Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCSE in Physics (1PH0)
Higher

Resource Set Topic F: Electricity and circuits, Magnetism and the motor effect

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

5 (a) A student has a bar magnet, a piece of iron the same size as the magnet, and some paper clips.

Describe how the student could use these items to demonstrate temporary induced magnetism.

(3)

Place a magnet in contact with the piece of iron and show that the paper clips get attracted to the iron rod. Then remove the magnet and the paper clips should fall off, demonstrating temporary induced magnetism.

(b) A student sets up the apparatus shown in Figure 9.

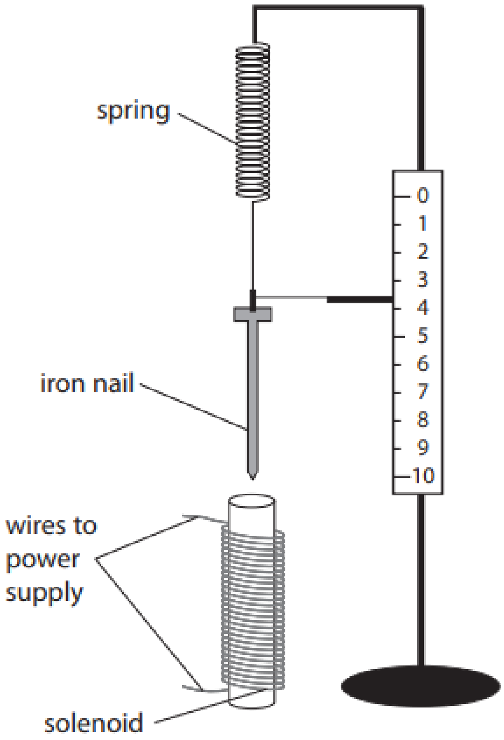


Figure 9

(i) When the current in the solenoid is switched on, the solenoid attracts the iron nail.

Describe how the student could use this apparatus to investigate how the size of the current in the solenoid affects the force of attraction between the solenoid and the iron nail.

(4)

Record the initial position of the pointer (R1). Then pass a known current, using an ammeter to measure the current, into the wires in the solenoid and measure the new position of the pointer (R2). Calculate the extension by finding the difference between the final and initial positions (R2-R1). Use the equation F = k.x where, k is the known spring constant and x is the extension to find the force. Repeat the experiment with different currents.

(ii) The spring constant of a different spring is 24 N/m.

The spring is extended from its unstretched length by 12 cm.

Calculate the energy transferred in extending the spring by 12 cm.

Use an equation selected from the list of equations at the end of this paper.

(2)

$$E = \frac{1}{2} \times 24 \times \left(\frac{12}{100}\right)^2$$

$$= \frac{1}{2} \times 24 \times \frac{144}{10000}$$

$$= 0.1728 \approx 0.17$$

energy transferred = 0.17 J

8 (a) A resistor is connected to a power supply.

The potential difference across the resistor is 6.0V.

(i) Which of these corresponds to a potential difference of 6.0V?

(1)

- ☐ **A** 6.0 joules per ohm
- ☐ **B** 6.0 amps per coulomb
- ☒ **C** 6.0 joules per coulomb
- ☐ **D** 6.0 amps per ohm

(ii) The resistor remains connected for a period of time.

The current in the resistor is 200 mA.

A total charge of 42 C flows through the resistor.

Calculate, in minutes, the time taken for this amount of charge to flow through the resistor.

(3)

$Q = It$

$42 = \frac{200}{1000} \times t$

$t = \frac{42 \times 1000}{200}$

$= 210$ seconds

$\frac{210}{60} = 3.5$

time = 3.5 minutes

(iii) Calculate the total energy transferred by the 6.0V power supply when a charge of 42 C flows through the resistor.

(2)

$E = VIt$

$= 6 \times 42$

$= 252$

energy = 252 J

(b) The resistor becomes warm while there is a current in it.

Explain why the resistor becomes warm.

(2)

As electrons move through the resister, they collide with the atoms in the resister causing them to vibrate more. This causes the KE of the atoms in the resister to increase.

(c) Figure 16 shows a cardboard tube with a wire coming out from each end.

