5860

Ph.D. ENTRANCE EXAMINATION, OCTOBER 2013

Name of Candidate	
Register Number	
Answer Booklet Code	
Signature of Candidate	
Signature of Invigilator	

Time : 140 Minutes Max. Marks : 160

Section – B & C

(This is to test the candidate's capability of defining concepts through short answers.)

***Note** :*

1) *Answer **any twelve** questions from Section **B** and **one** question from Section **C**.*
2) *In Section **B each** question carries **10** marks. Section **C** carries **40** marks.*
3) *In Section **B** an answer should not exceed **100** words. In Section **C** an answer should not exceed **500** words.*
4) *Candidates should **clearly** indicate the **Section**, **Question Number** and **Question Booklet Code** in the answer paper.*
5) *The candidates are **permitted** to answer questions **only** from the subject that comes under the **faculty** in which he/she seeks registration as indicated in the **application** form.*

FACULTY OF SCIENCE

1. **Biochemistry**
2. **Chemistry**
3. **Zoology**

FACULTY OF SCIENCE

1. Biochemistry

Section – B

1. Explain the term Chromatography. How are proteins separated by :

   a) Affinity Chromatography,

   b) Ion-exchange chromatography.

2. Given a mixture of proteins which contains a recombinant insulin among other proteins which of the above two chromatographic technique will you employ for purification of the insulin molecule. Why ?

3. Explain Beer Lamberts's law. Describe an experiment to verify this law. Given that the Molar extinction coefficient of a compound in water is 25,000 at 550 nm and a solution of this compound in water gave an absorbance of 0.552 at 550 nm calculate the concentration of the compound.

4. Explain the importance of-SH functional groups in stabilizing structure of proteins.

5. Explain the principle of density gradient centrifugation and describe how this technique can be used in purification of cell organelles.

6. Differentiate between colorimeter and spectrophotometers.

7. Why should glucose be stored as glycogen rather than be stored as glucose itself. Give your explanation in terms of colloidal properties.

8. What is the principle of Polyacrylamide gel electrophoresis ?

9. What are allosteric enzymes ? Give an example and explain its role in metabolism.

10. Identity the following by : a) Competitive b) Uncompetitive, and c) Noncompetitive inhibition, using Lineweaver-Burk plots.

11. How does substrate concentration affect velocity of enzyme catalyzed reactions ? Explain with Michaelis Menten equation.

12. Explain the mechanism of coordinated regulation of glycolysis and gluconeogenesis, comment on how this regulation is affected during diabetes mellitus.

13. What are natural killer (NK) cells ? How it is associated with tumor cells ?

14. Discuss the origin of the competence and progression signals required for activation and proliferation of B cells induced by (a) soluble protein antigens and (b) bacterial lipopolysaccharide (LPS).

15. What are Monoclonal antibodies ? Briefly discuss their synthesis and applications.

16. What are multienzyme complexes ? Explain with an example.

Section – C

1. Substance A is consumed by a reaction that only occurs in the presence of substance B. The role of substance B is unknown (i.e., it could be a reactant or a catalyst) and the reaction that consumes A is of unknown order. The initial concentration of A is 2.0 mm and the concentration of A as a function of time is :

Time (min)	[A] remaining
1	1.6
2	1.44
4	1.12
8	0.76
16	0.48

   i) Define what is meant when a reaction mechanism is called 'firstorder' or 'second'.

   ii) Is the consumption of A a first order reaction and how do you know explain with a graph.

   iii) If not how would you repeat this experiment such that 'first order' kinetics would be observed and why ?

2. A peptide was found to have the following amino acid composition by acid hydrolysis :

   Ala, Arg, Met, Tyr, Gly, 2 Lys, Ser, Pro, Glu. On further analysis the following data was obtained :

   A. N-terminal analysis yielded Dansyl-Gly

   B. Tyrptic digestion yielded 3 peptides : T-1, T-2, and T-3

   T-1 was a dipeptide and Edman degradation showed it had N-terminal Gln

   T-2 was a tripeptide with amino acid composition : Lys, Gly, Ser

   T-3 was a pentapeptide and Edman degradation showed it had N-terminal Lys

C. Chymotyrptic digestion yielded 2 peptides : Ch-1 and Ch-2

Ch-1 had amino acid composition : 2 Lys, Pro, Gly, Ser Tyr

Ch-2 yielded Met when degraded by Edman method

D. CNBr cleavage gave 2 peptides : CB-1 and CB-2

CB-1 contained homo Serlactone and had Gly as N-terminal by Edman method

CB-2 released PTH-Arg in first step of Edman and PTH-Gln in second step.

a) What is the sequence of the peptide ? Draw full chemical structure of the peptide and show its proper charges on all ionizable groups at pH 7.

b) What is net charge on Peptide Z at pH 3 and pH 10 ? (pK values for amino acids: Gly 2.4, 9.8; Ala - 2.4, 9.9; Phe-2.2,9.2;Tyr- 2.2, 9.1; Pro- 2.0, 10.7; His-1.8, 6.0, 9.3; Glu-2.1, 4.1, 9.5; Gln 2.2, 9.1; Asp 2.0, 3.9, 9.9; Asn 2.1, 8.8; Arg 1.8, 9.0, 12.5)

c) What is the pI of Peptide Z ?

