RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
First Year - Semester II Examination – October/November 2017

PHY 1104 – MODERN PHYSICS

Time: One (1) hour

Answer all questions.

Use of a non-programmable calculator is permitted.

Symbols have their usual meaning.

Some fundamental constants:

Planck constant, $h = 6.626 \times 10^{-34}$ J s   Electron charge, e $= 1.6 \times 10^{-19}$ C
Electron mass $m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space, $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2 N^{-1} m^{-2}$

---

1.   (a) (i) Discuss the advantages and the disadvantages of X-ray production methods.
                                                                    [08 Marks]

       (ii) Give a brief description on florescence and phosphorescence nature of X-rays.   [06 Marks]

   (b) (i) Write Moseley's law with defined terms.   [06 Marks]

       (ii) In a Moseley diagram, strong K_α line of $\lambda = 0.21$ Å and a weak K_α line of $\lambda = 1.427$ Å were obtained for tungsten. Identify the impurity (Z for tungsten is 74, R $= 1.097 \times 10^7 m^{-1}$).   [10 Marks]

   (c) (i) What are the limitations of Rutherford's and Thomson's atomic models?
                                                                    [10 Marks]
       (ii) Calculate the velocity and energy of an electron in an innermost orbit of a hydrogen atom.   [10 Marks]

Contd.

2.   (a) A cyclotron has an oscillator frequency of 12×10^6 cycles/s and a dee radius of 54 cm. Calculate

(i) the value of magnetic field B, needed to accelerate deuterons.

[06 Marks]

(ii) the resulting deuteron energy. (Mass of a deuteron is 3.343×10^{-27} kg, charge of a deuteron is 1.6×10^{-19} C)   [06 Marks]

(b) Write down the types of synchrotron and write a short note on one of them.

[08 Marks]

(c) In a betatron, maximum magnetic field at the stable electron orbit is 2×10^4 gausses. Diameter of the stable orbit is 1.5 m. If the frequency of alternating current through the magnetic coil is 50 Hz, calculate the final energy and the average energy gained per revolution for electrons.   [10 Marks]

(d) Prove by calculation that the ions with different masses strike the plate at different points in Bainbridge mass spectroscopy.   [10 Marks]

(e) Explain how the conduction of electricity through gases happens at low pressure by using appropriate diagrams for each step.   [10 Marks]

End.