Figure 16

There are two 10 ohm resistors inside the cardboard tube.

A potential difference of 6.0V is connected between P and Q.

There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

(3)

From the equation V=IR, the resistance can be calculated as 5Ω. This is in parallel as the combined resistance is lower than the resistance of a single resister.

10 (a) Figure 18 shows identical filament lamps connected together to a 12 V power supply.

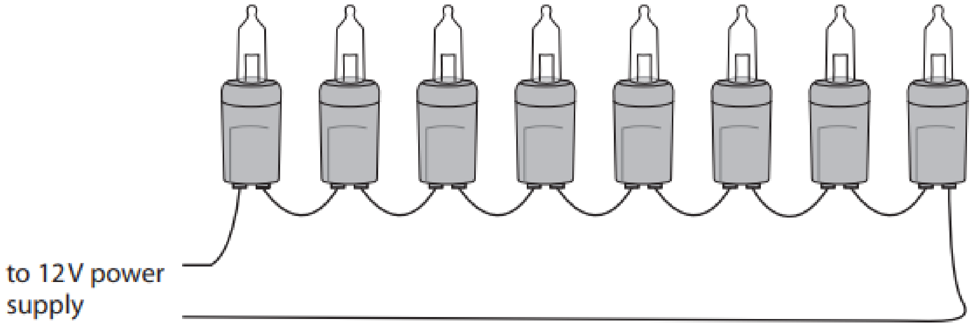


Figure 18

(i) Calculate the potential difference across each lamp.

(1)

$\frac{12}{8} = 1.5$

potential difference = 1.5 V

(ii) The power output of each lamp is 0.75 W

Calculate the resistance of each lamp.

(4)

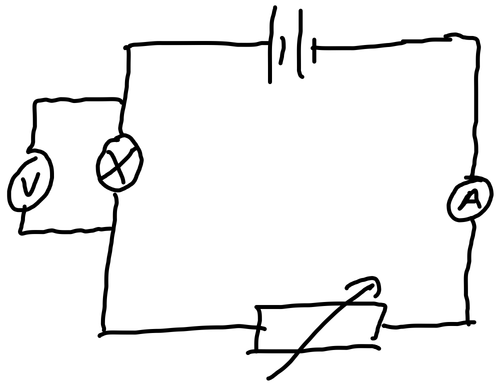
$P = \frac{V^2}{R}$

$0.75 = \frac{(1.5)^2}{R}$ $\quad R = \frac{(1.5)^2}{0.75} = 3$

resistance = 3 Ω

*(b) Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

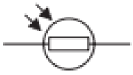
(6)

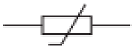


Connect the apparatus as above and measure the potential difference of the lamp by taking the voltmeter reading (V), for a specific current which is taken from the ammeter reading (A). Calculate the resistance using the equation R=V/A. Repeat the experiment by varying the pd across the lamp using the variable resistor. Compare the results on a graph.

3 (a) Which of these symbols is used to represent a thermistor in an electrical circuit?

(1)

- ☐ **A** 
- ☐ **B** 
- ☐ **C** 

- ☒ **D** 

(b) A student investigates how the current in a lamp changes with the potential difference across the lamp.

The student uses the results to calculate the resistance of the lamp.

The results are shown in the table in Figure 5.

potential difference in V	current in A	resistance in Ω
1.0	0.09	11
2.0	0.14	14
3.0	0.18	17
4.0	0.22	18
5.0	0.26	
6.0	0.30	20

Figure 5

(i) One value of resistance is missing from the table in Figure 5.

Calculate the value of resistance that is missing from the table.

(3)

$V = IR$

$5 = 0.26 \times R$

$R = \frac{5}{0.26} = 19.2 \approx 19$

missing resistance = 19 Ω

(ii) The student writes this conclusion:

'The resistance of the lamp is directly proportional to the potential difference.'

Comment on the student's conclusion.
Use information from Figure 5 in your answer.

(3)

The resistance has increased with the increase of the potential difference (pd). However, when the pd has doubled from 1V to 2V, the resistance has not doubled from 11Ω to 22Ω. Therefore, the relationship is not directly proportional.

(iii) The student used a power supply that had fixed output voltage settings.
Each of these outputs was a whole number of volts.

