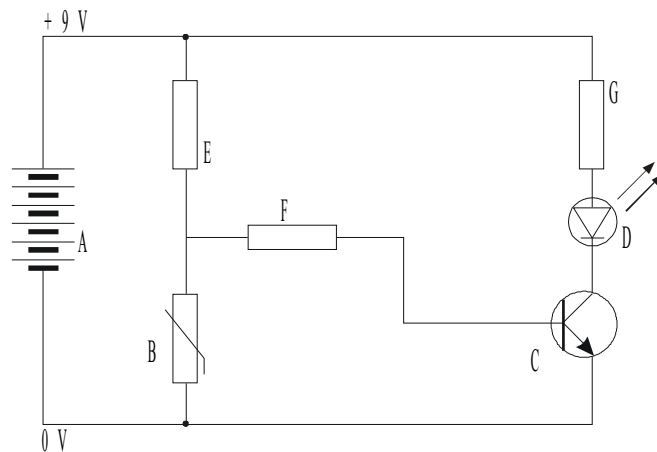


1. The diagram shows an electronic circuit.

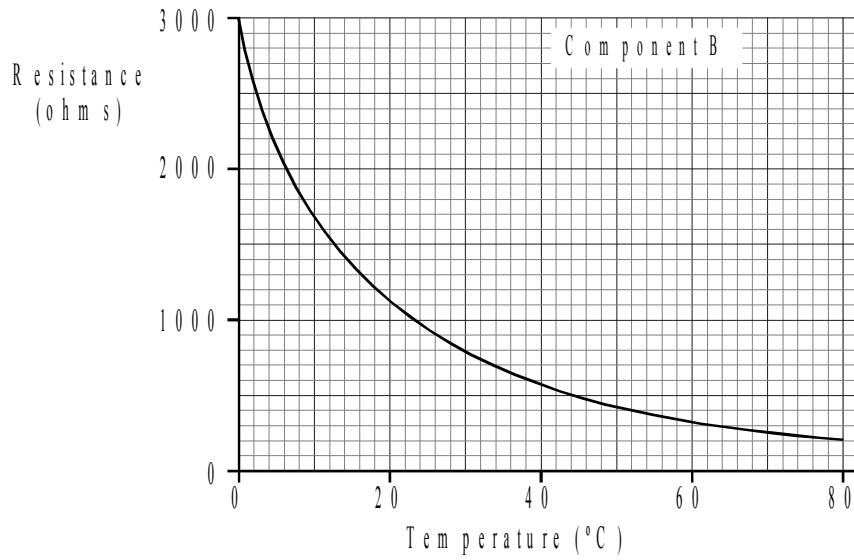


(a) Write down the names of the components in the list below.

- A =
- B =
- C =
- D =
- E, F and G =

(5)

(b) The graph shows how the resistance of component B depends on its temperature.



Describe, in as much detail as you can, how the resistance of component B changes as its temperature rises from 0°C to 80°C.

.....

.....

.....

.....

.....

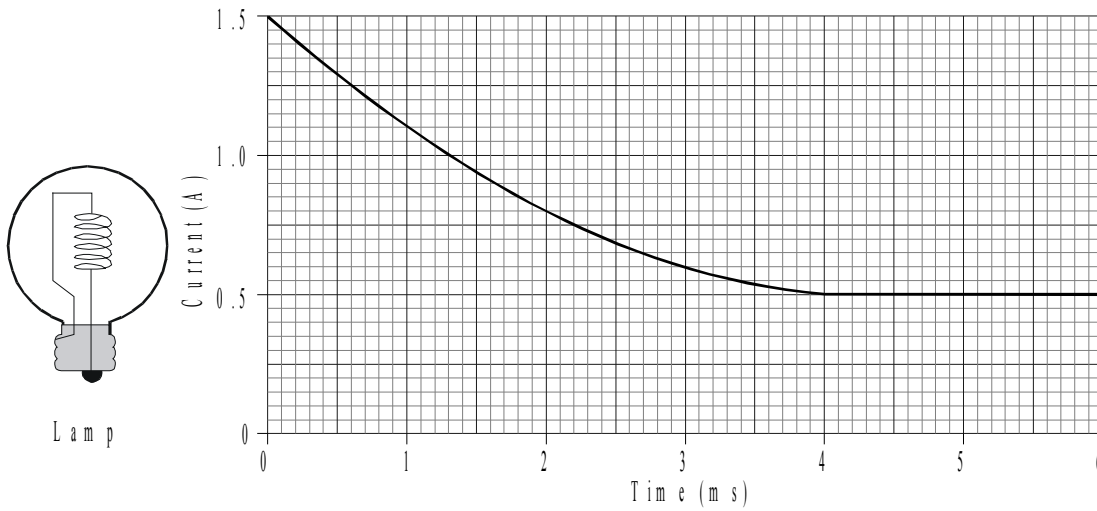
(4)

(c) At what temperature does component B have a resistance of 1000 ohms?

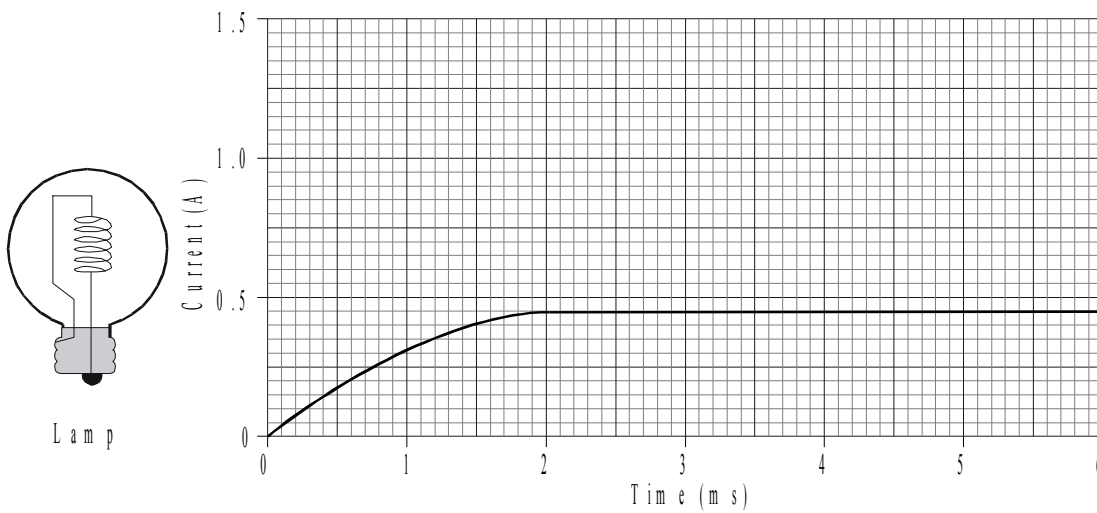
Answer °C .

(2)
(Total 11 marks)

2. A computer is set up to produce a graph of the current through an electric lamp during the first few milliseconds after it is switched on.



The lamp is modified then tested in the same way.



- (a) Describe **three** differences in the way the lamp behaves after it has been modified.

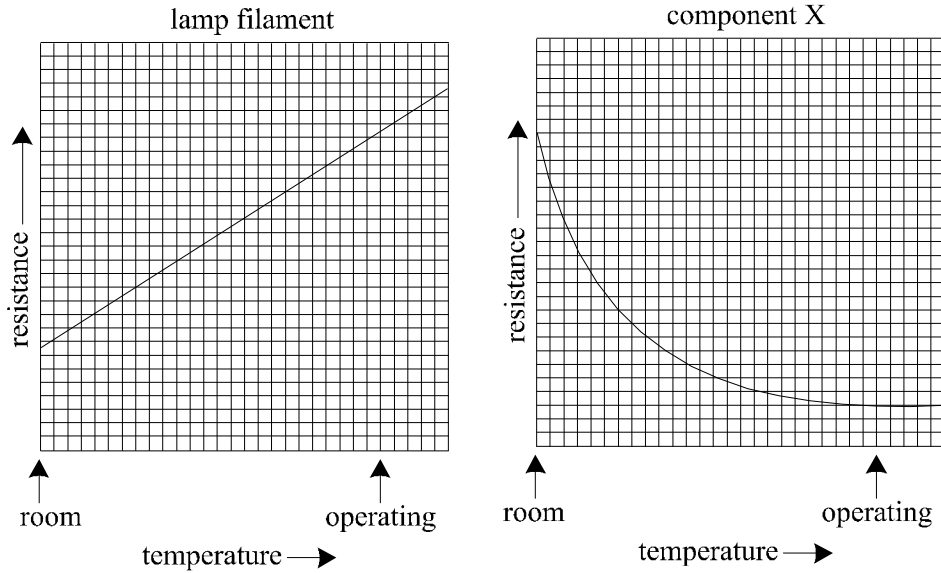
1.
2.
3.

