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 two sections: A and B.

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. Do NOT write in the margins.

6. All working MUST be clearly shown.

7. You may use a silent, non-programmable calculator, but you should note that the use of an inappropriate number of figures in answers will be penalized.

8. Mathematical tables are provided.

9. 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.**

10. **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.

You MUST write your answers in this answer booklet.

1. A student carried out an experiment to investigate the temperature rise of 250 g of a liquid when heated by an electrical immersion heater. The results of the experiment are recorded in Table 1.

TABLE 1

Electrical Energy, E (kJ)	Temperature Rise of Water, ΔT (K)
0.0	0.0
3.7	3.0
7.0	6.0
10.5	9.0
14.5	12.0
18.0	15.0

(a) **On the grid provided on page 5**, plot the graph of electrical energy, E, against temperature rise, ΔT. **(8 marks)**

(b) Using your graph, calculate the slope, S, of the graph.

(5 marks)
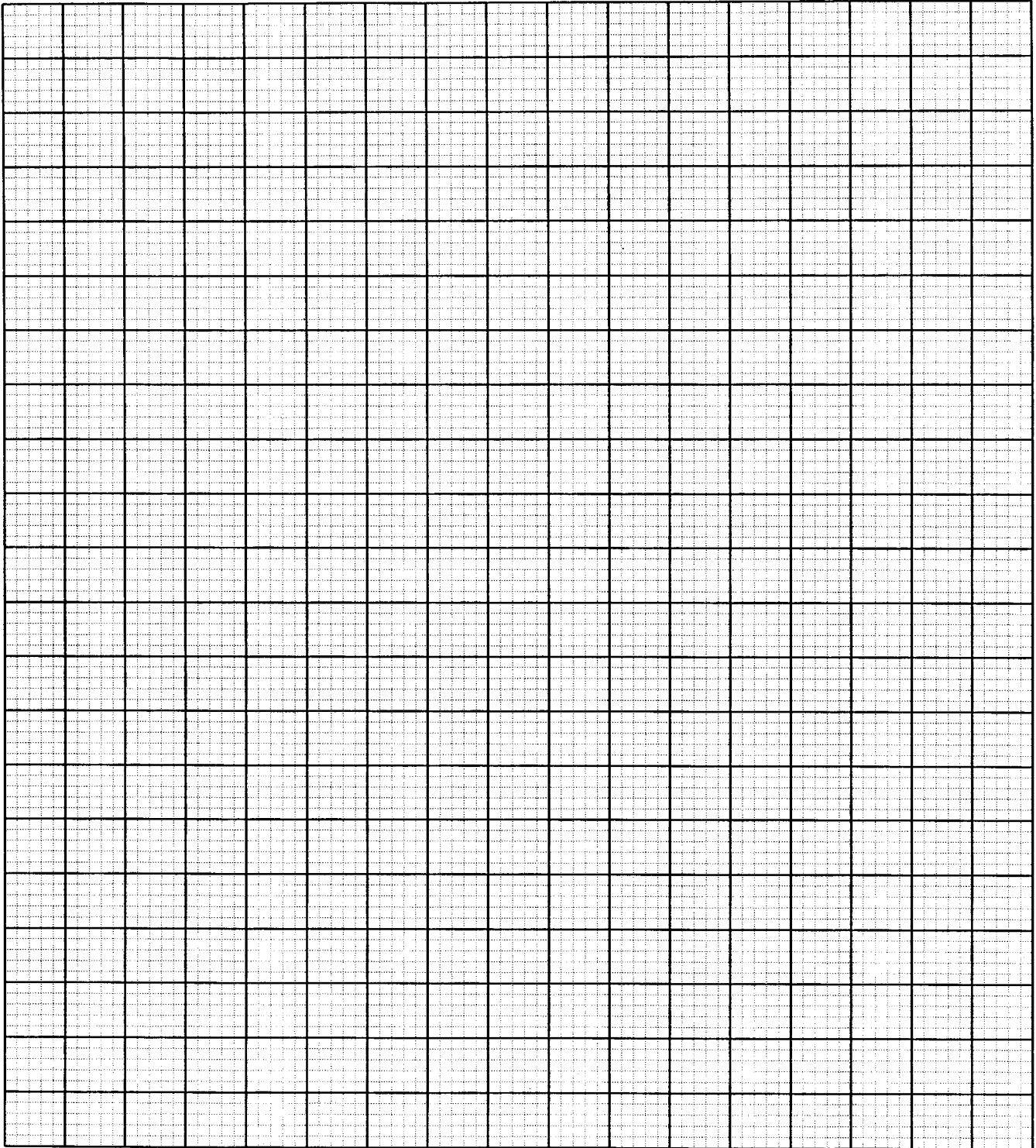
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(c)   What physical quantity does the slope represent?

