RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2016

SECOND YEAR [BATCH 2015-18]

Date : 12/12/2016 **MICROBIOLOGY [Honours]**

Time : 11 am – 3 pm **Paper : III** Full Marks : 100

[Use a separate Answer Book for each Group]

Group – A

Unit - I

(*Answer any four questions*) [4×10]

1. a) Write down the role of proof reading activity of DNA polymerase in replication. [2]
   b) DNA polymerases require a primer for initiation of DNA synthesis but RNA polymerase doesn't require such for initiation of transcription —why? [2]
   c) Could a single nucleotide deletion restore the function of a protein coding gene interrupted by the insertion of a four nucleotide sequence? [3]
   d) How does terminator and antiterminator loop acts antagonistically to establish a finer control on gene regulation? [3]

2. a) *E. coli* has two tRNAs for methionine. Why does nature select this feature for only to read one codon? [2]
   b) State true or false in the following : [3]
      i) tRNAs move from one codon of the mRNA to the next
      ii) the ribosomes move closer to the 3′-end of the mRNA
      iii) the growing polypeptide chain is passed from the tRNA of the P-site to the amino acid at the A-site.
   c) State two mechanisms by which the fidelity of translation is increased. [2]
   d) Design an experiment to prove that 'sigma' factor of RNA polymerase stimulates tight binding between RNA polymerase and promoter. [3]

3. a) What are two important elements of an intrinsic transcription terminator? [2]
   b) How did Nirenberg and his colleagues prove the triplet nature of genetic code by a simple triplet binding assay? [3]
   c) Monod constructed homozygous partial diploid by introducing a plasmid with lac^- gene into a cell containing a lac^- gene in the chromosome. In some cases these partial diploids exhibited lac^+ phenotype. How is it possible? [3]
   d) State two important features of non-ribosomal peptides. [2]

4. a) Name the components of initiation complex in prokaryotic protein synthesis. [2]
   b) What are the selective effects of removing each or both of the auxiliary operators of the *lac* operon? [3]
   c) For each of the following steps of translation, name the nucleotide cofactor involved and number of high energy phosphate bonds consumed [3]
      i) α-amino acid activation
      ii) formation of 70S complex
      iii) delivery of aminonyl tRNA to the ribosome
   d) What is meant by 5′-capping? [2]

5. a) What will happen to protein synthesis if puromycin is added to a growing bacterial culture? [2]
   b) Compare the role of DNA helicase and DNA gyrase in prokaryotic DNA replication. [3]

c) How is *lac* operon regulated both negatively and positively? [3]
d) Which step in translation does chloramphenicol block? [2]

6. a) What are the roles of 5´-UTR in translation of mRNA in prokaryotes? [2]
b) What will be the phenotypes of the partial diploids — $I^+O^CZ^+ / F'I^-O^+Z^-$, $I^+O^+Z^+ / F'I^-O^CZ^-$. [2]
c) How is a lariated intermediate formed during processing of primary transcript in eukaryotic cell? [3]
d) What is an amber suppressor? [2]
e) What is a corepressor in *trp* operon? [1]

7. a) Which features of tRNAs are needed for formylation and to enter the P-site of ribosome? [2]
b) Write down the features of *lacI*, *lac* I^{-d} and *lac* I^s. [3]
c) Describe the role of RNAi machinery in gene silencing. [3]
d) State the roles of micro RNAs in gene regulation of eukaryotes. [2]

8. a) State the role of tmRNA in prokaryotic transcription. [2]
b) Draw a diagram to illustrate where AraC is located in (i) absence of arabinose and (ii) presence of arabinose. [3]
c) What is a riboswitch? State its role in gene regulation. [3]
d) When growing *E. coli* is subjected to a rapid increase in temperature, a new and characteristic set of genes is expressed. Explain how this may happen? [2]

Unit - II

(*Answer <u>any two</u> questions*) [2×10]

9. a) What is cell signalling? How do signals affect cell function? [1+2]
b) Compare in between endocrine signaling and autocrine signaling with example. [3]
c) Discuss the role of second messengers in cell signaling. [2]
d) What is SMAD protein? [2]

10. a) What are phagocytosis and pinocytosis? Explain with suitable examples. [2+2]
b) Confirm the role of protease, ATPase and signal peptidase in mitochondrial membrane transport. [4]
c) Define "secretion" and "excretion". [2]

11. a) Write down the difference between endocytosis and exocytosis. [3]
b) If the hydrophobic interior of a membrane were about 3 nm thick, what would be the minimum number of amino acids in a stretch of transmembrane α helix? [2]
c) Cystic fibrosis is a hereditary disease which is due to defect in chloride ion channel function — comment. [3]
d) State two important differences between ion channels and ion transporters. [2]

12. a) Biological membranes act as capacitor— elaborate the statement. [2]
b) Write down the role of SRP in transport system. [3]
c) What is ionophore? Name any two and state their style of functions. [2·5]
d) Define and explain the term 'critical micelle concentration' in relation to usage of detergents in solubilising membrane proteins. Name one each of cationic, anionic and neutral detergents. [2·5]

