

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 3 Physics Extension

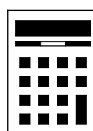
E

Wednesday 8 November 2023 07:00 GMT Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a protractor
- a scientific calculator
- the Physics Equations Sheet (enclosed).



Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a scientific calculator where appropriate.
- The Physics Equations Sheet is provided as a loose insert.



N 0 V 2 3 9 2 0 4 P E 0 1

IB/G/Nov23/E6

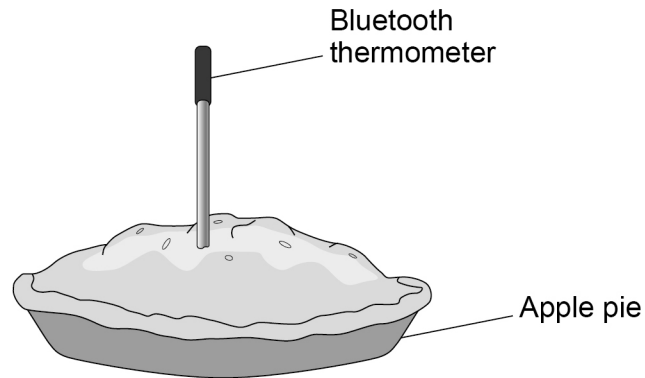
9204/PE

Answer **all** questions in the spaces provided.

0	1
---	---

Figure 1 shows a Bluetooth thermometer in an apple pie. The apple pie is in an oven.

Figure 1



The thermometer sends the temperature reading of the pie to a mobile phone using Bluetooth.

0	1	.	1
---	---	---	---

Bluetooth uses electromagnetic waves.

Electromagnetic waves are transverse waves.

Describe what is meant by 'transverse waves'.

[2 marks]



0 1 . 2

The initial temperature of the apples in the pie was 22 °C.

The final temperature of the apples in the pie was 93 °C.

The mass of the apples was 0.94 kg.

specific heat capacity of apples = 3600 J/kg °C

Calculate the energy transferred to the apples.

Use the Physics Equations Sheet.

Give your answer to **two** significant figures.

[4 marks]

Energy (two significant figures) = _____ J

0 1 . 3

The cooked apple pie was removed from the oven and left to cool.

Give **two** factors that affect the rate at which the apple pie cools.

[2 marks]

1 _____

2 _____



0	2
---	---

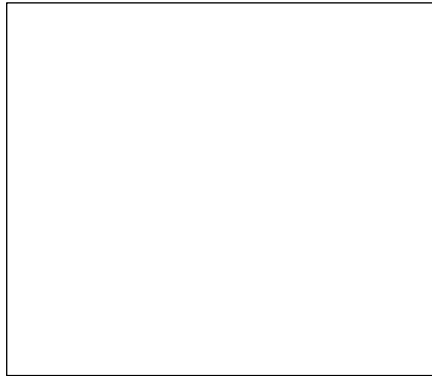
Filament lamps and LEDs are types of light bulbs used in homes.

LEDs are increasingly used in homes.

0	2	.	1
---	---	---	---

Draw the circuit symbol for an LED in the box below.

[1 mark]



0 2 . 2 **Table 1** gives information about the two types of light bulb.

Table 1

	Type of light bulb	
	Filament lamp	LED
Efficiency	0.10	0.75
Cost per light bulb in \$	1.00	4.00
Lifetime per light bulb in hours	1000	25 000

Both types of light bulb emit light of the same brightness.

Evaluate the benefits of replacing filament lamps with LEDs.

Use data from **Table 1**.

[4 marks]

Question 2 continues on the next page

Turn over ►



0	2	.	3
---	---	---	---

The efficiency of the LED is 0.75

The useful power output of the LED is 6.6 W.

Calculate the total power input to the LED.

Use the Physics Equations Sheet.

[3 marks]

Total power input = _____ W

0	2	.	4
---	---	---	---

What happens to the energy wasted from the LED?

[1 mark]

9



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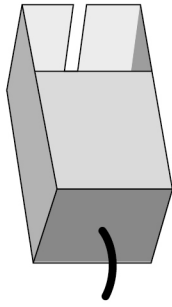
0 3

A student investigated how the angle of incidence affected the angle of refraction for a glass block.