Describe how the student could add a component to the circuit that would provide a continuously variable voltage across the lamp.

(2)

Use a variable resistor in series with the lamp.

5 (a) A student uses a plotting compass to investigate the magnetic field around a wire.

Figure 10 shows the wire going straight through a card.

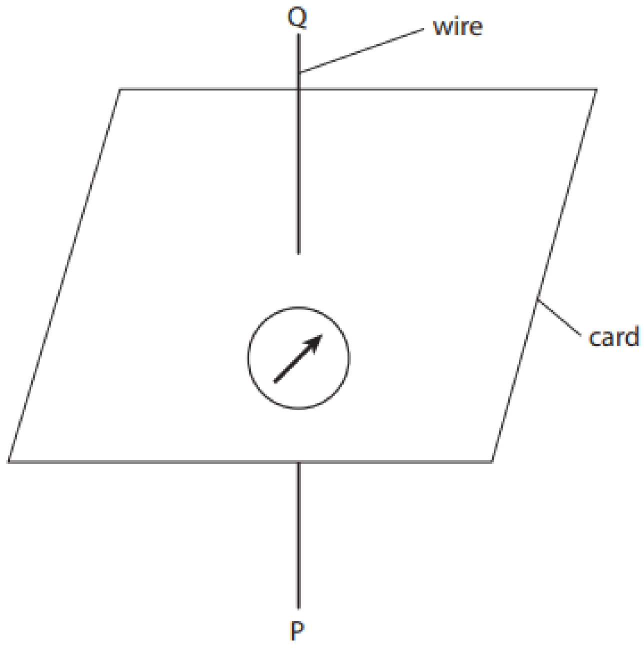
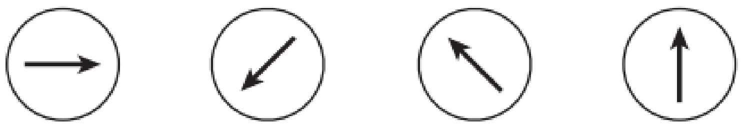


Figure 10

Figure 10 shows the compass needle when there is no current in the wire.

(i) Which of these shows a possible direction of the compass needle when there is a current in the wire going from P to Q?

(1)



☒ **A** ☐ **B** ☐ **C** ☐ **D**

(ii) Describe how the student could develop the investigation to find the shape of the magnetic field produced by the current.

(3)

Keep a compass at a point and mark with a dot the direction the needle points. Move the compass to different positions and repeat the marking process. Connect the dots to reveal the shape of the field, they should be in the form of concentric circles.

(b) Figure 11 shows a copper wire between two magnetic poles.

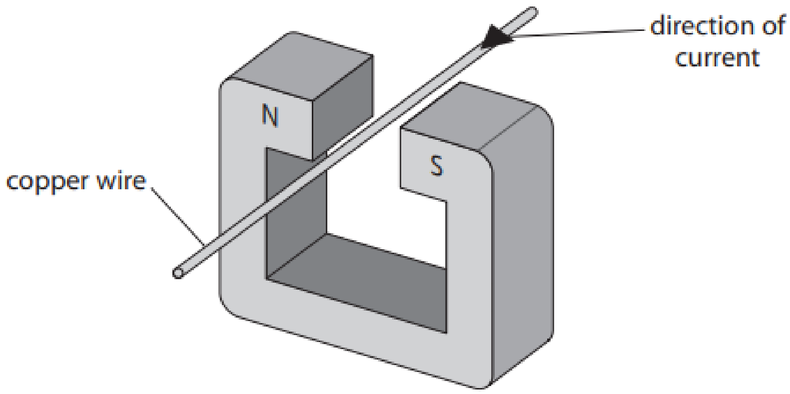


Figure 11

The current in the wire is in the direction shown by the arrow.

The wire experiences a force due to the magnetic field.

(i) The direction of the force due to the magnetic field is

(1)

☐ **A** down

☒ **B** up

☐ **C** towards the north pole of the magnet

☐ **D** towards the south pole of the magnet

(ii) The interaction between the magnetic fields produced by the magnet and the current in the wire produces forces on the magnet and the wire.

Compare these two forces.

