



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

INSTITUTE OF OPEN LEARNING (IOL)

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE AND

BACHELOR OF EDUCATION (SCIENCE)

SPH 202: MODERN PHYSICS

DATE: Tuesday, 13th December, 2011

TIME: 11.00 a.m. – 1.00 p.m.

INSTRUCTIONS:

Answer question **ONE** and any other **TWO** questions. Question **ONE** carries 30 marks while the other questions carry 20 marks each.

- Q.1
- a) What is Compton effect and what does it demonstrate? (4 marks)
 - b) Explain the aspect of photoelectric effect which depends on the light intensity influence. (5 marks)
 - c) Discuss the Rutherford experiment, its aim, results and conclusion. (8 marks)
 - e) Calculate the frequency of light which liberates electrons from a metal whose work function 1.8.0eV with a velocity of 1.2×10^6 m/s. (4 marks)
 - e) Explain the meaning of nuclear binding energy and the significance of low or high value of the energy. (5 marks)
 - f)
 - i) Explain how the theory of relativity is changing our perception about the effect of high velocity on the physical quantities mass, length and time. (2 marks)
 - ii) An object has a length of 100 cm and rest mass of 5×10^{-3} g. If it moves at a velocity of 1.5×10^8 m/s, what would be its perceived length and mass. (4 marks)

- Q.2 a) i) Discuss briefly two properties of electron in which its wave properties are demonstrated. (4 marks)
- ii) Using de Broglie's wave theory show that quantization of angular momentum of electron on an orbit of radius r is predictable. (4 marks)
- iii) Calculate a shift in the wavelength of a photon scattered at an angle of 180° in the Compton effect (4 marks)
- b) i) Discuss two factors believed to be the cause of radioactivity of radioactive elements. (4 marks)
- ii) In photoelectric effect the kinetic energy of the emitted electrons is independent of the intensity of the light used. Explain this and what it demonstrates. (4 marks)
- Q.3 a) Explain the Rutherford's assertion about electron in atom that was in conflict with the electromagnetic theory? (5 marks)
- b) State the Bohr's postulates and discuss the one in conflict with Pauli's exclusion principle (5 marks)
- c) i) A radioactive element has half-life of 1620 yrs, determine how long it would take 64g of the substance to decay to 8gm. (6 marks)
- ii) Differentiate between Fission and Fusion in nuclear reaction (4 marks)
- Q.4 a) i) Discuss the Davission-Germer experiment stating clearly what its results demonstrate. (5 marks)
- ii) Calculate the de Broglie wavelength for an electron moving at a speed of 2×10^6 m/s. (4 marks)
- b) i) Describe how X-rays are produced in an X-ray tube, stating factors which must be taken into consideration to generate X-rays of required quality. (4 marks)

- ii) State the two forms of energy conversion taking place in the x-ray tube (3 marks)
- iii) At what P.d should an x-ray tube be operated to generate x-rays of wavelength $4 \times 10^{-6} \text{ m}$ (4 marks)

- Q.5
- a)
 - i) State the Heisenberg's uncertainty principle. (2 marks)
 - ii) Write the two expressions for the Heisenberg's uncertainty principle. (2 marks)
 - b)
 - i) What is half-life of a radioactive element? (2 marks)
 - ii) 128g of a certain radioactive element was found to reduce to 32g in 6 min. What is
 - its half life (1 mark)
 - its decay constant? (3 marks)
 - c) The element $^{243}_{94}\text{Rn}$ decays by emitting one alpha and one beta particle and an element ^x_yP .
 - i) Find the values of x and y. (4 marks)
 - ii) Describe the Michelson – Morley experiment and explain the implication of the results. (6 marks)