RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2015

SECOND YEAR [BATCH 2014-17]

Date : 15/12/2015 **MICROBIOLOGY [Hons]**

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

(Use a separate Answer Book for each Group)

Group – A

Unit – I

(Answer **any two** questions)

1. a) Briefly mention the nature of "uptake targeting sequences" that direct proteins from the cytosol to mitochondrion and chloroplast. (1½ + 1½)

   b) What is transcytosis? Explain why there must be an input of free energy for the transport vesicles to mediate selective directional transport between any two membrane bound compartments? What are caveolacs? (2 + 1)

   c) "Proteins destined for the peroxisomal membrane contain different targeting sequences than peroxisomal matrix proteins and are imported by a different pathway." Explain. (2)

   d) A certain protein has been tagged with mannose -6-phosphate in the *cis* Golgi apparatus. What will be the most likely fate of this protein? (2)

2. a) How do mitochondrial inner membrane proteins and proteins of the inter-membrane space reach their respective destinations? (2 + 2)

   b) Describe what would happen to the precursor of a mitochondrial matrix protein in the following types of mitochondrial mutants :– (1 + 1 + 1 + 1)

      i) a mutation in the Tom 22 signal receptor

      ii) a mutation in the Tom 70 signal receptor

      iii) a mutation in the matrix Hsc 70

      iv) a mutation in the matrix signal peptidase

   c) What is "phagocytosis" and "pinocytosis"? (1 + 1)

3. a) How does facilitated diffusion vary from passive diffusion? Explain the immediate consequence of inactivating the Na^+–K^+- ATPase proteins in a cell? (2 + 2)

   b) Biological membranes act like a capacitor- Elaborate. (2)

   c) Respiratory chains and ATP synthase catalyze the electrogenic translocation of protons – Enumerate with the help of a diagram. (2)

   d) Write a brief account on the nature of ABC transporter superfamily. (2)

4. a) Apart from the F_1-F_0 ATP synthase which utilise proton gradient to produce ATP, a separate class of proteins utilise solar energy to create proton gradient and subsequently make ATP – Explain. (3)

   b) Metabolic reactions that energize the membrane always generate an electrochemical proton potential across it – Elaborate the statement. (2)

   c) Conversion of information into chemical change is a universal property of living cells – state about their patterns of manifestation. (3)

   d) Differentiate between autocrine and paracrine signalling. (2)

Unit – II

(Answer **any four** questions)

5. a) "RNA polymerase doesn't have any proof reading activity" – Why? (3)
   b) What are abortive transcripts and how are they generated? (1 + 2)
   c) What is a "double sieve" mechanism to ensure high fidelity of translation? (4)
6. a) A diploid organism has 4.5×10^8 bp in its DNA. The DNA is replicated in 3 minutes. Assuming that all replication forks move at a rate of 50 nt / sec; how many replicons are present in the organism's genome? (3)
   b) How did Jacob and Monod explain the process of synthesis of lactose metabolising enzymes in presence of lactose? (4)
   c) Gramicidin A's synthesis is not directed by ribosomes. Then state in brief how is this molecule made by bacteria and also cite its function. (3)
7. a) What are 'quick stop' and 'slow stop' mutants. State whether the mutants of the following proteins involved in replicaton will be 'quick stop' or 'slow stop'-DnaB, Tus. (2 + 1)
   b) How did Nirenberg and others prove that the genetic code is triplet by triplet binding assay? (4)
   c) How does alternative secondary structure of 5′UTR of an RNA play a role in gene regulation? (3)
8. a) Sigma factors play a critical role in switching gene expression. Explain. (3)
   b) How is it possible for 31 types of tRNA to read 61 sense codons during translation? (4)
   c) What is meant by RNA-induced gene silencing? Cite an example. (2+1)
9. a) Explain the difference between conserved and concensus sequence citing the example of the promoter sequence. (3)
   b) Why is it necessary to formylate the initiating amino acid during translation? Which base pair of the tRNA is needed for formylation? (3+1)
   c) You are given a string of mRNA. How would you determine just by inspecting its sequence whether it is potentially translatable or not? (3)
10. a) How does rifampicin kill endoparasite, *Mycobacteriaum tuberculosis*? What is meant by a cap of an eukaryotic mRNA? (2+1)
    b) Differentiate between positive and negative regulation of gene expression in a mechanistic viewpoint. (3)
    c) How does a single gene can produce multiple products? What is meant by exon shuffling? (2+2)
11. a) How is a lariate intermediate formed during excision of introns from an hn RNA? (3)
    b) State the characteristic features of the mutations – *lac* I^s and *lac* I^{-d}. What would be the phenotypes of $I^+O^+Z^- / F'\ I^+O^cZ^+$ and $I^+O^cZ^- / F'\ I^+O^+Z^+$? (4)
    c) By what mechanism does the tryptophan in the medium results in premature termination of *trp* mRNA transcription? (3)

Group – B

Unit – I

(Answer **any two** questions)

12. a) Do you think that air is favourable for the growth of microorganisms? (3)
    b) Name two airborne bacterial and two fungal pathogens. (1+1)