(1)

They are equal in magnitude and opposite in direction

(iii) Figure 12 shows a different wire inside a uniform magnetic field.

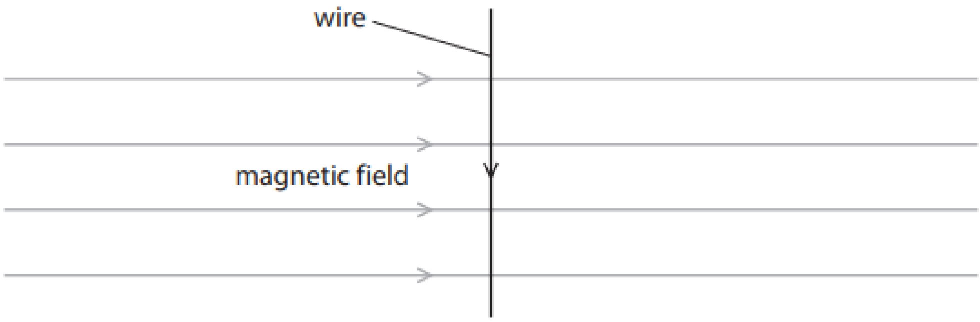


Figure 12

The magnetic flux density of the magnetic field is 0.72 N/A m.
The length of the wire inside the field is 30 mm.
The size of the force due to the magnetic field on the wire is 0.045 N.

Calculate the size of the current in the wire.

Use an equation selected from the list of equations at the end of this paper.

(3)

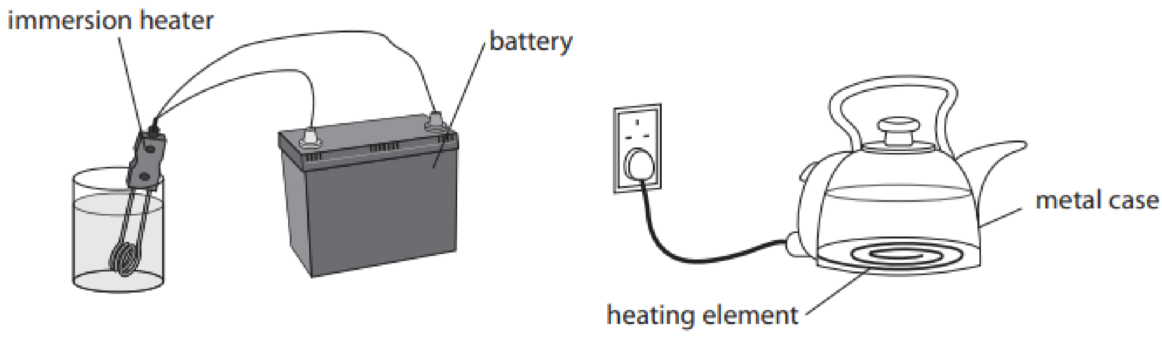
$F = BIL$

$0.045 = 0.72 \times I \times \frac{30}{1000}$

$I = 2.08\dot{3} \approx 2.1$

current in the wire = 2.1 A

10 (a) Figure 19 shows two electrical devices for heating water.



immersion heater connected to a battery

kettle connected to domestic mains supply

Figure 19

(i) The current in the element of the immersion heater is 14 A.

The power of the immersion heater is 130 W.

Calculate the resistance of the immersion heater.

Give your answer to two significant figures.

(3)

$P = VI$

$P = IR \times I$

$130 = 14 \times R \times 14$

$R = \frac{130}{14 \times 14} = 0.663 \approx 0.66$

resistance of immersion heater = 0.66 Ω

(ii) The current in the heating element of the kettle is 8.3 A.

State **two** differences between the movement of charge in the heating element of the kettle and the movement of charge in the immersion heater.

(2)

1 Charges move faster in the immersion heater compared to the kettle.

2 Direction of flow of the charge in the kettle keeps changing. while it is constant for the immersion heater.

*(b) Figure 20 shows the three-pin plug used to connect the kettle to the mains.

