RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2019

FIRST YEAR (BATCH 2018-21)

Date : 16/05/2019 **MICROBIOLOGY (Honours)**

Time : 11.00 am – 3.00 pm **Paper : II** Full Marks : 100

[Use a separate Answer Book for each group]

Group – A

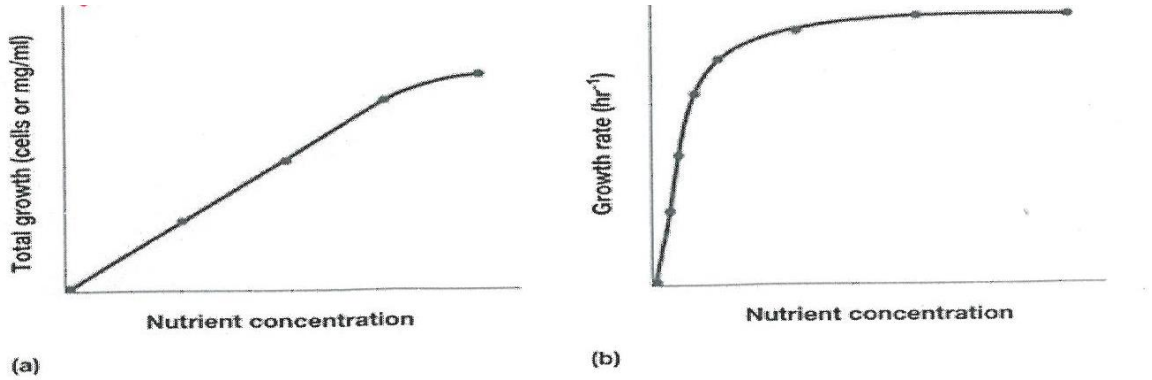
Answer **any four** questions of the following: [4×10]

1. a) How does population composition affect activity of antimicrobial substances? (2)
   b) What do you mean by decimal reduction time? (2)
   c) A bacterial culture increases in number from 200 to 20000 in 30 minutes. Calculate its generation time. Show a typical bacterial growth curve (log phase only) plotting cell number against time. (3+1)
   d) What is the difference between pasteurization and sterilization? (2)

2. a) State two characteristics of an ideal chemical antimicrobial agent. (2)
   b) Compare static and cidal chemical antimicrobial agent. (2)
   c) Autoclaving for a single cycle does not necessarily kill all life forms of a microbe. Justify the statement. Suggest a suitable method of accomplishing this. (1.5+1.5)
   d) Name one β -lactam drug and its mode of action. (1+2)

3. a) How does aerobes and other oxygen-tolerant microbes protect themselves from harmful effects of oxygen? (2.5)
   b) How can you differentiate between a slow growing bacterium and another one which has got short generation time if you don't have access to turbidity based measurement systems? (3)
   c) Finding the percentage of bacterial cell viability with the help of haemocytometer is possible. Conduct one experiment to justify the fact. (2)
   d) Suppose the plate of the 10^{-4} dilution yielded a count of 340 colonies in one experiment. What could be the total number of bacteria per ml of original sample? (1.5)
   e) What is synchronous culture? (1)

4. a) Explain the Monod relationship from the given picture: (1.5×2)



   b) What are semi-synthetic antibiotics? Explain with any one example. (1+1)
   c) You are sampling the bacterial population of the Sunderbans. Can you be absolutely certain to grow and identify most of the species to obtain a representative microbiota of the region? Explain your answer. (2)
   d) How will you differentiate between alpha, beta and gamma haemolytic group of bacteria by doing one short experiment? Interpret your result with proper justification. (3)

5. a) Design an experiment to find out the motility of a certain bacterium. (2)
   b) Explain the working principle of Mcintosh-Fildes' jar for doing anaerobic culture. (3)
   c) What is a thermophile? Apart from growth temperature, is there any other way of predicting whether a certain bacterium can be called a thermophile not? (1+1)
   d) What are compatible solutes? How is it useful for bacteria? (1+2)

6. a) The correlation coefficient between two variables X and Y is r = 0.60; if $\delta x = 1.5$, $\delta y = 2.0$ and $\bar{x} = 10$ and $\bar{y} = 20$, find the equation of regression
      i) X on Y and
      ii) Y on X. (5)
   b) Differentiate between correlation and regression. What do you mean by explained and unexplained variation in a regression line. (5)

7. a) What is the probability of throwing the same number in two successive throws of a dice? (1)
   b) Show that $\mathrm{Var}(x \pm y) = \mathrm{Var}(x) + \mathrm{Var}(y)$ (3)
   c) The mean score of 500 students in RKMV is 151 out of 200 marks in 1st Semester examination and the SD is 15. Assuming that the scores are normally distributed, find how many students' score remain
      i) Between 120 and 155
      ii) More than 155
      [Given, $\phi(0.27) = 0.6064$ and $\phi(2.07) = 0.9808$] (4)
   d) Explain what is meant by Type 1 error in testing a statisfied hypothesis. (2)

