SPECIMEN MATERIAL

AQA

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier Paper 6: Physics 2H

Specimen 2018 Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a calculator
- the Physics Equation Sheet (enclosed).

Instructions
- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- There are 70 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.
- When answering questions 01.6 and 06.3 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number | | | | | | Candidate number | 8 | 0 | 5 | 5 |

Surname GOODONE-LOOKSLIKE

Forename(s) WHATTA

Candidate signature _____

0 1 Four students tested their reaction times using a computer program.

When a green light appeared on the screen the students had to press a key.

Table 1 shows their results.

Table 1

Student	Reaction time in s			Mean reaction time in s
	Test 1	Test 2	Test 3	
Boy 1	0.28	0.27	0.26	0.27
Boy 2	0.28	0.47	0.22	0.25
Girl 1	0.31	0.29	0.27	0.29
Girl 2	0.32	0.30	0.29	0.30

0 1 . 1 What is meant by 'reaction time' in this experiment?

[1 mark]

THE TIME TAKEN BETWEEN SEEING THE LIGHT AND PRESSING THE KEY

0 1 . 2 Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

[1 mark]

HE COULD HAVE BEEN DISTRACTED

0 1 . 3 Give **one** conclusion that can be made from the results in **Table 1**.

[1 mark]

BOYS HAVE FASTER REACTION TIMES THAN GIRLS

0 1 . 4 Suggest further evidence that you could collect to support your conclusion.

[1 mark]

TEST MORE PEOPLE

Reaction time is important at the start of a race.

Table 2 shows the time taken by a boy to run different distances.

Table 2

Distance in m	Time in s
* 100	12.74
200	25.63
Δ 800	139.46

0 1 . 5 Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

[2 marks]

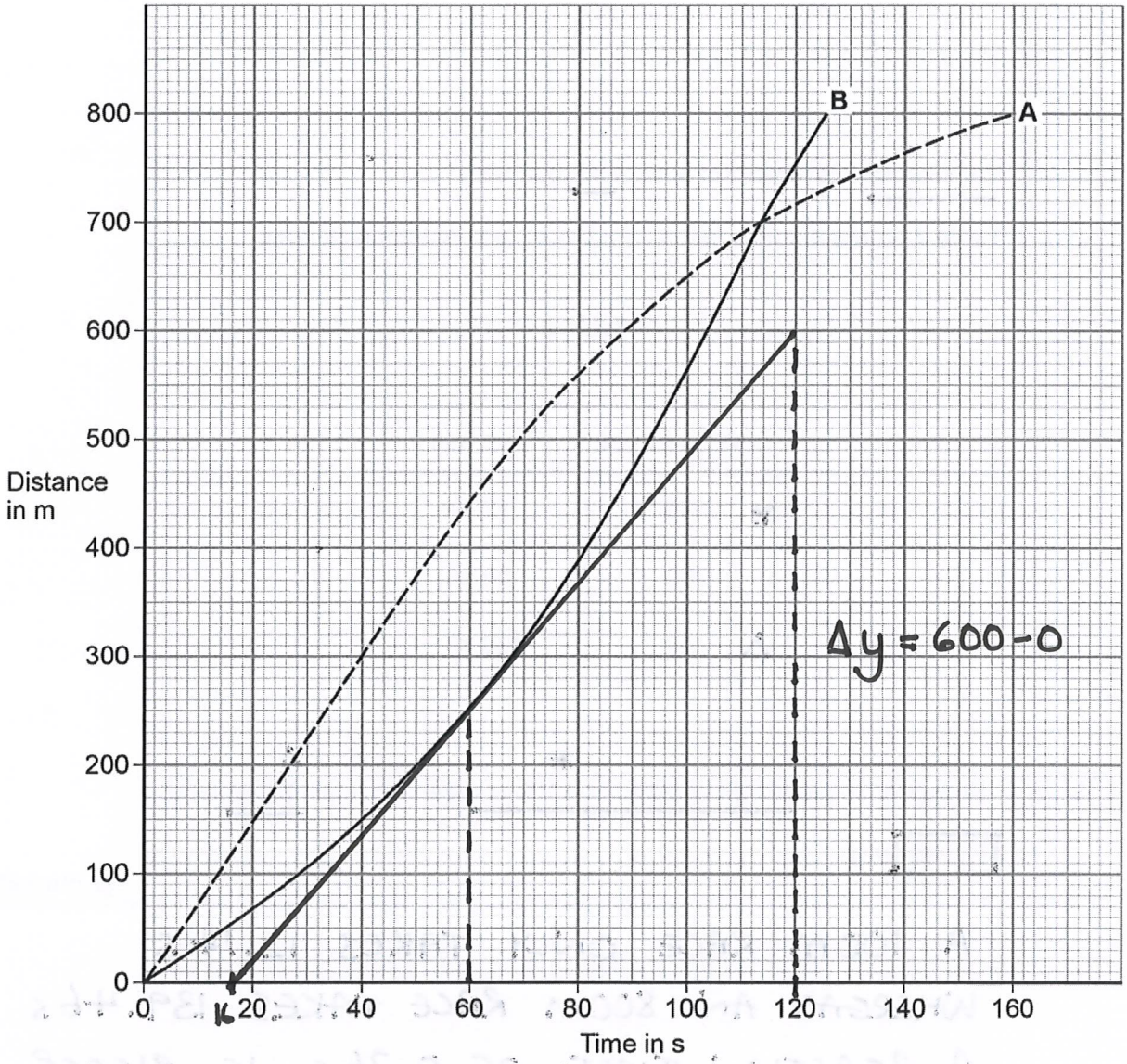
A 100M RACE ONLY TAKES 12.74S WHEREAS AN 800M RACE TAKES 139.46S. A REACTION TIME OF 0.26S IS BIGGER PROPORTIONALLY IN THE 100M RACE SO WILL HAVE MORE OF AN EFFECT

