....

(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?

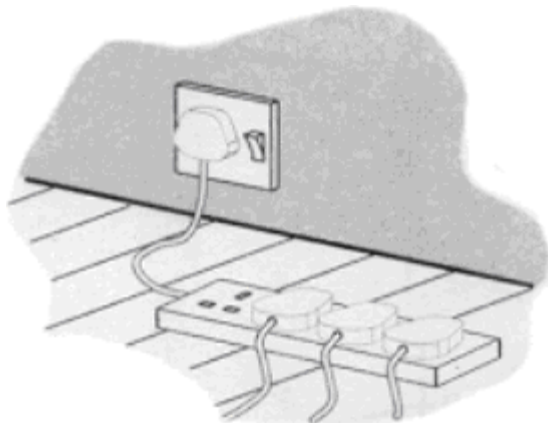
.....

Time = milliseconds

(2)
 (Total 6 marks)

24

(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.

.....

.....

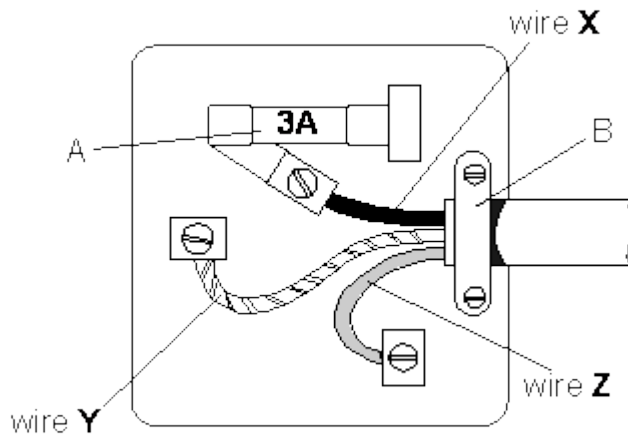
.....

.....

(2)
(Total 10 marks)

25

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)

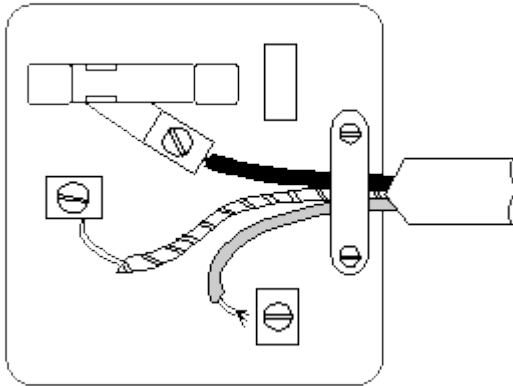
(ii) Why is it important that the third wire is also connected?

.....

.....

(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.

.....

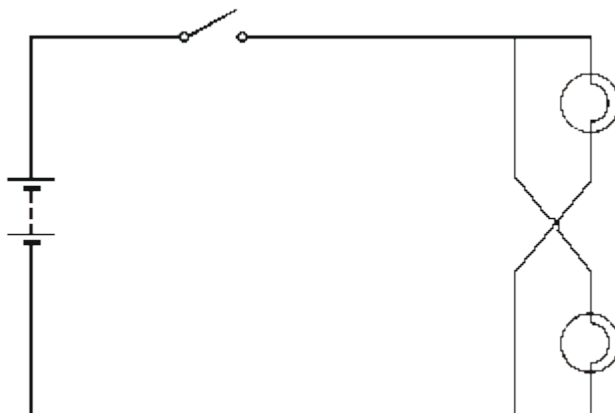
4.

.....

(4)
(Total 12 marks)

26

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?

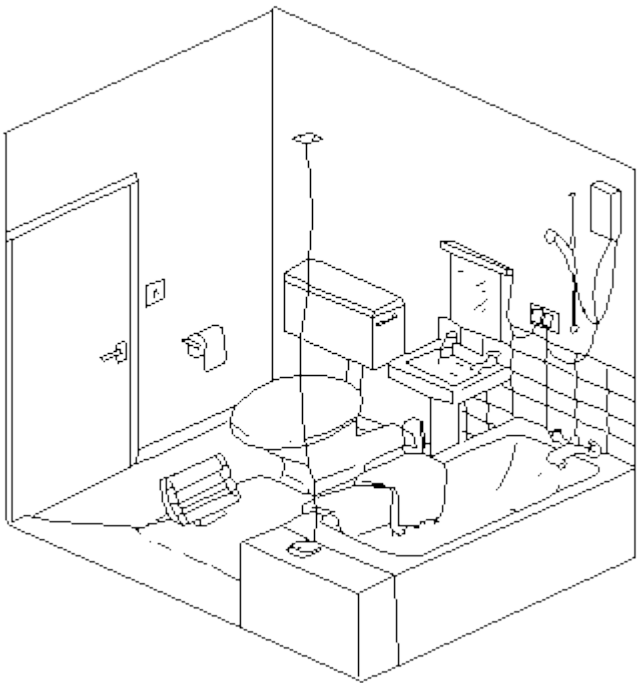
.....
.....
.....

