FORM TP 2017096

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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 figures in answers will be penalized.
6. Mathematical tables are provided.
7. 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.**
8. **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.

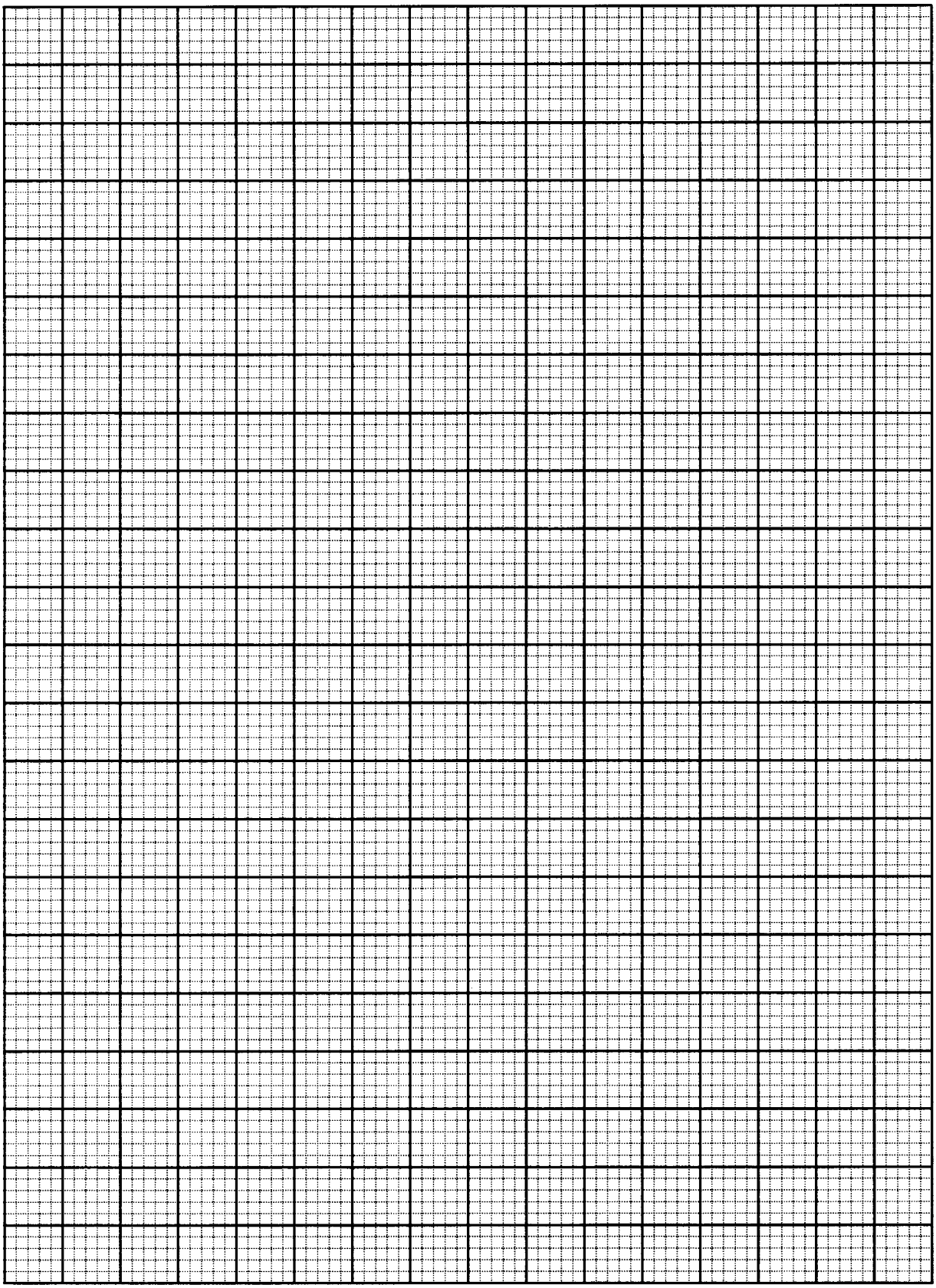
1. An experiment in which a magnet was allowed to fall through a coil was conducted to test the concept of induced e.m.f. The voltages were recorded at different time intervals.