Question 1 continues on the next page

Two girls, **A** and **B**, ran an 800 m race.

Figure 1 shows how the distance changed with time.

Figure 1



0 1 . 6 Compare the motion of runners **A** and **B**.

Include data from **Figure 11**.

[6 marks]

GIRL A STARTS THE RACE RUNNING AT A CONSTANT SPEED FOR 60s (440m) AFTER THIS TIME SHE GRADUALLY SLOWS DOWN UNTIL THE END OF THE RACE AT 160 s (800m)
GIRL B STARTS THE RACE RUNNING SLOWER THAN GIRL A BUT HER SPEED INCREASES THROUGHOUT THE RACE. SHE OVERTAKES GIRL A AT A DISTANCE OF 700 m AND FINISHES THE RACE IN 126s SO BEATS GIRL A BY 34 SECONDS

0 1 . 7 Use **Figure 1** to determine Girl **B**'s speed at 60 s.

Show how you use the graph to obtain your answer. * MATHS SKILL *

[3 marks]

$\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}} = \text{GRADIENT} = \frac{\Delta y}{\Delta x} = \frac{600 - 0}{120 - 16}$

Speed = 5.8 m/s

Turn over for the next question

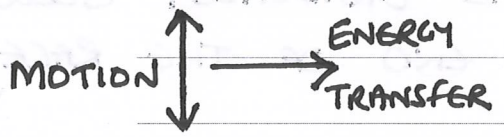
0 2 A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit. The monitor unit then displays an image of the baby and emits the noises the baby makes.

LIGHT SOUND

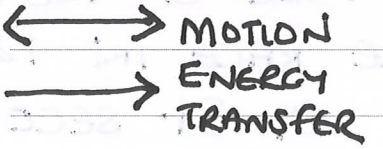
0 2 . 1 Compare the properties of the waves that transmit images and noises from the monitor unit.

[4 marks]

- LIGHT WAVES ARE TRANSVERSE WAVES



- THE OSCILLATIONS ARE AT 90° TO THE DIRECTION OF ENERGY TRANSFER
- LIGHT WAVES TRAVEL MUCH FASTER THAN SOUND (3×10^8 m/s COMPARED TO ~330 m/s)
- SOUND WAVES ARE LONGITUDINAL WAVES



- THE OSCILLATIONS ARE IN THE SAME PLANE (PARALLEL) TO THE DIRECTION OF ENERGY TRANSFER

0 2 . 2 The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

[1 mark]

THE BABY CAN BE SEEN IN THE DARK / WITH THE LIGHT OFF

0 2 . 3 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

Equation SPEED = FREQUENCY × WAVELENGTH

0 2 . 4 The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

Wave speed of electromagnetic waves = 3×10^8 m/s

Calculate the frequency of the signal.

