T(I)-Biochemistry-G-1

Write the answers to each Group in a separate answer-book.

# 2021

## **BIOCHEMISTRY — GENERAL**

## **First Paper**

## Full Marks : 100

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

## **Group-A**

## Unit-I

#### (Marks : 25)

#### Answer any two questions.

- 1. (a) Write two important limitations of the 1st law of thermodynamics.
  - (b) Differentiate between isotopes and isotones with proper examples.
  - (c) Joule expansion is isoenergetic. Explain.
  - (d) Find an expression for the work done by 'n' moles of an ideal gas on isothermal reversible expansion from  $V_1$  to  $V_2$  at a constant external pressure p.
  - (e) Differentiate between a quasi-static process and an irreversible process. How does the total work of a cyclic expansion and compression differ in each of these cases?  $2+2+2+3+3\frac{1}{2}$
- 2. (a) Classify the following parameters as intensive or extensive (*any four*):
  - (i) Enthalpy
  - (ii) Density
  - (iii) Specific Heat
  - (iv) Molar Volume
  - (v) Internal energy
  - (vi) Entropy.
  - (b) Show that for a first-order reaction, the time taken for 99.9% completion is almost 10 times than that required for 50% completion.
  - (c) For the *n*-th order reaction,  $A \rightarrow$  products, write the units of the rate of the reaction and the rate constant. Which of these properties may change with temperature?
  - (d) What are the characteristics of a pseudo first-order reaction? Give a proper example.

2+4+21/2+(2+2)

**Please Turn Over** 

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- **3.** (a) What is the physical significance of the decay constant of a radio-element? Mention atleast three uses of radioisotopes in modern day.
  - (b) Discuss the significance of the nuclear binding energy curve. How are  $\pi$ -mesons responsible for acting as carriers of nuclear force?
  - (c) The half-life of a radioactive element is 2 hours. How long does it take for  $\frac{3}{4}$  th of the sample to decay? (2+3)+(2<sup>1</sup>/<sub>2</sub>+2)+3
- 4. (a) Draw the 4 stages of an idealized reversible Carnot cycle mentioning each step involved. A Carnot cycle is operating between 100°C and 0°C. Find its efficiency.
  - (b) For the reaction, A → products, the half-life is doubled as the initial concentration of A is doubled. Calculate the order of the reaction.
  - (c) Show that it is impossible for the cycle to attain an efficiency of unity (1).  $(4+2\frac{1}{2})+3+3$

#### Unit-II

## (Marks : 25)

## Answer any two questions.

5. (a) Draw the orbital diagram of following compounds and mention the state of hybridisation and approximate bond angle of each carbon atom involved.

$$CH_2 = C = O$$

- (b) Define the following with example :
  - (i) Plane of Symmetry
  - (ii) Diastereomer.
- (c) Write down the Fischer Projection Formula of the following compound :

COOH — CH(OH) — CH(Br) — COOH

- (i) How many stereoisomers possible for the above compound?
- (ii) Give the R,S-nomenclature of each chiral centre of the above compound.
- (d) Write a short note on hyperconjugation.
- **6.** (a) Write the IUPAC names of the following compounds :



 $2+(2+2)+(1+1+2)+2\frac{1}{2}$ 

- (b) Write down the possible tautomers of acetyl acetone and comment on their relative stabilities.
- (c) Designate E/Z-notation of the following compounds :



- (d) What is resonance hybrid?
- (e) Name the symmetry elements present in
  - (i) Meso-tartaric acid
  - (ii) BCl<sub>3</sub>
- (f) Which one is more stable— acetic acid or acetate ion in aqueous solution?  $3+2+2+2+2+1\frac{1}{2}$
- 7. (a) What is resonance? Tick out the major contributing structure with proper reasoning, in the following pair of structures.

$$CH_2 = \ddot{N} - \ddot{N} \longleftrightarrow CH_2 = \overset{\bigoplus}{N} = \overset{\bigtriangledown}{N}:$$

- (b) What do you mean by specific rotation?
- (c) Write a short note on resolution of alcohols.
- (d) The dipole moments of nitromethane and nitrobenzene are 3.60D and 3.95D respectively.— Explain.
- (e) Designate the following structure with erythro or threo prefix.



