

# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

SSC2103

FACULTY OF APPLIED SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS

DEPARTMENT OF SPORTS SCIENCE AND COACHING

**THEORY: SSC2103: PRINCIPLES OF BIOCHEMISTRY**

JANUARY 2011

3 HOURS (100 MARKS)

## **INSTRUCTIONS**

Answer **four** questions only. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. In multiple choice questions, some questions may have more than one correct answer and in such cases, negative marking will apply to incorrect answers. Illustrate your answer where appropriate with large, clearly labeled diagrams.

- 1) a) Distinguish between the following:-
- i) heterodisaccharide and homodisaccharide. [2 marks]
  - ii) Primary bond and secondary bond. [2 marks]
  - iii) Protein denaturation and protein hydrolysis. [2 marks]
  - iv) Peptide bond and glycosidic bond. [2 marks]
  - v) Bronsted acid and Lewis acid. [2 marks]
- b) Which of the chemical formula refers to a monosaccharide and a disaccharide?
- i)  $C_6H_{12}O_6$ .
  - ii)  $CH_{12}H_{24}O_{12}$ .
  - iii)  $C_3H_6O_3$ .
  - iv)  $C_{12}H_{22}O_{11}$
  - v) None of the above [2 marks]
- c) A cricket batsman strikes a ball travelling at 120km/hr with his wooden bat but the bat does not shatter. Explain how the bat can withstand such a force without shattering. (Ignore changes in the elasticity of the ball). [8 marks]
- d) During the phosphoglucose isomerase reaction in glycolysis, a pyranose structure is converted to a furanose structure.
- i) Name the pyranose structure. [1 mark]
  - ii) Name the furanose structure. [1 mark]
  - iii) Explain whether additional enzyme is required in this conversion. [3 marks]
- 2) a) The properties of water include:-
- i) The ability to form hydrophobic bonds.
  - ii) A low dielectric point.
  - iii) Being a strong dipole with the negative end at the O atom.
  - iv) A disordered structure in the liquid state.
  - v) The ability to form 3.4 hydrogen bonds , on average, in the liquid state.

vi) The ability to form hydrogen bonds with itself. [2 marks]

b) For the bonds or interactions numbered i) –iv), indicate all the characteristics that are appropriate to them indicated by bullets:-

- i) Electrostatic interactions.
- ii) The hydrogen bond.
- iii) The van der Waal's bond.
- iv) Hydrophobic interactions.

- Requires nonpolar species.
- Involves charged species only.
- Requires polar or charged species.
- Involves either O and H or N and H atoms.
- Involves non specific atoms.
- Is also called a salt bridge.
- Only exists in water.
- Is optimal at the van der Waal's contact distance.
- Has an energy between 3 and 7 kcal/mol.
- Has an energy of around 1kcal/mol.
- Is weakened in water.

[13 marks]

c) Write an essay on properties of water that account for its solvation power.

[10 marks]

3) For the amino acids numbered i) – iv) match with the appropriate side chain types shown by bullets.

- i) Lys.
- ii) Glu.
- iii) Leu.
- iv) Cys.

- Basic.
- Acidic.
- Sulphur containing.
- Hydroxyl containing.
- Nonpolar aliphatic.
- Nonpolar aromatic.

[6 marks]

a) Distinguish between the following terms:-

- i)  $pK_a$  and pI
- ii) Denaturation and renaturation.

[2 marks]

[2 marks]

b) Water drawn from a swimming pool is found to have a pH of 5:-

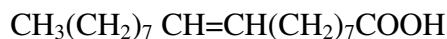
- i) Calculate the hydrogen ion ( $H^+$ ) concentration.
- ii) What is the desirable pH of the pool and how would we adjust the pH to this value?

[2 marks]

[3 marks]

- c) Write notes on the structure, properties and function of two connective tissue proteins. [10 marks]
- 4) a) Explain the function of the following enzymes:-  
 i) Lyase  
 ii) Mutase  
 iii) Kinase  
 iv) Oxidoreductase  
 v) Isomerase [5 marks]
- b) Sketch a graph of  $V_0$  vs  $[S]$  for an enzyme catalyzed reaction where in one instance a competitive inhibitor is present and in another a non-competitive inhibitor is present. [5 marks]
- c) Which of the following statements about the different types of enzyme inhibition are **correct**:-  
 i) Competitive inhibition is seen when a substrate competes with an enzyme for binding to an inhibitor protein.  
 ii) Competitive inhibition is seen when the substrate and the inhibitor compete for the active site on the enzyme.  
 iii) Non competitive inhibition of an enzyme can not be overcome by adding large amounts of substrate.  
 iv) Competitive inhibitors are often similar in chemical structure to the substrate of the inhibited enzyme.  
 v) Non competitive inhibitors often bind to the enzyme irreversibly.  
 vi) Competitive inhibitors are often relieved by increasing substrate concentration.  
 vii) Suicide inhibition is often associated with irreversible inhibition. [5 marks]
- d) Write notes on the application of inhibitors. [10 marks]
- 5) a) Which of the following are the features that a micelle has?  
 i) Assemble spontaneously in water.  
 ii) Made up of amphipatic molecules.  
 iii) Very large sheets-like structure.  
 iv) Has the thickness of two constituent in one of their dimensions.  
 v) Is stabilized by hydrophogen bonds and van der Waal's forces, hydrogen bonds and electrostatics forces.  
 vi) Polar head is hydrophilic whilst nonpolar tail is hydrophobic.  
 vii) Dissolves in water to form a true electrolyte solution. [5 marks]
- b) Compare and contrast the oxidation of phenylpentanoic acid ( 5 carbon side chain) and phenylhexanoic acid ( 6 carbon side chain) and deduce the biochemical meaning of this oxidation. [8 marks]

- c) i) For the fatty acid shown below, classify the fatty acid using the  $\omega$  convention. [2 marks]



- iii) Write short notes on the biological role of the  $\omega$ 3 fatty acids. [10 marks]

- 6) a) Choose which of the following are characteristics of the Watson – Crick DNA double helix:-

- i) The two polynucleotides are coiled about a common axis.
- ii) Hydrogen bonds between A and C and between G and T hold the two chains together.
- iii) The helix makes one complete turn every 3.4 nm.
- iv) The purines and pyrimidines are on the inside of the helix and the phosphodiester backbones are on the outside.
- v) Base composition analysis have shown that the amounts of A and T are equal as are the amounts of G and C.
- vi) The sequence in one strand of the helix varies independently of that in the other strand.
- vii) There are ten base pairs for each turn. [5 marks]

- b) Glucose readily enters into all tissues from blood but only specialized tissues (liver and kidney) are capable of releasing glucose into blood. Explain why most tissues cannot supply glucose to the blood? [5 marks]

- c) Discuss the Cori cycle and explain its biological role. [15 marks]

**END OF EXAMINATION**