1. **(a) (i)** State the laws of photoelectric emission (04 marks)

(ii) Explain briefly one application of photoelectric effect (04marks)

(b) In a photoelectric set up, a point source of light of power 3.2 x 10^{-3}W emits mono-energetic photons of energy 5.0eV. The source is located at a distance of 8.0m from the center of a stationary metallic sphere of work function 3.0eV and of radius 8 x 10^{-3}m . The efficiency of photoelectron emission is one in every 10^{6} incident photons. Calculate the,

(i) Number of photoelectrons emitted per second (04 marks)

(ii) Maximum kinetic energy in joules, of the photo electrons (02 marks)

(c) (i) State Braggs law of X-ray diffraction (01 marks)

(ii) Show that density of a crystal can be given by $\rho = \frac{M sin^3\theta}{125\, N_A (n\lambda)^3}$

Where is the glancing angle, n is the order of diffraction, is the x-ray wavelength and M is molecular weight of the crystal (05 marks)

d) briefly discuss X-ray spectra. (05 marks)

2. a)i) What is meant by half-life of a radioactive material (1 mark)

ii) Given the radioactive law Nt = Noe-λt, obtain the relation between λ and half-life T1/2

iii) What are radio isotopes (1 mark?)

iv) The radio isotope $^{90}_{38}Sr$ decays by emission of β-particles. The half-life of the radio isotope is 28.8years, determine the activity of 1g of the isotope (5 marks)

c) i) With aid of a diagram, describe the structure and action of a Geiger Muller tube (06 marks)

ii) Sketch the count rate –voltage characteristic of the Geiger muller tube and explain it's main features (3mk)

(iii) I identify, giving reasons, the suitable range in (b)(ii) of operation of the tube(2mk)

d) Describe milkans experiement to determine charge to mass ratio. (07 marks)