(3)

- (b) The current through the modified lamp depends on the total resistance of the filament and component X.

The smaller this total resistance is, the greater the current.

The following graphs show how the resistance of the lamp filament and component X change as the lamp heats up to its operating temperature.



Use the information shown on the graphs to explain the behaviour of the modified lamp.

.....

.....

.....

.....

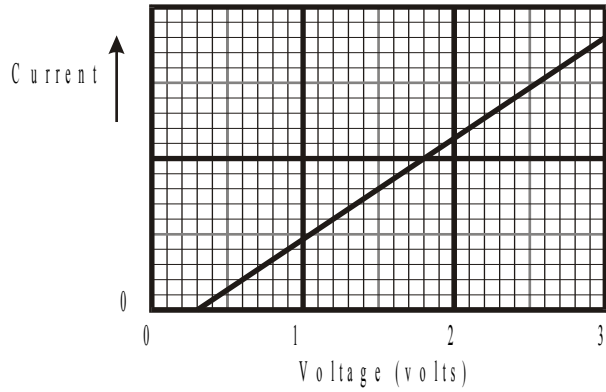
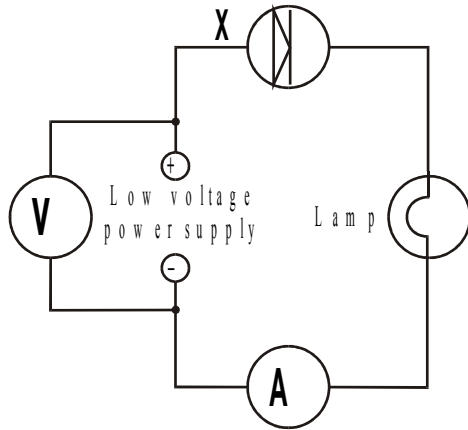
.....

.....

(4)
(Total 7 marks)

3. Some students want to find out how the current through component X changes with the voltage they use.

The diagram shows their circuit. The graph shows their results.



- (a) Describe, as fully as you can, what happens to the current through component X as the students increase the voltage.

.....

(4)

- (b) The students want to find out whether component X allows the same current to flow through it in the opposite direction.

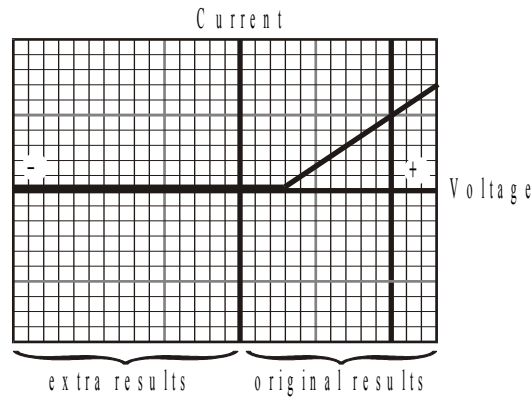
- (i) How should they change the circuit to test this?

.....

(1)

(ii) The graph shows the students' extra results.

What do the extra results tell you?



.....

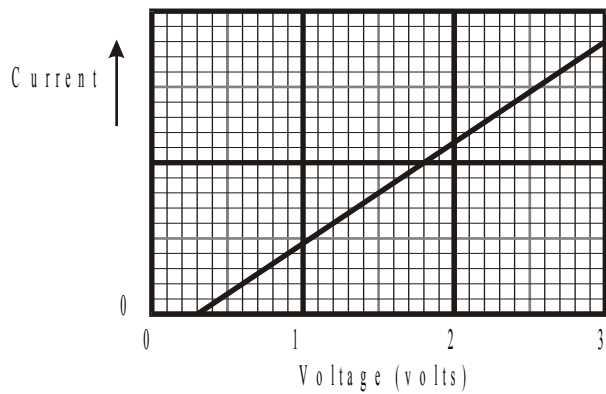
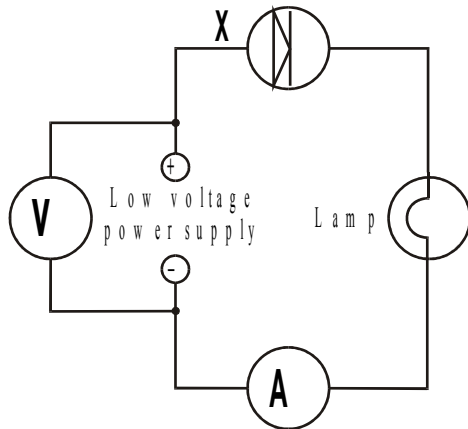
.....

.....

(1)
(Total 6 marks)

4. Some students want to find out how the current through component X changes with the voltage they use.

The diagram shows the students' circuit. The graph shows the students' results.



- (a) Describe, as fully as you can, what happens to the current through component X as the students both vary and reverse the voltage.

.....

.....

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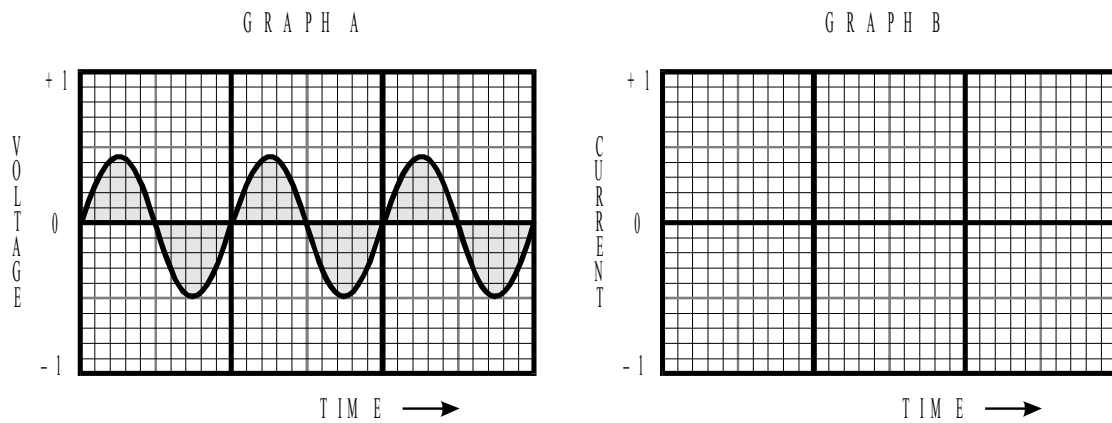
.....

(5)

- (b) The low voltage supply is changed to a.c.

The voltage between terminals P and Q of the supply then constantly changes as shown on Graph A.

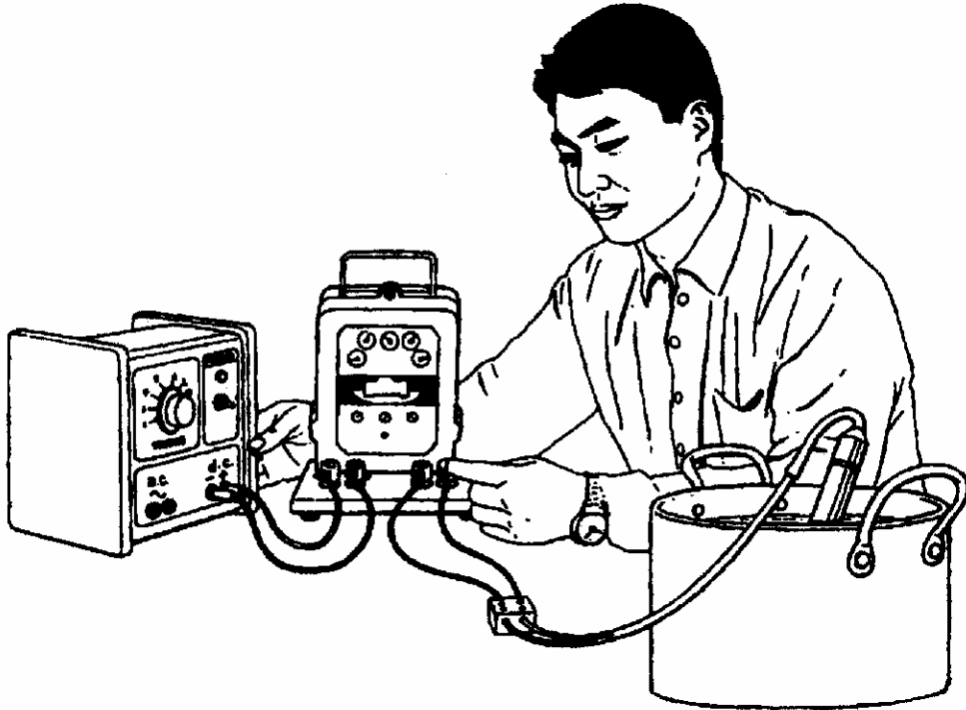
Complete Graph B to show what would then happen to the current through component X.



