



**103**

**Biochemistry**

TIME : 3 HOURS

MAXIMUM MARKS : 300

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**INSTRUCTIONS :**

1. *All questions are compulsory.*
  2. *Question Paper may be divided into 4 (four) Sections from Section-A to Section-D and carry marks as under :*
    - a. *Section - A - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 12 marks × 3 Questions = Total 36 Marks.*
    - b. *Section - B - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 20 marks × 3 Questions = Total 60 Marks.*
    - c. *Section - C - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 28 marks × 3 Questions = Total 84 Marks.*
    - d. *Section - D - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 40 marks × 3 Questions = Total 120 Marks.*
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**SECTION - A**

(Each question is of 12 marks and each sub part (a) and (b) are of 6 marks each)

- 1
  - (a) Conversion from the amino to imino form of cytosine allows it to pair with adenine, show the necessary structural changes that happen to facilitate the pairing.
  - (b) What is Hayflick limit ? How does this limit differ between normal and most cancerous cells ?
- 2
  - (a) What is the biochemical importance of weak electrolytes?
  - (b) Normal human blood plasma contains all the amino acids required for the synthesis of body proteins. Two amino acids are present in much higher concentrations than the rest. Name them and give justification for their higher concentrations.

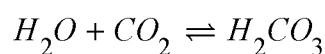
- 3 (a) Describe the principle of sandwich ELISA.  
(b) Create an ELISA kit for the detection of HIV infection. Explain your reasons for choosing various antigens/antibodies and reagents to accomplish this task.

### SECTION - B

(Each question is of 20 marks and each sub part (a) and (b) are of 10 marks each)

- 4 (a) How much energy (in ATP equivalents) will be used/generated in transforming glucose to pyruvate via glycolysis and back again to glucose via gluconeogenesis?  
(b) What are Okazaki fragments ? Explain pulse labelling and pulse chase experiments and how do they help in understanding discontinuous replication.

- 5 (a) A family from Mumbai embarked on a vacation in the Leh mountains. The family required about 48 h for acclimation to the high altitude and till that time were breathing rapidly. List and describe the compensatory mechanism that took place within the red blood cell during this acclimation period ?  
(b) Carbonic anhydrase of erythrocytes (Mr 30,000) has one of the highest turnover numbers we know of. It catalyzes the reversible hydration of CO<sub>2</sub> :



This is an important process in the transport of CO<sub>2</sub> from the tissues to the lungs. If 10.0 μg of pure carbonic anhydrase catalyzes the hydration of 0.30 g of CO<sub>2</sub> in 1 min at 37°C at

$V_{\max}$ , what is the turnover number ( $k_{cat}$ ) of carbonic anhydrase (in units of min<sup>-1</sup>)?

- 6 Why is water an important molecule for all living organism? Describe how the property of water is contributing to the following:  
(a) Thermoregulation  
(b) Plasma membrane structure

### SECTION - C

(Each question is of **28** marks and each sub part **(a)** and **(b)** are of **14** marks each)

- 7 (a) Give a flow chart representing the biosynthesis of Calcitriol. Justify why this molecule is considered a hormone.
- (b) Discuss the synthesis of glucose from non-carbohydrate sources.
- 8 (a) Enumerate differences between K and V series enzyme. Graphically represent the effect of activator on the rate kinetics of each.
- (b) What are long products in a standard Polymerase Chain Reaction? Can they be considered as non specific amplifications ? Explain diagrammatically how a primer could anneal to its target non specifically leading to the formation of PCR products of unexpected size.
- 9 Proteins are complex macromolecules that serve as building blocks of living organisms. Discuss the following :
- (a) The role of DNA and RNA in protein synthesis.
- (b) The role of proteins in membrane structure and transport of molecules across the membrane.

### SECTION - D

(Each question is of **40** marks and each sub part **(a)** and **(b)** are of **20** marks each)

- 10 (a) NO-derived species can react with thiols of proteins and form nitrosothiol adducts. HIV-1 protease (HIV-PR) contains two cysteine residues, Cys67 and Cys95, which are believed to serve a regulatory function. A researcher wanted to document the interaction, suggest which of the two, MALDI-TOF and ESI-MS techniques, would give him better results and why.
- (b) The lac operon has a weak promoter thus allowing a weak binding with RNA polymerase under normal circumstances. Explain how the same promoter still manages to transcribe its gene(s) at high efficiency, when glucose is absent and lactose is available in the system.

- 11 (a) Explain the principles underlying gene therapy for severe combined immunodeficiency disease. Illustrate how it has been used to treat the listed disease. Outline the advantages and disadvantages of gene therapy compared to allogenic bone marrow transplantation.
- (b) How fatty acid synthesis and breakdown is coordinated and regulated in Vertebrates.
- 12 (a) Every nucleated human cell has IL-2 gene, however only T cells express this gene and secrete its protein. Provide necessary arguments/mechanism(s) to justify this observation.
- (b) Describe major metabolic events happening during starvation in humans and support your answer with illustrated diagram showing the relationship between different organs during this phase.
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