

**B. Sc. BIOTECHNOLOGY**  
**Third Semester**  
**Biophysical Chemistry**  
**(BBT-14)**

**Duration: 3Hrs.**

**Full Marks: 70**

**Part-A (Objective) =20**

**Part-B (Descriptive)=50**

**(PART-B: Descriptive)**

**Duration: 2 hrs. 40 mins.**

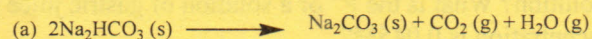
**Marks: 50**

**1. Answer the following questions: (any five)**

**2 × 5 = 10**

a) A gas absorbs 110 J of heat and expands against the external pressure of 1.20 atm from a volume of 0.5 L to 3.0 L. What is the change in internal energy? (1 L atm = 101.3 J).

b) Predict in which of the following entropy increases/decreases and explain why?



(b) Water crystallizes into ice.

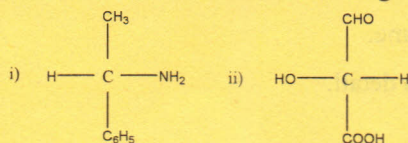
c) What do you mean by an ionophore? Discuss the structure of a group of common antibiotics used as an ionophore.

d) Write short notes on: Hydrophobic and hydrophilic amino acids.

e) Write short notes on: tRNA structure.

f) Boiling point of ethyl alcohol is much more than that of dimethyl ether, although they have the same molecular formula. Explain.

g) Assign R/S nomenclature of the following compound.



**2. Answer the following questions: (any five)**

**3 × 5 = 15**

a) Using the relations: (i)  $dA = -SdT - PdV$ , (ii)  $dG = VdP - SdT$ ;

prove that,  $\left(\frac{\partial A}{\partial T}\right)_v = \left(\frac{\partial G}{\partial T}\right)_p$

b) What are synthetic complexing agents? Discuss with examples.

c) What do you mean by DNA renaturation? DNA is isolated from two different species and GC content of the first species is found to be double the GC content of the second species. Determine the denature effect if temperature is same as the denaturation temperature.

d) What do you mean by B form of DNA? Explain chemical properties of a typical DNA showing the important bonds involved in the structure formation.

e) Differentiate DNA and RNA on the basis of structure and function.

f) How can you find out formal charges of individual atoms of the following molecules?

i)  $O_3$       ii)  $PH_4$       iii)  $N_2O$

g) What is  $P^H$  of a solution? What is the  $P^H$  of a solution of gastric juice whose hydrogen ion concentration is 0.045M?

**3. Answer the following questions: (any five)**

**5 × 5 = 25**

a) What do you mean by free energy of a system? How is it related to enthalpy and entropy of a system? How is it useful to predicting the feasibility of a process?

b) What is a cyclic process? Describe in details of Carnot cycle for establishing the maximum convertibility of heat into work.

c) Explain what is meant by change in entropy ( $\Delta S$ ) of a system. Show that,  $\Delta S = q_{rev}/T$ . Calculate  $\Delta S$  if one mole of an ideal monoatomic gas is heated from 27°C to 227 °C, at constant volume.

d) Describe protein folding in detail.

- e) What do you mean by DNA supercoiling? If one type of DNA is of 84 bp and one turn is removed from it. Calculate the change in linking number.
- f) What do you mean by Buffer Solution? Establish Henderson-Hasselbalch equation
- g) What do you mean by hybridization of atomic orbitals? Draw the orbital structures of ethane and ethylene molecule.