Answer s

(2)
(Total 7 marks)

27

(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?

.....

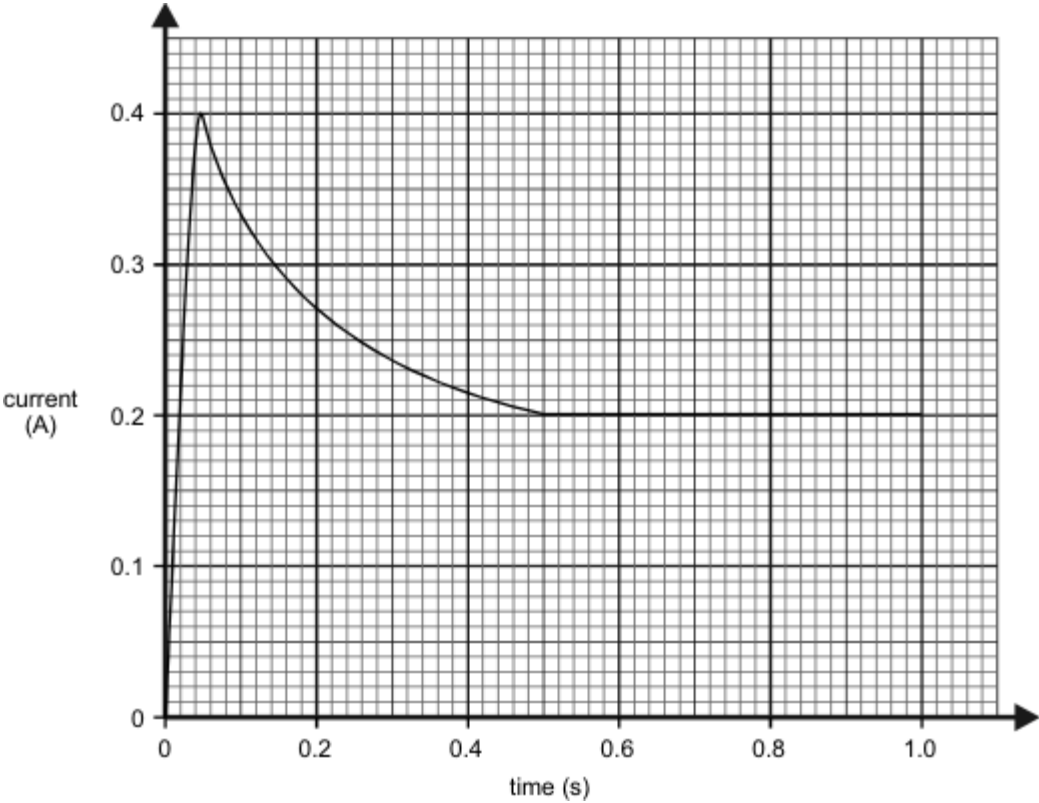
.....

.....

(6)
(Total 9 marks)

28

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.

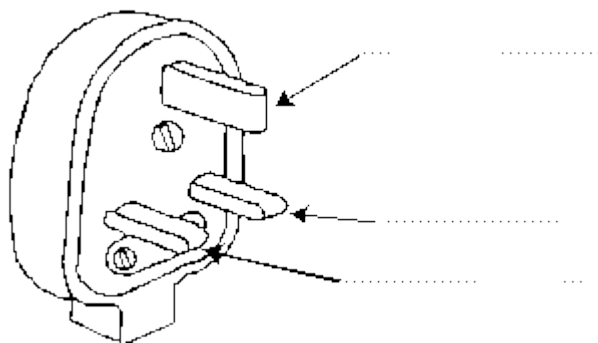
.....
.....
.....

(3)

(Total 12 marks)

29

(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:

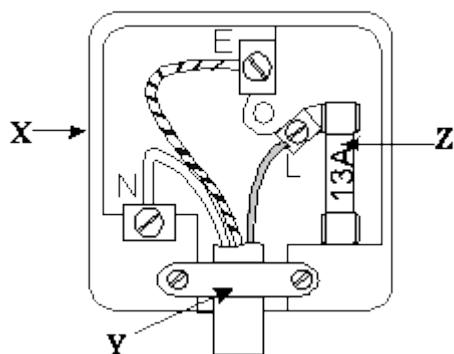
the live pin,

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.

