# CARIBBEAN EXAMINATIONS COUNCIL

## CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

**15 JANUARY 2019 (p.m.)**

**FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.**

TEST CODE | 0 | 1 | 2 | 3 | 8 | 0 | 2 | 0 |

SUBJECT — PHYSICS – Paper 02

PROFICIENCY — GENERAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH | D | D | M | M | Y | Y | Y | Y |

SIGNATURE _____

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**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

**PHYSICS**

Paper 02 – General Proficiency

*2 hours 30 minutes*

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### 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 group of students investigated the relationship between the electric power produced and the flow rate of water, which is channelled through a turbine.

Table 1 shows the recorded results of electric power (P)/W and the flow rate (F)/cm³ s⁻¹.

**TABLE 1: RESULTS**

| Electric Power, $P/W$ | Flow Rate, $F/\text{cm}^3 \text{ s}^{-1}$ | (Flow Rate)³, $F^3/(\text{cm}^3 \text{ s}^{-1})^3$ |
| --- | --- | --- |
| 0.0 | 0.00 | 0.00 |
| 13.0 | 0.27 | |
| 25.5 | 0.34 | |
| 38.5 | 0.39 | |
| 51.0 | 0.43 | |
| 64.0 | 0.46 | |
| 77.0 | 0.49 | |

(a) Calculate the CUBE of the flow rate readings, $F^3$, rounded to two decimal places, to complete Table 1. **(6 marks)**

(b) **On page 5**, plot a graph of electric power, $P/W$, versus (Flow Rate)³, $F^3/(\text{cm}^3 \text{ s}^{-1})^3$. **(7 marks)**

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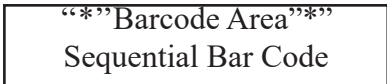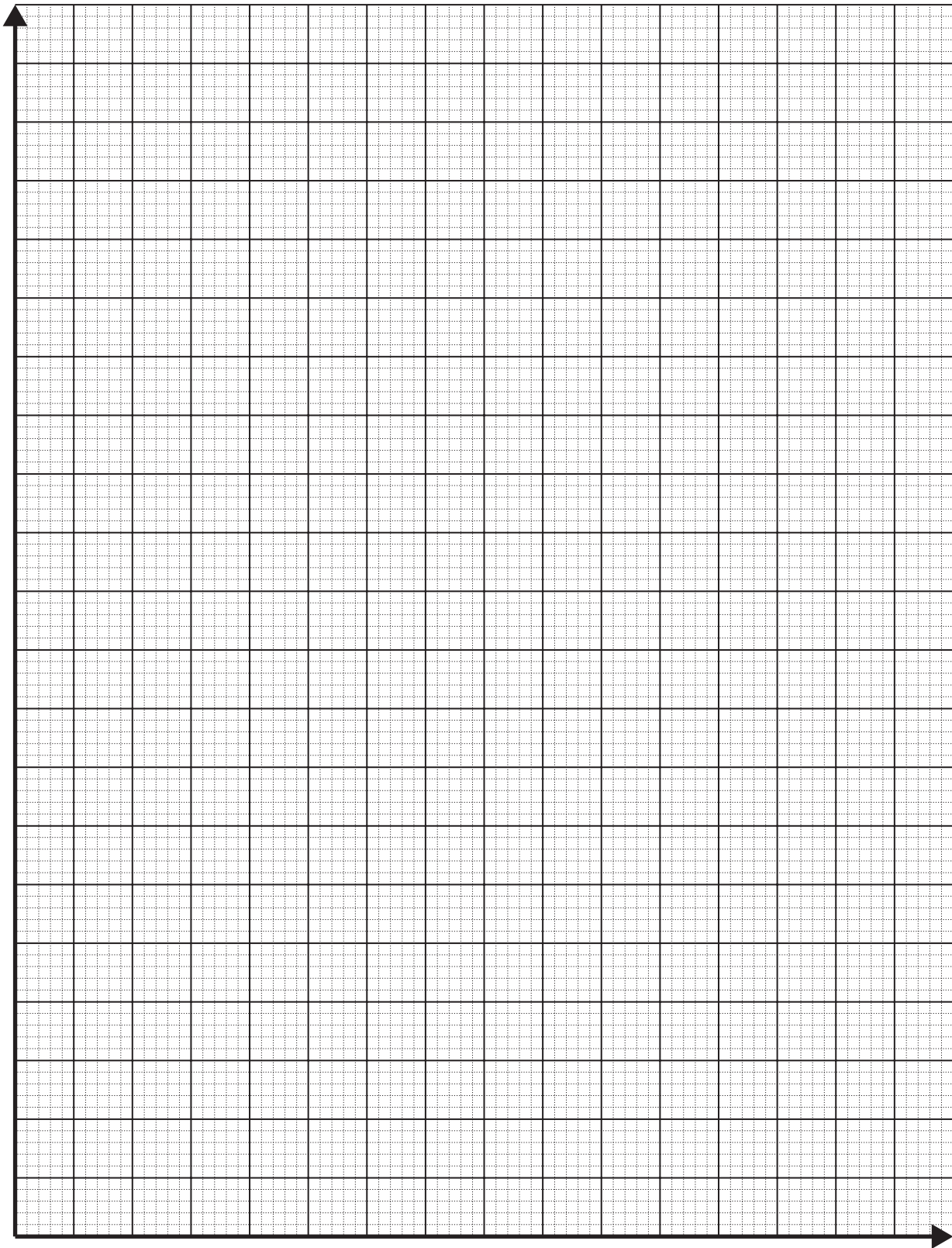
**Figure 1. Graph of P against F³**