The time scale is the same on both graphs

(2)
(Total 7 marks)

5. The drawing shows an experiment using a low voltage supply, a joulemeter, a small immersion heater and a container filled with water.



The voltage was set at 6 V d.c. The reading on the joulemeter at the start of the experiment was 78 882 and 5 minutes later it was 80 142.

- (i) Use the equation:

$$\text{voltage} = \frac{\text{energy}}{\text{charge}}$$

to work out the total charge which flowed through the immersion heater in five minutes. Clearly show how you get to your answer and give the unit.

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

Charge =

(3)

- (ii) Calculate the current through the immersion heater during the 5 minutes. Write the equation you are going to use, show clearly how you get to your answer and give the unit.

.....

Current =

(3)
 (Total 6 marks)

6. 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.

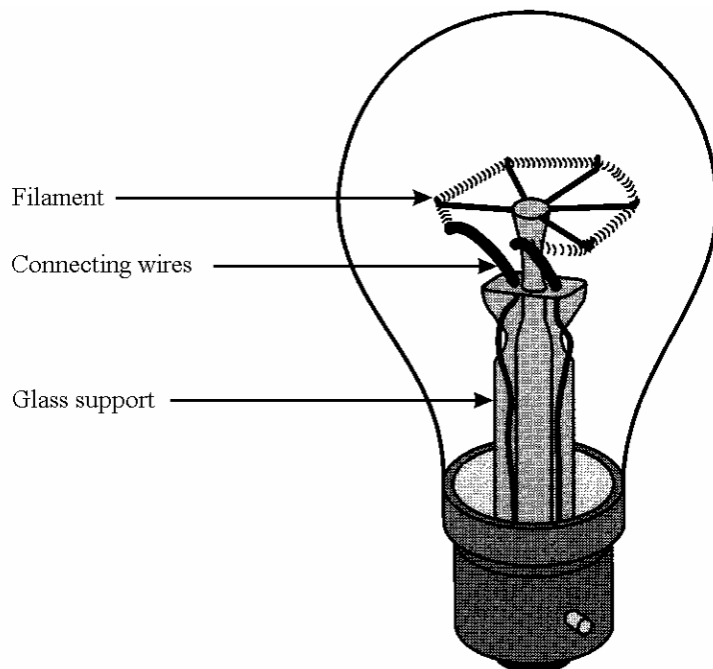
.....
.....

Resistance = ohms

(2)

(Total 10 marks)

7. The drawing shows a 230 V electric light bulb.



The filament is made of high-resistance wire. The connecting wires in the light bulb have a low resistance.

(a) The light bulb is switched on. Explain what happens when there is current in the filament.

.....

(2)

(b) Why must the connecting wires have a low resistance?

.....

(1)

(c) State **two** properties of glass that make it a good material to support the connecting wires.

Choose your answers from the words in the box.

conductor	insulator	opaque	soft
strong	transparent	weak	

..... and

(2)

(Total 5 marks)

8. 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:

$$\text{units (kWh)} = \text{power (kW)} \times \text{time (h)}$$

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

Energy = kWh

(2)

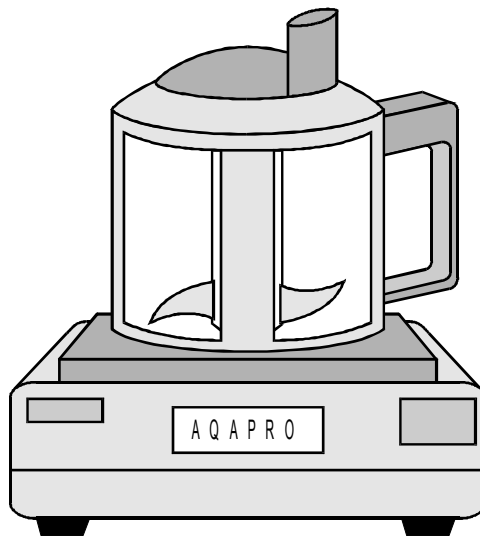
- (d) Why is a combination oven of this sort more economical than a convection-only oven?

.....
.....

(1)

(Total 8 marks)

9. (a) 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.

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$$

.....

Energy =

(3)

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

.....

(1)

- (b) Electricity from power stations is transmitted across the country at very high voltages.

- (i) What is the full name of the device which is used to increase the voltage?

.....

(ii) Explain why the electricity is transmitted at very high voltages.

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

(2)

(iii) Give **two** disadvantages of transmitting electricity at very high voltages.

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

(2)
(Total 10 marks)

10. 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.

.....

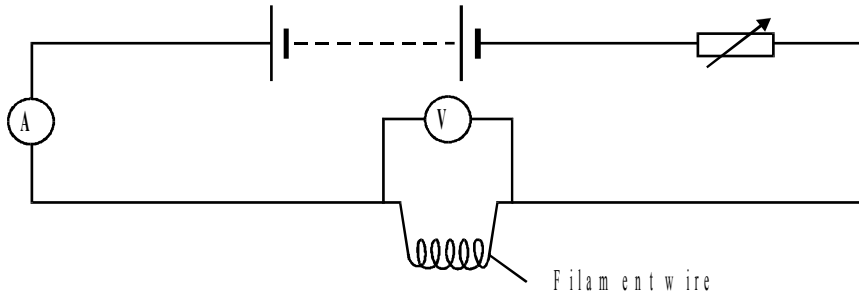
.....

Charge =

(3)

(Total 7 marks)

- 11. A bulb heats up when an electric current passes through the filament wire. The current was measured when different voltages were applied across the filament wire shown in the diagram below.



- (a) (i) Look at the circuit diagram. How was the voltage changed?

.....

.....

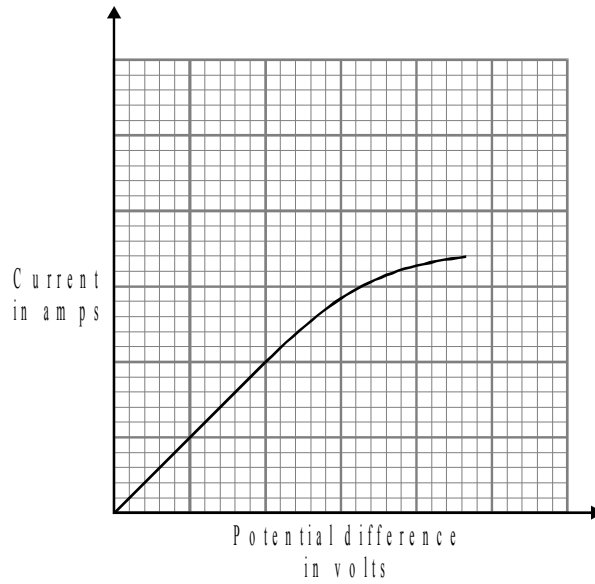
(1)

- (ii) Write an equation that shows the relationship between *current*, *potential difference* and *resistance*.

.....

(1)

- (b) The graph shows how the current through the filament wire changed as the potential difference across it changed.



- (i) Describe the effect of increasing the potential difference on the current flowing through the filament wire.

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

(2)

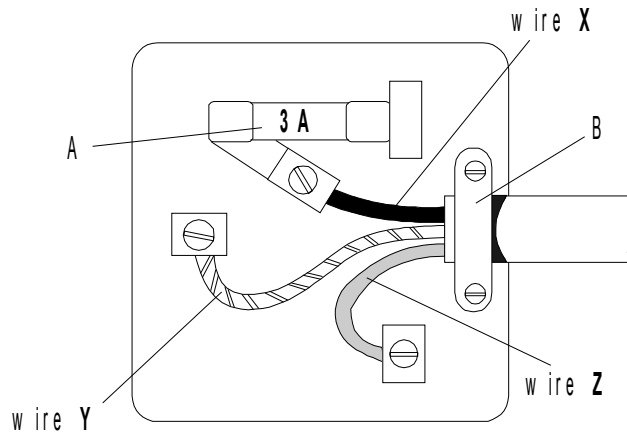
- (ii) Explain this effect in terms of the resistance of the filament wire.

