FORM TP 2018022

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JANUARY 2018

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

PHYSICS

Paper 02 – General Proficiency

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of two sections: A and B.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section.
3. Section B consists of THREE questions. Candidates must attempt ALL questions in this section.
4. All answers MUST be written in this answer booklet.
5. Do NOT write in the margins.
6. All working MUST be clearly shown.
7. You may use a silent, non-programmable calculator, but you should note that the use of an inappropriate number of figures in answers will be penalized.
8. Mathematical tables are provided.
9. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
10. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

You MUST write your answers in this answer booklet.

1. (a) A student conducted an experiment on light travelling from glass to air. Figure 1 is a diagram showing light travelling from glass to air. The results of the experiment are recorded in Table 1.

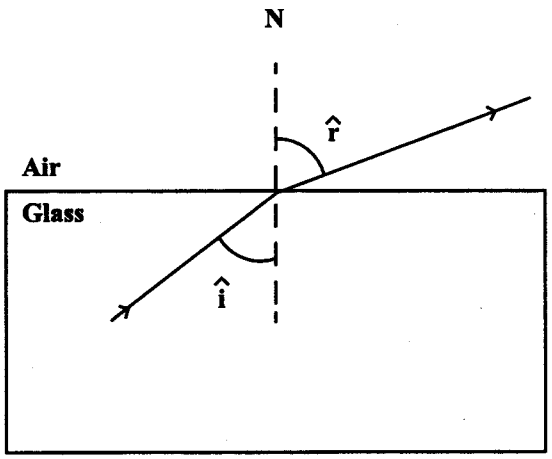

Figure 1. Light travelling from glass to air

TABLE 1

Angle of Refraction, $\hat{r}$	Angle of Incidence, $\hat{i}$	sin $\hat{r}$	sin $\hat{i}$
10.0	6.5		
30.0	19.0		
50.0	30.0		
70.0	38.0		
90.0	41.0		

(i) Complete Table 1 by calculating the values of sin $\hat{r}$ and sin $\hat{i}$. **(5 marks)**

(ii) Using the calculated values in Table 1, plot a graph of sin $\hat{r}$ against sin $\hat{i}$ on the grid **on page 5**. **(8 marks)**