[3 marks]

$c = f\lambda$ REARRANGING $f = \frac{c}{\lambda}$

$\therefore f = \frac{3 \times 10^8}{0.125}$

Frequency = 2.4×10^9 Hz

EXAM TIP:

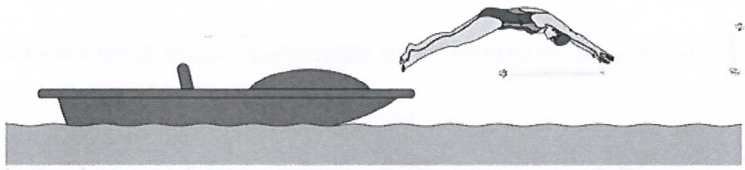
- MAKE SURE YOU USE YOUR CALCULATOR CORRECTLY
- USE BIDMAS

Turn over for the next question

0 3 A swimmer dives off a boat.

Look at **Figure 2**.

Figure 2



P

0 3 . 1 What **two** factors determine the momentum of the swimmer?

[2 marks]

1 MASS

2 VELOCITY

0 3 . 2 What is the unit of momentum?

[1 mark]

Tick **one** box.

- J/s ☐
- kg m/s ☑
- N m ☐
- m/s^2 ☐

0 3 . 3 The boat was stationary.

As the swimmer dives forwards, the boat moves backwards.

Use the idea of conservation of momentum to explain why the boat moves backwards.

[4 marks]

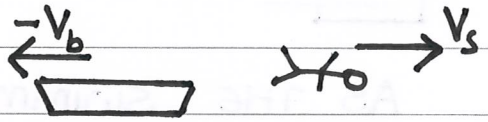
CONSERVATION OF MOMENTUM:

TOTAL MOMENTUM BEFORE = TOTAL MOMENTUM AFTER

BEFORE

MOMENTUM = 0

AFTER



TOTAL MOMENTUM = 0

SO $-V_b + V_s = 0$

THE MOMENTUM OF THE BOAT IS EQUAL & OPPOSITE TO THE SWIMMER

0 3 . 4 Explain what would happen to the motion of the boat if there were more people on the boat when the swimmer dived off.

[2 marks]

MOMENTUM = MASS × VELOCITY

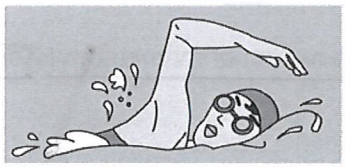
SO IF MASS INCREASES VELOCITY WILL DECREASE

∴ THE BOAT WILL MOVE BACKWARDS MORE SLOWLY

Question 3 continues on the next page

0 3 . 5

Forward thrust



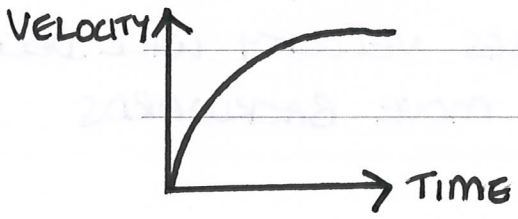
The swimmer's speed increases as she swims away from the boat.

The swimmer has a top speed.

Explain why.