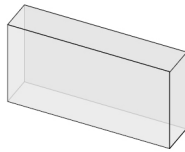
0 3**1**

Figure 2 shows some of the equipment used.

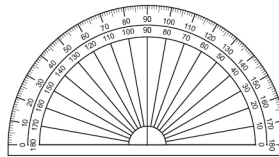
Figure 2



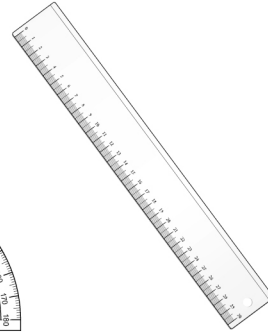
Ray box



Rectangular
glass block



Protractor



Ruler

Describe a method the student could have used to make measurements of the angle of incidence and the angle of refraction.

You may include a labelled diagram in your answer.

[6 marks]



Question 3 continues on the next page

Turn over ►



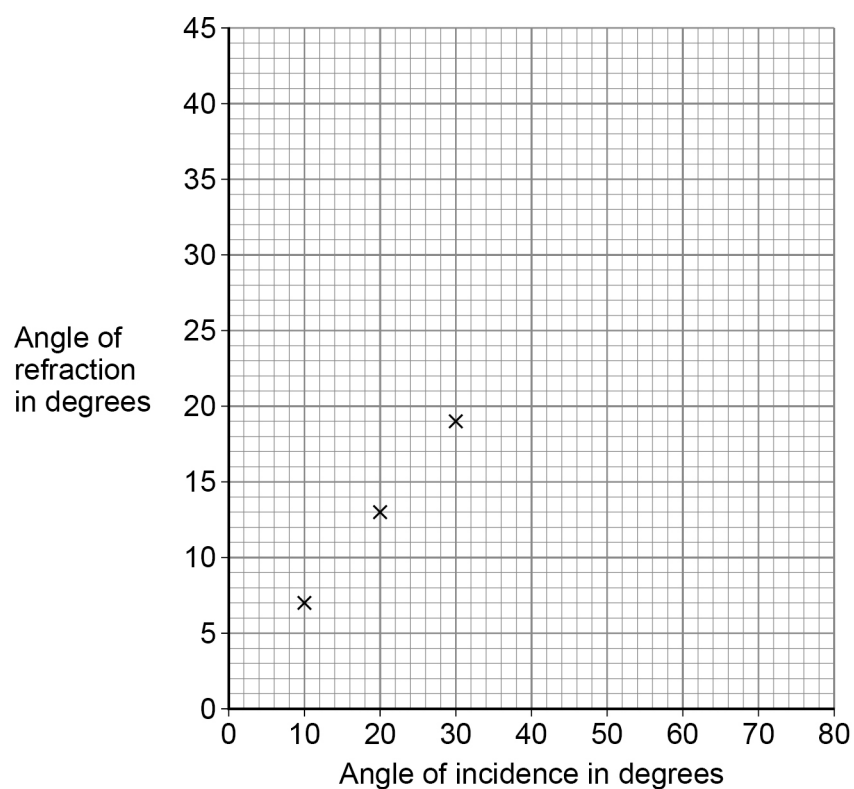
Table 2 shows the results.

Table 2

Angle of incidence in degrees	Angle of refraction in degrees
10	7
20	13
30	19
40	25
50	31
60	35
70	39
80	41

Figure 3 shows an incomplete graph of the data in **Table 2**.

Figure 3



0 3 . 2 Complete **Figure 3**.

You should:

- plot the remaining data from **Table 2** on the graph
- draw a line of best fit.

[3 marks]

0 3 . 3 Why is it more suitable to draw a line graph than a bar chart for the data in **Table 2**?

[1 mark]

Tick (✓) **one** box.

Both variables are categoric.

☐

Both variables are continuous.

☐

One variable is categoric and one is continuous.

