RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree

First Year – Semester II Examination – March/ April 2014

PHY 1104- Modern Physics

Index No:..... Time allowed: One Hour

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charge of an electron, e	= 1.6×10^{-19} C
Planck constant, h	= 6.626×10^{-34} J s
speed of light in free space, c	= 3.0×10^{8} m s^{-1}
electron mass, m_e	= 9.1×10^{-31} kg
permittivity of free space, ε_0	= 8.85×10^{-12} C^2 N^{-1} m^{-2}
1 electron volt eV	= 1.6×10^{-19} J
Proton mass, m_p	= 1.67×10^{-27} kg

Use of a non-programmable calculator is permitted.

Instructions

Answer all questions in **PART A** and only one question in **PART B.**

PART A

Use the given space to answer the questions

1. Answer the following questions referring Figure 01.

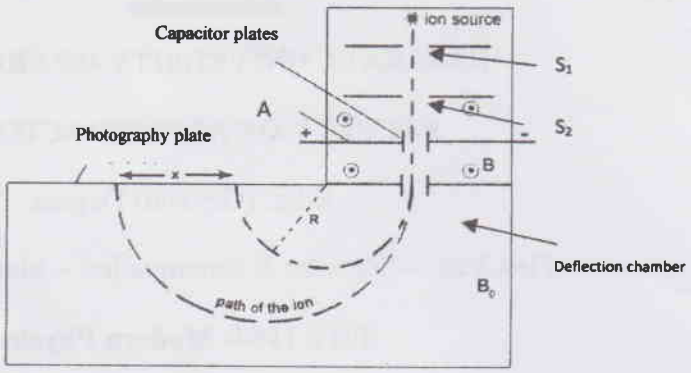

Figure 01

a. Write down the working principle of the above instrument.[5 marks]

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b. What is the purpose of S_1 and S_2? [2 marks]

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c. What is indicated by A and write down the function of it.[4 marks]

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d. Mark the direction of the magnetic field in the deflection chamber.[2 marks]

e. A singly ionized ^{30}X atoms pass into the deflection chamber with a velocity 10^6 m s^{-1}. Find the value of the magnetic field required to deflect the ions to have a path defining a radius of curvature of 2 m. [8 marks]

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f. Write down two applications of the above instrument. [4 marks]

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2. a. State the postulates of Bohr's theory. [6 marks]

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b. Drive the expression for the radius of n^{th} Bohr orbit. [8 marks]

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c. Hence calculate the radius of the hydrogen atom. [5 marks]

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d. Show that the velocity of the electron in the first Bohr orbit in hydrogen atom is (1/137 c) where c is velocity of light. [6 marks]

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PART B

1. a. Write down the postulates of Einstein's special theory of relativity. [15 marks]

   b. "Clocks in a moving space ships will appear to go slower than the clocks on the surface of earth" Explain. [10 marks]

   c. The density of gold is 19.3×10^3 kg m^3 in a frame S which is at rest. Calculate its density that an observer in a frame S' would determine if S' is moving along the x-axis with a speed of 0.9c.[25 marks]

2. a. What are accelerators? Group them according to the shape of the path of the particles. [10 marks]

   b. Describe the construction and working principle of cyclotron with suitable diagrams. [20 marks]

   c. Deuterons in a cyclotron describe a circle of radius 0.32 m just before emerging from the dees. The frequency of the applied e.m.f is 10 MHz. Find

   i. the flux density of the magnetic field, [8 marks]

   ii. velocity of deuterons emerging out of the cyclotron and [6 marks]

   iii. the energy of emergent deuterons.[6 marks]

   Mass of a deuterium atom = 3.32×10^{-27} kg