[5 marks]

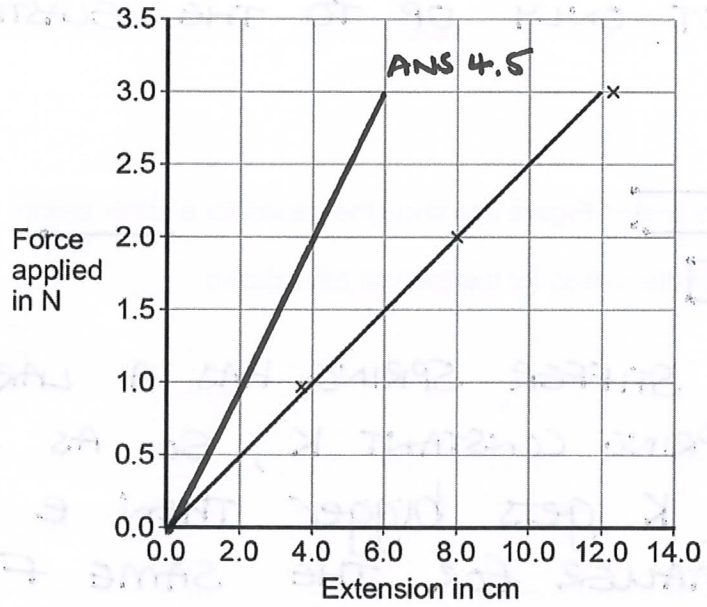
AS THE SWIMMER MOVES FORWARDS THROUGH THE WATER THERE IS A DRAG FORCE ACTING ON HER (ACTING BACKWARDS). THE SIZE OF THIS DRAG FORCE INCREASES WITH HER SPEED UNTIL THE DRAG FORCE = THRUST FORCE. AT THIS POINT SHE IS NO LONGER ACCELERATING AND HAS REACHED HER TERMINAL VELOCITY.



0 4 A student changed the force applied to a spring by adding weights.

Figure 3 shows a graph of her results.

Figure 3



0 4 . 1 Write down the equation that links the force applied and extension for a spring.

[1 mark]

FORCE APPLIED = SPRING CONSTANT x EXTENSION

0 4 . 2 Identify the pattern shown in **Figure 3**.

Explain your answer.

[2 marks]

THE EXTENSION IS DIRECTLY PROPORTIONAL TO THE FORCE APPLIED.
THE GRAPH SHOWS A STRAIGHT LINE WHICH GOES THROUGH THE ORIGIN

0 4 . 3 Give **one** way the student could improve her investigation.

[1 mark]

TEST A GREATER RANGE OF FORCE APPLIED

0 4 . 4 Describe the relationship between work done and elastic potential energy in stretching a spring.

[2 marks]

WORK DONE = ENERGY TRANSFERRED
= ELASTIC POTENTIAL ENERGY
BUT ONLY UP TO THE ELASTIC LIMIT

0 4 . 5 Draw a line on **Figure 3** to show the results for a stiffer spring.

Explain the reason for the line you have drawn.

[3 marks]

A STIFFER SPRING HAS A LARGER SPRING CONSTANT K, SO AS $F=ke$ IF K gets bigger THEN e WILL BE SMALLER FOR THE SAME F.

0 4 . 6 Explain what would happen to the spring if the student kept adding weights?

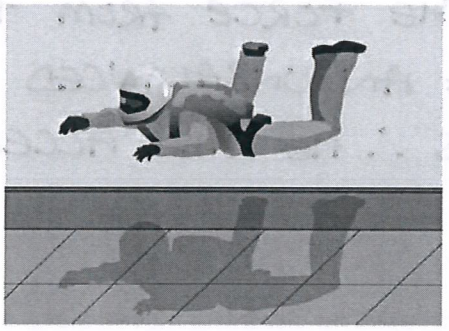
[2 marks]

THE SPRING WILL BE PERMANENTLY DEFORMED AS IT WILL HAVE BEEN STRETCHED BEYOND ITS ELASTIC LIMIT.

0 5 **Figure 4** shows a skydiver training in an indoor wind tunnel.

Large fans below the skydiver blow air upwards.

Figure 4

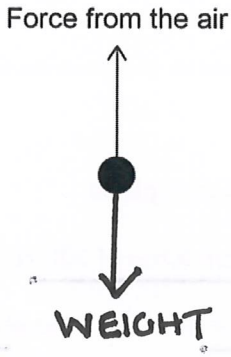


0 5 . 1 The skydiver is in a stationary position.

MEANS FORCES ARE BALANCED

Complete the free body diagram for the skydiver.