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

(2)

(Total 6 marks)

12. 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?

.....

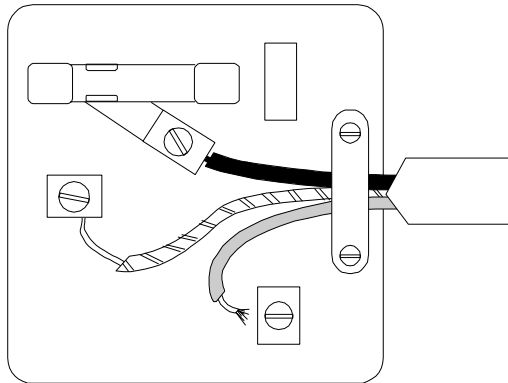
(1)

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

.....

.....

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

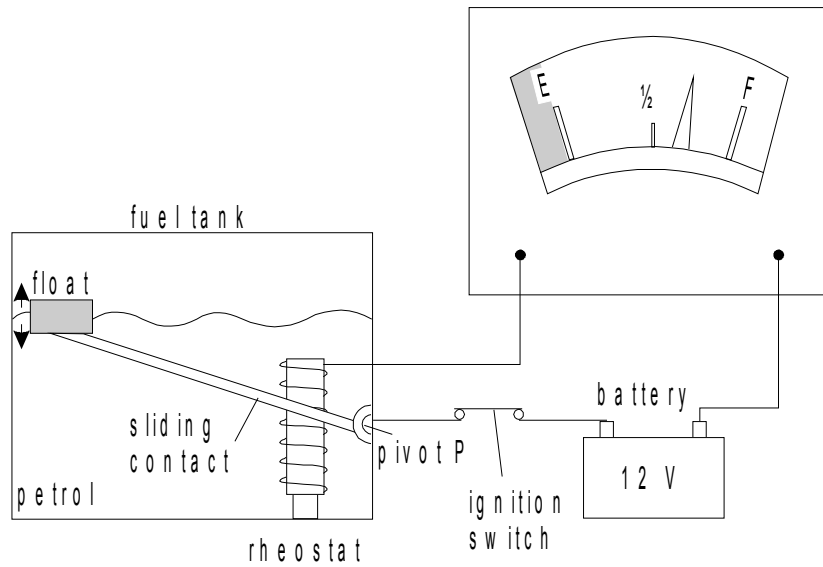


Look at the plug carefully. What **four** changes should be made to make the plug safe?

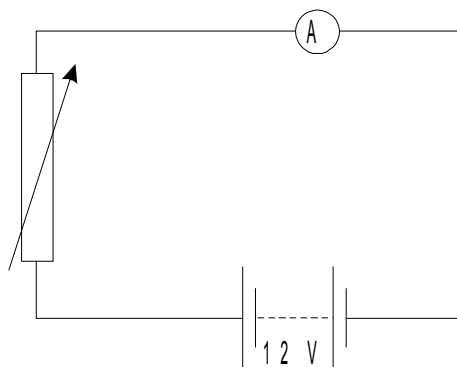
1.
.....
2.
.....
3.
.....
4.
.....

(4)
(Total 12 marks)

13. The diagram below shows how one type of fuel gauge in a car works. A sliding contact makes contact with a resistance wire wound in a coil (rheostat). It is connected to a float via a pivot P. When the petrol level changes the circuit resistance changes. This causes the pointer in the fuel gauge to move and show how much petrol is in the petrol tank.



The circuit diagram is shown below.



The petrol gauge is an ammeter. Explain why the reading on the ammeter falls as the petrol is used.

.....

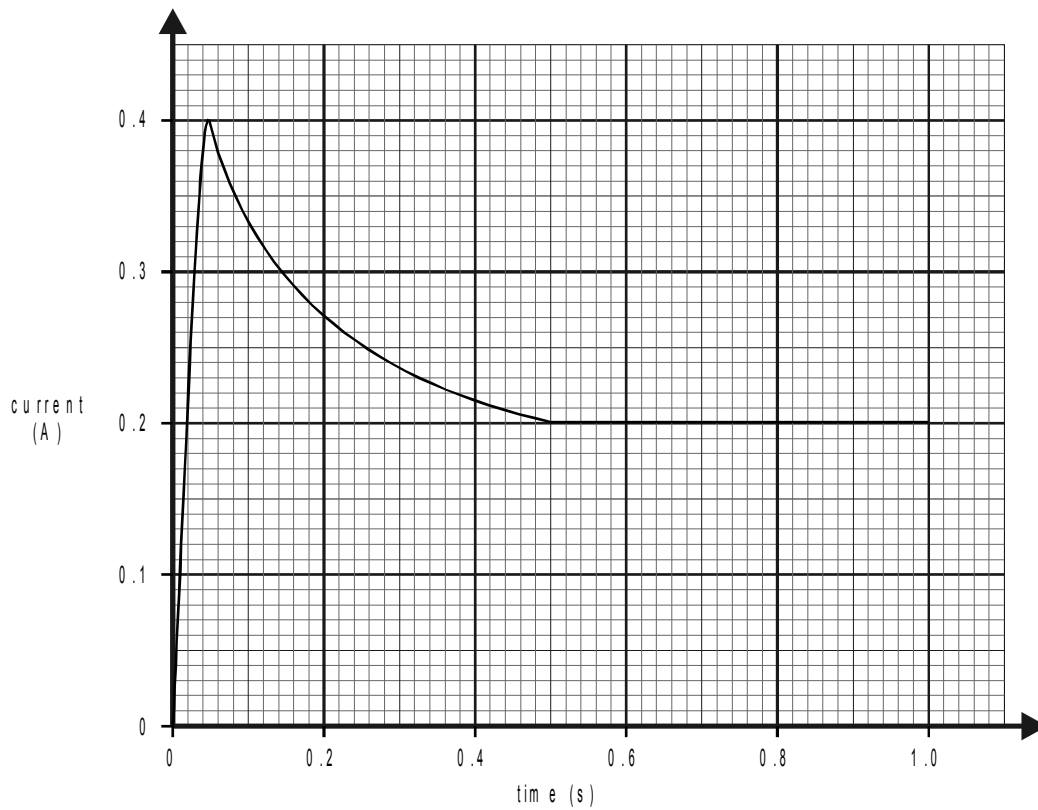
.....

.....

.....

(Total 3 marks)

14. 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.

.....

(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)

15. You wash and dry your hair, then comb it with a plastic comb. As you move the comb away from your head some hairs are attracted to the comb.

(a) What has happened to the comb to make it attract the hairs?

.....
.....

(1)

(b) If the comb is now held above some small pieces of dry tissue paper what is likely to happen?

.....
.....

(1)

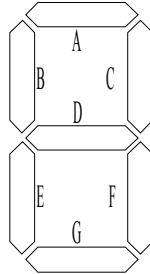
(c) If you rub your hands all over the comb it will no longer attract your hair. Explain why.

.....
.....

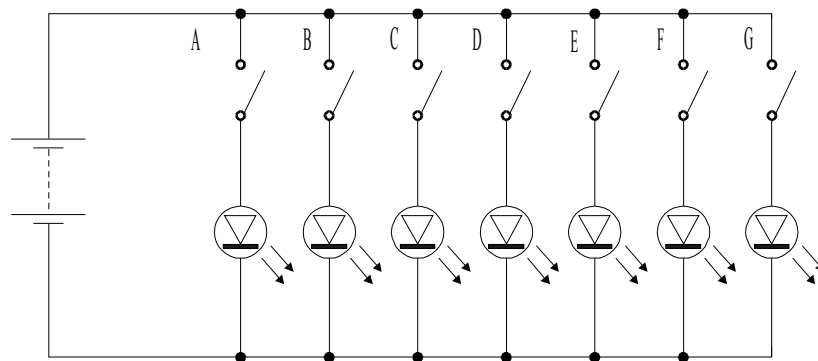
(2)

(Total 4 marks)

16. Some electronic calculators use light emitting diodes (LEDs) to display numbers. Each number in a display consists of up to seven LEDs. The LEDs are arranged as shown in the diagram below. The different numbers are formed by switching different LEDs on at the same time. The LEDs are labelled A to G.



A simplified circuit to provide power to the LEDs is shown below.



- (a) Explain why each LED has its own switch.

.....

(2)

- (b) What number is displayed when all switches except E are closed?

.....

