CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

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15 JANUARY 2020 (p.m.)

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

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SUBJECT PHYSICS – Paper 02

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FORM TP 2020025

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JANUARY 2020

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. 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.**

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SECTION A

Answer ALL questions.

1. A sprinter of mass 55 kg was running a 100 m race. Her velocity was measured at different intervals of a 11.0 s period. The results are recorded in Table 1.

TABLE 1: RESULTS

Velocity, v/ms^{-1}	0.00	1.20	3.75	8.75	10.00	10.00
Time, t/s	0.0	1.0	3.0	7.0	8.0	11.0

(a) (i) Define the term 'velocity'.

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(2 marks)

(ii) Complete the following statement.

Acceleration is defined as the rate of change of .....

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(1 mark)

(b) Using the grid provided **on page 5**, plot a graph of velocity, v/ms^{-1} against time, t/s.

(8 marks)

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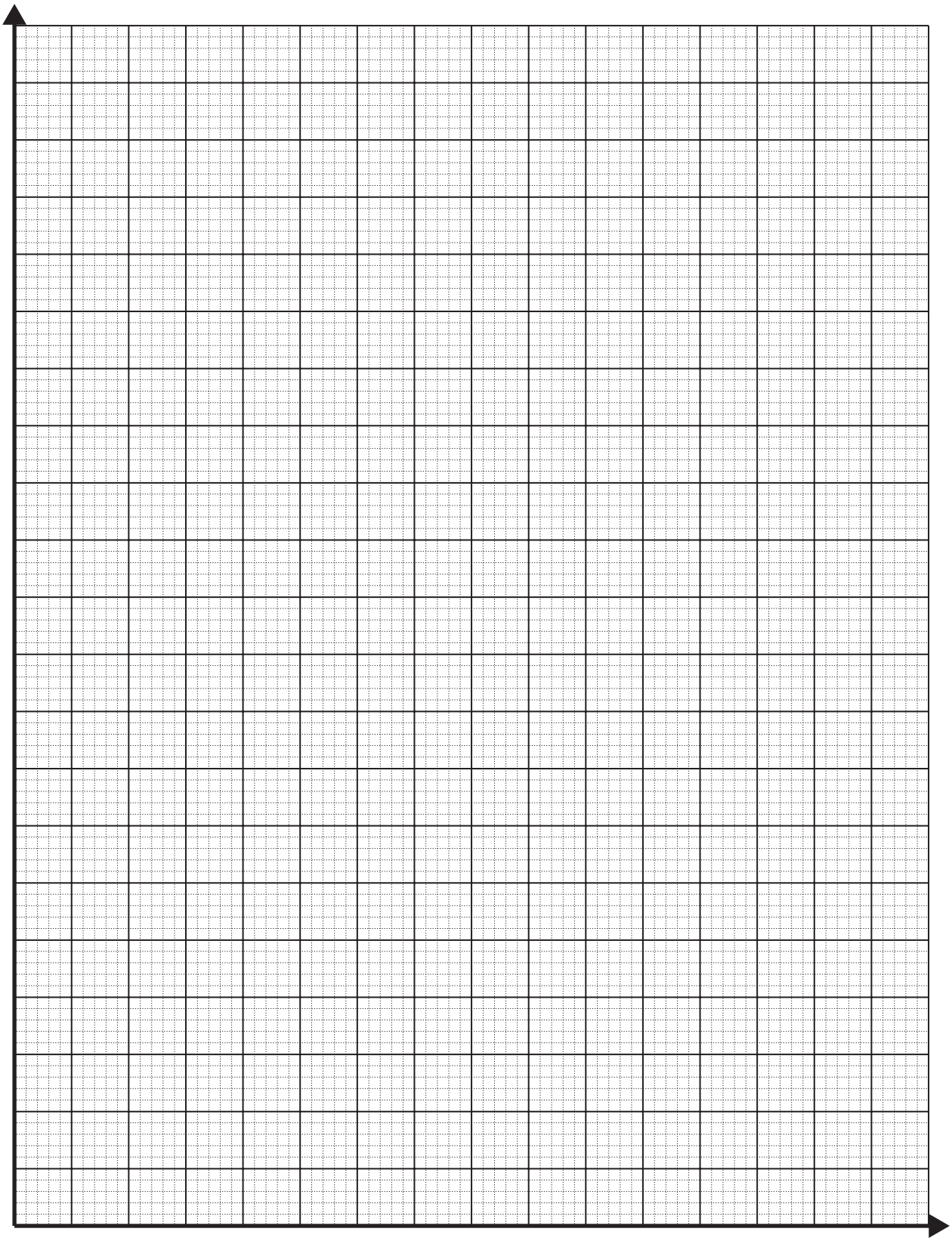


