FORM TP 2024026

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JANUARY 2024

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 SIX questions in TWO sections. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. Do NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions, but you should note that the use of an inappropriate number of significant figures in answers will be penalized.
6. 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.**
7. **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.

1. Figure 1 shows a copper rod moving through a uniform magnetic field. The symbol ⊙ represents the magnetic field coming *out* of the page. Each end of the rod is connected to leads that are connected to an ammeter, which measures the electric current. The rod is only allowed to move in a horizontal direction (left to right/right to left) while in the magnetic field.

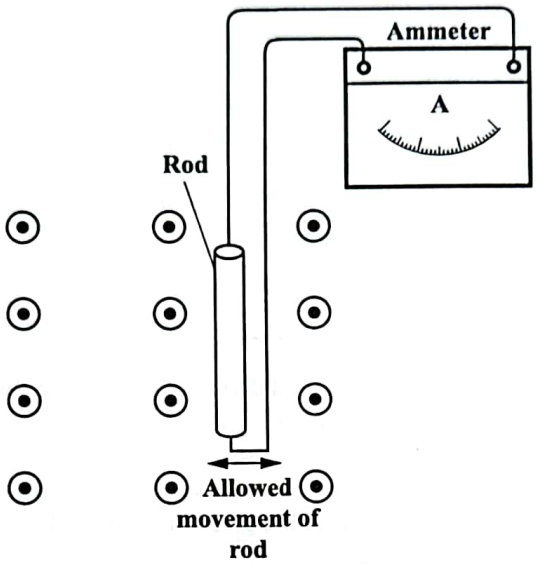

Figure 1. A copper rod moving through a uniform magnetic field

(a) (i) Draw an arrow on the rod to indicate the direction of the induced current, when the rod moves to the **left**. **(1 mark)**

(ii) Name the rule used to determine the direction of the induced current.

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(1 mark)

(b) An experiment was performed to determine how the strength of the magnetic field affects the value of the induced current. Readings of the speed of movement of the rod, (u), and the induced current, (I), were obtained and recorded in Table 1.

TABLE 1: READINGS OF THE SPEED OF MOVEMENT OF THE ROD, (u) AND THE INDUCED CURRENT, (I)

Speed of Movement, u (ms^{-1})	Induced Current, I (A)	Induced emf, V (V)
0.1	0.0045	
0.2	0.0110	0.275
0.4	0.0215	
0.5	0.0270	0.675
0.6	0.0300	
0.7	0.0380	0.950

(i) Given that the rod has a resistance of 25 Ω, use Ohm's law to complete Table 1 by calculating the induced emf, V. **(5 marks)**

(ii) Use the results from Table 1 to plot a graph of induced emf, V, (V) against speed of movement, u, (ms^{-1}) on the grid provided in Figure 2 **on page 7**. Draw the line of best fit through the points. **(8 marks)**

(iii) Use the graph to determine the gradient, G.

(5 marks)