....

                                                                                    (1 mark)

(d)   Use the value of the slope S, calculated in 1 (b) **on page 4**, to determine the specific heat capacity of the liquid in the units $Jg^{-1} k^{-1}$. Assume there is negligible heat transferred to or from the container holding the liquid.

                                                                                    (4 marks)

(e) The initial temperature of the water was 10 °C below room temperature and the final temperature was 10 °C above room temperature.

(i) How does this procedure help in minimizing error in the experiment?

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(2 marks)

(ii) State ONE other useful precaution that the student should have taken.

....

....

(1 mark)

(f) Given that the power supplied to the immersion heater was kept constant at 40 W, calculate the time taken for 18.0 kJ of energy to be supplied.

(4 marks)

Total 25 marks

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2. **(a)** Figure 1 shows a cross section of a zinc–carbon cell.
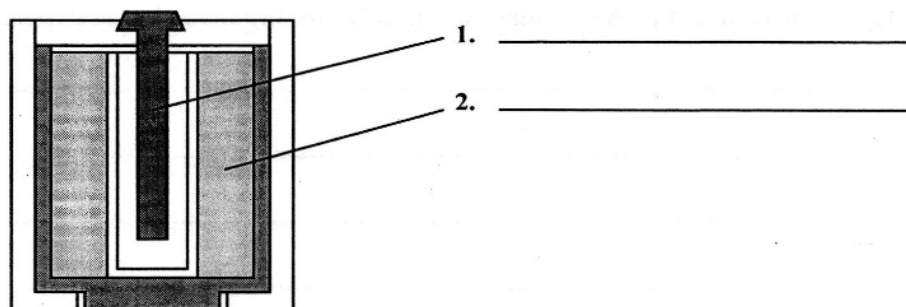

1. _____

2. _____

Figure 1

Label the parts of the cell indicated in Figure 1. **(2 marks)**

(b) The zinc–carbon cell is a primary cell. The lead–acid cell is a secondary cell. State THREE differences between these cells.

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....

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....

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(3 marks)

GO ON TO THE NEXT PAGE

(c) A solar module (power source) is used to charge a 12 V battery. During one phase of the charging, a constant current of 1 A is supplied for four hours.

    (i) Calculate the charge added to the battery in Coulombs.

(4 marks)

    (ii) Calculate the energy, in kJ, added to the battery.

(4 marks)

    (iii) Suggest, with a reason, a value for the voltage of the solar module during battery charging.

....

....

....

(2 marks)

Total 15 marks

3. **(a)** **(i)** Fill in the blanks in the following passage about the moments of forces.

The .... of moments states that when

a body is in equilibrium the sum of the ....

about any .... is equal to the

sum of the .... about

the same ....

(4 marks)

(ii) Apart from the 'seesaw', identify TWO situations in which a force will result in a turning effect.

....

....

....

....

(2 marks)

(b) Figure 2 shows Kyle and Keion balanced on a seesaw. Kyle's weight is 500 N and Keion's weight is 300 N. The seesaw is made of a uniform plank of weight 800 N which is 4 m long, pivoted at its centre.
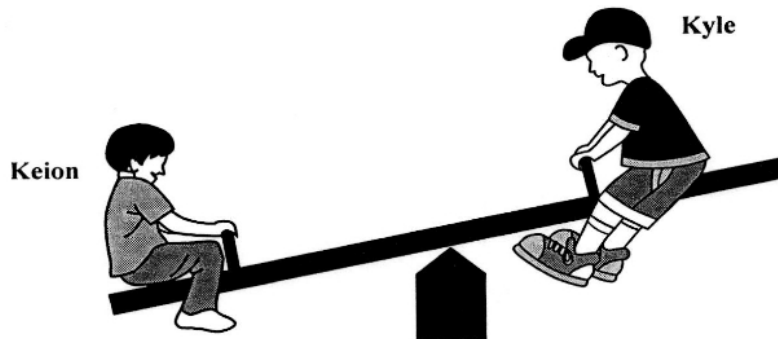

Figure 2

(i) By taking moments about the pivot, calculate the distance, x, that Keion must sit from the pivot to balance the plank if Kyle sits 1 m from one end of the plank.

(4 marks)

(ii)   If balanced, calculate the reaction force at the pivot.

