Topic 2 Electricity H

Name: _____

Class: _____

Date: _____

Time: **41 minutes**
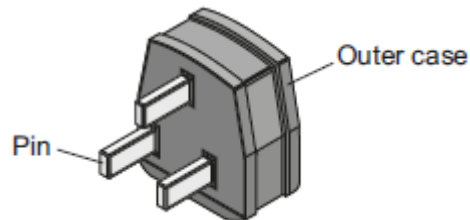
Marks: **41 marks**

Comments:

Q1.(a)   A washing machine is connected to the mains electricity supply using a cable and three-pin plug.

Figure 1 shows a three-pin plug.

Figure 1

Name the materials used in the structure of a plug. Give the reason why each material is used.

Pin ....

....

Outer case ....

....

(1)

(b)   The three-pin plug contains a fuse. The fuse is connected to one of the wires inside the cable.

(i)   Which **one** of the wires inside the cable is the fuse connected to?

....

(1)

(ii)   The fuse is a thin wire inside a closed glass tube. The wire acts as a resistor.

What effect does a current through a wire have on the wire?

....

(1)

(iii)   The power of the washing machine varies between 0.7 kW and 2 kW depending on which part of the wash cycle is operating.

Calculate the maximum current drawn from the mains electricity supply by the washing machine.

Page 2

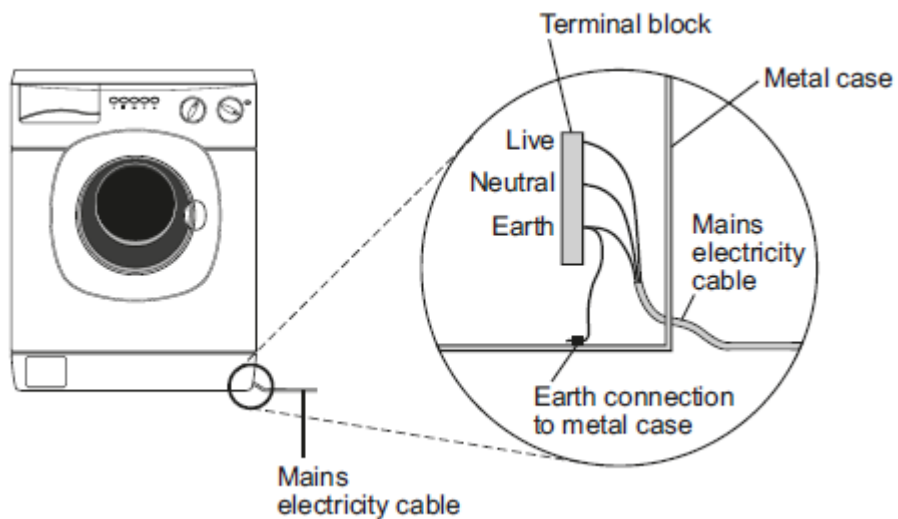The mains electricity supply is at a potential difference of 230 V.

....

....

....

Current = ... A

(2)

(c)   **Figure 2** shows how the mains electricity cable is connected to the washing machine.

The earth wire is connected to the metal case of the washing machine.

Figure 2

If a fault makes the metal case live, the earth wire and fuse inside the plug prevent the mains cable from overheating and causing a fire.

Explain how.

....

....

....

....

(2)

(d)   New research has shown that many people underestimate the hazards of using mains electricity.

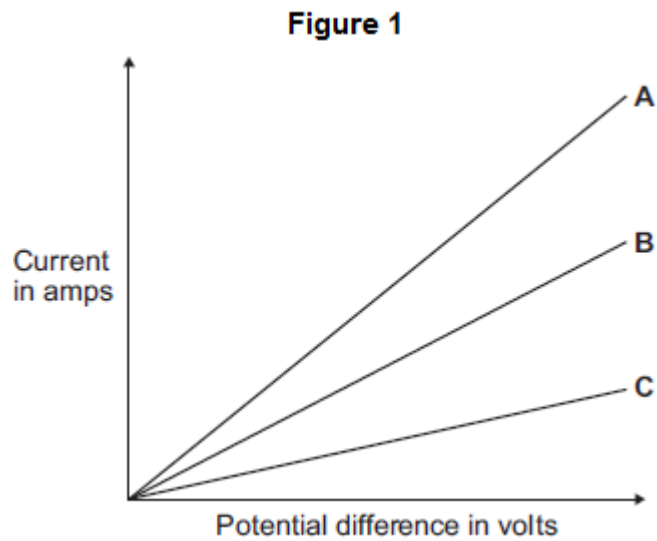It is important that people do understand the hazards of using mains electricity.

Suggest why.

....

....

....

(1)

(Total 9 marks)

Q2.(a) **Figure 1** shows the current−potential difference graph for three wires, **A**, **B** and **C**.

