CHUKA   **UNIVERSITY**

COLLEGE

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF DEGREE OF
BACHELOR OF SCIENCE (GENERAL) & BACHELOR OF EDUCATION (SCIENCE)

PHYS 317: BIOPHYSICS

STREAMS: B.SC. (GEN), B.ED (SC) Y3S1   **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 19/12/2012   **8.30 A.M – 10.30 A.M.**

**INSTRUCTIONS:**

The paper contains 5 questions.
Answer question One and any other two questions. Question One contains 40 marks and the other questions contain 15 marks each.

1. (a)   State

       (i)   Four characteristics of beta (β) particles.   [2 marks]
       (ii)   Four applications of X-rays.   [2 marks]

   (b)   Find the wavelength of X-rays of energy 7.2 x 10^6J. Take h = 6.6 x 10^{-34}J.s.
                                                           [3 marks]

   (c)   Two photons of wavelength 20mm and 1000mm are incident on a fractured human arm.

       (i)   Find the energy dissipated by each of them.   [4 marks]

       (ii)   Which of the two would you recommend for taking the picture of the fractured bone? Give reasons to support your answer.   [3 marks]

   (d)   Describe how a Fountain – pen dosimeter is used for measurement of radiation intensities.   [5 marks]

   (e)   (i)   A student using a fountain-pen dosimeter recorded deflections between the goldfoils as 40˚ and 70˚ for emissions A and B respectively from a radioactive element. Identify the emissions giving reasons for your answer.   [4 marks]

(ii)   If the initial angle between the gold foils for emission A is $120°$ and the scale of the dosimeter is 2 emissions per degree, find the number of radioactive emissions for A. [3 marks]

(f)   List five advantages of using a G-M counter for measuring radiation intensities. [5 marks]

(g)   By using a ray diagram of the eye, show the interfaces in the eye where refraction occurs and state the values of the refractive indices of those interfaces. [6 marks]

(h)   Define the following:

(i)   Loudness of sound
(ii)   Pitch of sound
(iii)   A decibel [3 marks]

Q2.   (a)   Explain the following terms as used in sound

(i)   Masking
(ii)   Beats
(iii)   Dissonance [6 marks]

(b)   Two tuning forks are vibrated together such that they produce sounds of frequencies 59Hz and 72 Hz respectively. Calculate

(i)   their beat frequency [2 marks]
(ii)   their beat wavelength if speed of sound 340mls. [2 marks]
(iii)   their beat energy. Take $h = 6.6 \times 10^{-34}$ J.s [2 marks]

(c)   During the process of diffusion through cell membranes, 2000 J of energy is dissipated in an organism of mass 200g. If the initial body temperature of the organism is $20°C$ and the average body specific heat capacity of the organism is 3000 $JKg^{-1}K^{-1}$, find the final body temperature of this organism. [3 marks]

Q3.   (a)   State three properties of sound. [3 marks]

(b)   Distinguish between sonic sound, ultrasound, and infrasound. [3 marks]

(c)   The human ear detects sounds of frequency 1000 Hz corresponding to an intensity 1×10^{-12} W/m^2. The loudest sounds the ear can tolerate at this frequency correspond to an intensity of about 1.0 W/m^2. Determine the pressure amplitude and displacement amplitude associated with these two limits. [6 marks]

(d)   Identify the radiations labeled A and B giving reasons for your answers, if they

are in magnetic field. [3 marks]

A

B
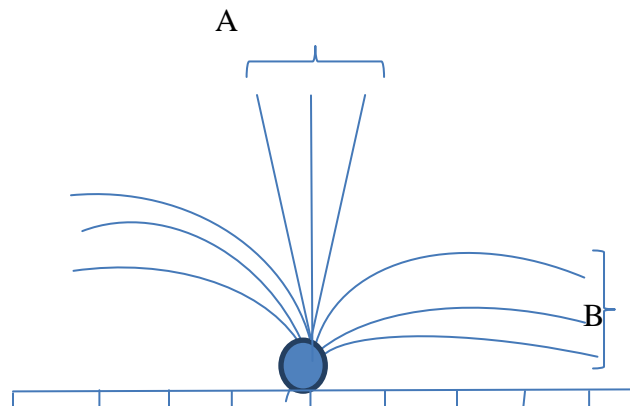
4. (a) Discuss how the following factors affect the rate of diffusion.

    (i)   Molecular size [2 marks]
    (ii)   Shape of the molecules [2 marks]
    (iii) Viscosity of the solvent [2 marks]

(b) With the help of a schematic diagram of an X-ray tube, explain how X-rays are produced. [6 marks]

(c) An uncomfortably loud sound having an intensity of 0.54 W/m^2 is played in amatatu. Find the maximum displacement of the molecules of air by the sound wave if its frequency is 800 Hz. Take the density of air to be 1.29kg/m^2 and the speed of sound to be 340m/s. [3 marks]

5. (a) Define radiation dose and state its unit of measure. [2 marks]

(b) A beam of alpha particles is directed at a tumor on a person's leg and deposits 0.2J of energy in each kilogram of flesh. The quality factor of these particles is 12 Sv/Gy.

    (i)   Find the dose in Gy. [3 marks]
    (ii)   Find the effective dose in Sieverts (Sv) [3 marks]

(c) State and explain two clinical uses of UV light. [4 marks]

(d) How is the eye related to a photographic camera? [3 marks]