The Open University of Sri Lanka
B.Sc. Degree Programme (Level 05) 2011/12

Final Examination –Biophysics –PYU3165/PYE5165

Duration: Two Hours (2 hrs)

Date 28th December 2011 **Time 9.30 am – 11.30 am**

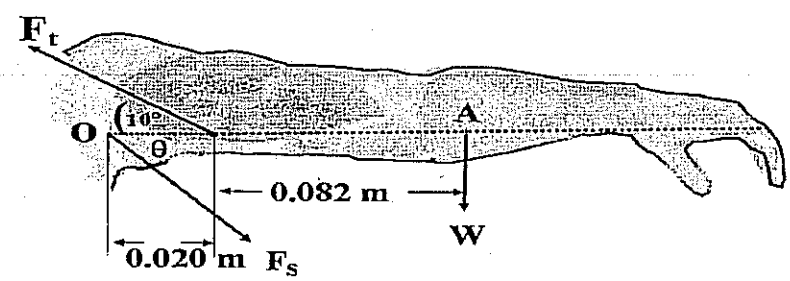
Answer Four (4) questions only

Use the following values when necessary,
Plank's constant = 6.63×10^{-34} J S, charge of an electron = 1.6×10^{-19} C, mass of the electron = 9.1×10^{-31} kg, 1eV=1.6×10^{-9} J and 1J =1 kg m^2 s^{-2}. Universal gas constant =R = 8.3 J $mol^{-1}K^{-1}$

1.(a) What is "BMR" ?

(b) What are the factors that influence BMR ?

(c) List the types of levers and write an example of each which you can find in the human body.



(d) The arm in the figure weighs 45 N. The weight of the arm acts through point A. Determine the magnitudes of the tension force F_t in the deltoid muscle and the force F_s of the shoulder on the humerus to hold the arm in the position shown.

2. (a) Describe *Myopia* (*shortsightedness*) and *Hypermetropia (longsightedness*). How are they corrected?

(b). A long sighted eye has a "far point" at infinity and a "near point" which is 35 cm from the eye. State the type of lens needed to correct this defect and calculate the power of the correcting lens.

(c). (i). Write down the expression for intensity level of a sound at a given point.

(ii). What is the decibel (dB) value of a sound with the intensity 10^{-8} W m^{-2} ?

(iii). Intensity value of part (ii) is observed with the distance 10 m from the source. Find the distance to the point with intensity level 60 dB from the source?.

3.(a) There are different kinds of interactions that keep atoms together when forming a molecule. List three types of interactions and compare two types of them giving an example for each case.

(b) What is meant by bond energy?

(c) When water molecules are placed with non-polar molecules (such as hydrocarbons), would the water molecules experience any hydrogen bonding with the non polar molecules with each other? Why? Give your answer briefly.

(d) Why ionic solutes such as sodium chloride (NaCl) generally dissolve in polar solvents but not in non-polar solvents ?. Give brief explanation.

4. (a) State briefly 1st and 2nd laws of thermodynamics with their differential forms.

(b) Explain following terms and draw the *P-V* graphs for each

(i) An isothermal expansion

(ii) An adiabatic expansion

(iii) An isobaric compression

(c) One mole of an ideal monatomic gas, initially at a volume of 0.05 m^{3}and a pressure of 1.0 x 10^5 Pa, is taken through a reversible cycle that consists of three processes:

a-->*b*: An isobaric compression that decreases the volume from 0.05 m^3 to 0.01 m^3

b-->*c*: An isochoric process where the pressure goes from 1.0 x 10^5 Pa to 5.0 x 10^5 Pa

c-->*a*: An isothermal expansion that returns the system to its original state.

(i). Show the cycle on a *P-V* graph, labeling all three processes. Be sure to label the axes with appropriate scales, units, etc.

(ii). Find the net work done by the gas per cycle?

(iii). Find the heat added to the gas per cycle?

Ctd..

5. (a). What is Sedimentation ?. Name one of the well known experiments done in the lab which tests the rate of sedimentation of *erythrocytes* in blood.

(b). A blood cell having a density ρ_B and a radius r falls with a terminal velocity, V_t through a liquid of viscosity η and the density ρ_L . Derive an expression for the terminal velocity V_t with the help of a Stokes formula for the drag of a blood cell in a liquid.

(c). (i). Calculate the terminal settling velocity V_t of a 70 micrometer diameter sphere of density 2600 kg m^{-3} in water (Density of water: 1000 kg m^{-3} and the viscosity: $1x10^{-3}$ Nsm^{-2}.)

(ii) .What is the new terminal velocity for a sphere of twice this diameter?

6. (a) An electron is accelerated through a potential difference of 64 volts. What is the ***De Broglie*** wavelength associated with It.? To which part of the electromagnetic spectrum does this value of wavelength corresponds?

(b) Draw a cubic unit cell indicating the locations of (011) (111) and (010). Label the axes.

(c) *X*-rays of wavelength 0.0153 nm are scattered from the (211) plane of a sample of protein, which has a simple cubic structure. Adjacent diffraction peaks are observed at scattering angles of 28° and 45°. Calculate the lattice constant of the protein.

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