Figure 1

(i) Using **Figure 1**, how can you tell that the temperature of each wire is constant?

....

....

(1)

(ii) Which **one** of the wires, **A**, **B** or **C**, has the greatest resistance?

Write the correct answer in the box.

Give a reason for your answer.

....

....

....

(2)

Page 4

(b) A student measured the resistance of four wires.

The table below shows the resistance of, and other data about, each of the four wires, **J**, **K**, **L** and **M**.

Wire	Type of metal	Length in cm	Diameter in mm	Resistance in …….
J	copper	50	0.17	0.36
K	copper	50	0.30	0.12
L	copper	100	0.30	0.24
M	constantan	100	0.30	7.00

(i) The last column of the table should include the unit of resistance.

What is the unit of resistance?

....

(1)

(ii) The resistance of a wire depends on many factors.

Look at the table. Which **two** wires from **J**, **K**, **L** and **M** show that the resistance of a wire depends on the **length** of the wire?

Wire ☐ and wire ☐

Give a reason for your answer.

....

....

....

(2)

(iii) A student looked at the data in the table and wrote this conclusion:

'The resistance of a wire depends on the type of metal from which the wire is

made.'

The student could **not** be certain that her conclusion is true for **all** types of metal.

Suggest what extra data is needed for the student to be more certain that the conclusion is correct
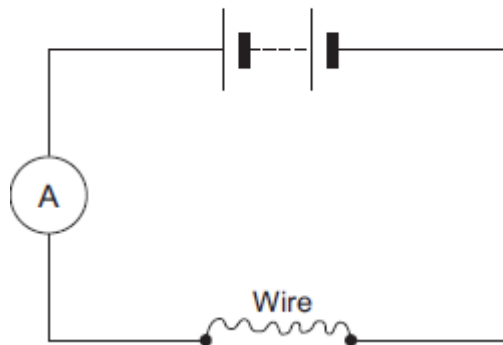
....

....

....

(1)

(c) The resistance of a wire can be calculated using the readings from an ammeter and a voltmeter.

(i) Complete **Figure 2** by drawing a voltmeter in the correct position in the circuit. Use the correct circuit symbol for a voltmeter.
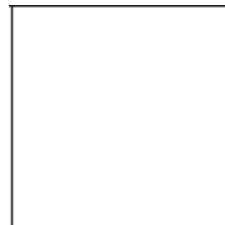
Figure 2

(1)

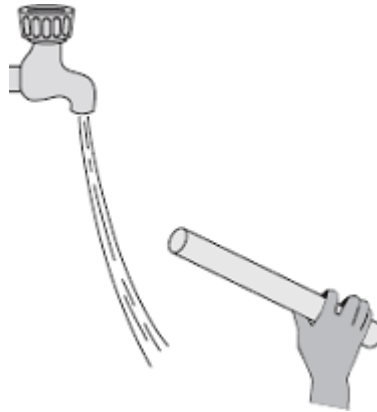(ii) In a circuit diagram, a wire can be represented by the symbol for a resistor.

In the box below, draw the circuit symbol for a resistor.

(1)
(Total 9 marks)

Q3.(a)   The diagram shows a negatively charged plastic rod held near to a thin stream of water. The water is attracted towards the rod.

Which **one** of the following statements explains what is happening to the charge in the water?

Tick (✓) **one** box.

The positive and the negative charges in the water are attracted to the rod.   ☐

The positive and the negative charges in the water are repelled by the rod.   ☐

The negative charge in the water is repelled by the rod and the positive charge is attracted to the rod.   ☐

The negative charge in the water is attracted to the rod and the positive charge is repelled by the rod.   ☐

(1)

(b)   A company that produces bottles of mouthwash found a problem with the automatic filling system.