Figure 1. Graph of velocity, v/ms^{-1}, against time, t/s

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(c) Determine the slope of the graph over the first 7.0 s of the race.

(4 marks)

(d) (i) State the physical quantity relating to the motion of the sprinter which the slope of the graph represents.

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(1 mark)

(ii) Describe the sprinter's motion from 8 s to 10 s.

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(1 mark)

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(e) Calculate the resultant force acting on the sprinter after 7.0 s.

(3 marks)

(f) Using the graph drawn **on page 5**, determine how far from the finish line the sprinter would be after 11.0 s.

(5 marks)

Total 25 marks

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2. (a) Define EACH of the following terms:

(i) Specific heat capacity

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(3 marks)

(ii) Specific latent heat of fusion of ice

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(3 marks)

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(b) A block of ice, which has a mass of 2.5 kg and a temperature of –10 ºC, is placed in a container.

Specific heat capacity of water = 4.2×10^3 J kg^{-1} (ºC)$^{-1}$
Specific heat capacity of ice = 2.1×10^3 J kg^{-1} (ºC)$^{-1}$
Specific latent heat of fusion of ice = 3.3×10^5 J kg^{-1}

Calculate

(i) the heat energy required to change the temperature of the ice at –10 ºC to ice at 0 ºC

(3 marks)

(ii) the heat energy required to convert all the ice at 0 ºC to water at 0 ºC.

(2 marks)

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(c) The water in the container is now heated to a temperature of 80 ºC by an electrical heater, in 600 seconds.

(i) Calculate the power output of the heater.

(3 marks)

(ii) State ONE assumption which must be taken into account in (c) (i).

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(1 mark)

Total 15 marks

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3. (a) (i) Define the term 'linear momentum'.

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(1 mark)

(ii) State the SI unit for linear momentum.

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(1 mark)

(b) (i) State the law of conservation of linear momentum.

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(3 marks)

(ii) State TWO real-life examples that demonstrate the law of conservation of linear momentum.

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(2 marks)

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(c) Trolley A and Trolley B collided head-on. Trolley A of mass 72.0 kg was moving towards the west at 5.50 ms^{-1}. Trolley B of mass 69.4 kg was moving towards the east at 4.50 m s^{-1}. Calculate

(i) the initial momentum of Trolley A

(2 marks)

(ii) the initial momentum of Trolley B.

(2 marks)

(d) Assuming the trolleys locked during the collision and that they moved off together in one direction, determine the speed and the direction of the joined trolleys immediately after the collision.

(4 marks)

Total 15 marks

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SECTION B

Answer ALL questions.

4. (a) (i) With the aid of a labelled diagram, state the TWO laws of refraction.

Law 1 .....

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Law 2 .....

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(4 marks)

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(ii) When a diver under the sea shines a beam of light towards the surface of the water, the light does not pass through the water–air boundary into the air above but reflects into the sea.

State the name of the phenomenon which occurs **and** briefly explain why it occurs.

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(2 marks)

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(b) Another diver shines a beam of light into the water to see some fishes as shown in Figure 2.