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(c)     Calculate the gradient of the graph.

**(4 marks)**

(d)     Use the graph to estimate the electric power produced if the flow rate, F, is 0.22 cm$^3$ s$^{-1}$.

**(2 marks)**

(e)     Use your result from Part (d) to calculate the electrical energy, in joules, produced in 300 s.

**(3 marks)**

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(f)   To determine the flow rate, the students used a stopwatch and measuring cylinder.  State TWO precautions which the students may have taken to ensure that the flow rate was accurately determined.

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**(2 marks)**

(g)   State the **major** energy conversion taking place in the turbine.

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**(1 mark)**

**Total 25 marks**

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**2.** (a) State the factor on which EACH of the following characteristics of sound depends.

(i) Pitch

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(ii) Loudness

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**(2 marks)**

(b) A sound wave completes three cycles in 6 ms. Calculate its frequency.

**(4 marks)**

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(c)  Figure 2 shows the side AB of a rectangular glass block and CD which is the normal at the point O.
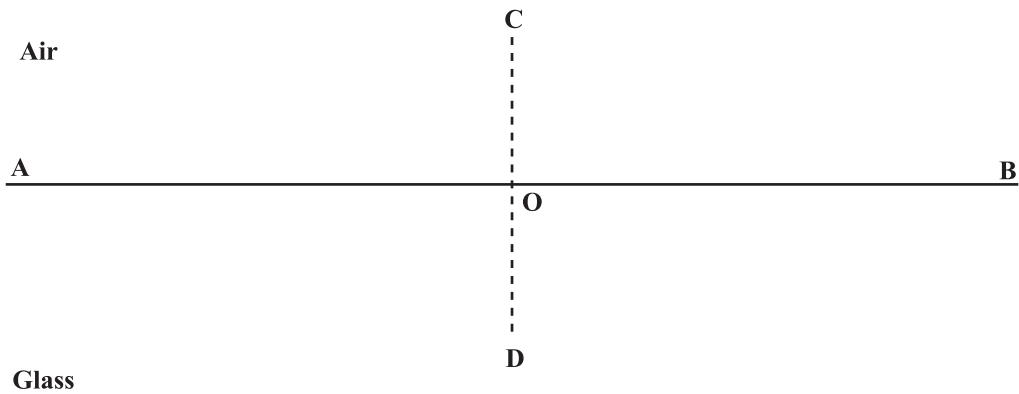


**Figure 2. Glass block**

(i)  On Figure 2, draw the path taken by a ray of light which meets the glass–air boundary at the point O at an angle of incidence equal to the critical angle.

Label the incident ray, the critical angle and the refracted ray (path taken by the ray).  **(3 marks)**

(ii)  The glass block has a refractive index of 1.5.  Determine the value of the critical angle of the glass.

**(4 marks)**

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(iii)    The ray of light now meets the glass–air boundary at the point O at an angle of incidence greater than the critical angle.  On Figure 3, draw a diagram to show the new path taken by the ray of light.