3. Explain the principle of PCR and describe an experiment where you would use qRT-PCR for Multiplexing.

2. Chemistry

Section – B

1. a) Differentiate electron affinity and electronegativity. Explain the variation of electronegativity in a group of the Periodic Table.

   b) State Schrodinger wave equation and explain the terms. Bring out the significance of ψ and ψ^2.

2. a) Outline the procedure for classification of molecules into different point groups.

   b) State and explain Born-Oppenheimer approximation.

3. a) Give one method of preparation of B_2H_6. Discuss its structure and bonding.

   b) State and explain Fajans rule. What are the factors that favour the polarization of anions ?

4. What are normal modes of vibration and group frequency concept ? How many normal modes of vibrations do you expect for NO_3^- ion ? How does the coordination modify the IR spectral features of NO_3^- ion ?

5. What is Green House effect ? Evaluate its causes, contributors, consequences and control measures.
6. What is the principle of cyclic voltametry ? How does it differ from polarography ? Explain two important applications of cyclic voltametric studies.
7. What is superoxide dismutase ? Discuss its structure and fractions.
8. What is FMO approach in pericyclic reactions ? Explain this concept in electrocyclic and cycloaddition reactions.
9. With suitable illustrations, explain the electrooxidation and electroreduction reactions used in organic synthesis.
10. Discuss the SPPS strategy employed in organic synthesis. Highlight its merits and demerits.
11. Comment on the stability of free radicals and carbenes.
12. Explain the mechanisms of
    a) Wolf rearrangement
    b) Beckmann rearrangement
    c) Barton reaction
    d) Di-π methane rearrangement
13. Explain the term partition function. Explain the factorization of the total system partition function into further divisions.
14. Explain various photophysical phenomena with the help of Jablonski diagram.
15. Explain transition state theory. Compare it with collision theory of reactions.
16. Derive BET adsorption isotherm. How is the surface area of materials determined using this method ?

Section – C

1. a) The reaction, $[Cr(NH_3)_5 Cl]^{2+} + NH_3 \Rightarrow [Cr(NH_3)_6]^{3+} + Cl^-$ in liquid ammonia is catalysed by KNH_2. Why ? Explain the mechanism of this reaction. **10**

   b) What is Zeise's salt ? How is it prepared ? Explain its structure and bonding. **10**

   c) What are Orgel diagrams ? Draw the Orgel diagrams of d^4 ion in octahedral- and tetrahedral ligand fields and illustrate their uses. **10**

d) What is meant spin-orbit coupling interaction ? What are the factors that determine the magnitude of spin -orbit coupling constant ? **10**

2. Discuss the theory and applications of ^{13}C NMR spectroscopy in the structure elucidation of organic compounds. **40**

3. a) Explain different steps involved in heterogeneous catalysis. Discuss the kinetics and mechanism of bimolecular surface catalysed reactions. **10**

   b) What are excess thermodynamic functions ? Derive expressions. Explain a method of determining excess volume. **15**

   c) Explain electrical double theory of colloids. Derive an expression for zeta potential. **15**

3. Zoology

Section – B

1. Give an account on different types of DNA.
2. What is gluconeogenesis ?
3. What are ecological pyramids ?
4. What is the importance of crossing over ?
5. What are multiple alleles ?
6. Explain Chemi-osmotic theory.
7. Distinguish between neurogenic and myogenic heart.
8. Explain the structure of nephron.
9. Give an account on neurotransmitters.
10. Distinguish between aestivation and hibernation

11. Explain second messenger hypothesis with an example.
12. Briefly explain egg-sperm interaction.
13. What do you mean by apoptosis ?
14. What is gene therapy ?
15. What are molecular markers ?
16. Give an account on immunoglobulins.

Section – C

1. Explain various types of membrane transport.
2. Give an account on types, causes and consequences of environmental pollution.
3. What do you mean by hypothesis ? Distinguish between Null and alternate hypothesis. Explain various methods for testing hypothesis.