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*(The figures in the margin indicate full marks for the questions)*

**Duration: 20 minutes**

**Marks – 20**

**PART A- Objective Type**

**1. Put '✓' mark on the appropriate answer**

**1×20= 20**

- i) Among the following, which one is an isolated system:
- (a) A chemical reaction taking place in a heterotrophic cell
  - (b) Helium filled in balloon
  - (c) A beaker containing boiling water
  - (d) A thermal flask containing hot tea
- ii) The correct expression for  $C_v$  is:
- (a)  $\left(\frac{\partial H}{\partial T}\right)_v$
  - (b)  $\left(\frac{\partial U}{\partial T}\right)_v$
  - (c)  $\left(\frac{\partial S}{\partial T}\right)_v$
  - (d)  $\left(\frac{\partial V}{\partial T}\right)_v$
- iii) In a cyclic process:
- (a)  $\Delta H = 0$
  - (b)  $\Delta H \neq 0$
  - (c)  $\Delta H > 0$
  - (d)  $\Delta H < 0$
- iv)  $\left(\frac{\partial G}{\partial T}\right)_p = ?$
- (a)  $-S$
  - (b)  $S$
  - (c)  $V$
  - (d)  $H$

- v) An active transport is associated with a/an:
- (a) decrease in free energy of the system
  - (b) increase in free energy of the system
  - (c) there is no change in free energy
  - (d) increase in enthalpy of the system

- vi) At 4°C,
- (a) the density of ice is less than liquid water
  - (b) the density of ice is more than liquid water
  - (c) the density of ice and liquid water are the same
  - (d) All the above statements are false

- vii) Among the following which can form intramolecular hydrogen bonding:
- (a) ammonia
  - (b) Ortho nitrobenzoic acid
  - (c) Para nitrophenol
  - (d) phenol

- viii) Which of the following colligative property can provide molar mass of proteins: Z form of DNA is
- (a) Right handed
  - (b) Left handed
  - (c) Has no orientation
  - (d) Can be found in any form

- ix) Codons are found in
- (a) DNA
  - (b) m RNA
  - (c) t RNA
  - (d) r RNA

- x) Linking number of DNA is negative
- (a) It is left sided supercoiled
  - (b) It is right sided supercoiled
  - (c) Can have both left and right supercoiling nature
  - (d) Has no supercoiling nature

- xi) Phosphodiester bond is responsible for connecting two adjacent
- (a) Nucleosides
  - (b) Nucleotides
  - (c) Nitrogenous bases
  - (d) Deoxyriboses

- xii) The ..... nucleotide site of the codon is known as wobble site
- (a) 1<sup>st</sup>
  - (b) 2<sup>nd</sup>
  - (c) 3<sup>rd</sup>
  - (d) 4<sup>th</sup>

- xiii) A DNA has 4000 nucleotides, out of the total bases ( in one strand) 400 are Adenine residues. The number of Thymine in the next strand will be
- (a) 600
  - (b) 400
  - (c) 1000
  - (d) 4000
- xiv) Protein folding is the process in which
- (a) Disulfide bond is formed
  - (b) Disulfide bond is digested
  - (c) Disulfide bond is denatured
  - (d) Disulfide bond is denatured and then renatured
- xv) The quaternary structure of the protein is the native form of protein. This protein contains
- (a) Single polypeptide
  - (b) More than one polypeptide
  - (c) Polypeptide number is not important
  - (d) All of the above
- xvi) Intermolecular hydrogen bonding is possible in
- (a)  $C_2H_5OH$
  - (b)  $H_2O$
  - (c) o- nitro phenol
  - (d) p-nitro phenol
- xvii) Ethylene molecule is
- (a)  $sp$ -hybridised
  - (b)  $sp^2$ -hybridised
  - (c)  $sp^3$ -hybridised
  - (d) none of these
- xviii)  $P^H$  of human blood is
- (a) 7
  - (b) 7.1
  - (c) 7.4
  - (d) none of these
- xix) Which of the following acid is optically active?
- (a) Butanoic acid
  - (b) acetic acid
  - (c) lactic acid
  - (d) propionic acid
- xx) Ethanol and dimethyl ether is a
- (a) Positional isomer
  - (b) functional isomer
  - (c) chain isomer
  - (d) optical isomer

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