C

Air

A                                                   B

O

D
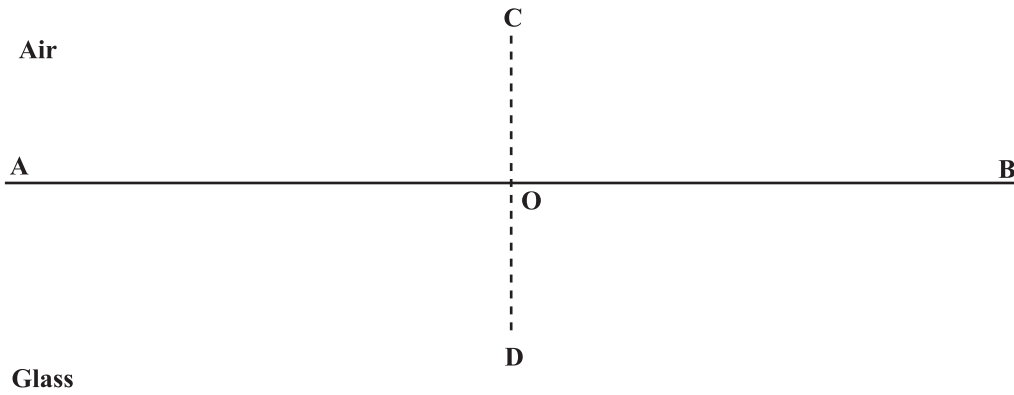
Glass

**Figure 3. Glass block**

**(2 marks)**

**Total 15 marks**

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**3.** (a) (i) State the law of conservation of energy.

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**(2 marks)**

(ii) A goalkeeper drops a football of mass 0.43 kg vertically downwards from rest at a height of 1.5 m.

Calculate the velocity of the ball as it makes contact with the ground. (Assume no air resistance or wind is present.)

[Acceleration due to gravity, g =10 ms$^{-2}$]

**(4 marks)**

(b) (i) Define the term 'force'.

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**(1 mark)**

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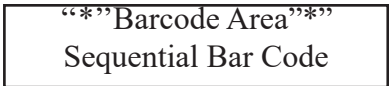
(ii)    Many types of forces are applied in various situations.

Complete Table 2 by inserting the appropriate types of forces and examples.

**TABLE 2: TYPES OF FORCES AND EXAMPLES OF WHERE THE FORCES ARE EXPERIENCED**

| Type of Force | Example of Where the Force is Experienced |
|---|---|
|  | A satellite falling in the earth's atmosphere |
| Nuclear |  |
|  | When a rubbed comb picks up a small piece of paper |
| Magnetic |  |

**(4 marks)**

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(c) A class of Physics students conducted a School-Based Assessment on the relationship between force (F) and extension (e) for a rubber band.

One of the groups produced the following graph from the results.
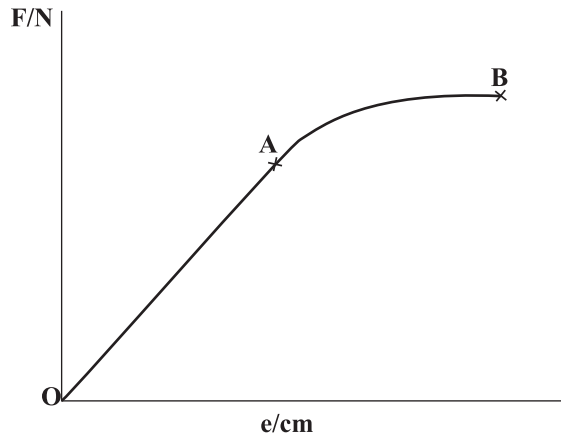


**Figure 4. Graph of Force (F) against extension (e)**

(i) State the mathematical relationship between force and extension in the segment OA.

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**(2 marks)**

(ii) State the point at which the elastic limit is located.

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**(1 mark)**

(iii) Give a reason for the shape of the segment AB in the graph.

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**(1 mark)**

**Total 15 marks**

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## SECTION B

## Answer ALL questions.

**4.** (a) (i) Explain what is meant by the term 'the specific latent heat of vaporization of water'.

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**(3 marks)**

(ii) Calculate the heat energy required to convert 8 kg of water at 100 °C to steam at 100 °C.

(Specific latent heat of vaporization of water / $l_v$ = 2 300 000 $Jkg^{-1}$)

**(3 marks)**

(b) (i) Define the pressure law.

