FORM TP 2013103

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MAY/JUNE 2013

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.
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. All working MUST be CLEARLY shown.
6. The use of silent, non-programmable calculators is permitted, but candidates should note that the use of an inappropriate number of figures in answers will be penalized.
7. Mathematical tables are provided.

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

SECTION A

Attempt ALL questions.

You MUST write your answers in this answer booklet.

1. Table 1 shows the results obtained by a student who performed an experiment to investigate how the length of a spring varies with the load applied to the end of the spring.

TABLE 1

Load, F/N	Length, L/m
2.0	0.36
4.0	0.35
6.0	0.40
8.0	0.46
10.0	0.51

(a) Plot, on page 3, a graph of length (L) on the vertical axis versus Load (F). Start each axis at zero.

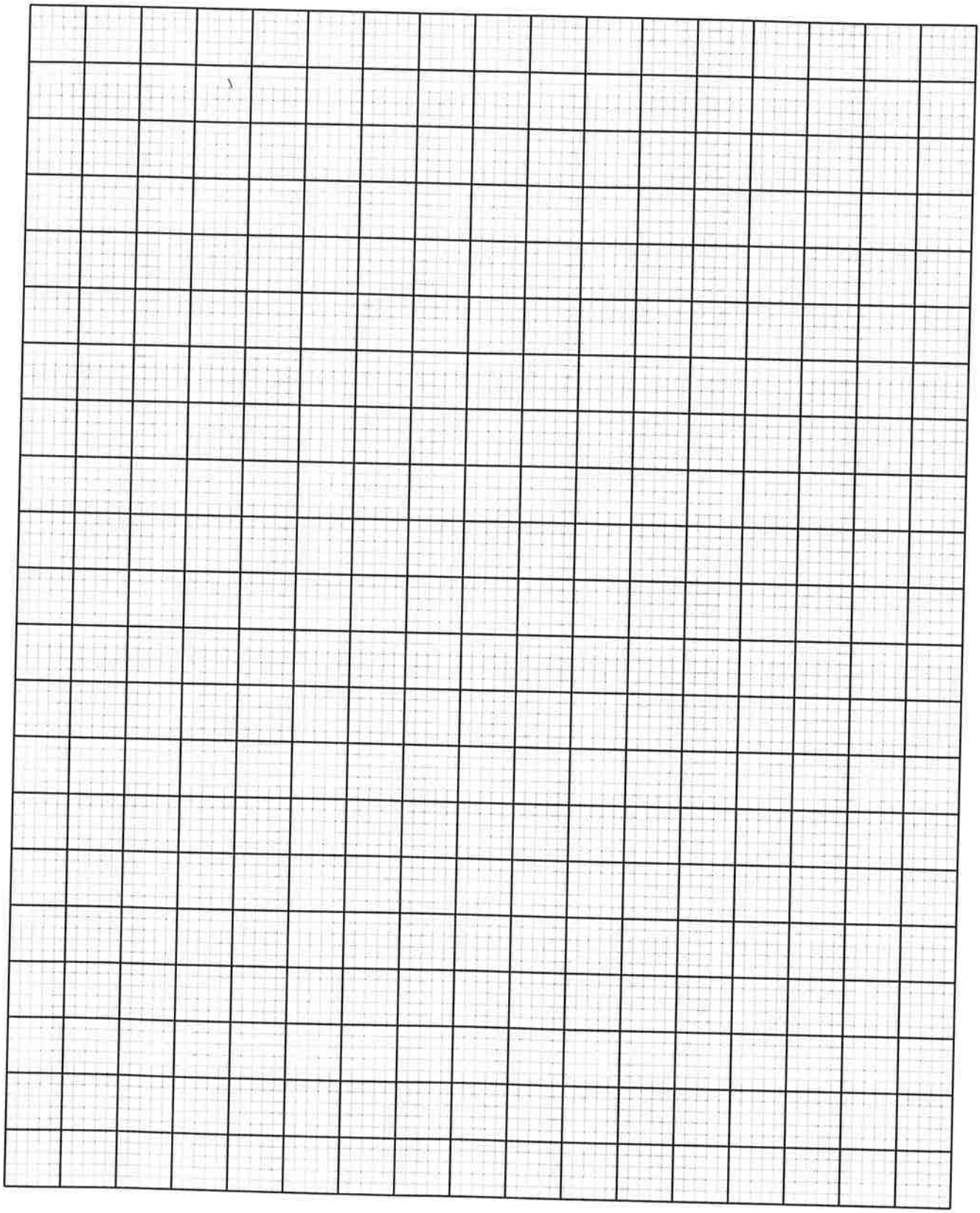
(7 marks)

(b) Determine the gradient of the graph.

(4 marks)

(c) What information about the spring does the gradient of the graph provide?

(1 mark)



(d) (i) Use the graph to find the original length of the spring.

(2 marks)

(ii) Use the gradient to calculate the extension of the spring if a 0.7 kg mass hangs freely from the end of the spring. Hence calculate the length of the spring with the mass attached.

(6 marks)

[g = 10 N kg^{-1}]

(iii) If the spring was stretched beyond its elastic limit how would this affect the shape of the graph?

(1 mark)

(e) (i) How would you identify the region where proportionality exists?

(2 marks)

(ii) Classify EACH quantity shown in Table 2, as a scalar or vector by inserting a tick (✓) in the appropriate column.