(1)

- (c) Which switches would be open if the number 3 is to be displayed?

.....

(1)

(d) Which of the numbers 0 to 9 draws least current from the battery? Explain your answer.

Number

Explanation

.....

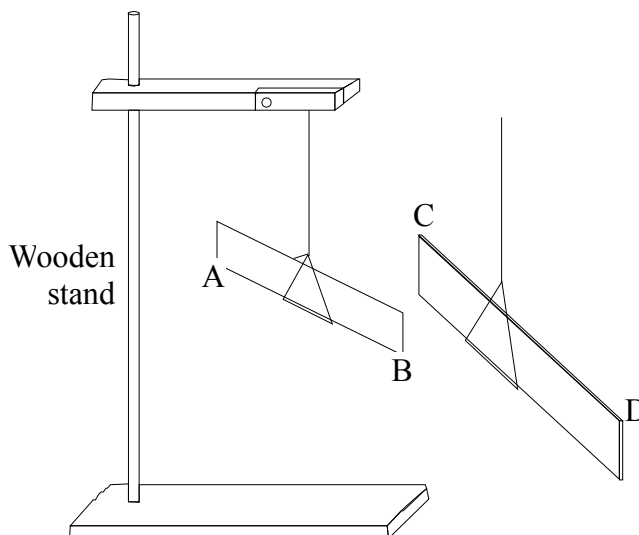
.....

(2)
(Total 6 marks)

17. A pupil did an experiment following the instructions below.

1. Take a polythene rod (AB), hold it at its centre and rub both ends with a cloth.
2. Suspend the rod, without touching the ends, from a stand using a stirrup and nylon thread.
3. Take a perspex rod (CD) and rub it with another cloth.
4. Without touching the ends of the perspex rod bring each end of the perspex rod up to, but without touching, each end of the polythene rod.
5. Make notes on what is observed.

The diagram below shows how the apparatus is to be set up.



(a) When end C was brought near to end B they attracted each other.

(i) Explain why they attracted each other.

.....

.....

(ii) What would happen if end C were brought near end A?

.....

(3)

(b) The experiment was repeated with two polythene rods.

(i) Describe what you would expect the pupil to observe as the end of one rod was brought near to the end of the other.

.....
.....

(ii) Explain your answer.

.....
.....

(2)

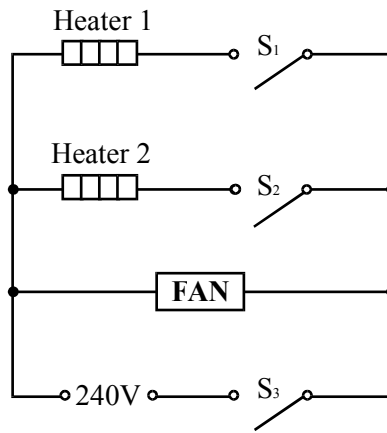
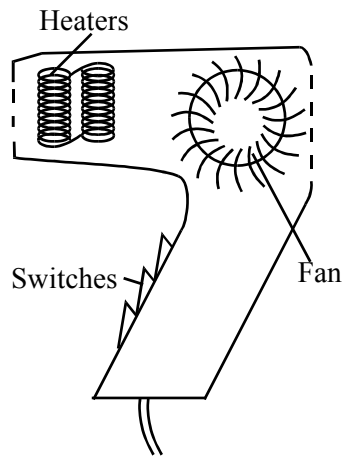
(c) Explain, in terms of electron movement, what happened as the rods were rubbed with the cloths.

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

(3)

(Total 8 marks)

18. 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?

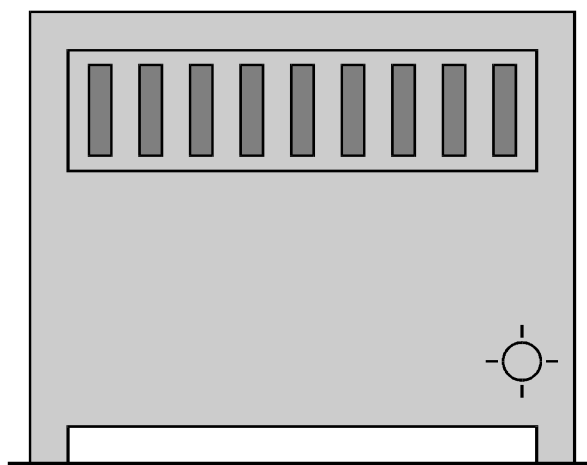
.....

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

.....

(2)
(Total 12 marks)

19. (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)

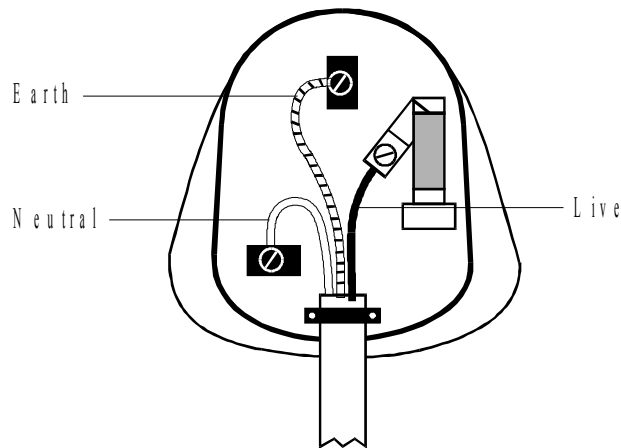
- (ii) How much will it cost to use the fan heater for 6 hours if one Unit of electricity costs 7p?

.....

Cost p

(2)
 (Total 7 marks)

20. The diagram shows the inside of a mains plug.

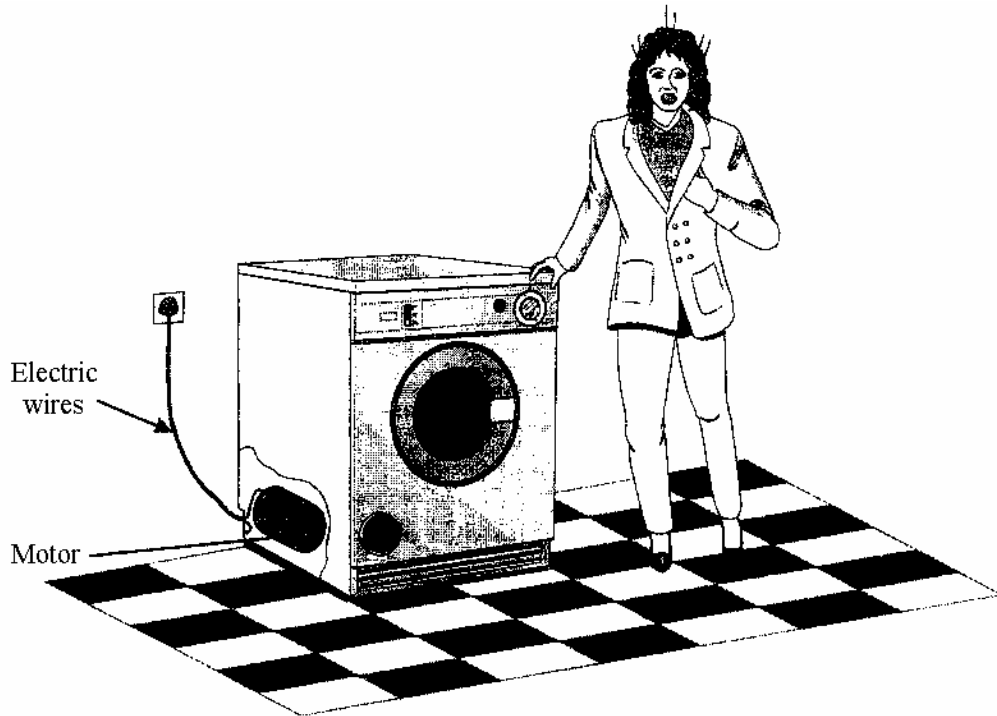


- (a) Complete the table.

