

**POST-GRADUATE DEGREE PROGRAMME**

**Term End Examination — December, 2024**

**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 × 2 = 18
  - a) What does the second law of thermodynamics state ? Entropy is a measure of disorder—explain. How can the entropy change of the universe be represented mathematically ? 3 + 3 + 3
  - b) Using examples such as water and alcohol, define a hydrogen bond and explain hydrogen bonds in a biological system. What is the difference between a hydrogen bond and a covalent bond ? ( 3 + 3 ) + 3
  - c) How is the rate of radioactive decay expressed mathematically ? What are the features of radioactive decay ? How do you calculate the decay constant from half-life ? 4 + 2 + 3
  - d) Clarify pH buffer with an example. State the mechanism of action of a buffer. What does the pH scale range from 0 to 14 mean ? 3 + 4 + 2
2. Answer *three* questions : 6 × 3 = 18
  - a) Compare Helmholtz free energy and Gibbs free energy.
  - b) What is the relationship between enthalpy and entropy ?
  - c) Discuss the characteristics of a coordinate covalent bond. Provide a diagram and an example of a coordinate bond. 3 + 3
  - d) What is a radioactive tracer ? Name one common radiotracer. What are the factors to consider in radiotracer selection ? 1 + 1 + 4
  - e) Calculate the degree of ionization of pure water at 25°C.
  - f) What is the difference between equilibrium and non-equilibrium thermodynamics ? Why is  $\text{KMnO}_4$  a self-indicator ? 4 + 2

3. Answer *two* questions : 4 × 2 = 8
- a) State the relationship between electronegativity and ionic bonding.
  - b) Explain key characteristics of irreversible processes in thermodynamics.
  - c) Write down the applications of autoradiography.
  - d) How is the tracer technique applied in the biosynthesis of cholesterol ?
4. Answer *two* questions : 3 × 2 = 6
- a) Mention the properties of hydrogen bonding.
  - b) Write a note on buffer capacity and its calculation.
  - c) A reaction's standard free energy change is 50 kJ and 70 kJ at temperatures 37°C and 47°C, respectively. Calculate the standard enthalpy of the reaction.
  - d) Define *G* value. How can it be expressed ? 1 + 2
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