POST-GRADUATE COURSE

Term End Examination — June, 2017

ZOOLOGY

Paper - 4A : Basic Physical and Chemical Principles

Time : 2 Hours **Full Marks : 50**

(Weightage of Marks : 80%)

Special credit will be given for accuracy and relevance in the answer. Marks will be deducted for incorrect spelling, untidy work and illegible handwriting. The weightage for each question has been indicated in the margin.

1. Answer *two* questions : $9 \times 2 = 18$

   a) Is there any difference between Gibbs free energy and Helmholtz free energy ? Justify your answer. Write down the Gibbs-Helmholtz equation and deduce the same. Deduce the standard free energy of the following chemical reaction :

   $$pP + qQ \rightleftharpoons rR + sS$$

   1 + 2 + 1 + 3 + 2

   b) What is isothermal irreversible process ? Deduce the working formulae for determining the work done in isothermal irreversible process. What do you mean by isochoric and isobaric process of thermodynamics ? 2 + 4 + 3

   c) What do you mean by co-ordinate covalent bond ? Cite an example of the same with sketch of electronic structure of a compound. Which factors are favouring the formation of electrovalent bond ? Write down the characteristics of electrovalent compounds. 2 + 2 + 3 + 2

   d) What is radioactivity ? How do you prove that the process of radioactivity is nuclear phenomena ? What types of radiations are emitted from a radioactive element ? Write down the characteristics of each type of radiation. 2 + 3 + 1 + 3

2. Answer *three* questions : $6 \times 3 = 18$

   a) Whether emission of β-rays is a nuclear phenomenon ? Justify your answer. Write down the characteristics of β-ray. How does β-ray effect living bodies ? 1 + 2 + 2 + 1

   b) How and why are H-bonds formed ? Arrange the following compounds in decreasing order of strength of H-bonds formation with justification : 3 + 3

   NH_3, H_2O, HF

c) What do you mean by 'Radiation Chemical Yield' ? How is the 'Radiation Chemical Yield' expressed mathematically ? Write down the advantages and disadvantages of radiotracers used in biological systems. 2 + 1 + 3

d) What is buffer ? What is the importance of buffer in biological system ? Write down the action mechanism of buffer. 1 + 2 + 3

e) What is ionic product of water ? How it can be deduced mathematically ? How do you differentiate simple buffer from mixed buffer ? 2 + 2 + 2

f) What are thermodynamic and non-thermodynamic equilibrium ? Define the standard free energy of a chemical reaction and deduce the standard free energy of the following chemical reaction :

$$\alpha A + \beta B = cC + dD$$ 2 + 1 + 3

3. Answer *two* questions : $4 \times 2 = 8$

a) State second law of thermodynamics. Write down the characteristics of entropy. 2 + 2

b) What is the pH of 0·1 (N) NaOH solution ? Is there any change in pH of the same solution if you add 1 ml water ? Justify your answer. 2 + 1 + 1

c) What do you mean by hydrophobic bond ? Cite an example of compound showing hydrophobic in nature with explanation. 2 + 2

d) Whether half life of a particular isotope is constant or not ? Justify your answer. "Half-life of radium is 1600 years." Clarify the statement. 2 + 2

4. Answer *two* questions : $3 \times 2 = 6$

a) What is vander Waals force ? Which factors can change the value of vander Waals force ? 1 + 2

b) What is hydrogen bond ? Cite an example of H-bonding. Why is this bond important in biological system ? 1 + 1 + 1

c) What is pH ? Calculate the pH of 0·000000001 M HCl solution. 1 + 2

d) What is decay constant ? How it can be determined ? 1 + 2