[2 marks]



EXAM TIP:
MAKE SURE YOU KNOW THE DIFFERENCE BETWEEN MASS & WEIGHT.

Question 5 continues on the next page

0 5 . 2 The skydiver now straightens his legs to increase his surface area.

This causes the skydiver to accelerate upwards.

Explain why straightening his legs cause the skydiver to accelerate upwards.

[2 marks]

AS HIS SURFACE AREA INCREASES SO DOES THE FORCE FROM THE AIR. THERE WILL BE AN UNBALANCED FORCE ACTING UPWARDS ∴ HE WILL ACCELERATE UPWARDS

0 5 . 3 A small aeroplane used for skydiving moves along a runway.

The aeroplane accelerates (a) at 2 m/s^2 from a velocity (u) of 8 m/s.

After a distance (s) of 209 m it reaches its take-off velocity (v).

Calculate the take-off velocity of the aeroplane.

[3 marks]

$V^2 = u^2 + 2as$

$V^2 = 8^2 + (2 \times 2 \times 209)$

$V = \sqrt{900}$

Take-off velocity = 30 m/s

0 5 . 4 A skydiver jumps from an aeroplane.

There is a resultant vertical force of 300 N on the skydiver.

There is a horizontal force from the wind of 60 N.

Draw a vector diagram on **Figure 5** to determine the magnitude and direction of the resultant force on the skydiver.

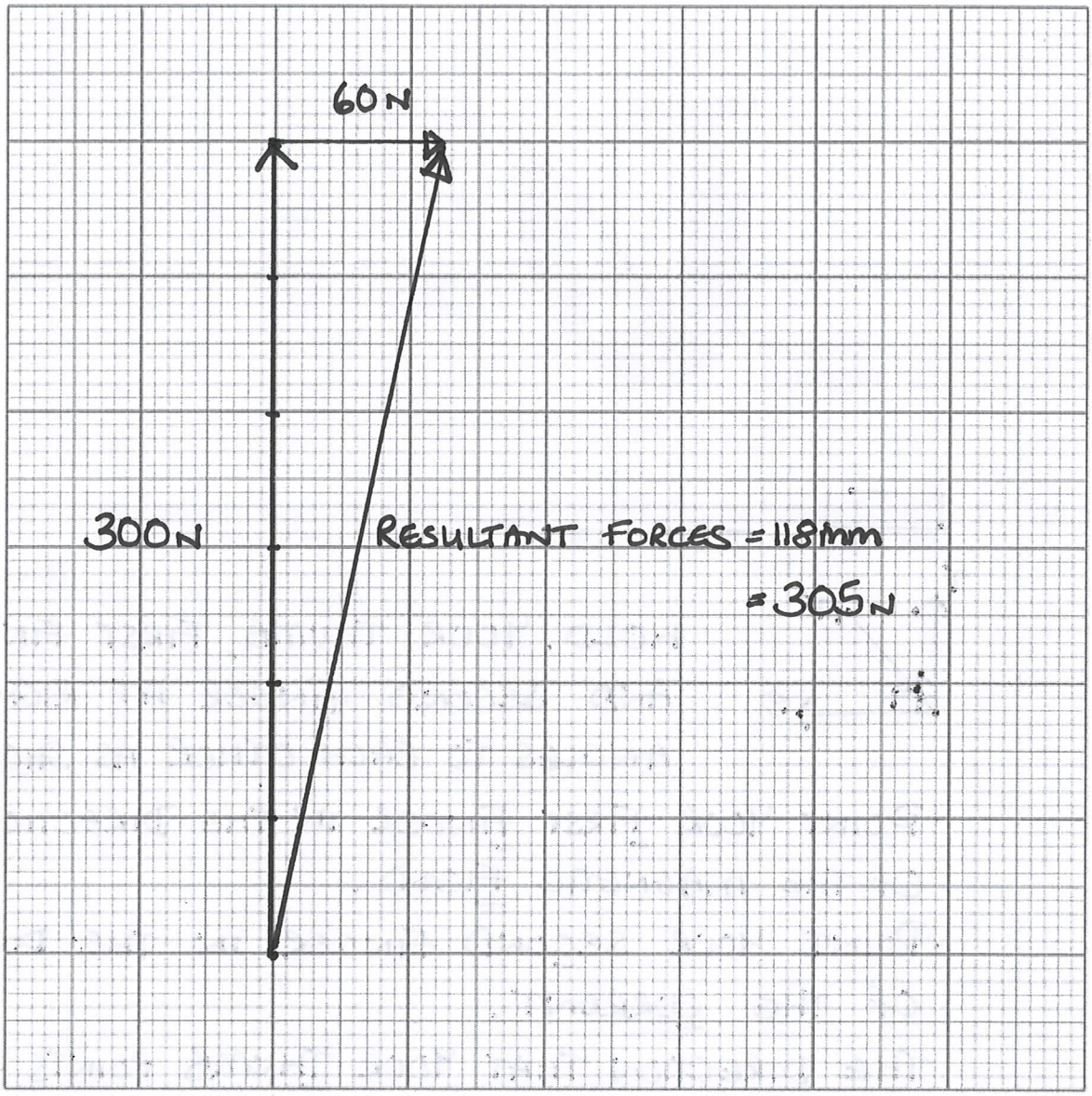
[4 marks]