As the bottles go towards the filler, the bottles move around on the conveyor belt and become electrostatically charged. This causes the stream of mouthwash to move sideways, missing the open top of the bottle.
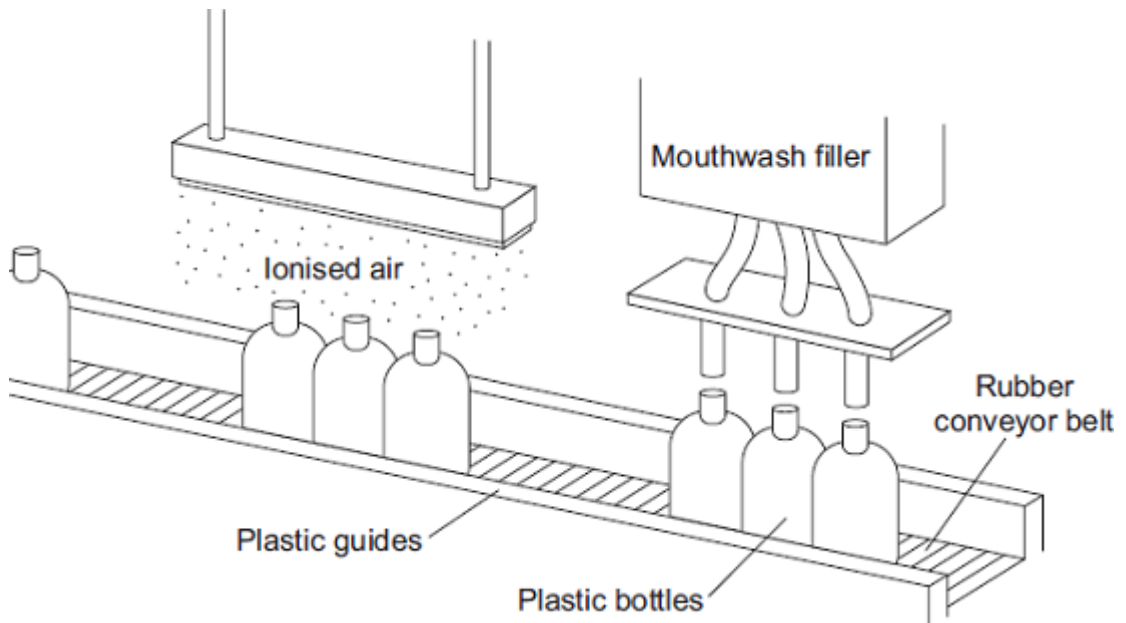
The company came up with an answer to the problem. Before the bottles reach the dfiller, the bottles pass through a stream of ionised air. The ions in the air neutralise the charge on the bottles.

(i)   Explain why the plastic bottles became charged.

....

....

....

....

(2)

(ii)   What happens to the structure of an atom to change the atom into an ion?

....

....

(1)

(iii)   Earthing the conveyor belt with a conducting wire would not have solved this problem.
Give a reason why.

....

....

(1)
(Total 5 marks)

Q4. The current in a circuit depends on the potential difference (p.d.) provided by the cells and the total resistance of the circuit.

(a) Using the correct circuit symbols, draw a diagram to show how you would connect 1.5 V cells together to give a p.d. of 6 V.
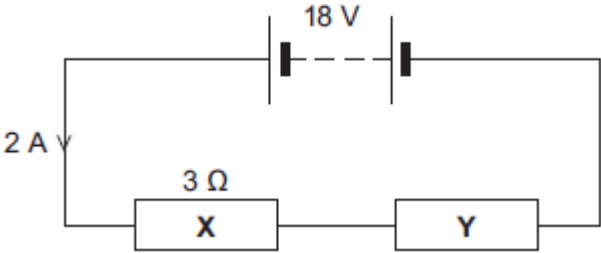
(2)

(b) **Figure 1** shows a circuit containing an 18 V battery.

Two resistors, **X** and **Y**, are connected in series.

• **X** has a resistance of 3 Ω.

• There is a current of 2 A in **X**.

Figure 1

(i) Calculate the p.d. across **X**.

....

....

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

(2)

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

....

....

....

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

(2)

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

....

....

....

Total resistance of **X** and **Y** = ... Ω

(2)

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

Figure 2
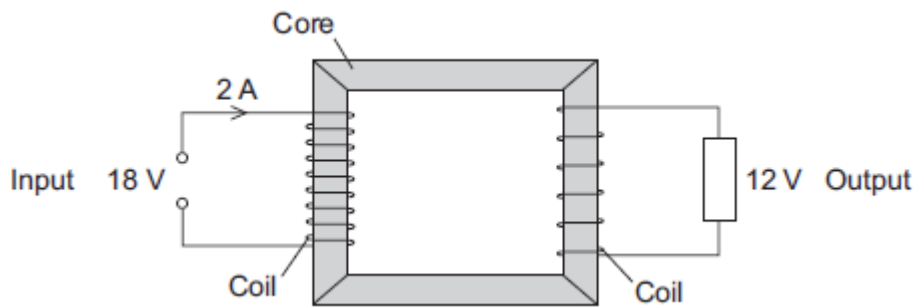
(i) An 18 V battery could **not** be used as the input of a transformer.

Explain why.

....

....

....

....

(2)

(ii) The transformer is 100% efficient.

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

....

....

....

Output current = ... A

(2)
(Total 12 marks)

Q5.   A homeowner had a new gas boiler installed.

(a)   The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)
Efficiency	0.95

(i)   Calculate the energy transferred each second by the gas boiler to the water inside the boiler.

Show clearly how you work out your answer.

....

....

Energy transferred by the gas boiler each second = ... kJ

(2)

(ii)   The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Calculate the total number of hours that the gas boiler would operate for £30.

