THE OPEN UNIVERSITY OF SRI LANKA
B.Sc DEGREE PROGRAMME – 2010/11 – LEVEL 3
FINAL EXAMINATION

CHU 1140/CHE 3140/NSU 1140 – INTRODUCTION TO BIOCEMISTRY & BIOPHYSICS

DURATION : TWO (02) HOURS

Date: 27th December 2010 Time: 1.30 p.m. – 3.30 p.m

Instructions to candidates

This question paper consists of two parts: Part A and Part B. Each part consists of three questions. You are required to answer four questions in all choosing two questions from each part.

PART A - BIOCHEMISTRY

Answer in a separate booklet.

01. a) Give four properties which make water a good solvent for biological processes. Explain briefly how these properties identified by you make water suitable for this purpose.

(30 marks)

b) Write down the essential trace elements found in each of the following biological molecules.

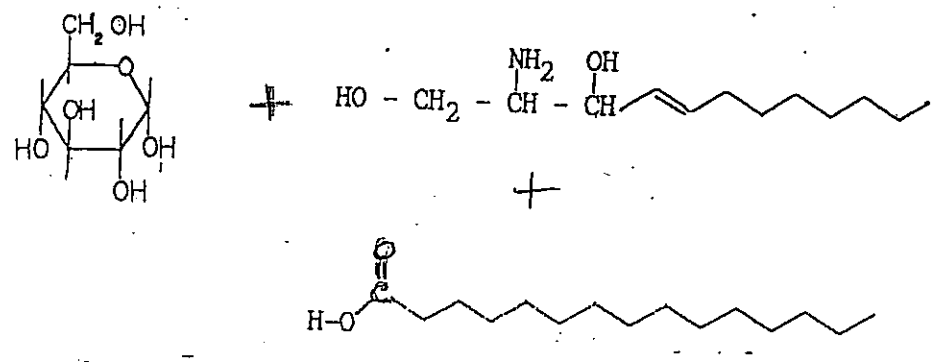
i)Thyroid hormone
ii) Chlorophyll
iii) Vitamin B_{12}
iv) Haemoglobin

(15 marks)

c) i. Draw the structure of an eukaryotic cell and label clearly five sub cellular organelles.
ii. Explain briefly the functions of these sub cellular organelles.
a) Endoplasmic reticulum
b) Mitochondria
c) Nucleus
d) Golgi apparatus

(30 marks)

d) i) Draw the basic structure of a phospholipids.
ii) Draw the structure of the glycolipid formed from the following precursors.
(Indicate the polar head with a circle and non polar tail with a square.)



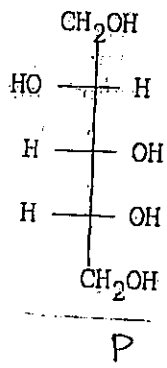
(25 marks)

02. a) Explain briefly the experimental procedure to distinguish between D & L forms of stereoisomers.

(15 marks)

b) How many stereoisomers are there for aldotetrose? Draw the Fisher projections and indicate them as D or L sugars. (35 marks)

c) Questions (i)-(iii) refer to the following molecules shown below.



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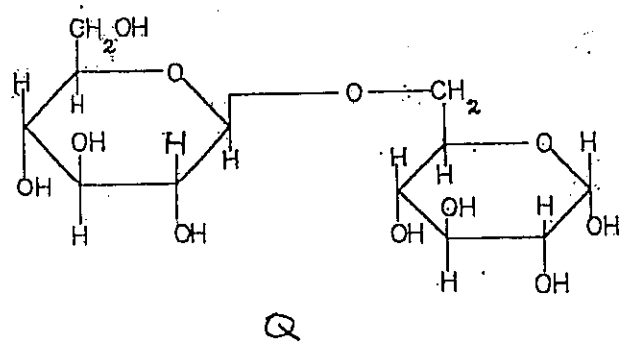

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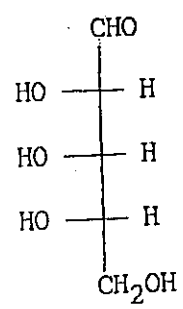

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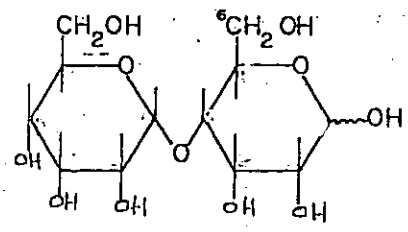