- (f) What is a meso compound? Explain with an example.
- **8.** (a) Write down the Fischer Projection Formula of D- and L- Glyceraldehyde and find out their absolute configuration.
  - (b) All geometrical isomers are diastereomers.— Justify this statement.
  - (c) Acetyl acetone shows 15% enol content in  $H_2O$  whereas 92% enol content in *n*-hexane.— Explain.
  - (d) Compare the stability of the following with reason :

(CH<sub>3</sub>)<sub>3</sub>Ċ, CH<sub>3</sub>ĊH<sub>2</sub>, (CH<sub>3</sub>)<sub>2</sub>ĊH, ĊH<sub>3</sub>

**Please Turn Over** 

3+2+2+2+1+21/2

(3)

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- (e) Write short notes on the following :
  - (i) Stereogenic centre
  - (ii) Optical activity.

## **Group-B**

## Unit-III

## (Marks : 25)

## Answer any two questions.

- 9. (a) What is mutarotation? Draw any epimeric structure of glucose.
  - (b) Define reducing and non-reducing sugar.
  - (c) Differentiate between aldose and ketose with example.
  - (d) How ring structure is formed in glucose?

## 10. (a) What are phospholipids?

- (b) Write short notes on :
  - (i) Hydrolysis of fat
  - (ii) Rancidity of fats.

## (c) What are the biological functions of cholesterol? What is Reichert-Meissel number?

(d) Differentiate between iodine value and saponification values of lipids.  $2+(2+2)+(2+2)+2\frac{1}{2}$ 

- 11. (a) What is the composition of RNA molecule?
  - (b) State the structural differences between DNA and RNA.
  - (c) What is a nucleotide? Give example.
  - (d) Differentiate between 'B'-form and Z-form of DNA.
- 12. (a) Cite one example for each where nucleotides are used as—
  - (i) Sources of energy
  - (ii) Component of coenzyme
  - (iii) Secondary messenger.
  - (b) Differentiate between ribose and deoxyribose.
  - (c) What is phosphodiester bond? How is a base and pentose sugar connected in a nucleoside?
  - (d) Discuss the experiment where DNA is proved as genetic material.  $1\frac{1}{2}+3+(2+3)+3$

2+2+11/2+3+(2+2)

(4)

3+3+21/2+4

(2+3)+2+(2+2)+11/2

## (5)

## Unit-IV

#### (Marks : 25)

## Answer any two questions.

- 13. (a) Which amino acid has imidazole ring in its structure? Draw its structure.
  - (b) Mention the principle followed in the estimation of an amino acid by formol titration.
  - (c) Draw a peptide bond in the energetically most favourable conformation.
  - (d) Define isoelectric point of an amino acid.
- 14. (a) Briefly describe the structure and functions of glutathione.
  - (b) What are conjugated proteins? Give any two examples.
  - (c) Differentiate between essential and non-essential amino acids with examples.
  - (d) Give three examples of non-protein amino acids.
- 15. (a) Write short notes on :
  - (i)  $\beta$ -pleated sheets / structures
  - (ii) Fibrous proteins
  - (iii) Ninhydrin reaction.
  - (b) What is the stereochemical difference between D-Serine and L-Serine? Draw their structures.
  - (c) What is Zwitterion? Give an example.  $(3+3+3)+(1+1)+1\frac{1}{2}$
- 16. (a) What is the function of ACTH? Write down the function of MSH.
  - (b) The pI value of Glycine is '6.06'. What will be the net charge of this amino acid in a buffer of pH 8.0? Explain your answer.
  - (c) What are the bonds affected during the denaturation of proteins?
  - (d) C–N in peptide bond is longer than the normal C–N single bond.— Justify.  $(1+2)+3\frac{1}{2}+3+3$
- 17. (a) Name three biologically important peptides.
  - (b) Give one example of— (i) polar, (ii) non-polar, (iii) charged side group containing amino acid.
  - (c) Why is proline called a alpha helix breaker?
  - (d) What is secondary structure of protein? Give example.
  - (e) Describe one reaction used for the identification of the C-terminal of a polypeptide chain.

11/2+11/2+3+31/2+3

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 $(1+1\frac{1}{2})+3+4+3$ 

 $(2\frac{1}{2}+2\frac{1}{2})+(2+1)+3+1\frac{1}{2}$