☐

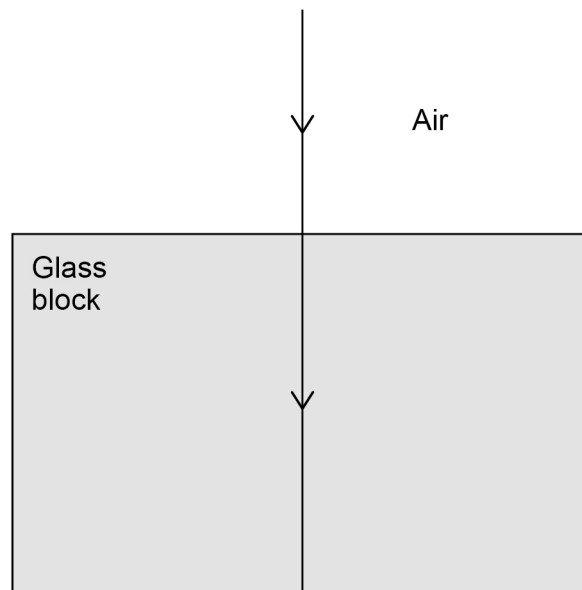
Question 3 continues on the next page

Turn over ►



Figure 4 shows a light ray in air incident on a glass block.

Figure 4



0 3 . 4

What happens to the speed of the light as the ray passes from the air into the glass block?

[1 mark]

0 3 . 5

Give the reason why the light ray does not change direction when entering the glass block.

[1 mark]



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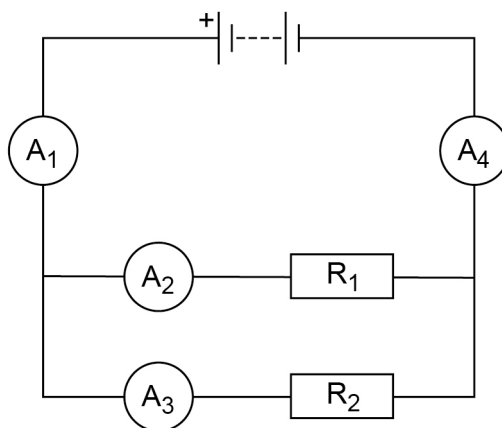
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0 4

Figure 5 shows a circuit set up by a student containing four ammeters, A_1 , A_2 , A_3 and A_4 .

Figure 5



The ammeters measure the current at different positions in the circuit.

The reading on A_1 is 30 mA.

The reading on A_3 is 20 mA.

0 4 . 1

Determine the readings on ammeters A_2 and A_4 .

Give your answers in mA.

[2 marks]

$A_2 =$ _____ mA

$A_4 =$ _____ mA

0 4 . 2

The student added a voltmeter to the circuit to measure the potential difference across R_2 .

Draw the voltmeter in the correct place on **Figure 5**.

You should use the circuit symbol for a voltmeter.

[1 mark]



The potential difference across R_2 is 9.0 V.

0 4 . 3

The current in R_2 is 20 mA.

Determine the resistance of R_2 .

Give the unit.

Use the Physics Equations Sheet.

[4 marks]

Resistance = _____ Unit _____

0 4 . 4

What is the potential difference across R_1 in **Figure 5**?

[1 mark]

Tick (✓) **one** box.

4.5 V

☐

9.0 V

☐

18.0 V

☐

Question 4 continues on the next page

Turn over ►



0 4 . 5

Explain why a current in a resistor causes the temperature of the resistor to increase.

[3 marks]

0 4 . 6

The potential difference across a resistor is constant.

The temperature of the resistor increases.

How do the resistance of the resistor and the current in the resistor change?

[1 mark]Tick (✓) **one** box.

