KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

INSTITUTE OF OPEN LEARNING

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 202: MODERN PHYSICS

DATE: TUESDAY 1ST FEBRUARY 2011 TIME: 8.00 A.M. - 10.00 A.M.

INSTRUCTIONS

Answer question 1 and any other two questions.

Question 1 carries 20 marks while the other question carry 15 marks each.

Use the following constants where necessary

Electron mass m_e = 9.1 x 10^{-31} kg		Speed of light 3 x 10^8 m/s
Electron charge	= 1.6 x 10^{-19} C	1eV = 1.6 x 10^{-19} J
Permittivity of free space	= 8.85 x 10^{-12} F m^{-1}	
Plank's constant	= 6.62 x 10^{-34} Js	
1 atomic mass unit (a.m.u)	= 1.66 x 10^{-27} kg	= 931 MeV

Q1.

a) Discuss the aspect of Rutherford's atomic model which contradicted the electromagnetic theory? (4 marks)

b)What is photoelectric effect and what does it demonstrate about energy absorption by electron. (3 marks)

c) Calculate the de Broglie wavelength for an electron moving at a speed of 1.5 x 10^8 m/s. (5 marks)

d)A radioactive element has half-life of 1620yrs, find its radioactivity constant (λ) in seconds and hence or otherwise how long it would take 10gm to reduce to 8gm. (5 marks)

e) Describe how X-rays are produced in modern form of X-ray tube, stating factors, which must be taken into consideration to generate X-rays of required quality. [3 marks]

Q2.

a) State the Bohr's postulates and explain any weaknesses associated with them [5 marks

b) Briefly discus the de Broglie's wave theory (4 marks)

c) Light of wavelength 3.0 x 10^{-7} m illuminates a metal whose work function is 1.0eV. Calculate the maximum kinetic energy in joules of the emitted electrons. (6 marks)

Q3.

a) Discus Compton effect and what does it demonstrate about photon? (4 marks)

b) Calculate a shift in the wavelength of a photon scattered at an angle of 30^0 in the Compton effect (3 marks)

c) Calculate mass lost and, hence, energy evolved when $^{214}_{82}Pb$ decays into $^{214}_{83}B$ and $^{0}_{-1}e$ as shown by the equation below. Use masses given below and 1a.m.u =931 MeV. (4 marks)

$^{214}_{82}Pb \rightarrow {}^{214}_{83}B + {}^{0}_{-1}e$

$^{214}_{82}Pb \rightarrow 213.9982$ amu

$^{214}_{83}B \rightarrow 213.9303$ amu

$^{0}_{-1}e \rightarrow 0.0005$ amu

d) Explain the meaning of nuclear binding energy and the significance of low or high value of the energy. (4 marks)

Q4.

a) Write Lorentz transformation equations and state condition under which they reduce to the Newtonian transformation equations. (5 marks)

b) Discuss the Davission-Germer experiment stating clearly what its results demonstrate. (5 marks)

c) Briefly discuss the concerns of the theory of relativity and state the physical quantities which would be affected, giving expressions (5 marks)

Q5. a) Describe the Michelson – Morley experiment and explain the implication of the results. (5 marks)

b) Differentiate between Fission and Fusion. (3 marks)

c) State the laws governing equation of nuclear reactions (3 marks)

d) Discuss two factors believed to be the cause of radioactivity of radioactive elements. (4 marks)