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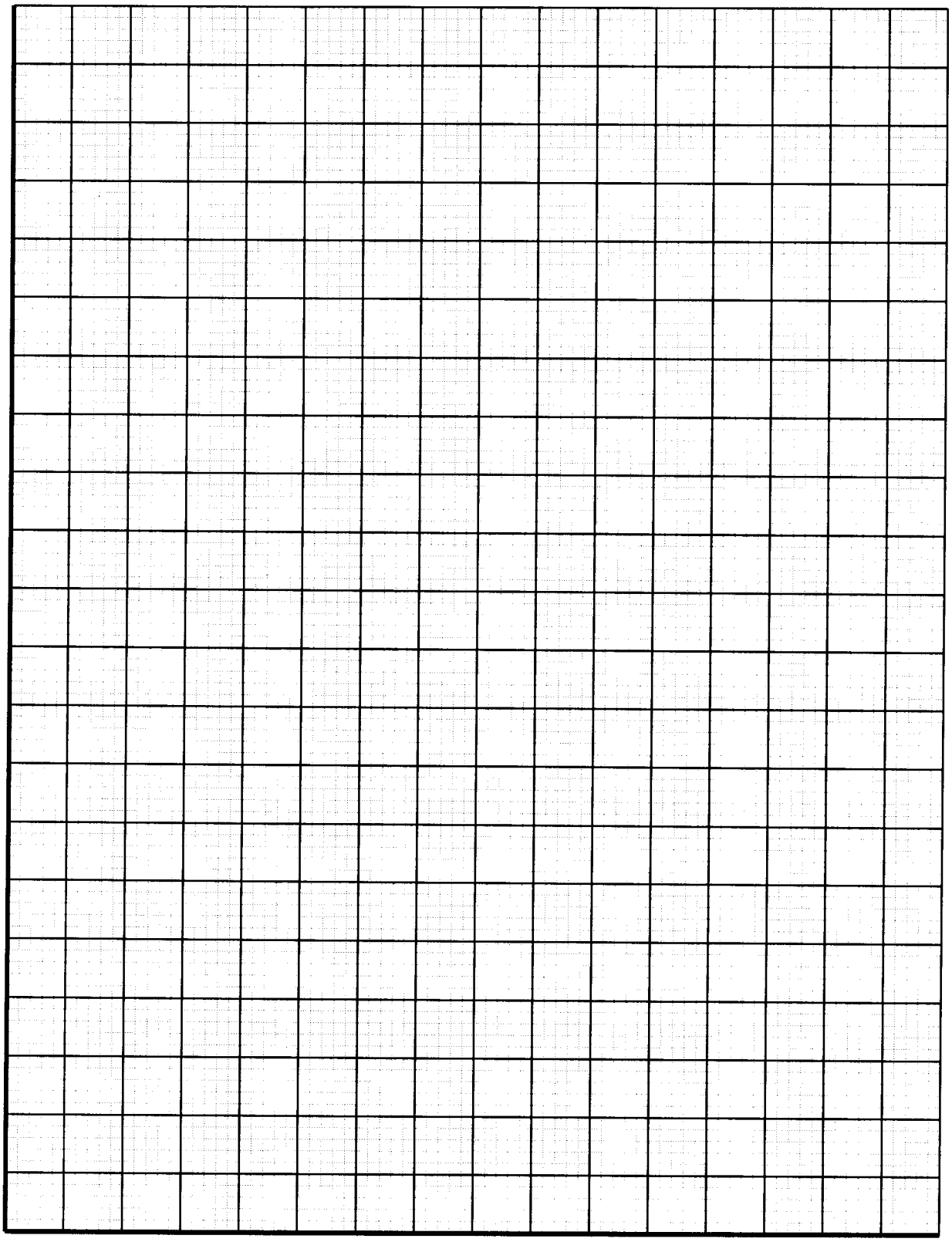

(iii) Calculate the gradient of the graph.

(4 marks)

(b) State the name of the physical property represented by the gradient in (a) (iii).

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(1 mark)

(c) (i) Explain the term 'critical angle'.

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(2 marks)

(ii) Using Table 1, or otherwise, state the critical angle for the glass used in (a).

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(1 mark)

(d) Figure 2 shows light travelling in the core of a fibre optic cable as it reflects off the cladding.

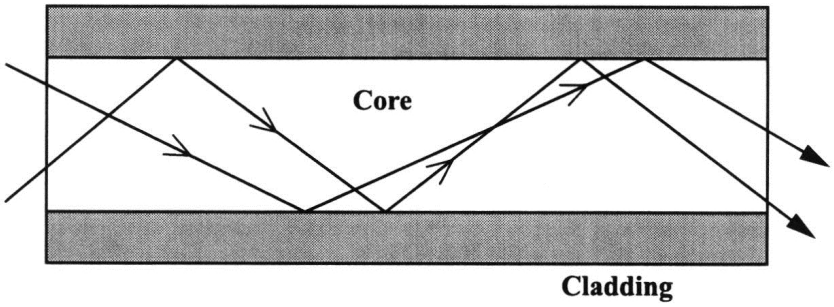

Figure 2. Light travelling in the core of the fibre optic cable

If the refractive index from the cladding to the core is 1.03, calculate the critical angle in the core.

(4 marks)

Total 25 marks

2. (a) Complete Table 2 to distinguish among solids, liquids and gases using the terms 'definite/ fixed', 'vibrate', 'move freely', 'very weak/negligibly weak', 'no fixed shape'.

TABLE 2

	Shape	Volume	Movement of Molecules	Intermolecular Forces
Solid		Definite/fixed		Strong
Liquid	Takes shape of container		Move amongst one another	
Gas		Full space		

(7 marks)

(b) Students in a fifth form Physics class used the apparatus in Figures 3a and 3b in an experiment to find the specific latent heat of vaporization of water, l_v.