(4 marks)

(iii)   What is the moment of the reaction force about the pivot?

....

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions.

You MUST write your answers in this answer booklet.

4.   (a)   (i)   State TWO examples of observations which provide evidence that light can be refracted.

....

....

....

....

                                                                (2 marks)

     (ii)   Figure 3 shows a ray of light travelling from air to water.
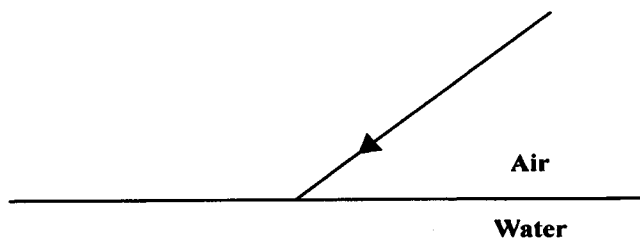
Air

Water

Figure 3

Complete Figure 3 by adding the normal at the point of incidence, the refracted ray, and indicating the angles of incidence and refraction.   **(3 marks)**

(iii) As the light ray travels from air to water, determine if the speed of the light ray will increase or decrease. Give a reason for your response.

....

....

....

....

(2 marks)

(b) A glass prism, as shown in Figure 4, may be used to produce a spectrum.
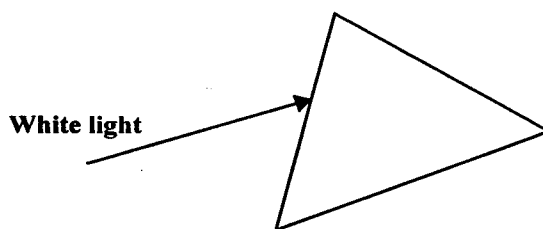
White light

Figure 4

(i) What is the name of the effect that is created?

....

....

(1 mark)

(ii) On Figure 4 above, trace the path of the white light into and out of the prism indicating the red ray and the violet ray. **(2 marks)**

GO ON TO THE NEXT PAGE

(c)   An experiment was conducted to verify Snell's law of refraction by measuring the angle of incidence, i, and the angle of refraction, r, for a light ray entering a glass block. The data was recorded as shown in Table 2.

TABLE 2

Angle of Incidence, i	Angle of Refraction, r	sin i	sin r	sin i/sin r
30°	20°	0.50		1.47
50°	31°		0.52	
60°	35°	0.87	0.57	

(i)   Complete Table 2 by inserting the missing values.   **(2 marks)**

(ii)   Determine the angle of refraction if an incident angle of 70° was recorded for this experiment. (Use the refractive index of glass as 1.52.)

....

....

....

....

(3 marks)

Total 15 marks

5.   (a)   State the name of EACH logic gate represented below.

(i)

....

(1 mark)

(ii)

....

(1 mark)

(iii)

....

(1 mark)

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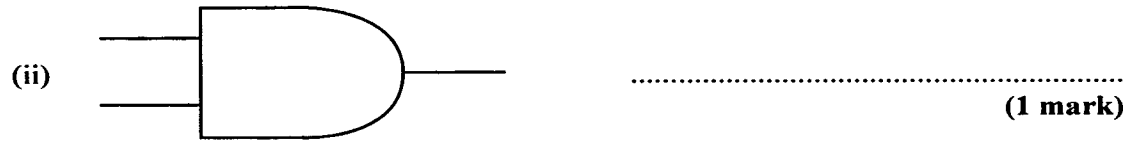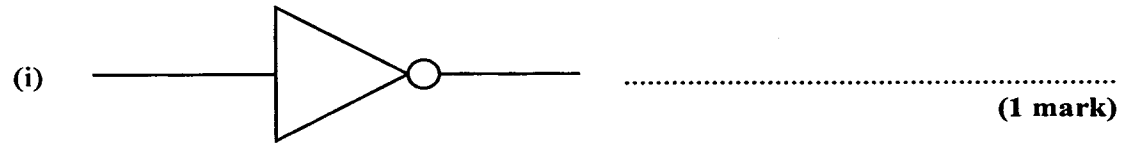
(b) Complete the truth tables for the NOT and NOR gates.