Group – B

(*Answer <u>any four</u> questions*) [4×10]

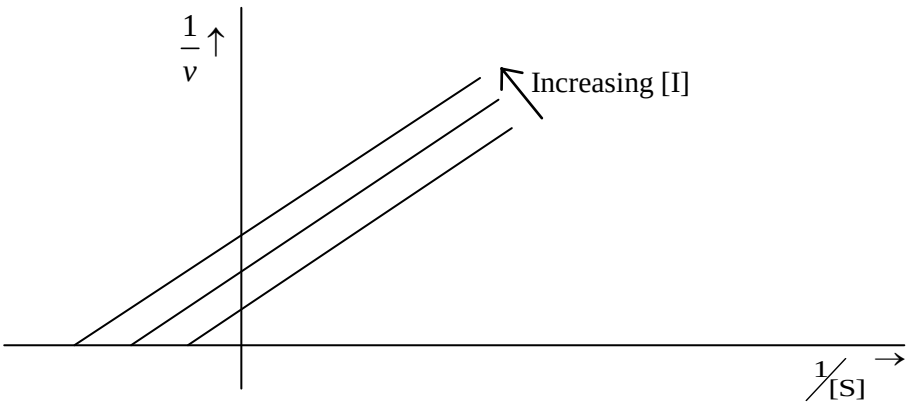
13. a) A crude cell free extract contains 20 mg of protein per millilitre. Ten microliters of this extract in a standard total reaction volume of 0.5 ml catalyse formation of 30 nmoles of product in 1 minute under optimal assay conditions.
    (i) Express '*v*' in terms of nmoles/assay, nmoles x ml x min^{-1}, nmoles x $liter^{-1}$ x min^{-1}, μmoles x $litre^{-1}$ x min^{-1}, M x min^{-1}. [5]
    (ii) What would be '*v*' if the same 10 μL extract were assayed in a total volume of 1 ml. [2]
    (iii) What is the concentration of enzyme in the assay mixture and in the extract (in units/ml)? [2]
    (iv) What is the specific activity of the preparation? [1]

14. a) What is allosteric constant? What is the significance of this constant? [3]
    b) 20 ml of an enzyme preparation contains 40 mg protein. 0.2 ml of this preparation catalyses the production of 80 micromoles of inorganic phosphate per min from Glu-6-P. Calculate the activity and specific activity of the enzyme. [3]
    c) How can nicotinamide adenine dinucleotide be synthesized biochemically? [2]
    d) Most of the cases the monomeric enzymes show isozyme character –Justify. [2]

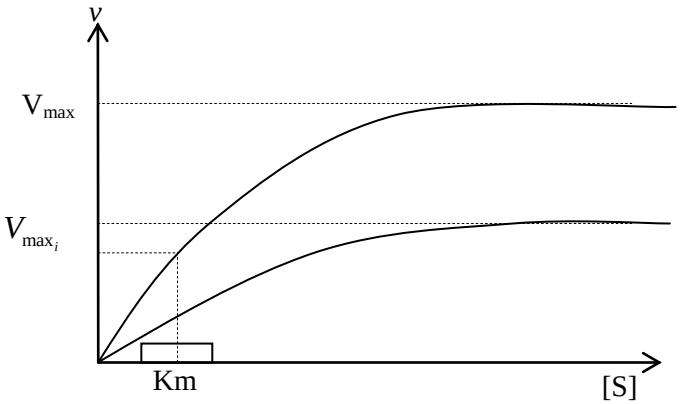
15. a) Write short notes on: [2½ × 2]
    (i) Different types of enzyme catalysis.
    (ii) ES complex
    b) What are the significance of Michaelis constant? [2]
    c) How do pH & [S] affect an enzyme catalysed reaction? [1½ × 2]

16. a) Explain what type of inhibition is occurring in the following curves:–

(i) [3]



(ii) [3]



Write down the reaction equation for both graphs.

b) Explain covalent modification of enzyme activity regulation with example. [3]

c) What do you mean by suicide inactivation? [1]

17. a) What is the significance of Km in Briggs – Haldane equation? [3]

b) What was the usefulness of steady state assumption of Briggs–Haldane approach? [3]

c) An enzyme preparation has a specific activity of 42 units/mg protein and contains 12 mg of protein per millilitre. [2+2]

Calculate the initial velocity of the reaction in a standard 1 ml reaction mixture containing:–

(i) 20 μl

(ii) 5 μl of the preparation

18. a) How would you disinfect air with mists and sprays? [4]

b) What do you mean by false positive result during coliform test? [3]

c) What is the role of sodium sulphite during preparation of ENDO agar? [3]

19. a) How would you measure BOD? [2]

b) What do you mean by sewage? [2]

c) What do you mean by activated sludge procedure? [3]

d) Write down the principle of citrate utilization test. [3]

20. a) How do microorganisms play an important role in wastewater (municipal) treatment? [3]

b) What are the advantages of forced air flow sampling over settling plate technique of bioaerosol sampling? [2]

c) How faecal & non-faecal coliform are differentiated depending on their cellular biochemistry? [3]

d) Give examples of two air borne respiratory disease. [2]

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