Show clearly how you work out your answer.

....

....

....

....

Number of hours = ...

(2)

(b)   Although the gas boiler is very efficient, some energy is wasted.

Explain what happens to the waste energy.

....

....

....

....

(2)
(Total 6 marks)

M1.(a)   pin

made from brass because it is (hard and) a (good electrical) conductor

accept copper for brass

metal is insufficient

heat conductor on its own negates

1

outer case
plastic/rubber because it is a (good electrical) insulator

heat insulator on its own negates

1

(b)   (i)   live

1

(ii)   makes it hot/warm

melts is insufficient

1

(iii)   8.7

accept an answer that rounds to 8.7

allow 1 mark for correct substitution ie 2000 = 230 × I

an answer of 0.0087 or 0.009 or 3.0(4) or 5.65 or 5.7 gains 1 mark

2

(c)   a (large) current goes from the live wire to the earth wire

accept metal case for live wire

accept a current goes from live to earth

do not accept electricity for current

1

(which causes) the fuse to (overheat and) melt

accept blow for melt

break is insufficient

do not accept snap / blow up for melt

1

(d)   reduce chance of an electric shock

accept to reduce the risk of an accident
accept prevent electric shock
accept prevent electrocution
accept prevent or reduce the risk of an (electrical) fire
accept an electric shock can kill you
accept it can kill you
accept so you can use it safely

1

[9]

M2.(a)   (i)   p.d. is (directly) proportional to current
    or
    gradient / slope is constant
    or
    the lines show constant resistance
            accept lines are straight / diagonal

1

        (ii)   C
            reason only scores if C is chosen

1

            for the same p.d. the current is the smallest
            *accept lowest gradient **and** the gradient = 1 / R*

1

    (b)   (i)   ohm
            accept correct symbol Ω
            accept an answer written in the table if not given in answer
            space

1

        (ii)   K and L
            reason only scores if both K and L are chosen

1

            only length varies
            accept type of metal and the diameter are the same

1

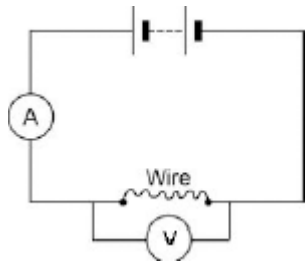   (iii)   measure the resistance of more wires made from different metals
            accept test more (types of) metals
            measure the resistance of more wires is insufficient
            they only use two metals is insufficient

1

    (c)   (i)   voltmeter symbol correct and drawn in parallel with the wire

Page 14

accept voltmeter symbol correct and drawn in parallel with the battery

1

(ii) correct symbol drawn

symbol must be rectangular

1

[9]

M3.(a)   3ʳᵈ box

The negative charge in the water is repelled by the rod and the positive charge is attracted to the rod.

1

(b)   (i)   friction between bottles and conveyor belt / (plastic) guides

accept bottles rub against conveyor belt / (plastic) guides

1

charge transfers between bottles and conveyor belt / (plastic) guides

accept specific reference eg electrons move onto / off the bottles
reference to positive electrons / protons negates this mark

1

(ii)   (the atom) loses or gains one (or more) electrons

1

(iii)   charge will not (easily) flow off the conveyor belt / bottles

accept the conveyor belt / bottles is an insulator / not a conductor accept conveyor belt is rubber

1

[5]

M4.(a)   *attempt to draw four cells in series*

1

correct circuit symbols

   circuit symbol should show a long line and a short line,
   correctly joined together
   example of correct circuit symbol:

   ⊣⊢⊣⊢⊣⊢⊣⊢

1

(b)   (i)   6 (V)

   *allow **1** mark for correct substitution, ie*
   *V = 3 × 2 scores **1** mark*
   provided no subsequent step

2

(ii)   12 (V)

   ecf from part (b)(i)
   18 – 6
   or
   *18 – their part (b)(i) scores **1** mark*

2

(iii)   9 (Ω)

   ecf from part (b)(ii) correctly calculated
   3 + their part (b)(ii) / 2
   or
   *18 / 2 scores **1** mark*
   provided no subsequent step

2

(c)   (i)   need a.c.

1

battery is d.c.

(ii)   3 (A)

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

*18 × 2 = 12 × I$_s$ scores **1** mark*

[12]

M5.   (a)   (i)   7.6

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

ie $0.95 = \frac{x}{8}$

95 × 8.0

(ii)   25 (hours)

*allow **1** mark for obtaining number of kWh = 200*

an answer of 26(.3) gains both marks

(b)   any **two** from

•   transferred to the surroundings / air / atmosphere

•   becomes spread out

•   shared between (many) molecules

•   (wasted as) heat / sound

[6]