Table 1 shows the results of the experiment.

TABLE 1

Time (ms)	Induced e.m.f. (V)
0	0.00
5	0.25
10	1.00
15	2.00
20	2.50
25	1.00
30	–0.75
35	–2.00
40	–1.00

(a) Using a scale of 2 cm to 5 ms on the horizontal axis and 2 cm to 0.5 V on the vertical axis, plot the graph of induced e.m.f., V, versus time, ms, on the grid provided **on page 5**.
(8 marks)



(b) Use your graph to determine

(i) the induced e.m.f. after 12.5 milliseconds

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(1 mark)

(ii) the time, in milliseconds, other than at the beginning of the experiment when the induced e.m.f. was 0 volts.

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(1 mark)

(c) Kevin, a Physics student, conducted an experiment to determine the effects of electromagnetic induction. He used the following apparatus:

- A coil made of fine wires
- A sensitive galvanometer
- Connecting wires
- A bar magnet

Figure 1 shows the setup of the apparatus used by Kevin.

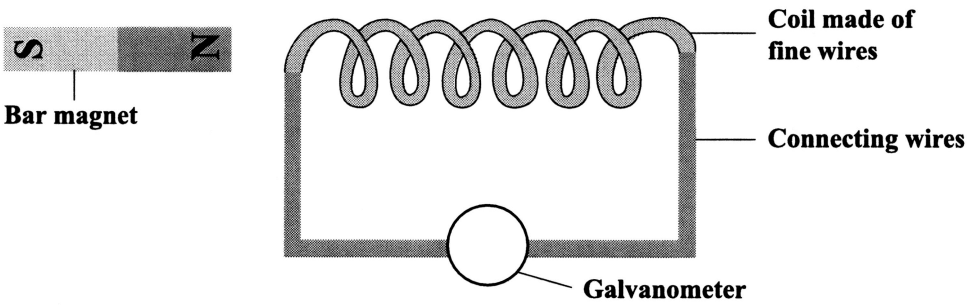

Figure 1

The magnet is pushed into the coil with the north pole entering first.

(i) Draw on Figure 1 the direction of the induced current and the direction of the arrow on the galvanometer as a result of this motion. **(2 marks)**

(ii) Explain why an induced current is produced.

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(2 marks)

(iii) Why is it necessary to use a sensitive galvanometer?

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(1 mark)

(iv) The magnet is then pulled out of the coil. Show on Figure 2 the direction of the induced current as a result of this motion.

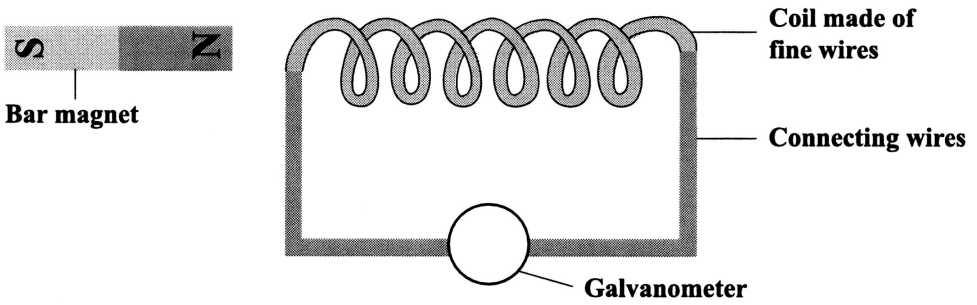

Figure 2

(1 mark)

(v) State THREE changes or adjustments that Kevin could make in this experiment to increase the induced e.m.f.

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(3 marks)

(vi) Describe what will happen if the magnet remains stationary in the coil.

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(1 mark)

(d) Figure 3 shows a simple layout of an a.c. generator. A coil PQRS is connected to other components of the circuit which allow the coil to rotate in the direction indicated by the arrow.

