KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE (BIOLOGY)

COURSE CODE: SBT 211*

COURSE TITLE: BIOPHYSICS

DATE: 19TH DECEMBER 2022   **TIME: 2.00 – 4.00 PM**

INSTRUCTIONS TO CANDIDATES
Answer Question one (1) and any other two (2) Questions. Question one is compulsory and carries 30 marks, the other Questions carry 20 marks each.

TIME: 2 Hours

This paper consists of 3 printed pages. Please Turn Over

Question One

a) Explain the functional difference in the following biophysical devices.

(5 Marks)

    i.   Optical tweezers

    ii.   Voltage clamp

    iii. Calorimeter

b) List any FIVE applications of Nuclear Magnetic Resonance Spectroscopy in biophysics and medicine. (5 Marks)

c) Highlight the concepts of Free energy using relevant examples.

(5 Marks)

d) Describe the Chemical Potential, stating the mathematical expression:

(5 Marks)

e) The figure below illustrates an electrocardiogram illustrating a cardiac function. (5 Marks)
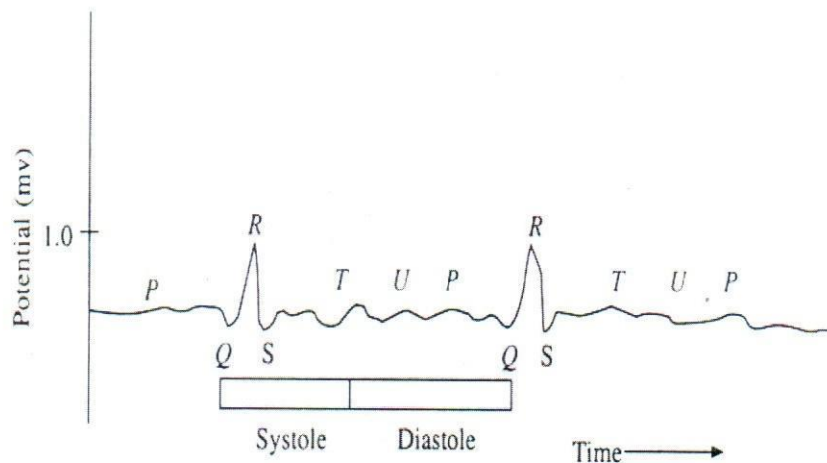
What do the following electrocardiogram cycles of signals corresponds to in in a cardiac function:

P, Q, S-T, T and T-P

f) A molecule of a gas is flowing through a 15 m (δr) long circular pipe of radius 40cm. The concentrations of the gas at the ends of the pipe are 50 kg/m^3 and 10 kg/m^3. The diffusion constant (D) for the gas at 40 ^{0}C is 2.6 x 10^{-5} m^2/s.

a) Calculate the diffusion flow rate ($\pi = 3.14$)   (3 Marks)

b) Calculate the concentration gradient   (2 Marks)

Question Two

a) Describe in details, the chemical structure of nucleic acids. (10 Marks)

b) Describe the main steps in specimen preparation for electron microscopy (10 Marks)

Question Three

a) Give a detailed description of Signal transduction in the cell (10 Marks)

b) A spherical human haemoglobin molecule has radius of 1.2×10^{-10}.m. Use the Stokes's Law to determine the frictional coefficient in kg/s assuming that its viscosity (η) in water at room temperature (298K) is 9×10^{-4} kg/ (ms). ($\pi = 3.14$) (4 Marks)

c) Differentiate between UV Spectroscopy and Fluorescence Spectroscopy stating the use in each case. (6 Marks)

Question Four

a) How can the X-Ray crystallography be applied to determine the atomic level structure of proteins: (10 Marks)

b) Describe how proteins can be made into crystals for analysis using X-Ray crystallography technique. (10 Marks)

Question Five

a) Explain the basic principles of electrophoresis using mathematical expressions where necessary . (5 Marks)

b) Describe in details, the following electrophoresis types. (15 Marks)

    i. Moving boundary electrophoresis.

    ii. Continuous flow electrophoresis.

    iii. Gel Electrophoresis