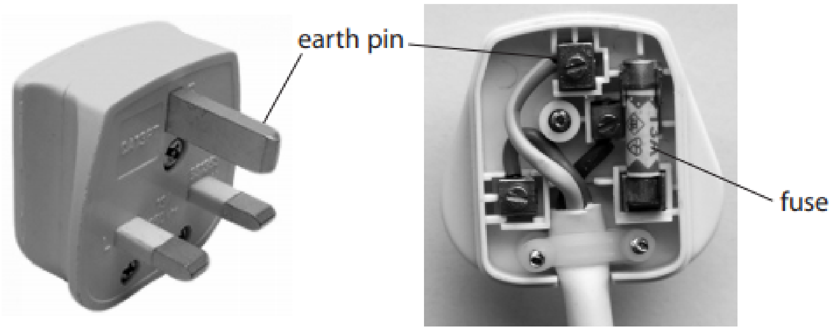


Figure 20

A fault occurs in the kettle causing the live wire to touch the metal case of the kettle.

Explain how the safety features of the plug operate when this fault occurs.

(6)

When the live wire touch the casing, the earth wire, which is also connected to the casing, provides a low resistant path for the electricity to flow to the ground. Due to the low resistance path, a large current flows to the ground. The fuse, which is made of a very thin wire, melts due to the high temperature in the fuse wire caused by the large current that flows. This causes the kettle to be disconnected from the mains supply.

5 Figure 11 shows the magnetic field of a magnet.

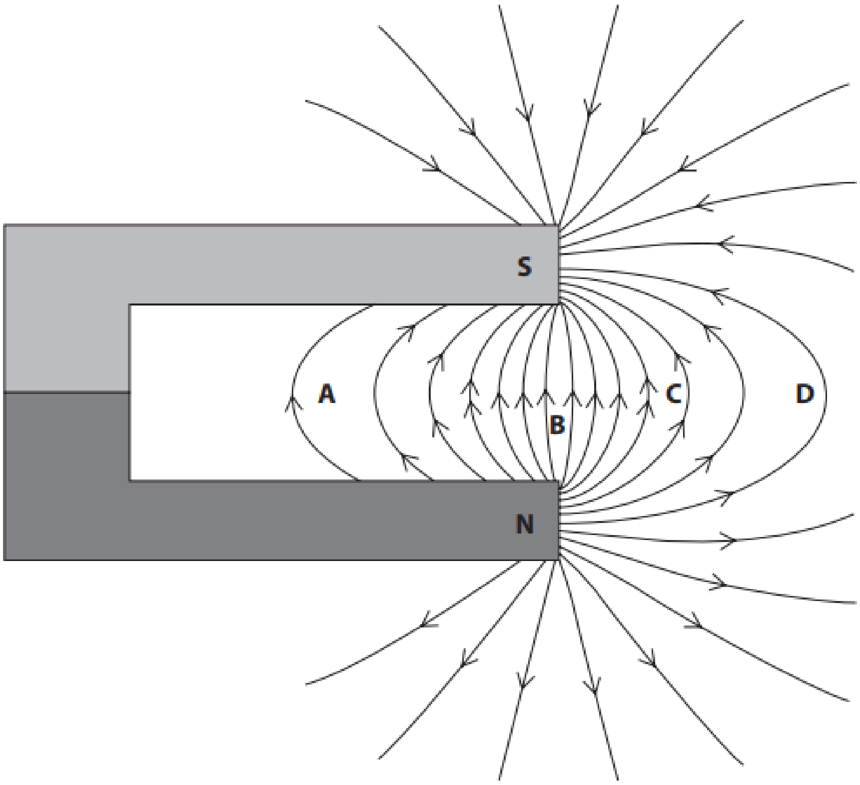


Figure 11

(a) At which point is the magnetic field strongest?

(1)

☐ **A**

☒ **B**

☐ **C**

☐ **D**

(b) Figure 12 shows a wire carrying a current.