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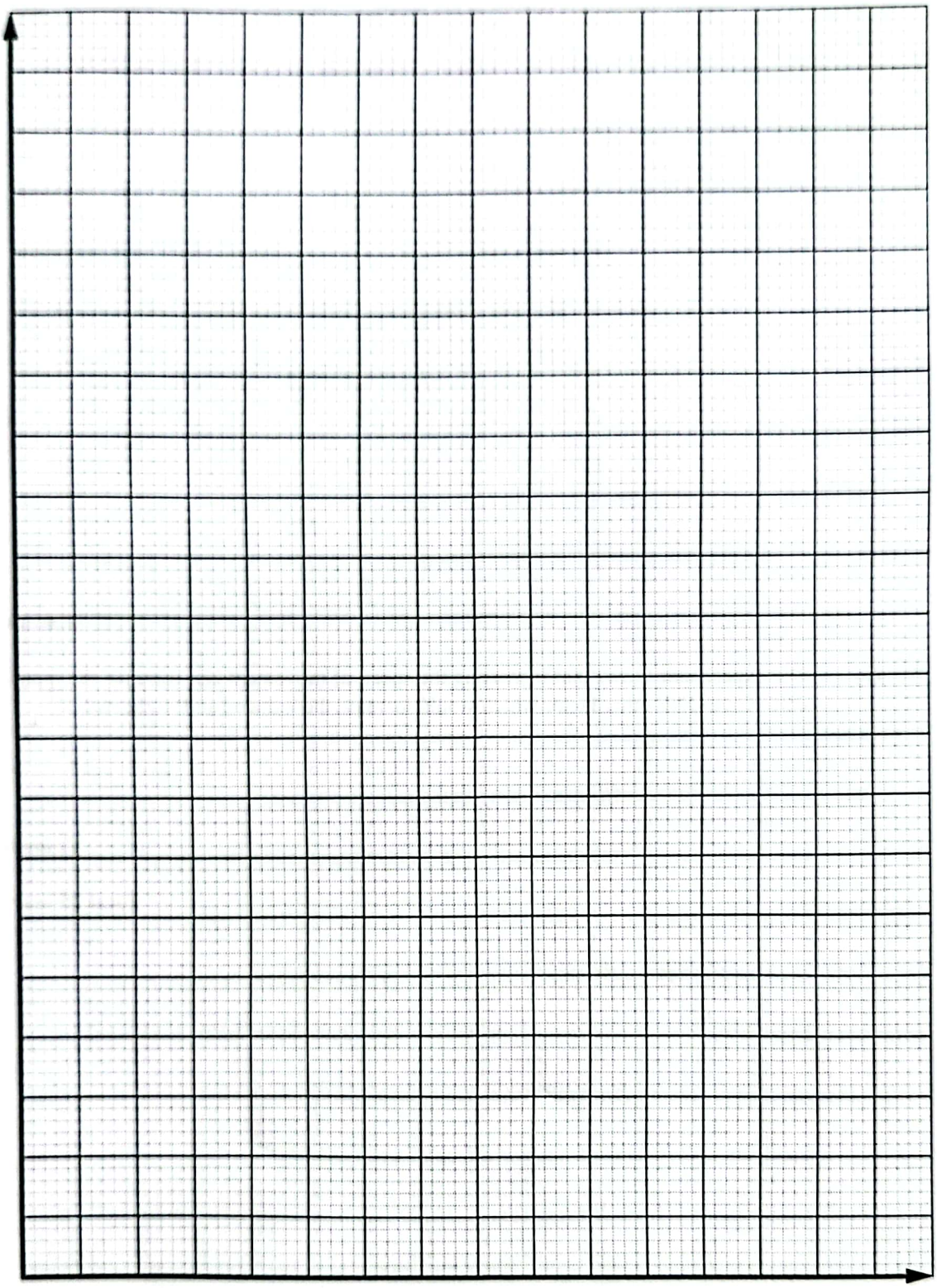

Figure 2. Graph of induced emf, V, (V) against Speed of movement, u, (ms^{-1})

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(iv) The gradient, G, is related to the length of the rod, L, by the equation $G = 4.3\ L$.

Calculate the length of the rod L, using the answer obtained in (b) (iii).

(4 marks)

(c) The experiment shows that increasing the speed of movement can increase the induced emf. Give ONE other factor which would increase the induced emf in the rod.

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(1 mark)

Total 25 marks

2. (a) (i) State the principle of conservation of energy.

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(2 marks)

(ii) Define the term 'momentum'. State its SI units.

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(2 marks)

(b) Figure 3 shows a girl throwing a shot put in a sporting competition.

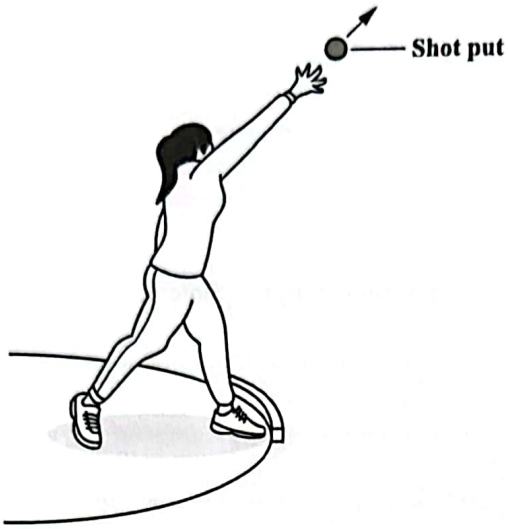

Figure 3. A girl throwing a shot put

State the energy changes that take place from the time the girl begins to exert a force on the shot put, until the shot put hits the ground and stops moving.

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(3 marks)

(c) The mass of the shot put is 4.0 kg. The girl exerts a force on the shot put for 0.60 s. The speed of the shot put increases from 0 ms^{-1} to 9 ms^{-1} before it leaves the girl's hand.