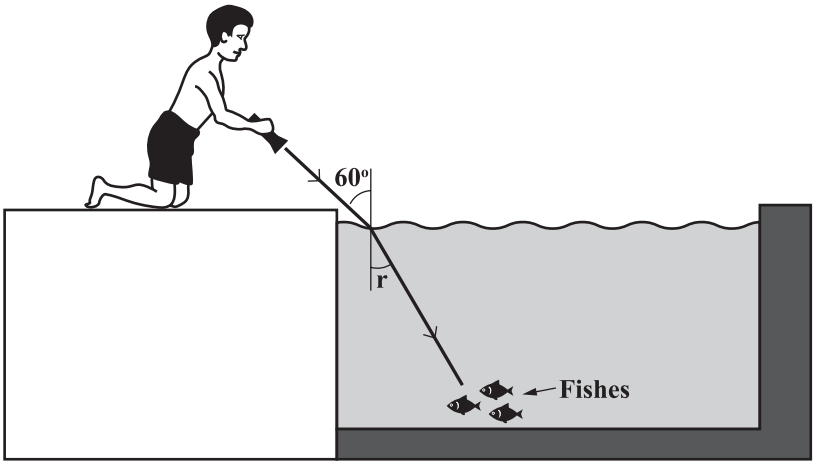


Figure 2. Diagram showing refraction

Given that the index of refraction for the water is 1.33 and the angle of incidence, $i = 60^{o}$, calculate the angle of refraction, r.

(3 marks)

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(c) An object 2 cm in height, is placed 10 cm in front a converging lens with a focal length, *f*, of 6 cm. Calculate

(i) the image distance, *v*.

(4 marks)

(ii) the linear magnification, *m*.

(2 marks)

Total 15 marks

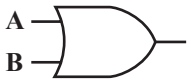
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5. (a) Complete Table 2 by inserting the missing logic gates, symbols and functions.

TABLE 2: LOGIC GATES, SYMBOLS AND FUNCTIONS

Logic Gate	Symbol	Function
		Changes logic 0 to logic 1
AND		
OR		
NAND		Produces a logic 1 only when A and B are logic 0

(6 marks)

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(b) (i) With the aid of a circuit diagram, describe how an alternating current (a.c.) can be half-wave rectified to produce a direct current across a resistor (load).

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(5 marks)

(ii) Sketch the voltage–time graph to show the expected output across the load in (b) (i).



Figure 3. Voltage–time graph to show the expected output across the load

(1 mark)

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(c) Draw a voltage–time graph showing an a.c. source with a frequency of 5 Hz and a peak voltage of 12 V.

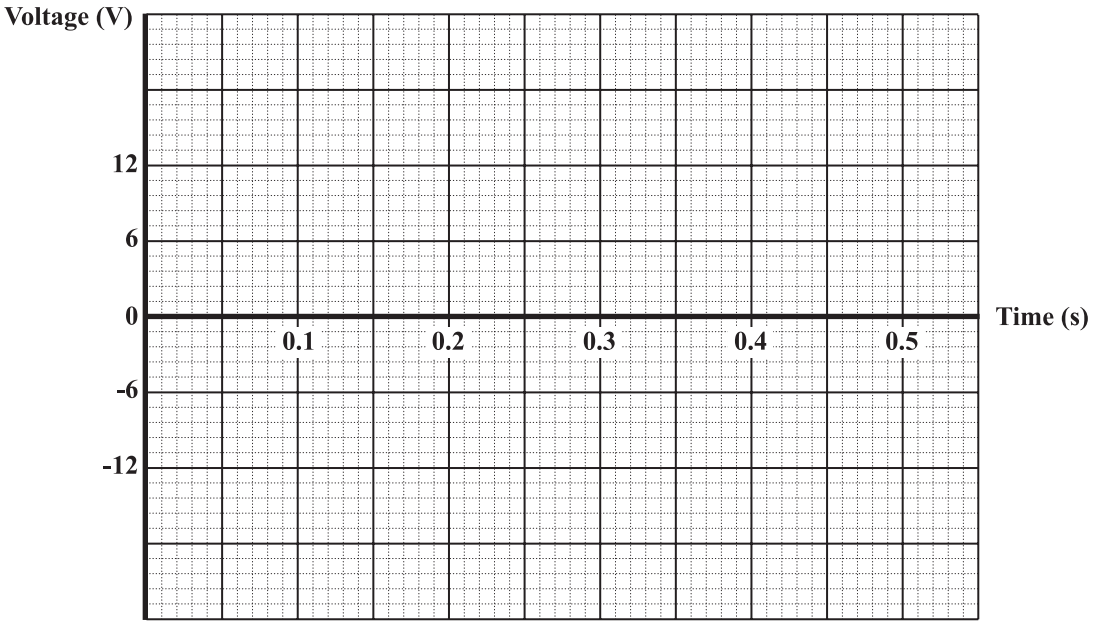


Figure 4. Voltage–time graph showing an a.c. source

(3 marks)

Total 15 marks

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6. (a) Three emissions, α, β, γ, from a radioactive source are subjected to a uniform magnetic field perpendicular to their path, as shown in Figure 5.