Resistance decreases and current decreases

☐

Resistance decreases and current increases

☐

Resistance increases and current decreases

☐

Resistance increases and current increases

☐

12



Turn over for the next question

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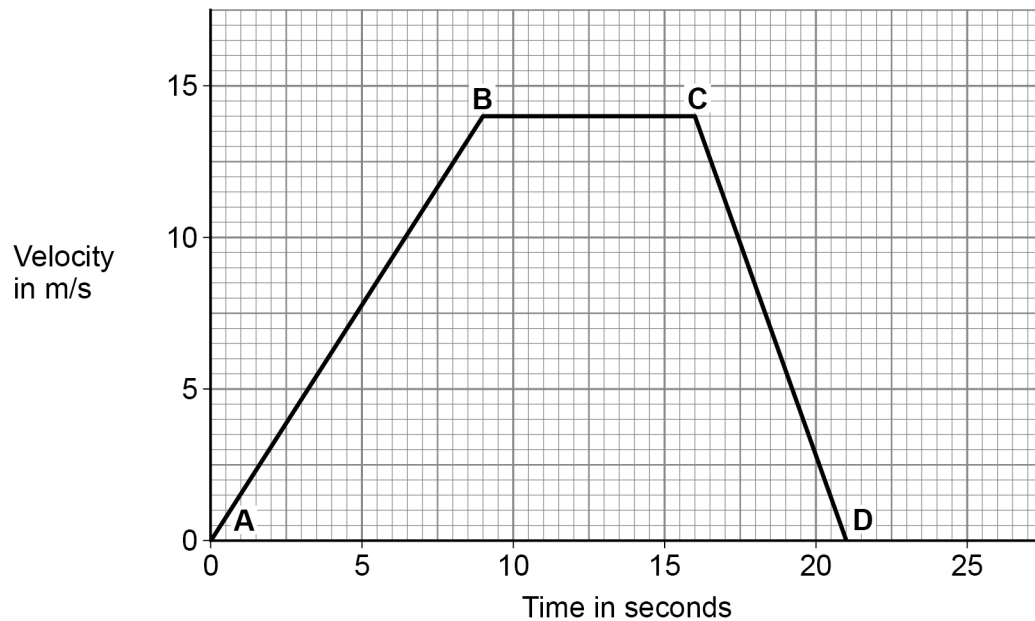
0 5

A delivery truck contains parcels.

The truck is driven along a route to deliver the parcels.

Figure 6 shows a velocity-time graph for part of the route.

Figure 6

**0 5****1**

Describe the motion of the truck during the sections labelled AB and BC.

[2 marks]

AB _____

BC _____

0 5**2**

Calculate the deceleration of the truck during the section labelled CD.

[2 marks]

Deceleration = _____ m/s²



0 5 . 3

Determine the total distance travelled by the truck.

Use **Figure 6**.**[3 marks]**

Total distance travelled = _____ m

Question 5 continues on the next page**Turn over ►**

The stopping distance of the truck depends on the thinking distance and the braking distance.

0 5 . 4

What is meant by 'braking distance'?

[1 mark]

The braking distance of the truck when full of parcels was 20 m.

The braking distance of the truck when empty was 16 m.

In both situations:

- the same braking force was applied
- the truck was travelling at the same speed.

0 5 . 5

Calculate the percentage decrease in braking distance of the truck when empty compared to the truck full of parcels.

[2 marks]

Percentage decrease = _____ %



0	5	.	6
---	---	---	---

The truck when empty has a shorter braking distance than the truck when full.

Explain why.

[3 marks]

13

Turn over for the next question

Turn over ►

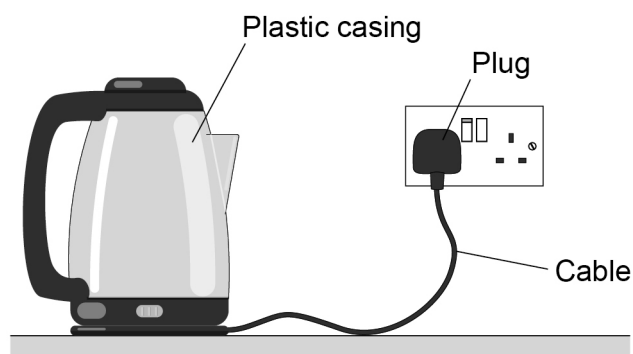


0 6

Kettles are used to boil water.

Figure 7 shows a kettle connected to the mains electricity supply by a cable and a plug.

Figure 7



0 6

1

Mains electricity is an alternating current (ac) supply.

What is meant by 'alternating current'?

[1 mark]

0 6

2

The cable in **Figure 7** does not have an earth wire.

Explain why the kettle does not need to be earthed.

[2 marks]



0 6 . 3

The plug contains a fuse.

Explain how a fuse works.

[2 marks]

0 6 . 4

The kettle is filled with water and switched on for 3.0 minutes.

The power of the kettle is 2400 W.

One kilowatt-hour of energy costs \$0.25.

Calculate the cost of switching the kettle on for 3.0 minutes.