Calculate the

(i) momentum of the shot put on leaving the girl's hand

(2 marks)

(ii) acceleration of the shot put

(3 marks)

(iii) average force exerted.

(3 marks)

Total 15 marks

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3. Figure 4 shows a car on a sunny day in a Caribbean country. A tourist placed a sunshade inside the windscreen to reduce the temperature rise of the air inside the car.

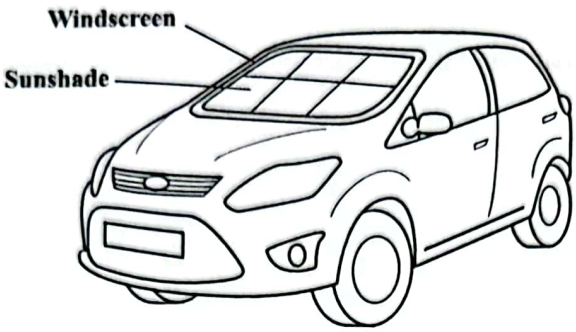

Figure 4. Diagram of a car

(a) Which material, dull black, dull white, shiny black, shiny white, is MOST suitable for the outer surface of the sunshade. Justify your choice.

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(2 marks)

(b) Complete the scenarios below by inserting the word which BEST describes the main process of thermal energy transfer.

(i) A girl goes for a walk on a cold day. She touches an iron gate that removes thermal energy from her hand. This energy is then transfered through the iron gate by ..... .

(ii) The girl holds the sides of a cup containing a hot drink. Her hands gain thermal energy by ..... .

(iii) Some farm workers light a fire. The girl warms her hands by the side of the fire. Her hands gain thermal energy by ..... .

(3 marks)

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(c) Define the term 'specific latent heat of fusion of a substance'.

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(3 marks)

(d) Small pieces of ice with a temperature of 0 °C are added to 0.35 kg of water. The initial temperature of the water is 24.5 °C. The water loses 35 000 J of thermal energy as the temperature of the water decreases to 0 °C.

Calculate the

(i) specific heat capacity of water

(4 marks)

(ii) mass of ice added to the water if all the ice melts.

[The specific latent heat of fusion of ice is 3.3×10^5 J kg^{-1}.]

(3 marks)

Total 15 marks

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SECTION B

Answer ALL questions.

4. (a) Visible light, radio waves, X-rays, infrared, γ-radiation and ultraviolet radiation are types of electromagnetic waves.

Name the electromagnetic waves in EACH of the regions labelled A, B, C, D in the electromagnetic spectrum shown in Figure 5.

Increasing wavelength

γ-radiation	A	B	Visible Light	C	D

Figure 5. Electromagnetic spectrum

A .....

B .....

C .....

D .....

(4 marks)

(b) State which sound wave parameters affects EACH of the following properties of a musical note.

(i) Pitch .....

(ii) Loudness .....

(2 marks)

(c) A person standing 100 m from a wall claps his hands and hears an echo 0.6 s later. Calculate the speed of sound in air.

(4 marks)

(d) Figure 6 shows a plane mirror AB. A ray of light strikes the mirror at point X with an angle of incidence, *i*, between 0° and 90°.

Complete the diagram to show the path of the incident ray and the corresponding reflected ray.

Mark on the diagram the angle of incidence, *i*, and the angle of reflection, *r*.

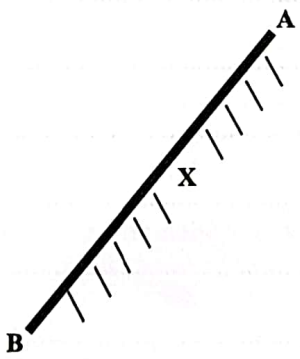

Figure 6. A plane mirror, AB

(5 marks)

Total 15 marks

5. (a) Differentiate between alternating current (ac) and direct current (dc).

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(2 marks)

(b) A transformer is a device used for stepping up or stepping down ac voltages.

(i) Draw the electrical symbol for a transformer.

(1 mark)

(ii) State TWO advantages of using alternating current (ac) instead of direct current (dc) for transmitting electrical energy.

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(2 marks)

(iii) Complete the statement below.

Transformers work on the principle of mutual ..... .

(1 mark)

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(c) A mobile phone charger contains a step-down transformer which converts the input of 220 V to a working output voltage of 5 V.