(i) Draw the three rays to represent the path of EACH of the three emissions, α, β, γ, on Figure 5, as they pass through the magnetic field.

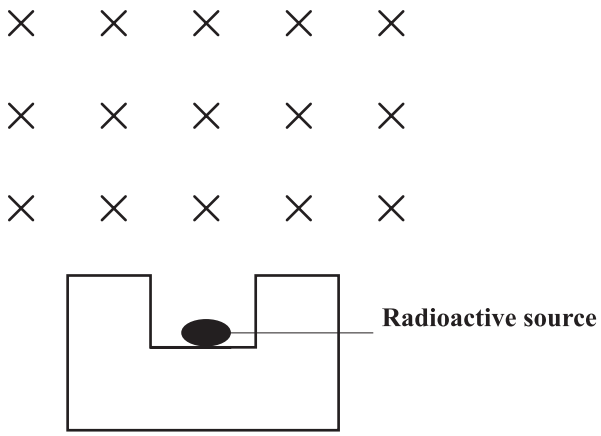


Figure 5. Radioactive source in a uniform magnetic field

(3 marks)

(ii) The magnetic field is replaced by an electric field as shown in Figure 6. Draw the three rays to represent the path of EACH of the three emissions, α, β, γ, on Figure 6, as they pass through the electric field.

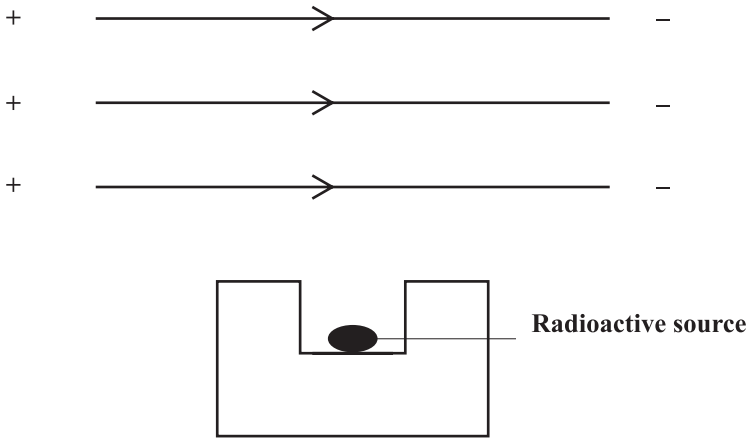


Figure 6. Radioactive source in an electric field

(3 marks)

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(b) An unstable isotope of lead, $^{210}_{82}Pb$, undergoes exactly two sequential beta particle decays followed by an alpha particle decay to become stable lead, $^{206}_{82}Pb$.

With reference to the information in Table 3, write the nuclear equations that will result in the formation of stable lead, $^{206}_{82}Pb$ from $^{210}_{82}Pb$.

TABLE 3: ELEMENTS AND ATOMIC NUMBERS

Element	Atomic Number
Bi	83
Po	84

First beta decay equation .....

Second beta decay equation .....

Alpha decay equation .....

(6 marks)

(c) Calculate the energy given off in a nuclear reaction if the change in mass is 0.3018 u. ($u = 1.66 \times 10^{-27}$ kg, $c = 3 \times 10^{8}$ ms^{-1})

(3 marks)

Total 15 marks

END OF TEST

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

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EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No. ☐

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1. **Fill in all the information requested clearly in capital letters.**

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PROFICIENCY: GENERAL

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FULL NAME: _____

(BLOCK LETTERS)

Signature: _____

Date: _____

2. **Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.**

3. **Keep it in a safe place until you have received your results.**

INSTRUCTION TO SUPERVISOR/INVIGILATOR:

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature: _____
Supervisor/Invigilator

Date: _____