RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, MARCH 2022

SECOND YEAR [BATCH 2020-23]

Date : 05/03/2022

MICROBIOLOGY (HONOURS)

Time : 11 am – 1 pm

PAPER : VI [CC6]

Full Marks : 50

Answer **any five** questions of the following: [5×10]

1. a) Write down the ATP/GTP generating steps of TCA cycle.
   b) How the enzyme PFK-1 is regulated by PFK-2?
   c) What would be the effect if ingestion of 2, 4-dinitro phenol on the P/O ratio for ATP synthesis using NADH as an electron donor? Give reason(s) for your answer.
   d) Why is pentose phosphate pathway more active in cells that are dividing than in cells that are not?
   e) Compare and contrast substrate level phosphorylation and oxidative phosphorylation. (2+2+2+2+2)
2. a) Describe the fate of pyruvate formed in glycolysis during anaerobic conditions.
   b) What are the differences between linear and branched fermentation pathways?
   c) Name a bacterium that follow-
      i) Both homolactic and heterolactic acid fermentation.
      ii) Both mixed acid and butanediol fermentation.
   d) What do you mean by assimilatory and dissimilatory nitrate reduction?
   e) What is the utility of fermentation in anaerobic organisms? (2+2+2+2+2)
3. a) Give a brief account on nutritional application of vitamin K. What is anti-vitamin? Explain with example.
   b) What will happen if vitamin D is deficient in normal diet, explain properly?
   c) Excess amount of avidin results in accumulation of propionyl CoA in cell. Why?
   d) State the importance of vitamin C to inhibit the intracellular pathogen. [(2+2)+2+2+2)
4. a) State the importance of pantothenic acid in the metabolic process.
   b) State the role of vitamin B1 in carbohydrate metabolism.
   c) What do you mean by the term prosthetic group?
   d) Give an example of vitamin that will act as a prosthetic group and state its role in the metabolism.
   e) What is provitamin? Give an example. [2+2+1+(1+2)+2]
5. a) Plant rhizobium relationship is mutual symbiosis- justify
   b) Explain the role of reductase in nitrogen fixation.
   c) What is mixotrophy? Give an example.
   d) Why do nitrite oxidizing bacteria use reverse electron flow? (3+2+2+3)

6. a) What do you mean by photochemical apparatus?
   b) What may happen if a plant cell can't produce carotenoids?
   c) Denitrification is detrimental as well as beneficial- justify.
   d) Which steps in nodulation would not occur if *Rhizobium* cells become deficient of *nod* genes?(2+2+3+3)

7. a) How can synchronous growth of a bacterial culture be obtained? In what way could a synchronously growing culture be useful for the electron microscopist who is trying to determine the cytological changes associated with bacterial growth?
   b) What are 'photolithoautotrophs' and 'photoorganoheterotrophs'? Explain with example.
   c) Classify bacteria on the basis of their oxygen requirements. Explain each type with proper example.
   d) Discuss the various adaptation mechanisms of psychrophiles. [(1+2)+2+3+2]

8. a) Differentiate primary and secondary active transport.
   b) One of the most important membrane proteins is the sodium-potassium pump which is an antiport system – Justify the statement.
   c) What would happen to a cell if this pump suddenly stopped working?
   d) According to Darcy's law –

$$Q = \left(\frac{K}{\eta}\right)\left(\frac{\Delta P}{\Delta L}\right)A$$

- Q = flow rate (m^3/s)
- K = permeability (m^2)
- ΔP = pressure difference (Pa)
- ΔL = flow length or test sample thickness (m)
- A = cross-sectional area of flow (m^2)
- η = Dynamic viscosity

Now suppose you are doing free energy calculation for a membrane transport event. Should you consider Darcy's law for that? Give proper justifications. (2+2+2+4)

9. THE FOLLOWING DATA WAS RECORDED FOR THE ENZYME CATALYZED REACTION

$S \rightarrow P$

[S] (M)	v (nmoles x litre^{-1} x min^{-1})
6.25 x 10^{-6}	15.0
7.50 x 10^{-5}	56.25
1.00 x 10^{-4}	60
1.00 x 10^{-3}	74.9
1.00 x 10^{-2}	75

. a) Estimate V_{max} and K_{max} .
   b) What would υ be at [S] = 2.5×10^{-5} M and at [S] = 5.0×10^{-5} M ?
   c) What would υ be at 5.0×10^{-5} M if the enzyme concentration were doubled?
   d) The υ given in the above table was determined by measuring the concentration of product that had accumulated over a 10-minute period. Verify that υ Represents a true initial (or "instantaneous") velocity. [(1+1)+(2+2)+2+2]

10. A crude cell-free extract contained 20 mg of protein per millilitre. Ten microliters of this extract in a standard total reaction volume of 0.5 ml catalysed the formation of 30 nmoles of product in 1 min under optimum assay conditions (optimum pH and ionic strength, saturating concentrations of all substrates, coenzymes, activators, and the like).

a) Express υ in terms of nmoles/assay, nmoles $ml^{-1}\times min^{-1}$, nmoles$\times liter^{-1}\times min^{-1}$, μmoles$\times liter^{-1}\times min^{-1}$.

b) What would υ be if the same 10 μ 1 of extract were assayed in a total volume of 1.0 ml?

c) What is the concentration of the enzyme in the assay mixture and in the extract (in terms of units/ml)?

d) What is the specific activity of the preparation? (2.5+2+3+2.5)

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