

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2019

SECOND YEAR [BATCH 2018-21]

MICROBIOLOGY [Honours]

Date : 11/12/2019

Time : 11 am – 3 pm

Paper : III

Full Marks : 100

[Use a separate Answer Book for each Group]

Group – A

Answer any six questions from Question Nos. 1 to 12 :

[6×10]

1. a) Why does glucose need a transporter? [2]
b) The plasma membrane of an animal cell consists of 45% by weight of phospholipid and 55% protein. What is the mole ratio (moles of lipid/moles of protein) if the average molecular weight of phospholipids is 750 and the average molecular weight of membrane proteins is 50,000? [4]
c) State two important criteria for permeability of materials across biological membranes. [2]
d) State the significance of GLUT 4 transporter. [2]
2. a) When a preparation of mitochondrial membranes was treated with high salt (6.0 M KCl), it was observed that 40% of the total protein in this preparation was solubilized. What kind of membrane proteins are in this soluble extract and what forces normally hold them to the membrane? What kind of proteins constitutes the insoluble 60% and what forces hold these proteins in the membrane?
b) Distinguish among the nature of structures and functions of P, V, F type ATPases.
c) Glucose transport from intestinal lumen to blood is being carried out via two transporters present in intestinal epithelial cells. Briefly elaborate the nature and function of these two transporters. [1.5+1.5+3+4]
3. a) How does Shine-Dalgarno sequence help in initiation of translation?
b) In a polycistronic prokaryotic message though the downstream mRNA lacks a ribosome binding site, it may be translated efficiently – write down the probable mechanism.
c) Name the enzyme that helps in the charging of tRNA.
d) Define initiation factor. Mention the function of IF2 in human. [3+3+1+(1+2)]
4. a) Partial diploids were constructed in which both the F' *lac* plasmid and the chromosome carried *lac* genes. These were tested for the *lac*⁺ phenotype. A few *lac*⁺ colonies were found to arise. How can you explain these observations?
b) State the structural peculiarities of tryptophan mRNA meant for finer regulation on tryptophan biosynthesis.
c) The sequence of a gene may not correspond the amino acid sequence in protein. How does this take place within the cell. [3+4+3]
5. a) How did Nirenberg prove the triplet nature of genetic code?
b) If the *E.coli* cells are allowed to grow in the medium with abundance of tryptophan, what metabolic change will be seen in *E.coli* and why?
c) Neither *cya*⁻ nor *crp*⁻ cells are unable to metabolize lactose. Why?
d) Define a catabolic operon. [3+(1+2)+2+2]

6. a) Cite example of an enzyme which catalyzes the synthesis of polypeptide without the participation of ribosome. Name the essential domains of this enzyme with their specific functions.
 b) What is riboswitch? How do they exercise their role in gene regulation?
 c) How is the *lac* operon controlled following both the negative and positive mode of regulation? [3+(1+3)+3]
7. a) What do you understand by "Secondary messengers"?
 b) State the role of any one secondary messenger.
 c) Which type of signalling is involved in clotting of blood? Justify.
 d) How is cAMP involved in signal transduction pathway? [2+2.5+(1+2)+2.5]
8. a) "The number of proteins may be higher than the number of genes in the genome"- How can it be possible?
 b) The number of sense codons far exceed the number of tRNAs in the cell. Then how are all the codons in mRNA read by them?
 c) Schematically show the mechanism of gene regulation by means of micro RNA.
 d) What is meant by gratuitous inducer? [3+3+3+1]
9. a) Which molecule acts as GTP exchange factor for EF-tu? Write down the process.
 b) Where is the factor binding centre of translation located? Write down its function.
 c) Class I release factors, functionally, but not structurally, mimic a tRNA –explain. [(1+2)+(1+2)+4]
10. a) How biological membranes can act as capacitor?
 b) Compare and contrast valinomycin and gramicidine in terms of their style functions as ionophore.
 c) Cite two example each of primary and secondary active transport systems present in *E.coli*.
 d) Write a brief account on Cystic Fibrosis, a genetic disease, in relation to the nature of membrane function disorder. [2+2+3+3]
11. a) What is FACT? How does it work?
 b) Write down the role of following enzymes in capping process : RNA triphosphatase, Guanylyl transferase and guanine 7-methyltransferase.
 c) Write down the role of CPSF and CSTF protein complex in polyadenylation event. [(1+3)+(1+1+1)+3]
12. a) How does CTD tail of Eukaryotic Pol II regulate transcription?
 b) Write down the assembly catalysis step of spliceosome complex.
 c) Write down the role of cleavage and polyadenylation specificity factor in polyadenylation process. [2+(2+2)+(2+2)]

Group – B

Answer any four questions from Question Nos. 13 to 20: [4×10]

13. a) Fifteen microlitres of an enzyme preparation catalysed the production of 0.52 μ mole of product in 1 minute under standard optimum assay condition.
 (i) How much product will be produced in 1 minute by 150 μ L of the preparation under the same reactions conditions?

- (ii) How long will it take 150 μL of the preparation to produce 0.52 μ mole of product under same assay conditions?
- b) What is Non-competitive inhibition? Explain with graphs.
- c) What is International unit of enzyme activity? [(2+2)+(2+2)+2]
14. a) Penicillin is found to be active on rapidly dividing bacterial cells but not on resting cells, why? Explain.
- b) An enzyme preparation has a specific activity of 42 units/mg long protein and contains 12 mg of protein per ml. Calculate the initial velocity of the reaction in a standard 1 ml reaction mixture containing :
- (i) 20 μL and (ii) 5 μL of the preparation. (iii) should the preparation be diluted before an assay? [3+(2.5+2.5+2)]
15. A crude cell free extraction contain 20 mg of protein/ml. 10 μL of this extract in a standard total reaction volume of 0.5 ml catalysed the formation of 30 n moles of product in 1 minute under optimum conditions.
- i) Express 'v' in terms of n moles/assay, n moles $\times \text{ml}^{-1} \times \text{min}^{-1}$, n moles $\times \text{litre}^{-1} \times \text{min}^{-1}$, μ moles $\times \text{litre}^{-1} \times \text{min}^{-1}$, $\text{M} \times \text{min}^{-1}$.
- ii) What would 'v' be if the same 10 μL of extract were assayed in a total volume of 1 ml?
- iii) What is the concentration of enzyme in the assay mixture and in the extract in terms of units/ml.
- iv) What is the specific activity of the preparation? [5+2+2+1]
16. a) State the techniques used to isolate & purify the membrane bound enzymes.
- b) What are Abzymes?
- c) Derive the Briggs-Haldane expression of enzyme kinetics? [4+2+4]
17. a) What is the significance of Winogradsky column?
- b) Who proposed the concept of 'contagiumvivumfluidum'. What does it mean?
- c) What is the difference between littoral and limnetic zone?
- d) How would you differentiate eutrophic lake from oligotrophic lake? [3+2+2+3]
18. a) What is thermocline?
- b) Name one waterborne disease.
- c) What do you understand by BOD?
- d) Write down the procedure of trickling filter method of water purification. [2+1+3+4]
19. a) Write down the procedure of membrane filtration test.
- b) What do you mean by coliform bacteria? Give an example.
- c) How will you determine microbial content of air?
- d) Why does ENDO medium act as a selective-differential medium? [3+(2+1)+2+2]
20. a) Write down the principle of indole test. Name one indole positive and one indole negative bacteria.
- b) What are aerosols?
- c) How would you classify aerosols?
- d) How would you sanitize air chemically? [(2+2)+2+2+2]

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