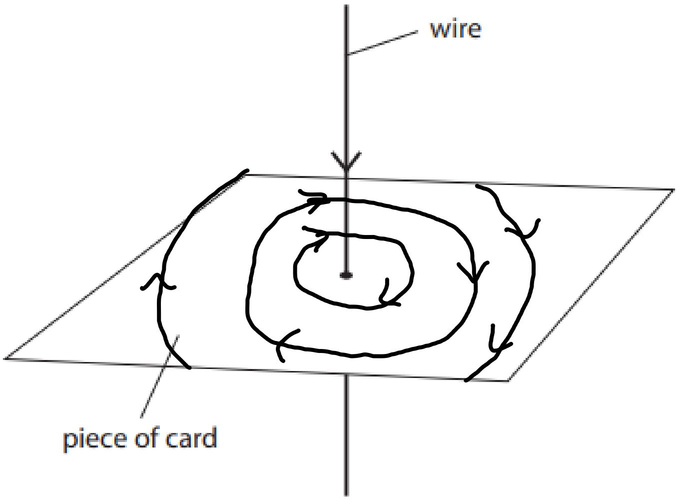


Figure 12

Draw, on the card in Figure 12, the magnetic field that is produced by the current.

(2)

(c) Figure 13 shows two metal rods carrying a current.

A metal roller touches both rods and completes the circuit.
The roller is in the magnetic field produced by a magnet.

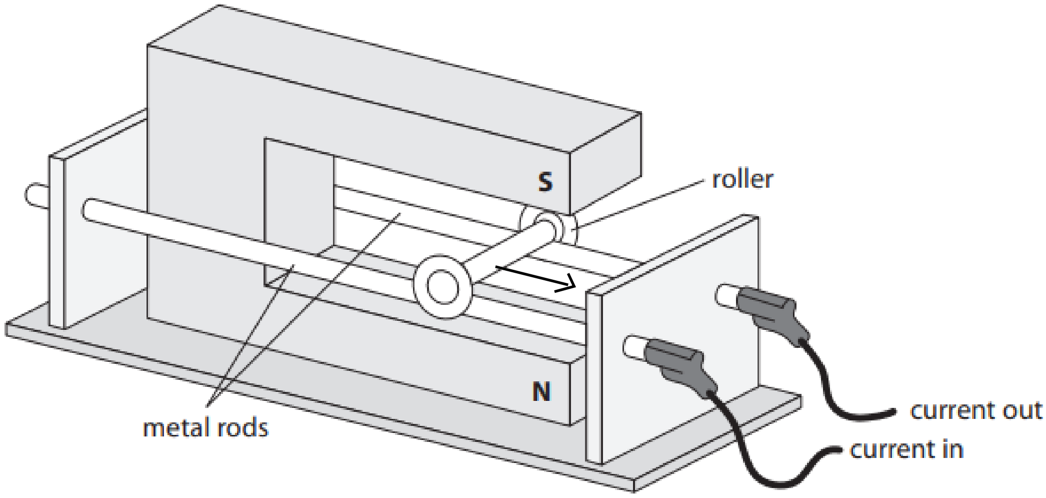


Figure 13

(i) The magnetic flux density of the magnetic field at the roller is 1.2 T.

The current in the roller is 2.5 A.

The length of the roller carrying the current is 0.060 m.

Calculate the force on the roller.

Use the equation

$$F = B \times I \times l$$

(2)

$F = 1.2 \times 2.5 \times 0.06$

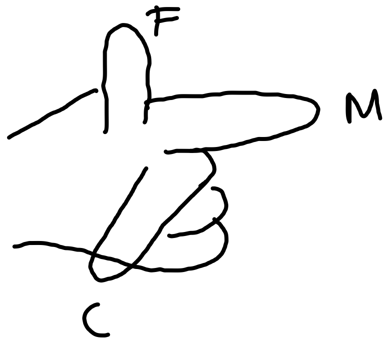
$= 0.18$

force on the roller = 0.18 N

(ii) Describe how Fleming's left-hand rule can be used to determine the direction of the force acting on the roller.

You may draw a diagram to help your answer.

(3)



Place the thumb, index finger and the third finger of the left hand at right angles to each other. Position the index finger to show the direction of the magnetic field and the third finger to show the direction of the current. The thumb will then show the direction of the force acting.

(iii) Draw an arrow on Figure 13 to show the direction of the force acting on the roller.

(1)

8 (a) A student investigates resistors connected in parallel using a number of resistors. Each resistor has the same resistance.

Figure 19 shows a circuit diagram with one resistor, R.