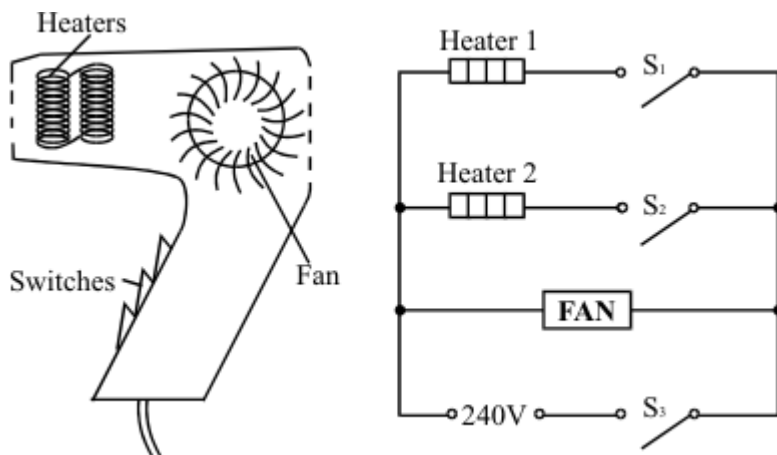
Which part of the electric fire is connected to the earth pin?

.....

(5)
(Total 8 marks)

30

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.



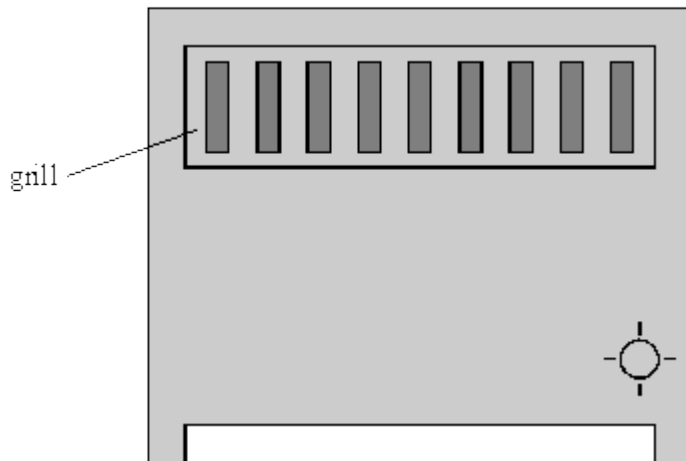
- (i) Which number tells us how fast the hair-dryer uses energy?

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

(2)
 (Total 12 marks)

31

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.

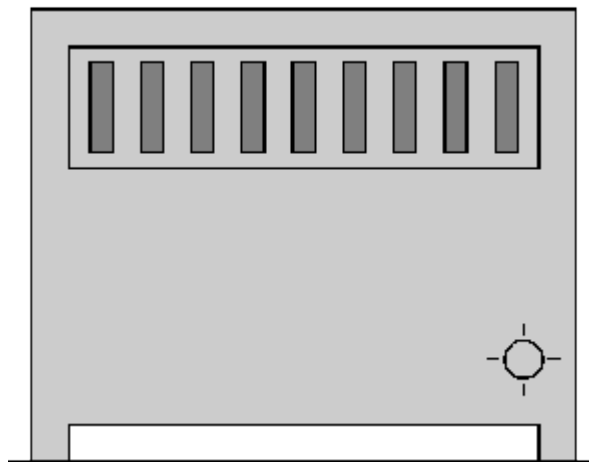
.....
.....
.....

(2)

(Total 10 marks)

32

- (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?

.....
.....

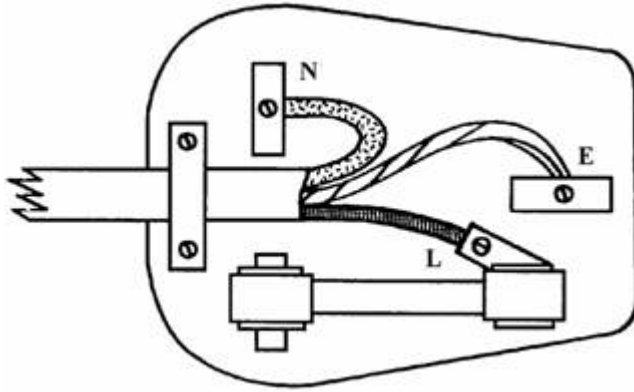
Cost p

(2)

(Total 7 marks)

33

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)

34

(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)

35

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.

.....
.....

