



UNIVERSITY EXAMINATIONS

**THIRD YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF
BACHELOR OF SCIENCE IN BIOMEDICAL SCIENCES AND TECHNOLOGY
SECOND SEMESTER 2022/2023
[JAN – APRIL, 2023]**

BMED 317: BASIC BIOPHYSICS

STREAM: Y3 S2

TIME: 3 HOURS

DAY: MONDAY, 2:00 – 5:00 P.M.

DATE: 03/04/2023

INSTRUCTIONS:

- 1. Do not write anything on this question paper.**
- 2. Answer ALL questions in Section A (Compulsory) and any other TWO questions in section B.**

- Make use of the following constants;
 - Molar mass of nitrogen= 28kg/Kmol
 - Universal gas constant $R_0=8314.3 \text{ Nm/Kmol}$
 - Speed of light in air, $c = 3.0 \times 10^8 \text{ ms}^{-1}$
 - Planks constant $h, = 6.64 \times 10^{-34} \text{ Js}$
 - Electronic charge, $e = 1.062 \times 10^{-19} \text{ C}$
 - $1/4\pi\epsilon_0 = 9 \times 10^9 \text{ xFm}^{-1}$

- a) What do you understand by the term Biophysics? (3 marks)
- b) State and explain Planck's quantum hypothesis (3 marks)
- c) Entropy and enthalpy are not the same. Discuss. (3 marks)
- d) In the compression stroke of a gas engine the work done on the gas by the piston is 120kJ/Kg and the heat rejected to cooling water is 90 kJ/Kg.

Calculate the change of specific internal energy stating whether it is a gain or a loss. (3 marks)

e) Calculate the de Broglie wavelength for an electron whose speed is $2.2 \times 10^8 \text{ ms}^{-1}$. (3marks)

f) Based on the Bohr's model of the atom, explain the equation
$$hf = E_2 - E_1$$
(3 marks)

g) Explain the statement 'radiation with LET of $100 \text{ keV}/\mu\text{M}$ is the most efficient in producing biological damage. (3marks)

h) Discuss the zeroth law of thermodynamics. (3marks)

i) Explain the terms in the Bernoulli's Principle. (3marks)

j) Light of frequency $4.25 \times 10^{14} \text{ HZ}$ is made to strike a surface whose work function is 3.25 eV . Show that photoelectric effect will not take place. (**$h = 6.6 \times 10^{-34} \text{ Js}$**) (3 marks)

QUESTION TWO (20 MARKS)

a) Biophysics provided both the tools and the understanding for treating the diseases of growth known as cancers. Discuss.

b) With the aid of appropriate diagrams discuss the Van de Waals forces and hydrogen bonding. (10 marks)

QUESTION THREE (20 MARKS)

a) Discuss the interaction of laser waves with the human body system. (10 marks)

b) Define and describe consequential late effects in normal tissues after radiation therapy. (10 marks)

QUESTION FOUR (20 MARKS)

Discuss the operation of biophysical techniques below;

- (a) Ultracentrifugation (4 marks)
- (b) Electrophoresis (4 marks)
- (c) Size Exclusion Chromatography (SEC) (4 marks)
- (d) Spectroscopy (4 marks)
- (e) Absorption Spectroscopy (4 marks)

QUESTION FIVE (20 MARKS)

(a) Distinguish between isotones and isotopes (2 marks)

(b) Write a decay equation for the following;

(i) Sodium 24 (^{24}Na) decaying to give Magnesium 24 (^{24}Mg) by emitting a β -particle (Z for Na = 11) (2 marks)

(ii) Radium-226 (^{226}Ra) decaying to radon-222 (^{222}Rn) by an emission of an alpha by an emission of an alpha particle (Z for Ra = 88) (2 marks)

(c) i) What is half of half life of a radioactive substance? (1 mark)

ii) Starting from the fact that the rate decay of radioactive nuclide is

$$dN/N = - \lambda dt,$$

where N_0 is the original number of nuclide, dN is the change in the number of nuclide and λ is rate of decay of nuclide, show that at a time = $t_{1/2}$ for a decaying sample of nuclides,

$$\lambda = 0.693 / t_{1/2} \quad (4 \text{ marks})$$

iii) Calculate the fraction of a radioactive sample that decays in 5 days if the substance has a half-life of 2.5 days (4 marks)