THE OPEN UNIVERSITY OF SRI LANKA

BACHELOR OF SCIENCE DEGREE PROGRAMME - LEVEL 05

FINAL EXAMINATIONS 2008/2009

PHU 3152/PHE 5152 – BIO PHYSICS

TIME ALLOWED : TWO AND A HALF (02 ½) HOURS

Date : 25th June 2009 Time : 10.00 a.m. – 12.30 p.m.

Answer four questions.

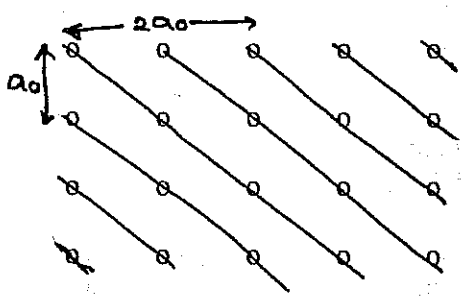
Use the following values where necessary
Boltzymann constant (k) = $1.38 \times 10^{-23} JK^{-1}$
Velocity of light (c) = $3 \times 10^{8}\ ms^{-1}$
$1eV = 1.6 \times 10^{-19} J$
Plank constant (h) = $6.63 \times 10^{-34} Js$.

01. i. Discuss briefly the importance of Bragg equation in X ray diffraction studies.

ii. Sketch three possible sets of Bragg planes (all different) of a two dimensional lattice.

iii. Draw planes with miller indices ($\bar{1}$,00), (0,2,0), (1,0,0), ($\bar{1}$,1,1) for cubic lattice.

iv. Assume that an X ray beam is incident on the family of planes of a Nacl crystal shown below. Calculate the Bragg angles that produce diffraction maxima if a_0 = 5.63A.
Assume the wave length of X-ray beam to be 1.10A.



A family of planes in a Nacl crystal with $d_{hkl} = a_0/\sqrt{5}$ where a_0 is the edge of a unit cell.

02. i. Discuss the importance of the discovery of NMR technique to solve protein structure in solution.

ii. Explain the chemical shift.

iii. What is the fine structure of a NMR spectrum. Explain the reason behind it.

iv. The proton NMR signal of nitro-methane occurs at a frequency 259.8Hz higher than that at Tetramethylsilane (T.M.S) for a spectrometer operating at 60 MHZ. Give the δ value for nitro-methane and calculate the shift from T.M.S in Hz for 100 MHZ spectrometer.

03. i. Discuss briefly, why motion of molecules in a fluid can be considered as a random walk problem.

ii. A large spherical protein molecule having a diameter of 10nm diffuses through a cell of viscosity 3.0×10^{-3} Nm^{-2} at room temperature (27^0C) what is the mean square displacement of the molecule after 3 seconds?

iii. Discuss briefly, the process of sedimentation.

iv. In a disease condition blood cells can stick up in arrangements resembling stack of coins. Discuss the situation when the sedimentation rate suddenly increases from 3mm hr—1- to 7.5 mm hr^{-1}.

04. i. Discuss the structure and the characteristics of a typical amino acid. Explain how the back bone of a protein chain is made.

ii. Explain why the peptide group has a planer structure.

iii. What are the two most common secondary structure types found in proteins? Discuss the major differences between them.

05. a) i. Write down the differential form of the first law of thermodynamics and define the terms.

ii. Calculate the change in the internal energy of a system which absorbs 500J of heat and does work equivalent to 200J on the surroundings.

b) How would you define the change in entropy for a living system?

How the expression for Gibbs free energy should be modified to include process occurring in a living system?

c) i. Discuss the different methods of heat transform briefly.
ii. What is the meaning of black body radiation.
iii. The sun radiates energy at the rate of 6.4×10^{-7} calculate its temperature assuming it to be a black body.

06. a) i. What is meant by wave particle duality?

ii. Can the electron be considered as a wave? Why?

iii. Express the De Broglie wave length in terms of energy.

iv. An electron initially at rest is accelerated through a potential difference of 5000V.

Compute (i) the momentum
(ii) the de Broglie wave length.

b) i. The bond energies of the diatomic molecules O_2 and N_2 are 118 kcal/mol. And 236 kcal/mol respectively. What are the reasons for the difference in these values?

ii. Two molecules are separated by 3.5 nm in air. One molecule has one excess electron and the other lacks two electrons. Calculate the electrostatic force between them.