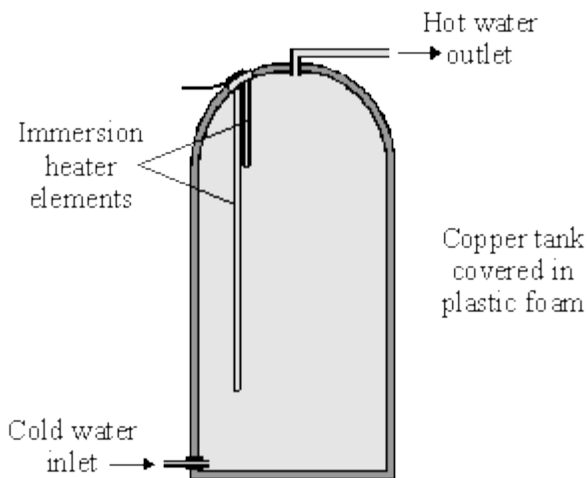
Resistance = ohms

(2)

(Total 10 marks)

36

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 =

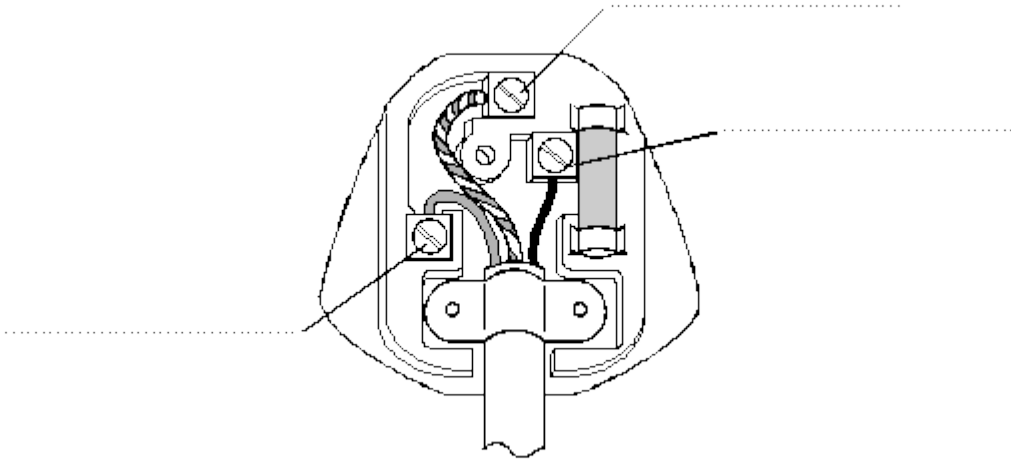
(2)

(Total 10 marks)

37

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)

38 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)

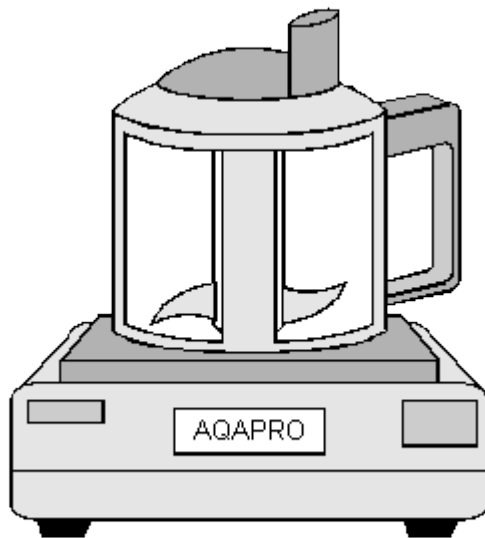
(d) Why is a combination oven of this sort more economical than a convection-only oven?

.....
.....

(1)
(Total 8 marks)

39

The drawing shows a food processor. It has an electric motor. Inside is a blade which spins round and cuts up the food.



The food processor is designed to transfer electrical energy to kinetic energy. However some of the energy is wasted as heat and sound.

The power input to the food processor is 1150 W. The power of the spinning blade is 900 W.

(i) Calculate how much energy is wasted when the food processor is used for two minutes.

Show clearly how you get to your answer and give the unit.

.....
.....

Energy =

(3)

(ii) Why does the food processor produce sound when it is switched on?

.....
.....

(1)
(Total 4 marks)

40

Carefully read the following extract from a safety leaflet. Then answer the questions.

An RCD adaptor is an automatic safety switch. It should be used when there is a particular risk of electric shock. For example, it is recommended that it is used with an electric lawnmower.

Inside one make of RCD is an electromagnet that holds the switch closed so that the RCD is switched on. An electronic circuit in the RCD monitors the difference between the current in the live wire and the current in the neutral wire.

If something goes wrong and this difference is greater than 30 milliamps then the RCD will trip (= switch off) within 40 milliseconds.

(a) Suggest **two** reasons why there is a particular risk of an electric shock when using an electric lawnmower.

1.
.....

2.
.....

(2)

(b) Why will there be a difference between the current in the live wire and the current in the neutral wire if something goes wrong?

.....
.....

(1)

(c) (i) Use the words charge, current and time to write an equation which shows the relationship between them.

.....

(1)

- (ii) Calculate how much charge flows when a current of 30 milliamps passes for 40 milliseconds.

Clearly show how you get to your answer and give the unit.

.....

.....

Charge =

(3)
(Total 7 marks)