(i) NOT Gate

TABLE 3

INPUT	OUTPUT
0	
	0

(1 mark)

(ii) NOR Gate

TABLE 4

INPUT		OUTPUT
0	0	
0	1	
1	0	
1	1	

(2 marks)

(c)   Figure 5 shows a basic home security system that provides protection for two windows and front and back doors. The use of OR gates facilitates the system with all inputs on Low (0). If a disturbance occurs the input turns to High (1). The alarm will sound only if a High (1) output is received.
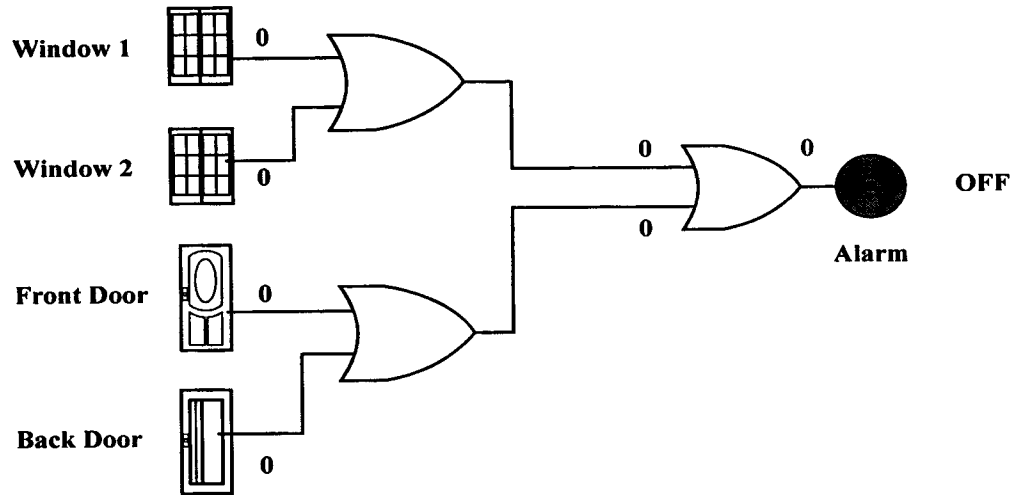

Figure 5

Figure 6 shows an intruder at Window 2 causing its input to change to High (1).
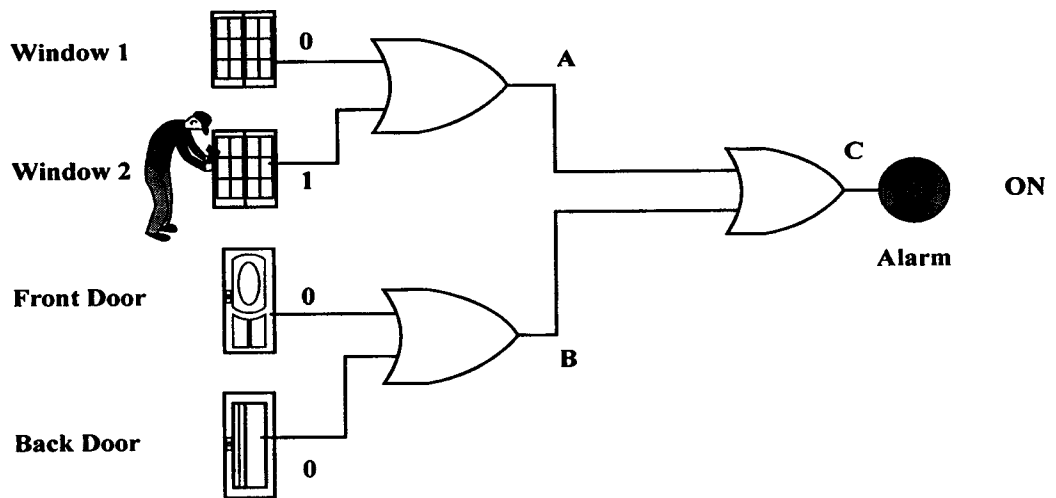

Figure 6

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(i) Find the logic combination that causes the alarm to sound by determining the outputs at A, B and C in Figure 6.

A = ...

B = ...

C = ...

(3 marks)

