THE OPEN UNIVERSITY OF SRI LANKA
BACHELOR OF SCIENCE DEGREE PROGRAMME – LEVEL 05
FINAL EXAMINATIONS – 2010/2011
PHU 3152/PHE 5152 – BIO PHYSICS
TIME ALLOWED : TWO AND A HALF (02 ½) HOURS

Date : 18th December 2010 Time 9.30 am – 12.00 noon

Answer four questions.

Use the following values where necessary.
Boltzmann constant (K) = $1.38 \times 10^{-23} JK^{-1}$
Velocity of light (c) = $3.x10^{8} ms^{-1}$
1eV = $1.6x\ 10^{-19} J$
Plank constant (h) = $6.63x10^{-34} Js$.

(1) (a) (i) Explain the phenomenon of sedimentation.

(ii) Derive an expression for the terminal velocity of a small sphere with radius r and a density σ falling through a liquid with density ρ.

(iii) Deduce the equation for sedimentation coefficient (s)

(b) According to the Poisseille's equation
The rate of steady volume flow of a viscous fluid through a tube is given by

$$V = \frac{\pi a^4}{8\eta} \frac{\Delta P}{l}$$

Where l = Length of the tube
a = Radius of the tube
ΔP = Pressure difference
η = Coefficient of viscosity
Prove that the equation is dimensionally correct.

(c) Suppose a patient is to be given blood by a needle inserted in a vein. The needle is 3 cm long and has an inner radius 0.25 mm. If the blood flows into the needle through a tube from a bottle, how high the bottle should be placed so that a steady flow of $0.1cm^3$ per second is maintained? The blood pressure of patent is 20 mmHg above atmosphere.

(2) (a) What are the types of intermolecular attraction between the molecules and briefly explain .

(b) Experimental observation show that dipolar moments of C = O and N – H groups are approximately 8×10^{-3} Cm and $3x10^{-30}$Cm, and their bond lengths are about 0.12nm and 0.1 nm respectively.

Supposing that H – bond between C = O and N – H is linear, with distance between O and H atoms to be about 0.18 nm. Estimate the order of electrostatic potential energy between the two dipoles.

(3) (a) (i) Derive an expression for the total energy of an electron in the n^{th} state of an atom.

(ii) Discuss various quantum numbers associated with the atomic model.

(b) The ionization potential of hydrogen atom is 13.6 eV. Draw the energy level diagram showing four levels.
Calculate

(i) the energy of the photon emitted when an electron falls from the third orbit to the second orbit.

(ii) wavelength of the above photons.

(iii) what will be the minimum energy of photon which can be absorbed by hydrogen atom at ordinary temperature.

(4) (a) (i) Explain the method of producing X-rays with the aid of a rough diagram.
If the potential difference applied across an X-ray tube is 12.4 kV and the current through it is 2 mA.
Calculate:

(i) the number of electrons striking the target per second.

(ii) the speed at which they strike the target

(iii) the shortest wave length of the X- rays emitted

(b) (i) Explain the following:

(i) Braggs law of diffraction

(ii) Miller indices of planes.

(ii) An X-ray beam of wave length 3 $\mathring{A}$ is diffracted from (100) planes of a cubic crystal. The first order diffraction in obtained at an angle of 45°.
Determine the spacing between the (100) plane and the volume of the unit cell.

(5) (a) (i) State Huygen's principle.

(ii) Explain the terms of (i) Constrictive interference
(ii) Destructive interference
& write down the required path difference & phase difference for each interference pattern.

(iii) Derive an expression for the fringe width in double slit experiment.

(b) In the double slit experiment, the band width on a screen is doubled when the screen is moved through 1.5 m.
The wavelength of the light used is 590 nm and distance between the slits is 0.3 mm. Calculate the band width.

(6) (a) (i) Write down the first law of Thermodynamics.

(ii) What is meant by:

(i) an adiabatic and

(ii) an isothermal change of state of a gas.

(iii) An ideal gas is expanded adiabatically from volume v_1 to volume v_2 and then compressed isothermally to its original volume v_1.
Draw the P – V curves representing the above changes.
Show, the net work done by the gas. in your graph in your graph.

(b) (i) Define the term black body. What is meant by black body radiation.

(ii) State Stefan's law of radiation & write down the corresponding mathematical equation.

(iii) How much is the heat lost from the body of a person per hour whose body temperature is 37°C and the surrounding temperature is 20°C ? The emissivity of the skin is 0.92 and the surface area of the skin is $1.6m^2$ (Assume that the person is unclothed?)

7 (i) What is tertiary structure of a protein?

(ii) Discuss the major differences between globular and fibrous proteins.

(I) Discuss the features of the highest level of the structure of a proteins.