[4 marks]

Cost = \$ _____

Question 6 continues on the next page**Turn over ►**

0	6	.	5
---	---	---	---

There is a heating element in the bottom of the kettle.

Explain how a convection current forms in the water when the kettle is switched on.

[4 marks]

13



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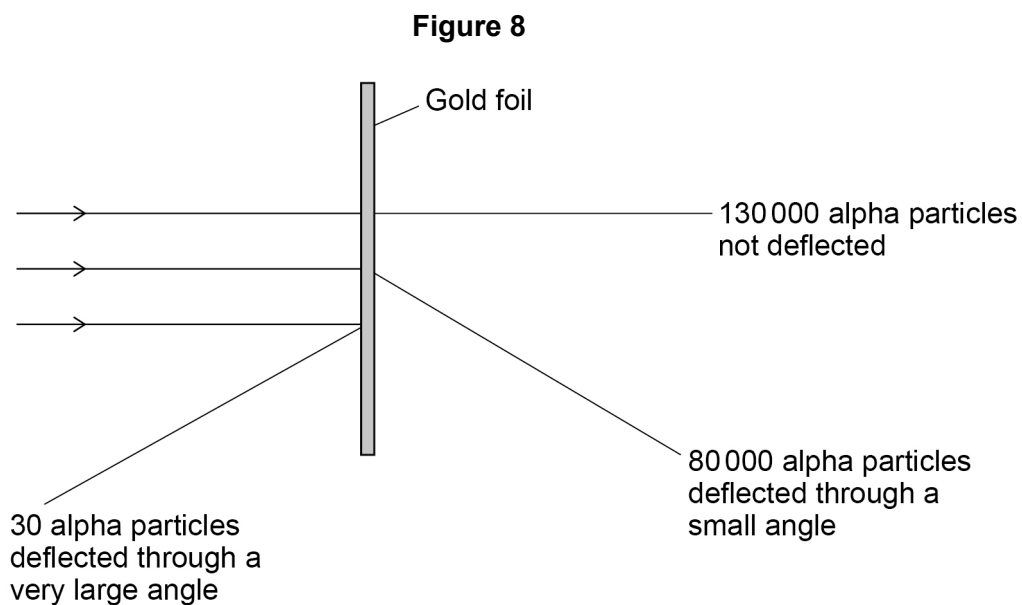
0 7

In 1909, scientists carried out alpha particle scattering experiments.

The experiments involved directing alpha particles at a piece of gold foil.

The paths of the alpha particles were detected.

Figure 8 shows some of the paths of the alpha particles.

**0 7 . 1**

What does an alpha particle consist of?

[1 mark]



0 7 . 2

Explain how the alpha particle scattering experiment provided evidence for the distribution of mass and charge in an atom.

[4 marks]

0 7 . 3

A piece of gold foil has a thickness of 5.1×10^{-6} m.

The diameter of a gold atom is 1.7×10^{-10} m.

Calculate the number of gold atoms that would make up this thickness.

Give your answer in standard form.

[3 marks]

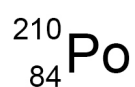
Number of gold atoms (standard form) = _____

Question 7 continues on the next page

Turn over ►

0 7 . 4

Polonium-210 (Po-210) is a radioactive isotope that can be represented as:



Polonium-210 decays by emitting an alpha particle.

Give the mass number and atomic number of the new isotope formed.

[2 marks]

Mass number = _____

Atomic number = _____

0 7 . 5

An alpha source inside the human body is more harmful than an alpha source outside the human body.

Explain why.

[4 marks]

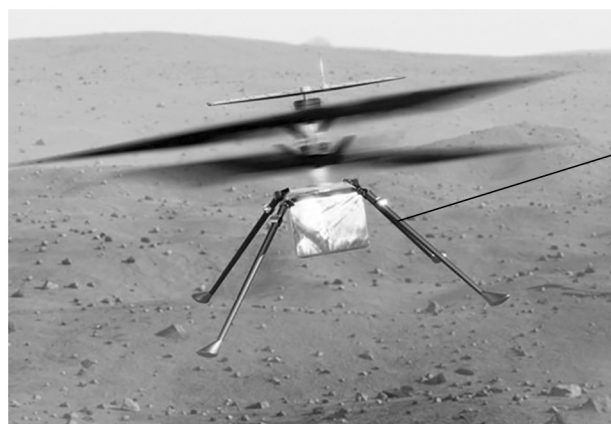


0 8

A small helicopter was flown on the planet Mars. The helicopter was controlled by scientists on Earth.