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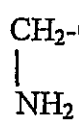
i) Draw the Haworth projections of P & R.
ii) Which molecule (s) has (have) β (1→6) linkages?
iii) Which molecule (s) has (have) α (1→4) linkages? (40 marks)

d) What do you mean by mutarotation? Explain taking D – sugar as an example. (10 marks)

03. a) i) Explain the acid-base behaviour of an amino acid. (10 marks)

ii) The structure of glycine is,



Draw the structures of glycine that you expect in solutions of pH=2 and pH=10. (Clearly indicate the relevant pH for the particular structure) (30 marks)

b) Explain briefly the following using glycine.
i) Isoelectric point.
ii) Zwitter ion.
iii) Primary structure of a protein. (30 marks)

c) i) What is the difference between the nucleoside and the nucleotide?

ii) Write down the complementary sequence to the following nucleotide chain.
5' T-T-C-G-A-A-T-C-G 3'

iii) What are the characteristics of the secondary structure of DNA? (30 marks)

PART B – BIOPHYSICS

(Assume g, the gravitational field strength as $10 Nkg^{-1}$ where necessary unless otherwise stated)

Answer in a separate booklet.

01. (a) A champion weight lifter can raise a mass of 250 kg. His fore arm has a length from elbow joint to palm of hand of 0.5m, and a weight of 30N. Assuming that the force of the biceps muscle acts at a point 0.07m from the fulcrum, calculate the minimum value of the force required in each biceps and the corresponding reaction in each upper arm.

(25 marks)

(b) The specific latent heat of sweat is about 2425 $kJ\ kg^{-1}$. What is the rate of its excretion from the skin to produce the maximum rate of energy loss of 625 W?

(25 marks)

(c) The average energy liberated from the combustion of carbohydrates, fats and proteins is 20.17 kJ per litre of oxygen.
What is the Basal Metabolic Rate (BMR) of a person who, when resting, consumes 1.5 litres of oxygen in 5 minutes. Give your answer in
(i) kJh^{-1}.
(ii) W.

(25 marks)

(d) A pole vaulter has a take-off speed of 9.5 ms^{-1}, and a centre of gravity height above the ground of 1m. Assuming all the kinetic energy is converted to potential energy, calculate the maximum vault height.

(25 marks)

02. Explain the following observations.

(20 When the red filament of a lamp is viewed through a blue filter two images, red and blue, are produced side by side.

(10 marks)

(b) Two objects about 10cm apart are viewed by the right eye looking directly at the left object. When the eye is about 0.5m away, the right hand object disappears from view. (10 marks)

(c) A printed page can be read clearly when it is placed nearer than the near point, if it is viewed through a small hole. This clarity is lost if the hole has a diameter of less than about 1mm.

(10 marks)

(d) With the aid of a diagram give a brief account of the optical system of the eye. Explain how images of objects at different distances are focused on the retina, and how the amount of light entering the eye is controlled.

(20 marks)

(e) Distinguish between long sight and short sight. (10 marks) 00126

(f) Person A cannot obtained focused images of objects further away than 0.5m. Person B cannot obtain focused images of objects nearer than 0.5m. For each person identify the defect and suggest the type of lens which would be required. Calculate the strength of each lens. Assume that the near point is 250mm from the eye.

(40 marks)

03. (a) Sketch a graph of the action potential as a function of time for atypical nerve axon, giving approximate scales on the axes. Air breaks down so that current flows when the electric field strength is 2.5×10^6 Vm^{-1}. If a typical axon has a membrane thickness of 10nm, State giving your reasoning, whether air or the membrane is the better insulator. You may assume that the maximum value of the action potential for a nerve as 90mV.

(25 marks)

(b) 4.3×10^{-8} mol of sodium ions enter the core of an axon per square metre of membrane area during an action potential lasting one milli second. Calculate the average electrical current density associated with this ionic flow and the average electrical current if the action potential involves a membrane area of 5.0×10^{-12} m^2.
Charge of an electron = -1.6×10^{-19} C,
Avogadros constant = 6.0×10^{23} mol^{-1}

(40 marks)

(c) Electrodes are placed on the surface of the body to record the cardiac waveform in a healthy person.

i. Sketch a graph of potential difference between the electrodes as a function of time during a single beat of the heart, giving appropriate scales on the axes.

(10 marks)

ii. Mark on the time axis the approximate points when the sino-atrial node is triggered and when ventricular stimulation occurs.

(10 marks)

iii. What change would you expect to find in the electro cardiogram of a patient suffering from poor ventricular contraction?

(10 marks)

iv. Why should the person under examination be as quite and relaxed as possible?

(05 marks)