WORK OUT A SUITABLE SCALE TO FILL OVER 1/2 THE GRAPH

SCALE = 10mm = 50 N

Figure 5

∴ 300N = 600mm 60N = 12mm



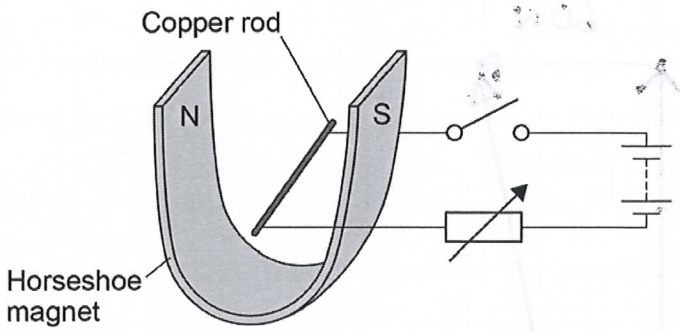
EXAM HINT / TIP: YOU CAN USE PYTHAGORAS THEOREM TO CHECK YOUR ANSWER

Magnitude of resultant force = 305 N N

Turn over for the next question

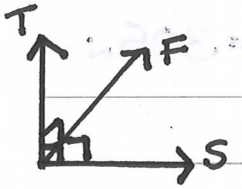
0 6 A teacher used the equipment shown in **Figure 6** to demonstrate the motor effect.

Figure 6



0 6 . 1 Describe how Fleming's left-hand rule can be used to determine the direction in which the rod will move when the switch is closed, and state the direction.

[4 marks]



HOLD YOUR THUMB, FIRST FINGER AND SECOND FINGER AT RIGHT ANGLES TO EACH OTHER AS SHOWN

- POINT YOUR FIRST FINGER IN THE DIRECTION OF THE MAGNETIC FIELD.
- POINT YOUR SECOND FINGER IN THE DIRECTION OF THE CURRENT.

THE DIRECTION THAT YOUR THUMB POINTS SHOWS THE DIRECTION THE WIRE MOVES ∴ IT WILL MOVE UPWARDS.

0 6 . 2 Increasing the current can increase the force acting on the copper rod.

Give **one** other way in which the size of the force acting on the copper rod could be increased.

[1 mark]

USE A STRONGER MAGNET

L = 0.07m

m

0 6 . 3 The copper rod in **Figure 6** has a length of 7 cm and a mass of 4×10^{-4} kg.

I

F

When there is a current of 1.12 A the resultant force on the copper rod is 0 N.

Calculate the magnetic flux density.

Gravitational field strength = 9.8 N/kg

g

[5 marks]

$F = BIL$ BUT $F = mg$

COMBINING AND REARRANGING

$$B = \frac{mg}{IL} = \frac{9.8 \times (4 \times 10^{-4})}{1.12 \times 0.07}$$

Magnetic flux density = 0.05 T

END OF QUESTIONS

There are no questions printed on this page