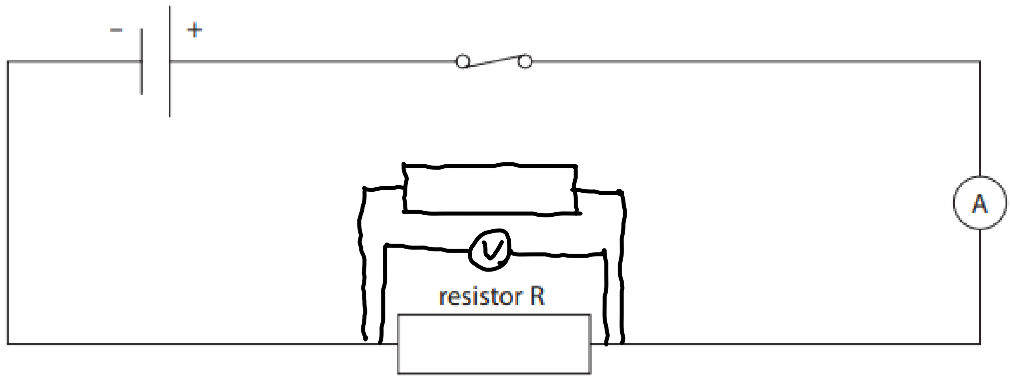


Figure 19

(i) Add to Figure 19:

- a voltmeter to find the potential difference across resistor R
- another resistor in parallel with resistor R.

(2)

(ii) State the measurements that the student must take to find the overall resistance of the resistors in parallel.

(2)

The overall pd across the system of resistors using a voltmeter and the total current in the system of resistors using an ammeter.

(iii) The student investigates how the overall resistance of the circuit changes when additional resistors are added in parallel to R.

Each resistor has the same resistance.

Figure 20 shows the results of the student's investigation.

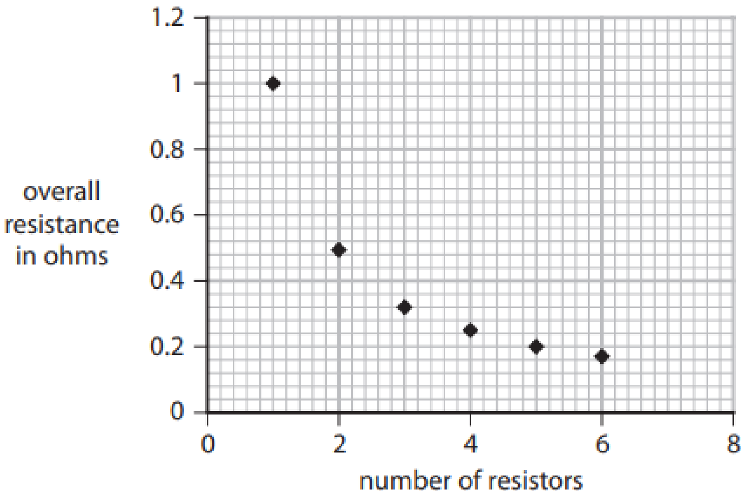


Figure 20

State the resistance of a single resistor.

(1)

resistance = 1 Ω

(iv) Comment on the relationship between the overall resistance of the circuit and the number of resistors in parallel.

Use information from Figure 20 to support your answer.

(3)

As the number of resistors increase from 1 to 6, the overall resistance has decreased from 1 to 0.6 Ω.

The decrease in overall resistance has a decreasing gradient.

(b) A different circuit is then set up with two resistors as shown in Figure 21.

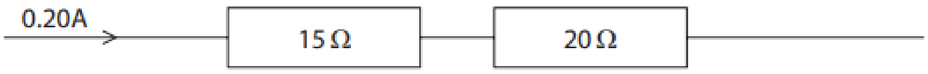


Figure 21

(i) Calculate the potential difference across the 15 Ω resistor.

(2)

$V = IR$

$= 0.2 \times 15$

potential difference = 3 V

(ii) Calculate the total power dissipated when there is a current of 0.20 A in the two resistors.

Use the equation

$$P = I^2 \times R$$

(2)

$P = (0.2)^2 \times [15 + 20]$

$= 0.04 \times 35$

power produced 1.4 W

TOTAL FOR PAPER IS 56 MARKS