Figure 3a shows the initial readings as the water begins to boil and Figure 3b shows readings taken after 5 minutes and 45 seconds.

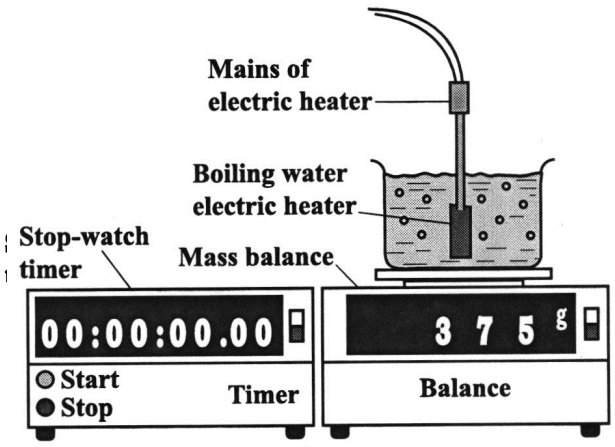

Figure 3a. Initial Readings

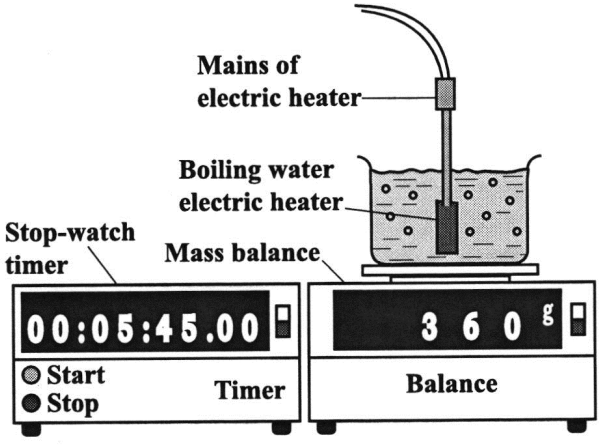

Figure 3b. Readings after 5 minutes and 45 seconds

(i) Convert the time recorded in Figure 3b to seconds.

(ii) Calculate the mass of water evaporated in the experiment.

(3 marks)

(c) The power of the electric heater used in the experiment was 100 W. Assuming no heat was lost to the surroundings, calculate the specific latent heat of vaporization of water, l_v.

(5 marks)

Total 15 marks

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3. (a) Define the term 'energy' and state its SI unit.

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(2 marks)

(b) (i) Complete Table 3 to show the MAIN form of energy associated with EACH of the following examples.

TABLE 3

Forms of Energy	Example
	Radioactive decay
	Radio waves, X-rays
	Objects in motion

(3 marks)

(ii) State the MAIN energy conversions taking place when a flashlight is turned on.

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(2 marks)

(c) Figure 4 shows a pendulum of mass 0.5 kg oscillating in a vacuum. X is the lowest position of the pendulum, where its maximum speed is 1.8 ms^{-1}.

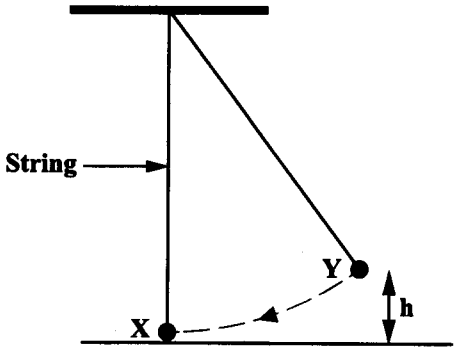

Figure 4. Simple pendulum

(i) Calculate the maximum kinetic energy of the pendulum.

(3 marks)

(ii) Use the principle of conservation of energy to find the maximum gravitational potential energy of the pendulum.

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(2 marks)

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(iii) Calculate the greatest height, h.

(3 marks)

Total 15 marks

SECTION B

Answer ALL questions.

You MUST write your answers in this answer booklet.