(i) If the output current that flows into the mobile phone is 120 mA, calculate the input current from the ac supply.

(3 marks)

(ii) Determine the power supplied by the secondary turns. State your answer in SI units.

(4 marks)

(iii) If there was a 10% loss of power within the transformer, calculate the actual power delivered to the secondary circuit?

(2 marks)

Total 15 marks

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6. (a) The cloud chamber is a device used to detect the three types of radioactive emissions, alpha, beta and gamma. Figure 7 shows a cross section of three identical cloud chambers containing the different sources.

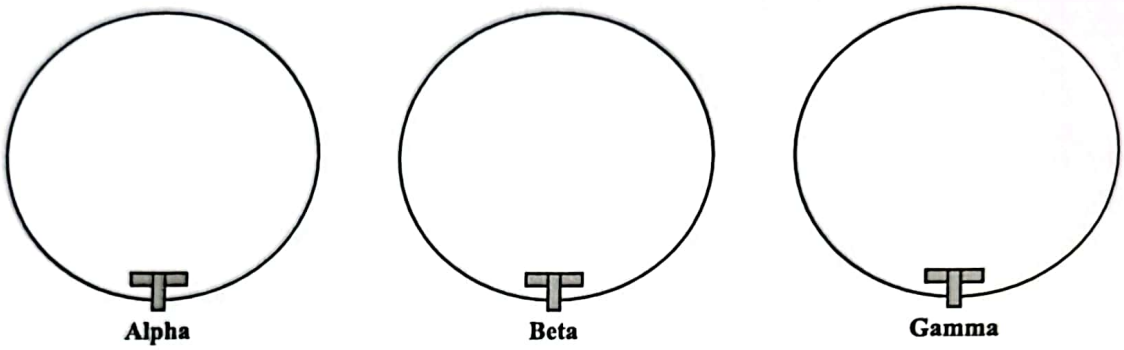

Figure 7. Cross section of three identical cloud chambers containing alpha, beta and gamma sources

(i) Illustrate the appearance of the tracks of radioactive emission in the cloud chambers in Figure 7.

(3 marks)

(ii) State THREE properties of gamma emissions.

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(3 marks)

(b) Figure 8 shows the graph of the mass of a radioactive isotope against time elapsed.

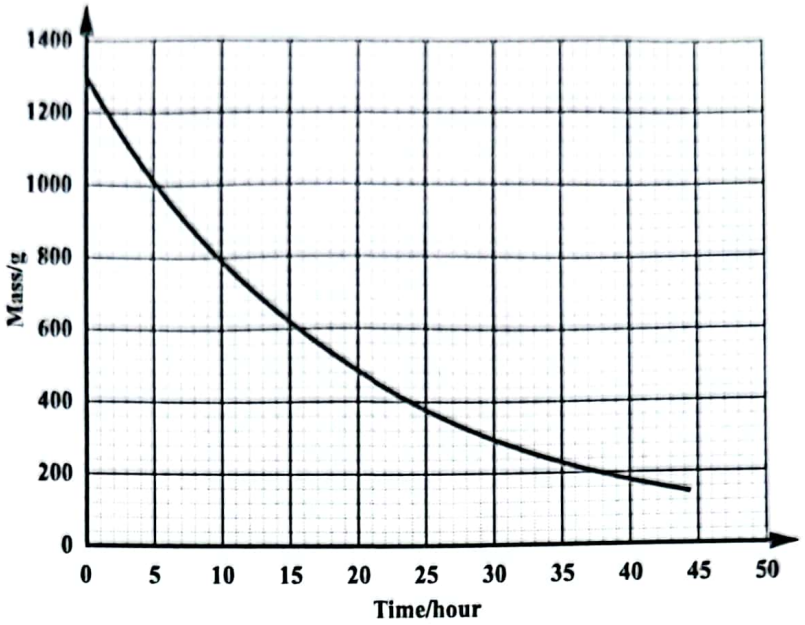

Figure 8. Graph of the mass of a radioactive isotope against time elapsed

Use the graph in Figure 8 to

(i) determine the initial mass of the radioactive isotope

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(1 mark)

(ii) calculate the average half-life of the radioactive isotope. **Show ALL working.**

(5 marks)

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(c) The half-life of another radioactive nuclide is 10 hours. Determine the fraction of this radioactive nuclide that remains after 30 hours.

(3 marks)

Total 15 marks

END OF TEST

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