TABLE 2

Quantity	Scalar	Vector
Load		
Extension		

(2 marks)

Total 25 marks

2. (a) (i) Define the term 'specific heat capacity' of an object.

_____

_____

(2 marks)

(ii) Complete Table 3 below by inserting the correct symbol and SI Unit which relate to the quantity shown in Column 1.

TABLE 3

Quantity	Symbol	SI Unit
Heat Capacity	C	
Specific Latent Heat of Fusion		$J\ kg^{-1}$

(2 marks)

(iii) Write the formula for the General Gas Law, stating clearly what each letter represents.

_____

_____

_____

_____

(3 marks)

(b) A physicist converts 8 kg of water at 33 °C to steam at 100 °C.

Assuming there is no heat lost, calculate the energy required

(i) to heat the water to 100 °C.

_____

_____

_____

(3 marks)

(ii) to convert the water to steam at 100 °C.

_____

_____

_____

(3 marks)

(iii) What is the total energy, in mega joules, required to heat the 8 kg of water at 33 °C to steam at 100 °C?

_____

_____

(2 marks)

[Specific heat capacity of water = 4 200 J $kg^{-1}K^{-1}$]

[Specific latent heat of vaporization of water = 2 300 000 J kg^{-1}]

Total 15 marks

3. (a) (i) State Snell's Law.

_____

_____

_____

(3 marks)

(ii) In the space below, draw a labelled diagram using the converging lens to show clearly the following features:

- Principal axis
- Principal focus
- Focal length
- Focal plane

(4 marks)

(b) (i) Describe the path into a prism and out of a prism when a ray of light is incident at 90° to the hypotenuse of a right-angled glass prism as shown in Figure 1.

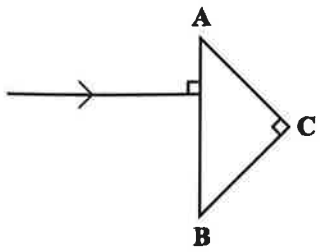


Figure 1

(7 marks)

(ii) Through what angle would the ray be turned after emerging?

(1 mark)

[Critical angle for glass = 42°]

Total 15 marks

SECTION B

Attempt ALL questions.

You MUST write your answers in the spaces provided after each question.

4. (a) (i) State the law of conservation of linear momentum. **(3 marks)**

(ii) Describe a situation that demonstrates the law of conservation of linear momentum. **(3 marks)**

(b) A truck, of mass 1250 kg, heading north crossed the median on the Jasper Highway, then slammed head-on at 25 ms^{-1} into a 625 kg car heading south at 30 m s^{-1}.

(i) What was the initial momentum of the truck?

(ii) What was the initial momentum of the car?

(iii) Assuming the car and truck move as one following the collision, what is the speed and direction of the wreck right after the collision?

(9 marks)

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

5. (a) Describe an experiment that can be used to determine the resistance of a metallic conductor. **(6 marks)**

(b) Figure 2 shows a 12 V battery of negligible internal resistance connected to an arrangement of resistors.

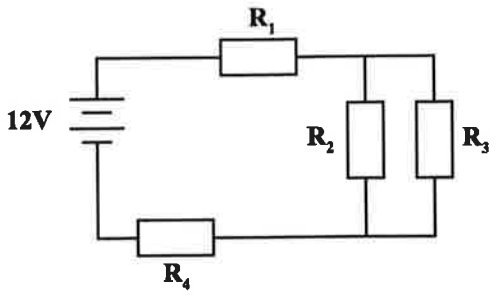


Figure 2

Given that resistors R_1 to R_4 each have a resistance of 3Ω, calculate

(i) the total resistance in the circuit **(3 marks)**

(ii) the current drawn from the 12V battery **(3 marks)**

(iii) the voltage across R_2. **(3 marks)**

Total 15 marks

Write your answer to Question 5 here.

6. (a) Describe an experiment to compare the ranges of β and γ emissions in aluminium.

(6 marks)

(b) A liquid fluoride thorium reactor is said to be the new 'green' nuclear reactor.

(i) Rewrite the nuclear sequence to show how thorium-232 becomes uranium-233, a nuclear fuel, by calculating the numerical values of *x*, *y*, *u*, *v*, and *z*.

$$^{1}_{0}n + {}^{232}_{90}Th \longrightarrow {}^{x}_{y}Th$$

$${}^{x}_{y}Th \longrightarrow {}^{0}_{-1}e + {}^{u}_{v}Pa$$

$${}^{u}_{v}Pa \longrightarrow {}^{0}_{-1}e + {}^{233}_{z}U$$

(5 marks)

(ii) The equation representing the fission of U- 233 is

$$^{233}_{92}U + {}^{1}_{0}n \longrightarrow {}^{133}_{51}Sb + {}^{98}_{41}Nb + 3\,{}^{1}_{0}n + \text{energy}\ .$$

Table 4 provides the data for these nuclides where u = 1.66×10^{-27} kg.

TABLE 4

Nuclide	Atomic Mass/u
$^{233}_{92}U$	233.03964
$^{133}_{51}Sb$	132.91525
$^{98}_{41}Nb$	97.91033
$^{1}_{0}n$	1.00867

Calculate the energy released in the fission of $^{233}_{92}U$.

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

(4 marks)

Total 15 marks