Figure 9 shows an image of the helicopter above the surface of Mars.

Figure 9



Helicopter

0 8**. 1**

The weight of the helicopter on Mars is less than the weight of the helicopter on Earth.

Give the reason why.

[1 mark]

Question 8 continues on the next page

Turn over ►



0 8 . 2

The helicopter flew vertically upwards from the surface of Mars to a height of 3.0 m.

The mass of the helicopter is 1800 g.

The useful output power of the helicopter's motor is 5.55 W.

Calculate the time taken for the helicopter to reach a height of 3.0 m.

gravitational field strength of Mars = 3.7 N/kg

[6 marks]

Time = _____ s



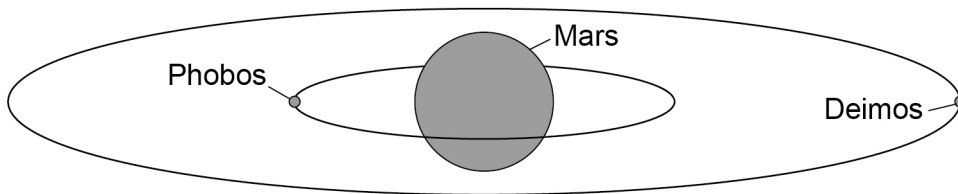
Mars has two moons, Deimos and Phobos.

Deimos and Phobos orbit Mars at constant speeds.

The orbits of Deimos and Phobos are circular.

Figure 10 shows the circular orbits of Deimos and Phobos around Mars.

Figure 10



0 8 . 3 The orbital speed of Deimos is 1400 m/s.

The orbital speed of Phobos is 2100 m/s.

Explain why Phobos has a greater orbital speed than Deimos.

Use **Figure 10**.

[2 marks]

0 8 . 4 Explain why Deimos and Phobos are accelerating even though their speeds are constant.

[3 marks]



0 9

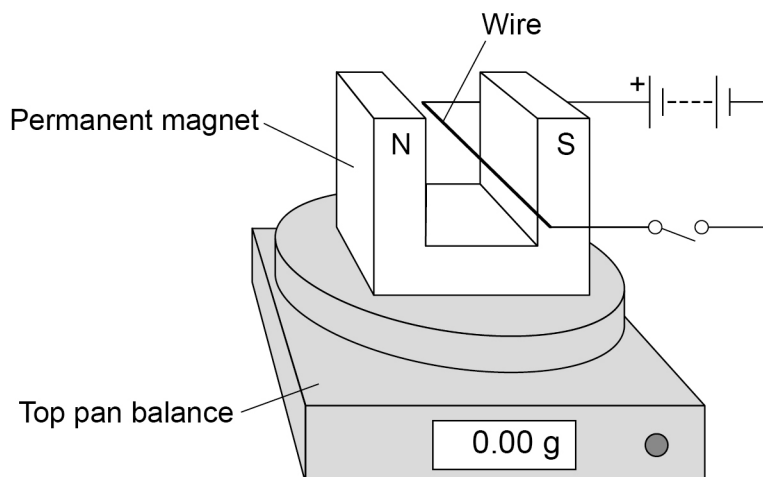
A student placed a permanent magnet on a top pan balance and reset the balance to zero.

The student placed a straight piece of wire perpendicular to the magnet's magnetic field.

The student connected the wire to a battery and a switch.

Figure 11 shows the arrangement.

Figure 11



The student closed the switch and the wire in **Figure 11** experienced an upwards force.

0 9

. 1

What effect was demonstrated when the wire experienced an upwards force?

[1 mark]

0 9

. 2

Describe how the direction of the force on the wire can be determined using Fleming's Left-Hand Rule.

[2 marks]



0 9 . 3

Give **two** ways to reverse the direction of the force acting on the wire.**[2 marks]**

1 _____

2 _____

0 9 . 4

Explain why the reading on the balance increased when the wire experienced an upwards force.

[2 marks]

7**END OF QUESTIONS**

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