8. a) Prof Watson took a class test for 2nd semester students of Microbiology Hons. Out of 50 marks allotted for the test, the following marks were obtained by the students-
      20,15,26,32,18,28,35,14,26,12,19,35
      The variability of the scores is so high that it is very difficult for Prof. Watson to decide the cut-off marks for the pass out candidates. He decided that the students who will score 1SD(σ) below, will be considered fail.
      What will be the cut off marks for the class test? (3)
   b) Systolic blood pressure of 566 male were recorded and the unbiased SD is 13.05mm. Calculate S.E. of the mean. (3)
   c) State the differences between the probability mass function and probability density function? What do you mean by standard normal distribution? (2+2)

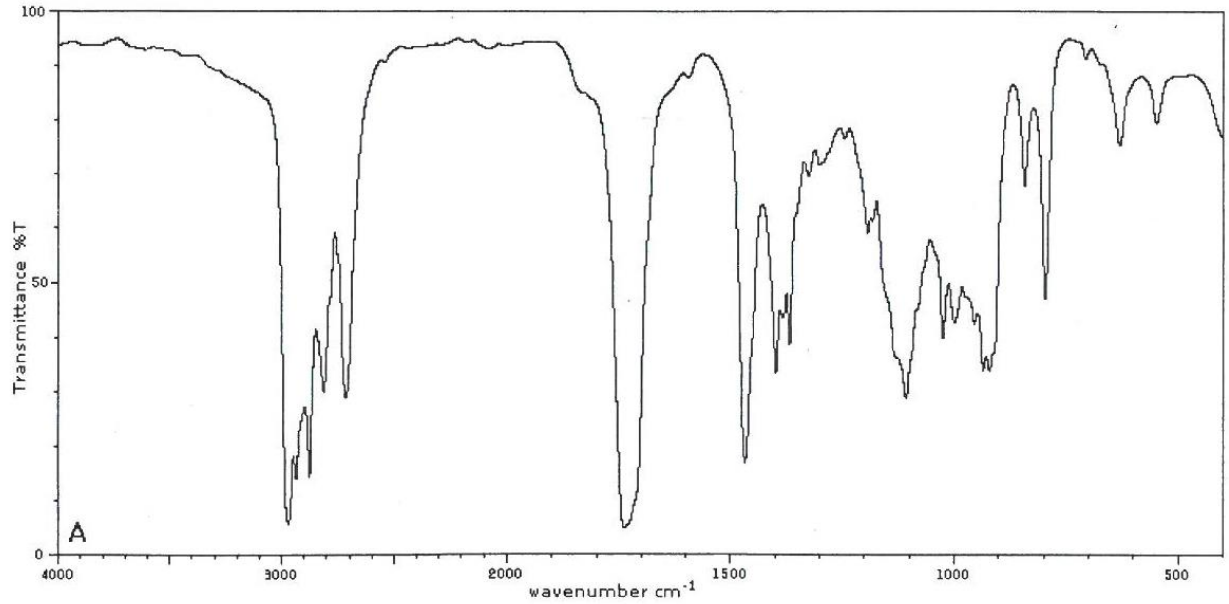
Group – B

(*Answer <u>any three</u> questions*) [3×10]

9. a) You have obtained two components while separating them using TLC. Their Rf values are given below. Explain this separation technique with proper diagram. Component A, Rf- 2.5; component B, Rf – 1.7. State the working principle for size exclusive chromatography. (2.5+2.5)
   b) Enumerate the chief differences between a native PAGE and a SDS-PAGE highlighting the scopes of the two different forms of protein electophoresis. Why is a protein gel run in a vertical manner? (3+2)

10. a) State the working principle of IR spectroscopy. (2)

b) You are given with a characteristic spectrum of a compound after performing IR spectroscopy. Logically find the possible functional groups that the compound may contain. Functional groups and corresponding wave number ranges are given. (5)



Bond	Molecule	Wavenumber (cm^{-1})
C-O	Alcohols, ethers, esters, carboxylic acids, etc.	1300 – 1000
C=O	Aldehydes, ketones, esters, carboxylic acids	1750 – 1680
C=O	Amides	1680 – 1630
N-H (Stretching)	Amines and amides	3500 – 3100
-N-H (Blending)	Amines and amides	1640 – 1550
O-H	Alcohols	3650 – 3200
C-N	Amines	1350 – 1000
S-H	Mercaptans	2550

c) What do you mean by finger print region of a typical IR spectrum? (3)

11. a) Define half-life and average life of a radioactive substance. (1+1)

b) An isotope has a half life of 4 yrs. Calculate

i) The decay constant, λ, in terms of yr^{-1}, hr^{-1}, min^{-1} and sec^{-1} and