(ii) If a simultaneous disturbance is triggered at the back door and at Window 2, show on Figure 7, the logic output at A, B and C.
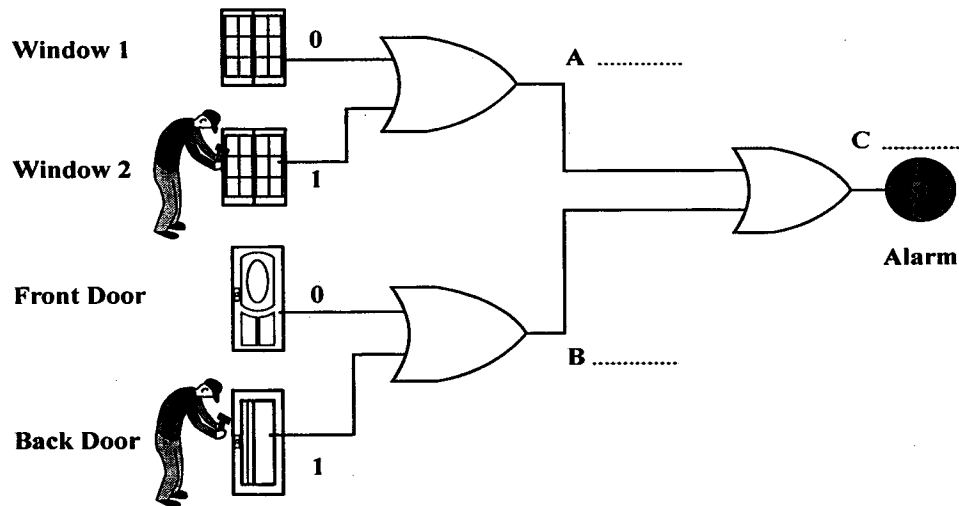
Figure 7

(3 marks)

(d) State THREE ways in which advances in electronics, such as the introduction of logic gates, have made a positive impact on society.

(i) ....

....

(ii) ....

....

(iii) ....

....

(3 marks)

Total 15 marks

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6. **(a)** Figure 8 shows a typical layout of Rutherford's experiment used to determine the composition of the atom.
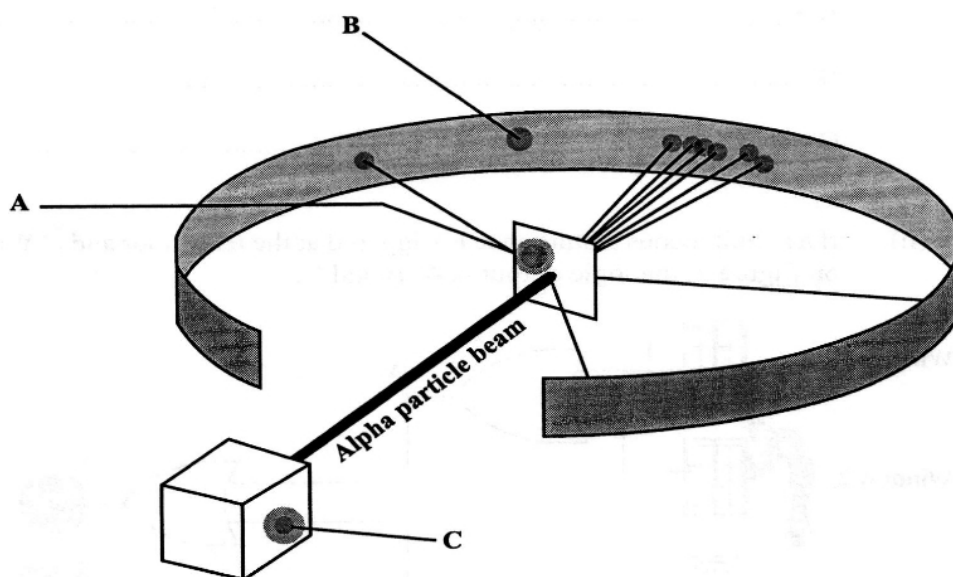
Figure 8

(i) State the names of the components labelled A, B and C.

A ....

B ....

C ....

(3 marks)

(ii) Using your knowledge from Rutherford's experiment, explain why it was critically important for him to use the substance or element for the component labelled A.

....

....

....

....

(2 marks)

(iii) State TWO conclusions from Rutherford's experiment about the model of the atom.

....

....

....

....

(2 marks)

(b) The symbol $_{14}^{28}Si$ represents an atom of the metal silicon.

(i) Determine the number of neutrons found in ONE atom of silicon.

....

(1 mark)

(ii) Using the same standard notation, state a possible isotope of $_{14}^{28}Si$.

....

(1 mark)

(c) A radioactive element X undergoes a decay process which results in the formation of a new element Y, as shown in the following equation.

$$^{222}_{76}X \rightarrow {}^{p}_{q}Y + {}^{4}_{2}He$$
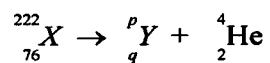
(i) State the type of decay process that occurred.

....

(1 mark)

(ii) Determine the values of p and q.

....

....

(2 marks)

(iii) If element Y then undergoes a beta decay and forms an element Z, write the reaction equation.

....

....

....

(2 marks)

(iv) How does radioactive decay affect a particle's mass?

....

....

(1 mark)

Total 15 marks

END OF TEST

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