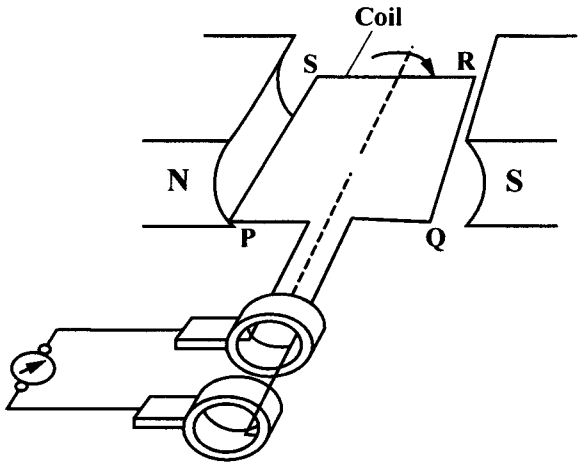

Figure 3

(i) Draw on Figure 3 the direction of the induced current if the coil rotates in a clockwise direction. **(1 mark)**

(ii) If the period of rotation of the coil is 0.02 s, calculate its frequency.

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(2 marks)

(iii) If the speed and direction of rotation of the coil are constant, sketch a graph of voltage (V) against time (s) to show the output for the generator for one complete cycle, given that it starts rotating from its current position.

(2 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. (a) (i) Distinguish between 'transverse' and 'longitudinal' waves.

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(2 marks)

(ii) State ONE example **each** of transverse and longitudinal waves.

Example of transverse wave: .....

Example of longitudinal wave: .....

(2 marks)

(iii) In the wave equation, velocity (v), frequency (f) and wavelength (λ) are related. Write the equation.

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(1 mark)

(iv) A wave motion has a frequency of 10 Hz and a wavelength of 250 m. Calculate the speed of the wave.

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(2 marks)

(b) Figure 4 shows a sinusoidal wave.

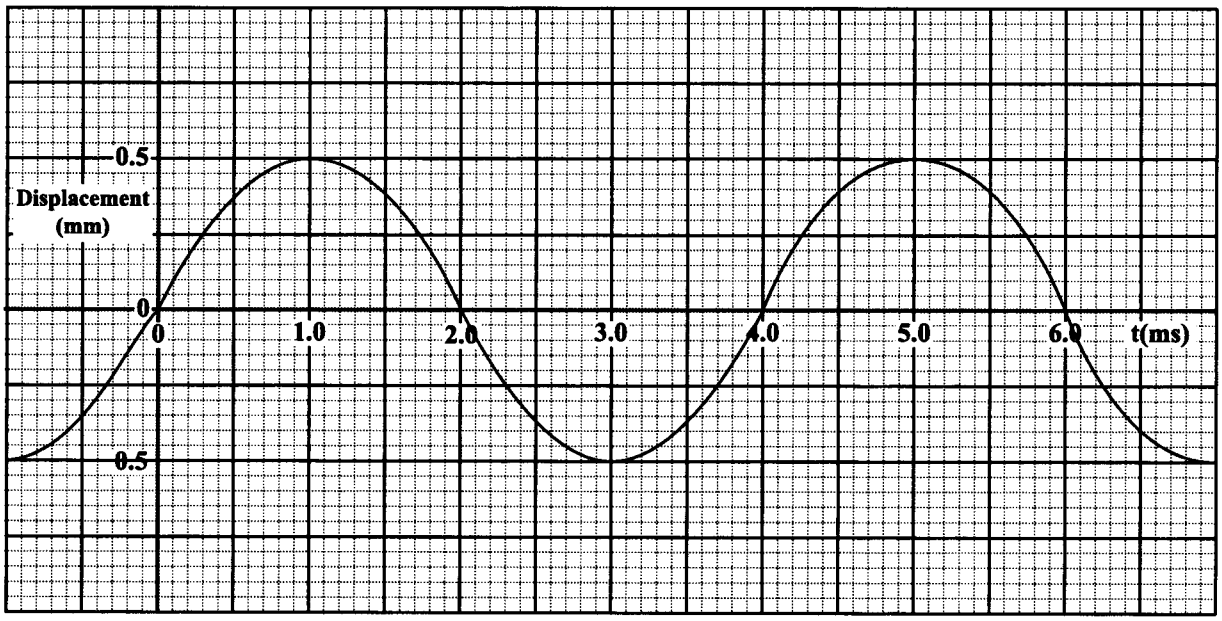

Figure 4

(i) Indicate on Figure 4 the amplitude of the wave. **(1 mark)**

Using Figure 4, determine the wave's

(ii) amplitude (in metres)

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(iii) period (in seconds)

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(iv) frequency (in hertz).