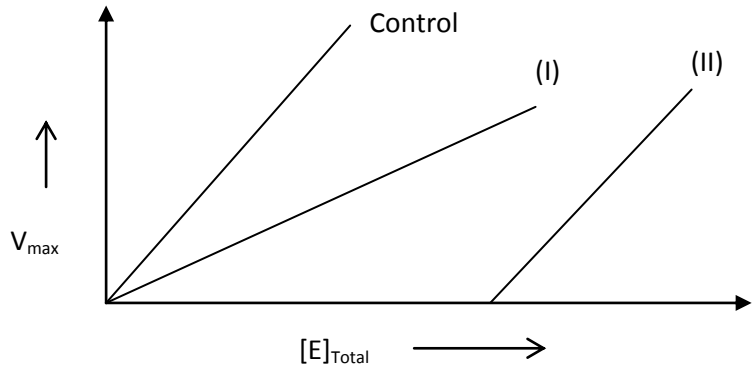
c) What are bioaerosols? How are bioaerosols transported from one place to another? Enumerate the significance of macroscale transport in this respect. (2+1+2)

13. a) What is the role of HEPA and UV in room air sanitation? (2+2)
    b) What do you mean by indicator bacteria? (2)
    c) One type of peptic ulcer is caused by water borne bacteria. Explain how this bacteria manage to survive and cause pathogenicity in the intense acidic environment of the stomach? (2)
    d) Why are most of the marine microbes seldom pathogenic to human beings? (2)
14. a) What is sludge? Certain microbes are often selectively employed in the secondary treatment of the sludge. Explain the statement. (1+2)
    b) What are halophiles? Cite an example. (2)
    c) Write down the principle of indole and citrate utilization tests. (2½+2½)
15. a) What are benthic organisms? (2)
    b) It is generally difficult to ascertain the entire diversity of a marine microbiota by conventional culture techniques. Explain what will you do in this respect? (3)
    c) What do you mean by black smokers? Which bacteria would you find there and why? (3+2)

Unit – II

(Answer **any two** questions)

16. a) What is allosteric constant? What is the significance of this constant? (3)
    b) 20ml of an enzyme preparation contain 80mg protein. 0.2ml of this preparation catalyzes the production of 40 micromoles of inorganic phosphate per minute from Glu-6-P. Calculate the activity and specific activity of the enzyme. (3)
    c) Aspartate transcarbamoylase in allosterically inhibited by CTP and activated by ATP. Explain the logic behind why the roles of ATP and CTP cannot be reversed? (2)
    d) What happens when aspartate trans –carbamoylase is treated with mercurial benzoate? (2)
17. a) From the graph below



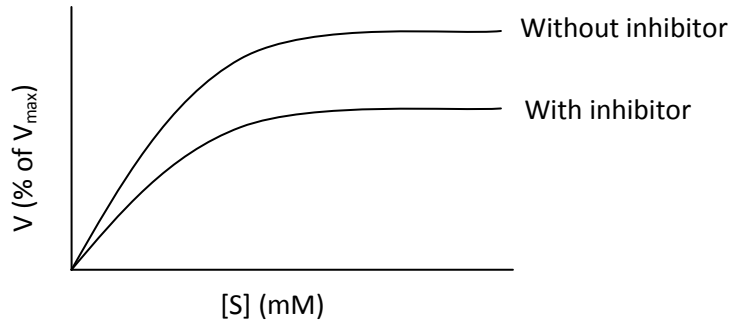
State what type of enzymatic reaction is followed?
(i) Plot number (I)
(ii) Plot number (II) (3+3)

    b) An enzyme was assayed at an initial substrate concentration of 10^{-6} M. The K_M for the substrate is 2×10^{-3} M. At the end of 1 mm, 2% of the substrate had been converted to product. What percent of the substrate will be converted to product at the end of 3 min? (4)
18. a) What type of reaction is depicted by the equation, (3)

$$\frac{v}{V_{max}} = \frac{[S]}{K_S + [S]\left(1 + \frac{[I]}{K_i}\right)}$$

b) "The Km of a competitively inhibited reaction is higher than its control reaction"— Explain whether this statement is true or false. (3)

c) Following graph shows the inhibition of carbonic anhydrase by acetazolamide. Determine the nature of this inhibition. (2)



d) Explain in brief the concert model of action of allosteric enzymes. (2)

19. a) In your studies of the enzyme ribonuclease A, you obtain the data for a wild type enzyme and a mutant ribonuclease A. The two enzymes differ at a single amino acid position in the protein. The activity data is given below.

	V_{max}	Km
Wild type	100 µmole/min	10 mM
Mutant	1 µmole/min	0.1 mM

(i) Which enzyme has a higher affinity for the substrate? (½)

(ii) What is the initial velocity of the reaction catalysed by the wild type enzyme at a substrate concentration of 5mM? (1½)

b) Differentiate between reversible and irreversible enzyme inhibition citing an example of each case. (1+1)

c) Plot the graph of [ES] with time when,

(i) $[S] >>> [E]_t$

(ii) Product once formed degrades back to form substrate. (2+2)

d) What do you mean by Turnover number? (2)

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