4. (a) The 2011 Fukushima nuclear disaster raised questions about the wisdom of utilizing nuclear power. State TWO arguments for and TWO arguments against the use of nuclear fission reactors.

Arguments for

1. .....

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2. .....

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Arguments against

1. .....

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2. .....

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(4 marks)

(b) Nuclear fusion is seen as the great energy hope of the future. State TWO advantages of nuclear fusion over nuclear fission.

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(2 marks)

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(c) Correctly complete the following nuclear fusion reaction.

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow \_\_\_\_\_ + {}^{1}_{1}H$$

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(3 marks)

(d) A commonly used fusion reaction is

$$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n.$$

The mass of the reactants and products for this reaction are recorded in Table 4 below.

TABLE 4

Nuclide	Mass/u
$^{2}_{1}H$	2.01410178
$^{3}_{1}H$	3.01604927
$^{4}_{2}He$	4.00260325
$^{1}_{0}n$	1.00866492

$u = 1.66 \times 10^{-27}$ kg

$c = 3.0 \times 10^{8}$ m s^{-1}

Using the information in Table 4, calculate the energy released in this reaction.

(6 marks)

Total 15 marks

5. (a) Newton and Huygens were two of the scientists who made significant contributions to the modern view of light as embracing both a wave and particle nature. State what evidence each proposed and whether this evidence supported the wave theory or particle theory.

Newton.....

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Huygens.....

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(4 marks)

(b) A homemade projector is constructed from a cardboard box, a cellphone, a cellphone stand to hold the phone upright and a magnifying glass embedded into one face of the box, as shown in Figure 5. The focal length of the lens is 15.0 cm.

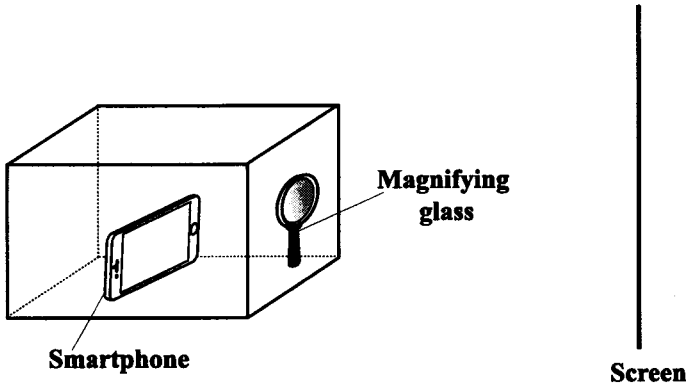

Figure 5. A diagram of a homemade projector

(i) Suggest, with a reason, an appropriate distance from the lens at which the phone should be placed in order to get a magnified image on an external screen.

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(2 marks)

(ii) If the phone is placed 20 cm from the lens, calculate the distance the screen must be placed from the lens in order to obtain a clear image of the phone.

(3 marks)

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(iii) Calculate the magnification of the image on the external screen formed in (b) (ii).

(3 marks)

(iv) If the dimensions of the phone screen are 11.0 cm × 6.0 cm, calculate the dimensions of the image of the phone screen on the external screen.

(1 mark)

(v) State whether the image formed in (b) (ii) is upright or inverted.

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(1 mark)

(vi) Suggest one way in which the image formed in (b) (ii) can be made larger.

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(1 mark)

Total 15 marks

6. (a) Figure 6 shows the magnetic field between the poles of a strong magnet.