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

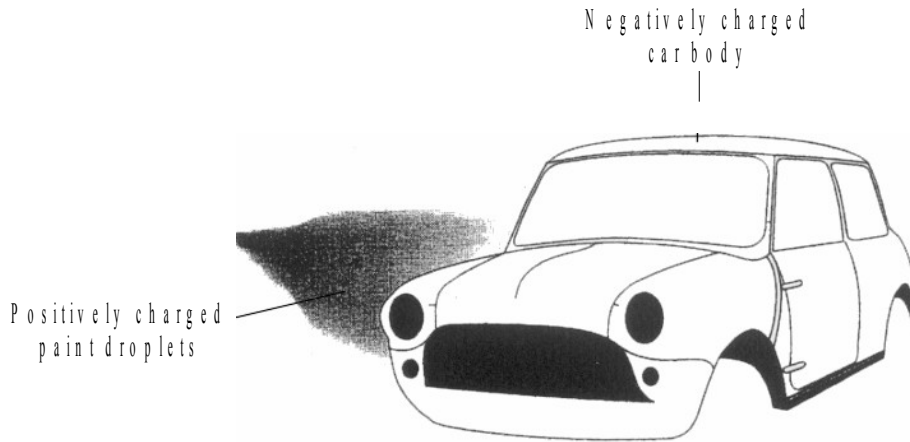
.....

Give a reason for your answer.

.....

(2)
 (Total 8 marks)

21. (a) One method of painting a car uses electrostatics. A paint spray produces paint droplets, all of which are given a positive charge. The car body is given a negative charge.



- (i) Explain why it is important to give all of the paint droplets a positive charge.

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

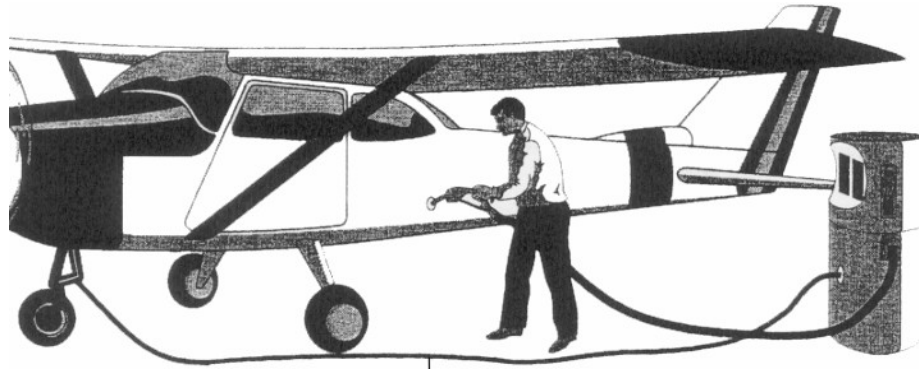
(2)

- (ii) Explain why it is important to give the car body a negative charge.

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

(2)

(b) The picture shows a light aircraft being refuelled after a flight.



Metal wire

Explain why it is important that, before refuelling starts, the aircraft is first connected to the fuel pump by a metal wire.

.....

.....

.....

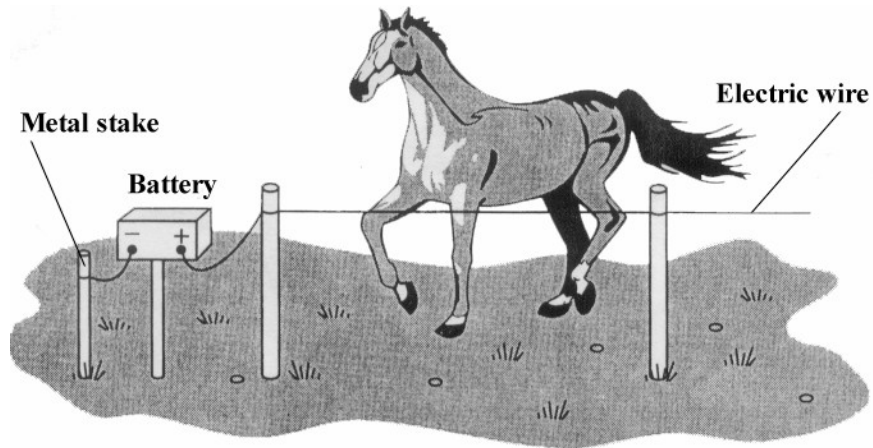
.....

.....

.....

(4)
(Total 8 marks)

22. (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.

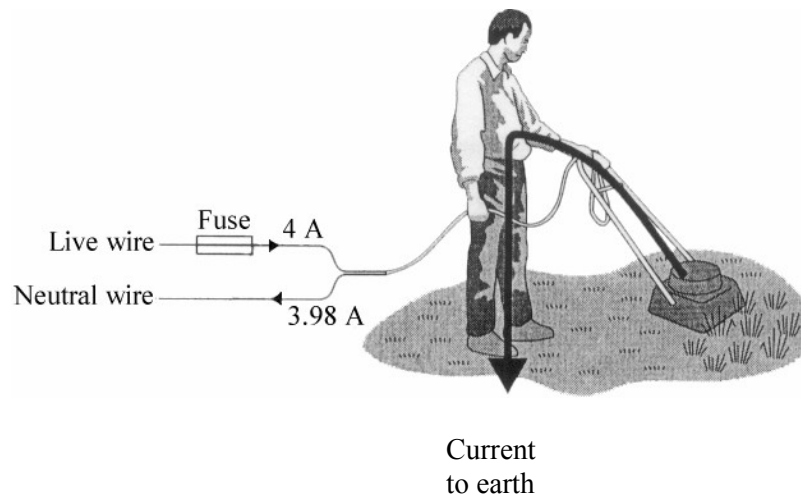
.....

.....

.....

(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.

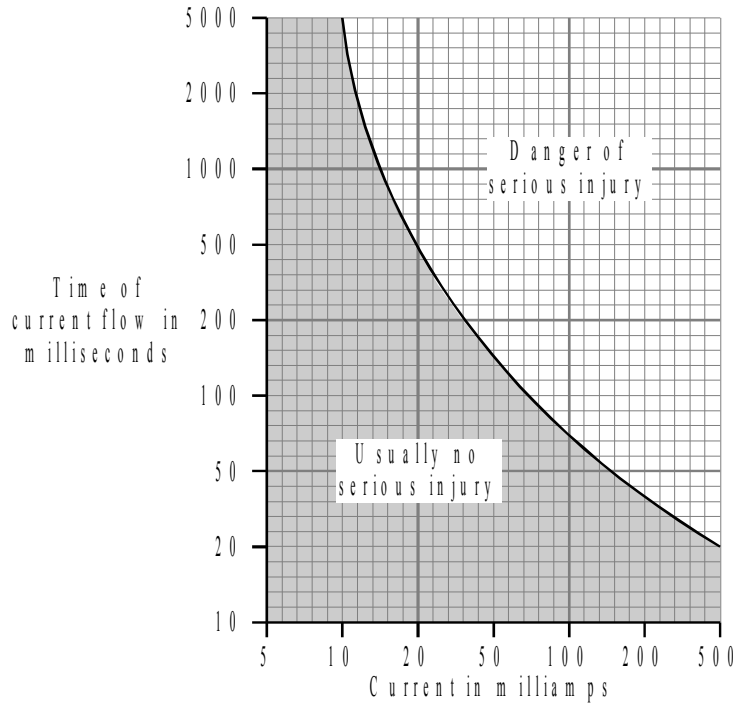
.....

.....

.....

(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.



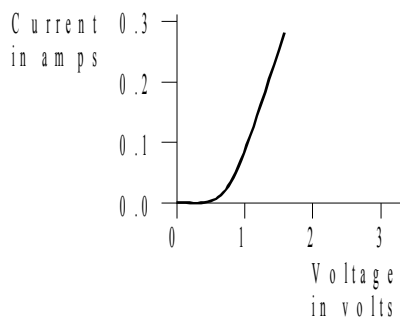
Within how long must the RCB cut off the current if the person using the lawnmower is to be in no danger of serious injury?

.....

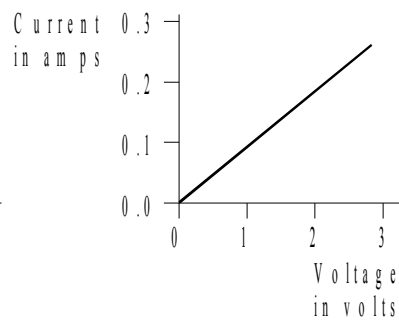
Time = milliseconds

(2)
 (Total 6 marks)

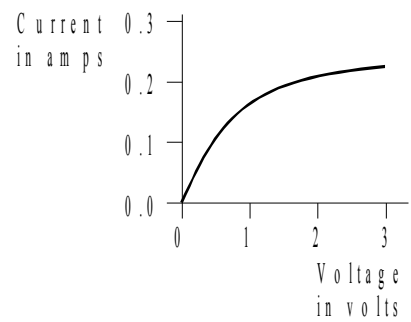
23. (a) The diagram shows the voltage-current graphs for three different electrical components.