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**(3 marks)**

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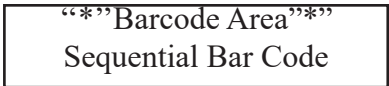
(ii) The initial pressure of a sample of gas is 3 Pa, the final pressure is 9 Pa, while its volume remains unchanged.

If the initial temperature of the gas was 27 °C, calculate the final temperature of the gas.

**(6 marks)**

**Total 15 marks**

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**5.** House wiring circuits contain fuses and earth wires. Appliances are connected to these circuits in parallel.

(a)    (i)    What is the purpose of the fuse in a circuit?

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**(2 marks)**

(ii)    What is the purpose of the earth wire in a circuit?

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**(2 marks)**

(iii)    State TWO reasons why appliances are connected to the circuit in parallel.

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**(2 marks)**

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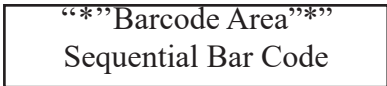
(b)  Figure 5 shows a circuit diagram.
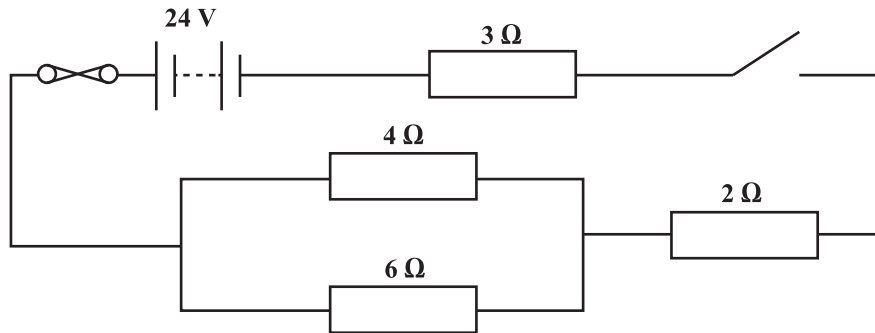


**Figure 5. Circuit diagram**

Use the circuit diagram in Figure 5 to determine

(i)  the TOTAL resistance in the circuit

**(6 marks)**

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(ii)    the TOTAL current in the circuit.

**(2 marks)**

(iii)    Which fuse, a 2A fuse, a 3A fuse or a 4A fuse, is the most suitable to use in the circuit shown in Figure 5?

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**(1 mark)**

**Total 15 marks**

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**6.** (a) Complete Table 3 below to show the properties of the THREE types of radioactive emissions.

**TABLE 3: PROPERTIES OF RADIOACTIVE EMISSIONS**

| Type of Radioactive Emission | Charge | Ionizing Ability |
|---|---|---|
| Alpha/α | | |
| Beta/β | | |
| Gamma/Υ | | |

**(6 marks)**

(b) Complete the following nuclear equations.

(i) $^{14}_{6}C \dashrightarrow \ ^{14}_{7}N \ + \ \boxed{\phantom{xxx}}$

(ii) $^{226}_{88}Ra \dashrightarrow \ ^{222}_{86}Rn \ + \ \boxed{\phantom{xxx}}$

**(4 marks)**

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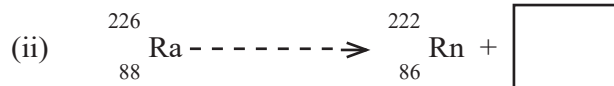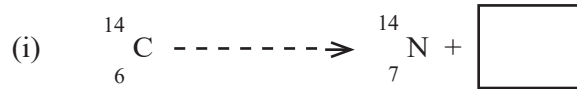
(c)      A radioactive sample had an initial count of 1000 as measured on a Geiger–Müller counter.

After 15 hours, the count rate was 250. Calculate the half-life of the sample.

**(5 marks)**

**Total 15 marks**

**END OF TEST**

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

**EXTRA SPACE**

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# CANDIDATE'S   RECEIPT

## INSTRUCTIONS TO CANDIDATE:

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

TEST CODE: | 0 | 1 | 2 | 3 | 8 | 0 | 2 | 0 |

SUBJECT: _____ PHYSICS – Paper 02 _____

PROFICIENCY: _____ GENERAL _____

REGISTRATION NUMBER: | | | | | | | | | | |

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: _____