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(6 marks)

(c) State ONE property of an electromagnetic wave.

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(1 mark)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Elements with unstable nuclei are susceptible to decay.

(i) What is meant by the term 'nuclear fission'?

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(1 mark)

(ii) State TWO advantages of utilizing nuclear energy.

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(2 marks)

(b) Workers in nuclear power plants need to be extra careful on the job.

(i) State ONE precaution that workers in nuclear power plants need to take.

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(1 mark)

(ii) Give TWO disadvantages of using nuclear reactors to generate energy.

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(2 marks)

(c) Uranium isotope U-238 undergoes nuclear fussion when struck by a neutron. Barium-139 and krypton-97 nuclei are emitted along with three neutrons as shown in the following equation.

$$^{238}_{92}U + {}^{1}_{0}n \longrightarrow {}^{139}_{p}Ba + {}^{97}_{36}Kr + 3\ {}^{1}_{0}n$$

Uranium-238	398.350×10^{-27} kg
Barium-139	232.560×10^{-27} kg
Krypton-97	152.620×10^{-27} kg
Neutron	1.670×10^{-27} kg
c	3.0×10^{8} ms^{-1}

(i) State the value of p.

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(1 mark)

(ii) State the meaning of 'c' in Einstein's equation $\Delta E = \Delta mc^2$.

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(1 mark)

(iii) Calculate the **total** mass of the elements formed after the reaction.

(2 marks)

(iv) Calculate the energy released in the reaction.

(4 marks)

(v) State ONE use of the energy released from the reaction.

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(1 mark)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) For a popular amusement park ride, patrons board a carriage at the top of a high tower and are subjected to a wild ride of 'terror'.

Name and state the Newton's Law which applies if the

(i) carriage is moving horizontally at a constant speed in a straight line

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(3 marks)

(ii) carriage is in free fall.

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(3 marks)

(b) (i) Calculate the length of time that the carriage in Part (a) **on page 14** is allowed to free fall if it reaches a speed of 64.8 km h^{-1} from rest. **[Use g = 10 ms^{-2}]**

(5 marks)

(ii) Determine the distance the carriage falls in (b) (i).

(4 marks)

Total 15 marks

5. (a) Four factors of the surface of a material on which the absorption and emission of radiation depend are:

- Texture (rough or smooth)
- Nature (dull or shiny)
- Colour (black or white)
- Area (large or small)

State, with a reason, the appropriate characteristics of TWO of the above factors in the design of

(i) a car radiator

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(3 marks)

(ii) the roof of a Caribbean home.

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(3 marks)

(b) The following data were obtained in an experiment using an immersion heater to determine the specific latent heat of vaporization of water.

Mass of can and water at start of boiling	m_1	= 0.28 kg
Mass of can and water at end of boiling	m_2	= 0.26 kg
Power of heater		= 150 W
Time of heating		= 5 minutes

(i) Using the data above, calculate the specific latent heat of vaporization of water, assuming negligible heat is lost to the surroundings.

(6 marks)

(ii) The coil of the immersion heater was NOT completely submerged. Explain how this would have affected the value for the specific latent heat of vaporization obtained in (b) (i) **on page 17**.

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(3 marks)

Total 15 marks

6. (a) Using fully labelled diagrams, define the principal focus of

(i) a converging lens

(3 marks)

(ii) a diverging lens.

(3 marks)

(b) An object of height 7.2 cm is placed 18.0 cm from a converging lens of focal length 12.0 cm. Determine

(i) the image distance

(3 marks)

(ii) the magnification

(3 marks)

(iii) the height of the image formed

(2 marks)

(iv) whether the image formed is real or virtual.

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(1 mark)

Total 15 marks

END OF TEST

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