A



B



C

Which **one** of the components **A**, **B** or **C** could be a 3 volt filament lamp? Explain the reason for your choice.

.....

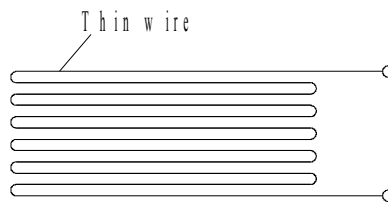
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(3)

- (b) Using the correct symbols draw a circuit diagram to show how a battery, ammeter and voltmeter can be used to find the resistance of the wire shown.



(3)

- (c) When correctly connected to a 9 volt battery the wire has a current of 0.30 amperes flowing through it.

- (i) Give the equation that links current, resistance and voltage.

.....

(1)

- (ii) Calculate the resistance of the wire. Show clearly how you work out your answer and give the unit.

.....

.....

Resistance =

(3)

- (iii) When the wire is heated, the current goes down to 0.26 amperes. State how the resistance of the wire has changed.

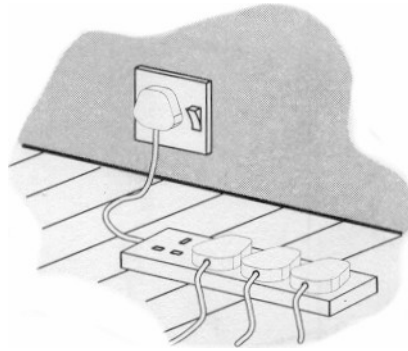
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(1)

(Total 11 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 =

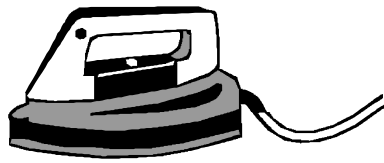
(2)

- (iv) What would happen to the fuse if the heater is also plugged into the adaptor?
Give a reason for your answer.

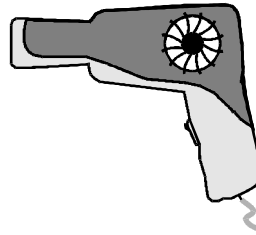
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.....

(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.

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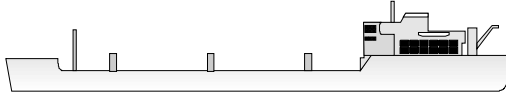
(2)

- (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. (a) The table contains typical data for an oil tanker.

	Mass	56 000 000 kg
	Cruising speed	12 m / s
	Deceleration force	392 000 N
	Stopping distance	10 000 m

- (i) Write down the equation which links acceleration, force and mass.

.....

(1)

- (ii) Calculate the deceleration of the oil tanker. Show clearly how you work out your answer.

.....

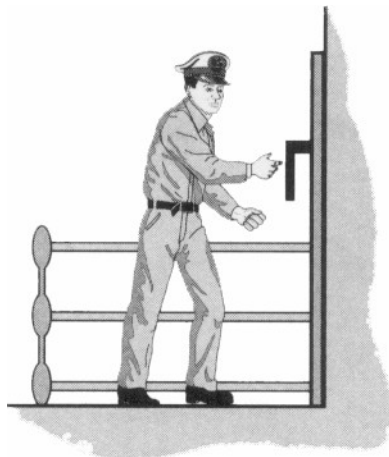
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Deceleration = m/s^2

(2)

- (b) A sailor working on the tanker becomes positively charged. When the sailor goes to touch a metal handle negative charge flows to him causing a spark.



- (i) Write down the equation which links charge, current and time.

.....

(1)

- (ii) Calculate, in coulombs, how much charge flows to the sailor if a current of 0.02 A flows through him for 0.04 s.

.....

.....

Charge = C

(1)

(Total 5 marks)

26. A set of Christmas tree lights is made from twenty identical lamps connected in series.



(a) Each lamp is designed to take a current of 0.25 A. The set plugs directly into the 230 V mains electricity supply.

(i) Write down the equation that links current, potential difference and resistance.

.....
.....

(1)

(ii) Calculate the resistance of **one** of the lamps. Show clearly how you work out your final answer and give the unit.

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

Resistance =

(4)

(iii) What is the total resistance of the set of lights?

.....
.....

Total resistance =

(1)

(b) How does the resistance of a filament lamp change as the temperature of the filament changes?

.....

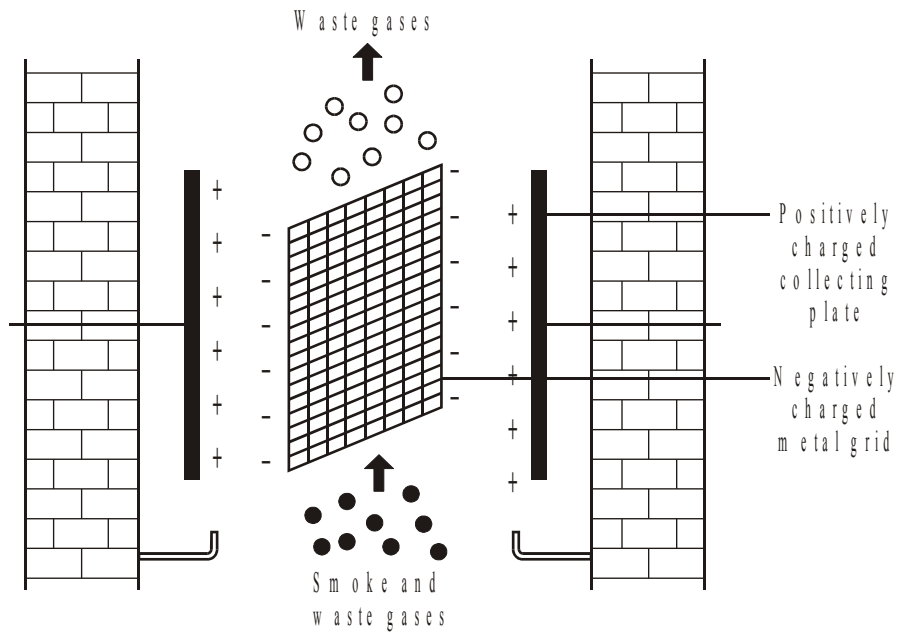
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(1)
(Total 7 marks)

27. (a) Burning fuels produce smoke particles and waste gases. An electrostatic smoke precipitator can remove the smoke particles from the waste gases.



The following sentences **A** to **E** describe how an electrostatic smoke precipitator works. The sentences are in the wrong order.

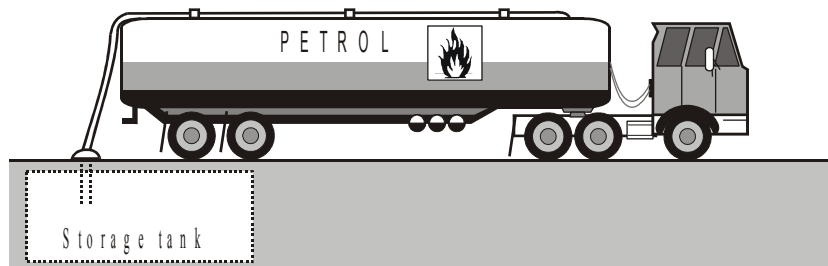
- A** The smoke particles stick to the positively charged collecting plates.
- B** The smoke particles are given a negative charge.
- C** The waste gases and smoke pass through a negatively charged metal grid.
- D** The collecting plates are knocked so the smoke particles fall and can be taken away.
- E** The smoke particles are repelled from the grid and attracted to the positively charged collecting plates.

Arrange the sentences in the right order. Start with sentence **C**.



(3)

- (b) The underground storage tanks at petrol stations are filled from tankers. A static electric charge can build up on the tanker as the petrol flows through the pipe to the storage tank. This could be dangerous.



Why is the static electric charge dangerous and what should be done to stop the charge building up?

.....

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.....

.....

(2)

- (c) A 3-pin plug should always be fitted with the correct value fuse for a particular electrical appliance. The fuse protects the appliance and wires from damage.

Explain how a fuse works.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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.....

.....

.....

.....

(3)
(Total 8 marks)

28. (a) Combing dry hair with a plastic comb makes the comb become positively charged.



Why does the comb become positively charged?

.....

.....

