RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. THIRD SEMESTER EXAMINATION, DECEMBER 2013

SECOND YEAR

Date : 14/12/2013 **MICROBIOLOGY (Honours)**

Time : 11 am – 3 pm Paper : III Full Marks : 75

[Use Separate Answer Scripts for each group]

Group - A

1. Answer all the questions :
   a) Cite two examples of non-ribosomal peptides. Mention the important distinctive features of non-ribosomal peptide synthetases (NRPSs). [1+1·5]
   b) Write down the differences between DNA polymerase I and DNA polymerase III of *E. coli*. [2·5]

2. Answer **any three** of the following :
   a) i) How can you prove that DNA replication is semi-conservative in nature? [3]
      ii) How does puromycin inhibit translation of mRNA in *E. coli*? [2]
      iii) Why is it not so essential for RNA polymerase to have proof-reading activity? [1]
      iv) Mention the important features of the tertiary structure of t-RNA. [2]
   b) i) ''A different σ factor comes into play in *E. coli* when the *E.coli* culture is abruptly raised to a higher temperature (say 42°C) from 37°C.'' Explain. [2]
      ii) What is an operon? [1]
      iii) What is meant by glucose effect? How does CAP – cAMP complex play an important role in *lac* operon? [1+2]
      iv) What are the activators that work together in *ara* operon? [1]
      v) How does allolactose control the functioning of the *lac* operon? [1]
   c) i) Briefly describe the mechanism of ρ-dependent termination of transcription in *E. coli*. [3]
      ii) Mention the roles of the consensus sequences of DNA in carrying out transcription. [2]
      iii) Define the terms : template strand, open-promoter complex. [2]
      iv) Mention a drug which is an inhibitor of both DNA replication and transcription. [1]
   d) i) What is 'Wobble' hypothesis? [2]
      ii) How does aminoacyl tRNA synthetase proofread during translation? [3]
      iii) How can you prove that translation occurs in the $5' \rightarrow 3'$ direction? [3]
   e) i) What are introns? [1]
      ii) Mention the two types of posttransciptional processing of mRNA in eukaryotes. Give brief explanations. [2×3]
      iii) What do you mean by polycistronic mRNA? [1]
   f) i) Calculate the number of GTP molecules utilized per ribosomal cycle during translation. [2]
      ii) What is attenuation? How does it work? [1+3]
      iii) What are the features of I^s and I^{-d} alleles of I^+ gene in *lac* operon? [2]

3. Answer **any two** of the following :
   a) i) Mention the functional differences between chloroplast and mitochondria. [3]
      ii) What is Kartagenre's syndrome? [2]
      iii) Explain the similarities and dissimilarities between doubling of a centrosome and DNA replication. [3]

b) i) Mention the marker enzymes (two for each) of : mitochondria and plasma membrane. [2]
ii) Briefly describe the molecular organisation of thylakoids. [3]
iii) Describe the composition of 70S ribosome. [1]
iv) Briefly describe the arrangement of microtubules in a flagellum. [2]

c) i) Write a brief account on the architecture of biological membranes. [2]
ii) What are porins? Briefly explain their general structure. [2]
iii) How do chain length and degree of unsaturation of fatty acids and the presence of cholesterol in biological membrane control the membrane function? [3]
iv) What is the cause of cystic fibrosis? [1]

d) i) Define : Ionophore, Liposome [2]
ii) What is the difference between eubacteria and archaebacteria with respect to the composition of membrane phospholipids? [2]
iii) What do you mean by primary and secondary active transport? Give an example in each case. [3]
iv) What is cotransport? [1]

Group – B

4. Answer **any three** of the following :

a) i) What do you mean by ribozyme? [1]
ii) What do you mean by the term 'Activation Energy' for an enzyme-catalyzed reaction? [2]
iii) Write down two reactions where NAD^+ and TPP one used as cofactors/coenzymes. [1·5×2]

b) i) Explain the importance of K_m (Michaelis-Menten constant) for an enzyme catalyzed reaction. [2]
ii) Given the reaction : $E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_P} E + P$

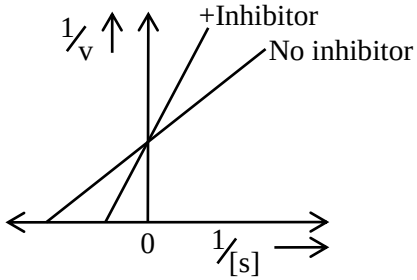
$k_1 = 1\times10^7\, M^{-1}\, sec^{-1}$, $k_{-1} = 1\times10^2\, sec^{-1}$ and $k_P = 3\times10^2\, sec^{-1}$

Calculate : (1) K_S (2) K_m (3) Can k_P be very much greater than k_1? [1+1+2]

c) i) Discuss the roles of p^H and temperature on enzymatic activity. [1·5×2]
ii) Define the terms : Prosthetic group, Holoenzyme [1·5×2]

d) i) What do you mean by rate limiting step of an enzyme-catalyzed biochemical pathway? Give example. [2]
ii) Discuss with example 'covalent modification' as a mechanism of regulation of enzyme activity. [3]
iii) What do you mean by ternover number of an enzyme-catalyzed reaction? [1]

e) i) What fraction of V_{max} is observed at—
(1) [S] = 0·75 Km, (2) Calculate the ratio of $[S]_{0\cdot75}$ / $[S]_{0\cdot5}$. [1+1]
ii) What type of enzyme inhibition gives the following plot, [2]



iii) Give one example of each of the enzyme class— (1) Lyase (2) Ligase [2]

f) i) The following data were recorded for the enzyme catalyzed reaction, $S \rightarrow P$.

[S]	v
(M)	(nmoles×litre^{-1} × min^{-1})
$6{\cdot}25\times10^{-6}$	15·0
$7{\cdot}5\times10^{-5}$	56·25
$1{\cdot}00\times10^{-4}$	60
$1{\cdot}00\times10^{-3}$	74·9
$1{\cdot}00\times10^{-2}$	75

1. Estimate V_{max} and K_m
2. What would the value of 'v' at [S] = $2{\cdot}5\times10^{-5}$M?
3. What would be the value of 'v' at $5{\cdot}0\times10^{-5}$M if enzyme concentration is doubled? [2+1+1]

ii) How do isomerases work? Give one example of an isomerase —catalyzed reaction. [2]

5. Answer **any two** of the following :

a) i) What is the importance of indicator organism in microbiological analysis of water? [2]

ii) Suggest four important criteria of an ideal indicator organism. [2]

iii) Name two waterborne diseases with their causative agents. [2]

b) i) Discuss the principle of 'Indole test'. [2]

ii) What are the advantages and disadvantages of membrane filtration technique? [2+2]

c) i) What is sludge? [1]

ii) Define BOD? [2]

iii) Discuss the expected result if *E. coli* and *Klebsiella* are subjected to IMV_{iC} test. [3]

d) i) What is aerosol? [1]

ii) What are the differences between droplet proper and droplet nuclei? [3]

iii) Name two airborne diseases with their causative agents. [2]