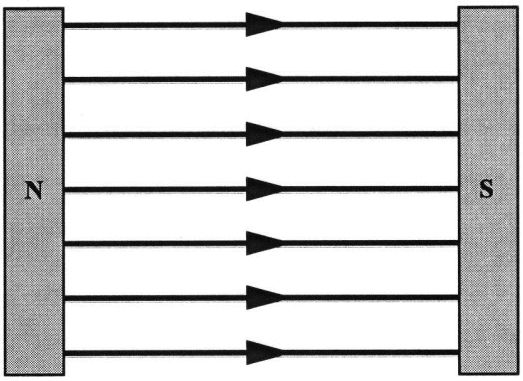


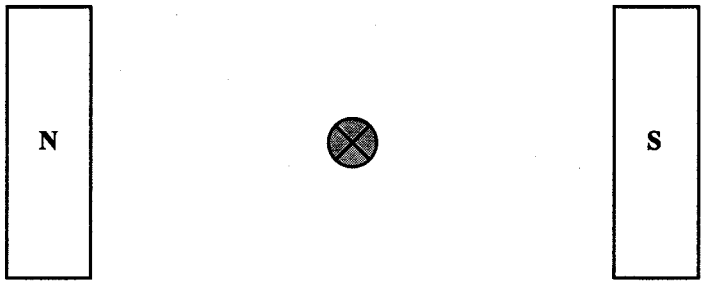
Figure 6. Magnetic field between the poles of a strong magnet

Complete the following diagrams to show

(i) the magnetic field due to a current carrying conductor where the current is directed into the plane of the paper

(2 marks)

(ii) the resulting magnetic field when the current carrying conductor in (a) (i) is placed between the poles of the magnet, as shown in Figure 6.



(3 marks)

(b) Figure 7 shows the end view of a simple d.c. motor.

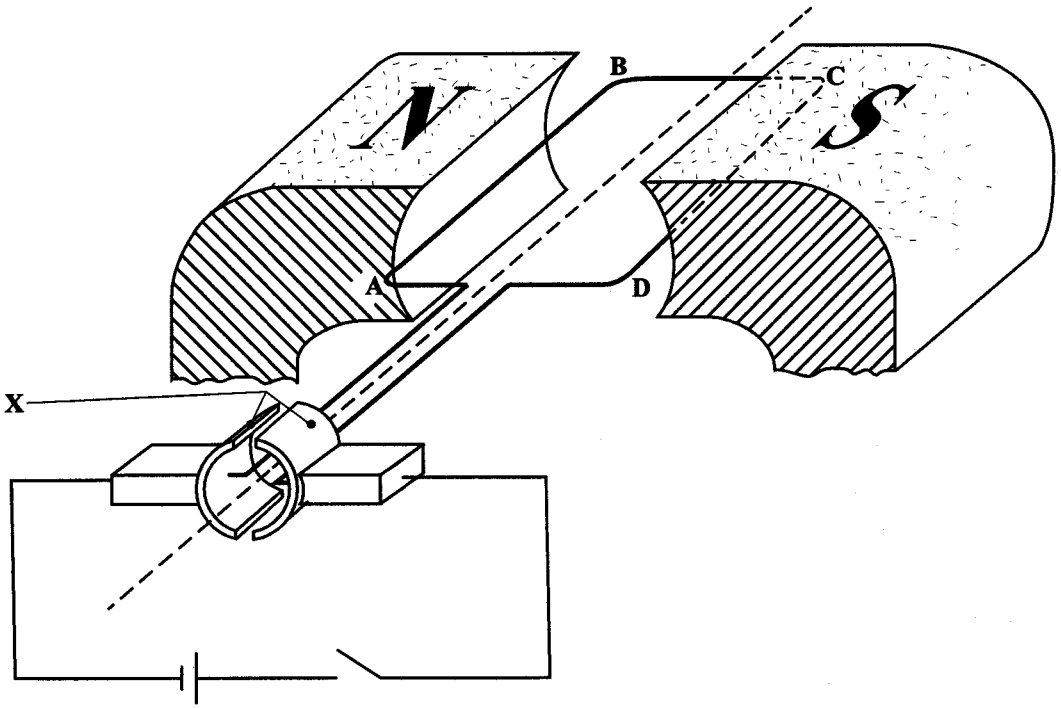


Figure 7. Diagram of a simple d.c. motor

(i) Name the part labelled X.

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(1 mark)

(ii) Explain what happens when the switch is closed. Your answer should include the direction of the current, the forces acting, any rules applied, the direction of rotation and how continuous rotation is achieved.

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(9 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.