(1)

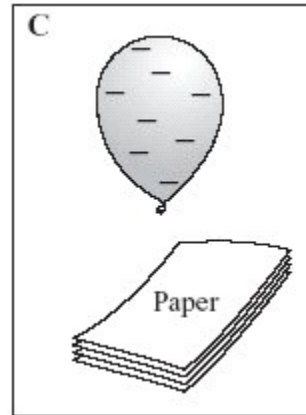
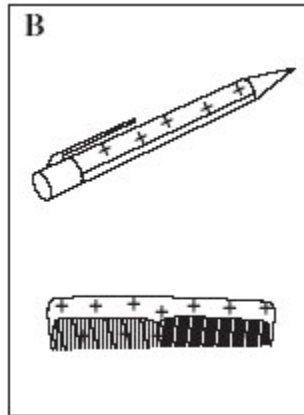
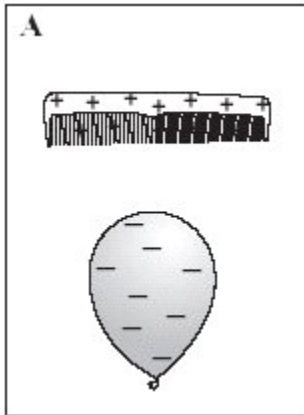
- (b) Two objects are drawn in each of the boxes **A**, **B** and **C**. Each object is positively charged, negatively charged or uncharged.

Write under each box whether the two objects will:

repel each other;

attract each other;

do nothing.



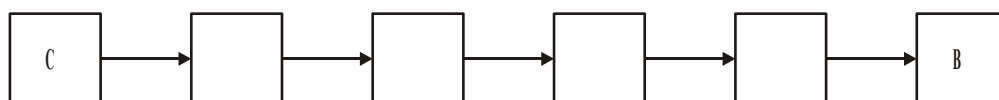
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(3)

- (c) The following sentences describe how a photocopier uses static electricity to make a photocopy. The sentences are in the wrong order.

- A** The charge left on the plate has the same pattern as the black parts of the original page.
- B** The paper is heated to make the powder stick; this is now a photocopy of the original page.
- C** The copying plate is given a charge. An image of the page to be copied is projected onto the plate.
- D** The charged parts of the plate attract particles of black powder.
- E** The black powder is transferred from the plate onto a piece of paper.
- F** Where light hits the plate, the charge leaks away.

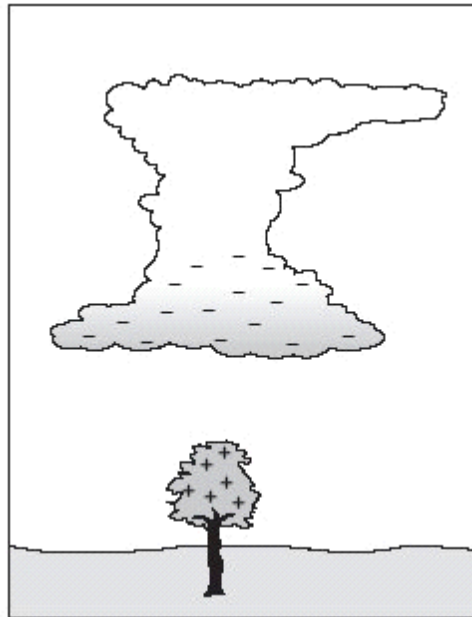
Arrange the sentences in the right order. Start with sentence **C** and end with sentence **B**.



(3)

(Total 7 marks)

29. The diagram shows a charged thundercloud.



(a) Why does the tree below the thundercloud become positively charged?

.....
.....

(1)

(b) The base of the cloud has a negative charge of 18 coulombs.

The potential difference between the base of the cloud and the ground is 1200 000 kilovolts.

(i) Write down the equation that links charge, energy transferred and potential difference.

.....

(1)

(ii) Calculate the maximum energy that could be transferred to the ground by a lightning strike. Show clearly how you work out your answer.

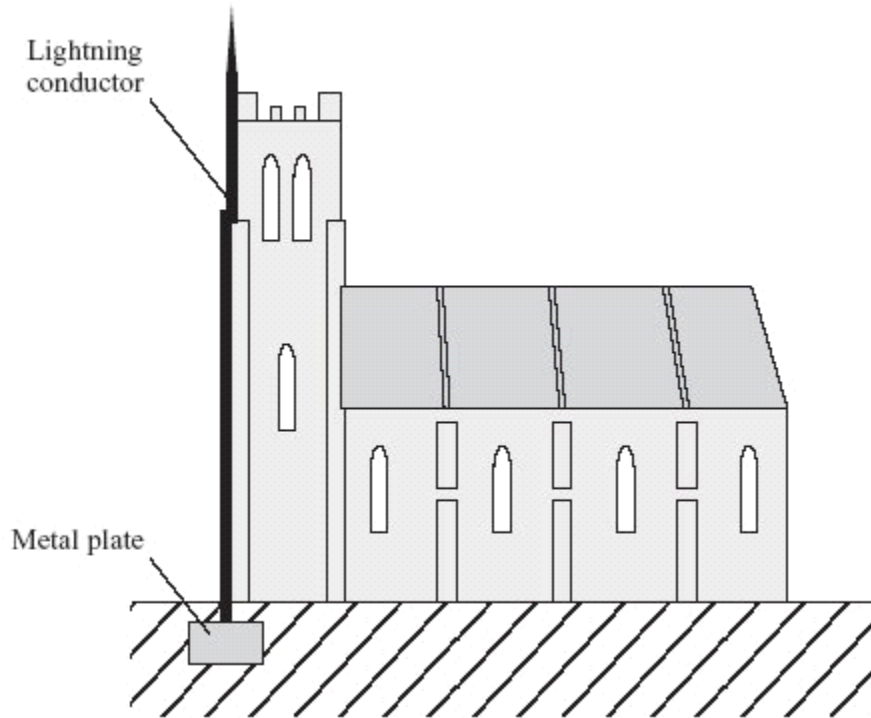
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Maximum energy transferred = joules

(2)

- (c) A lightning conductor is usually attached to tall buildings. This reduces the risk of damage by a lightning strike.



Explain why the lightning conductor is made of copper.

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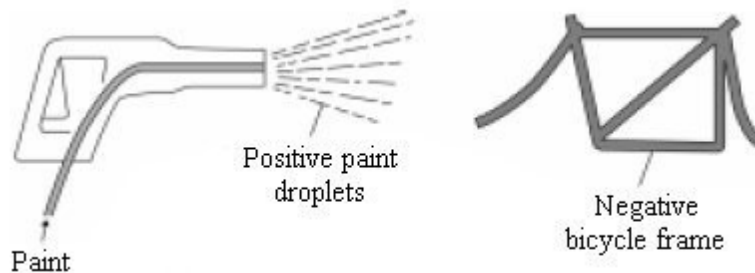
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(2)
(Total 6 marks)

30. (a) Bicycle frames can be painted using an electrostatic paint spray. The paint droplets leave the spray gun with a positive charge. The bicycle frame is given a negative charge.



(i) Explain why the paint droplets are all given a positive charge.

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

(2)

(ii) Explain why the bicycle frame is given a negative charge.

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

(2)

- (b) The picture shows a hospital operating theatre.
The drug used to make the patient unconscious is explosive.



Explain why the operating theatre has a floor designed to conduct electricity.

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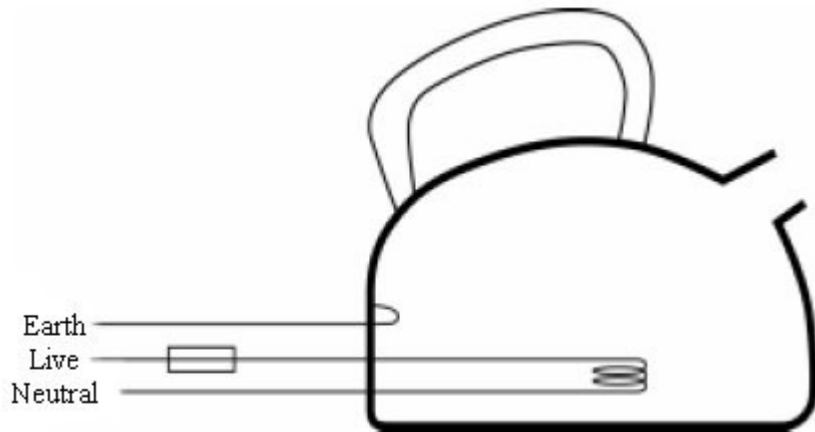
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(3)
(Total 7 marks)

31. The diagram shows the wiring to an electrical appliance. The outside of the appliance is metal.



Explain how the earth wire and fuse protect both the appliance and the user. The answer has been started for you.

If a fault occurs which causes

.....

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(Total 3 marks)