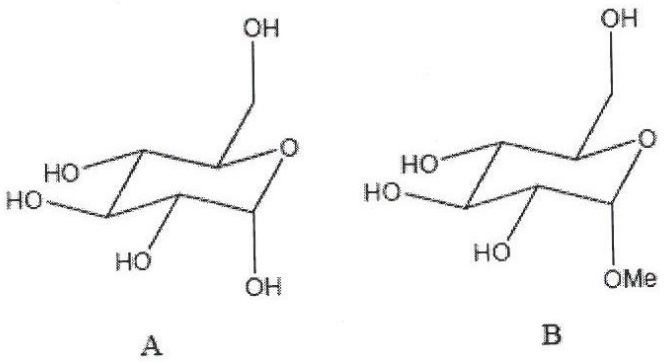
ii) The fraction of the original activity remaining after 13 months. (2+2)

c) Write a short note on

i) LET

ii) Biological half life of a radioisotope (2+2)

12. a) Which of the following structures depicted here will give an acyclic structure on treatment with a base? Rationalize your answer. (2)



(3)

b) How can you chemically differentiate between a reducing and a non-reducing disaccharide in a laboratory? (2)

c) What impact does the type of glycosides bond have on the structures of glycogen and cellulose? (2)

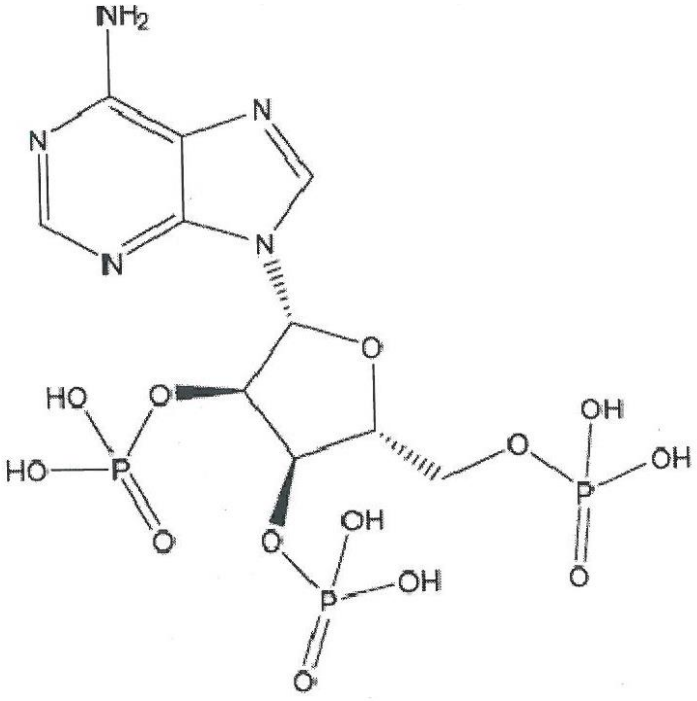
d) Write true or false with proper explanation.

D-glucose and D-gulose both must be dextrorotatory because both are D sugars. (2)

e) A student was provided with two samples of glucose and fructose labelled A and B, but does not know the exact identity of the two sugars. How can he figure out the identity of the samples? (2)

13. a) A hexose gave an optically inactive product when treated with HNO_3. When the same hexose was treated with $NaCN/H_2O$ followed by hot aqueous acid, $NaOH/H_2O$, aqueous acid again and finally sodium amalgam at pH 3, two monosaccharides were produced. Both of these monosaccharaides when oxidized with HNO_3 give optically active products. What is the identity of the original hexose? (3)

b) Shown the below structure of ATP. (2)



Identify the sugar and the chemical nature of the glycosidic bond.

c) Explain with a Jablonski diagram why are same compounds weakly fluorescent or non-fluorescent where as some others show strong fluorescence. (3)

d) State any two deviations which might occur in practical implementation of Lambert Beer's law. (2)

14. a) What difference between fats and oils? Why is there such a difference? (2+2)

b) A 250 mg sample of pure olive oil required 47.5 mg o KOH for complete saponification. Calculate the average MW of the triglycerides in the olive oil. (3)

c) Write down the structure of :

i) Cardiolipin ii) Plasmalogen (1.5+1.5)

Group – C

(*Answer <u>any three</u> questions*) [3×10]

15. a) What do you mean by extracellular matrix(ECM)? Give an example of ECM. (2+1)
    b) Do you think that hydroxylation of amino acids in collagen is important? Justify. (2)
    c) What are lectins? Explain in brief the differences between a glycoprotein and a proteoglycan. (2+1)
    d) How does hemidesmosome differ from desmosome? (2)

16. a) Explain the structure of a microtubule. (2)
    b) What is MTOC? Give an example. (2)
    c) State two evidences in support of the endosymbiotic origin of mitochondria. (2)
    d) Write short notes on: Vesicular transport and fusion (4)

17. a) What do you mean by fidelity of replication? What is the fidelity of DNA polymerase III and how is it achieved? (2+3)
    b) What are bypass polymerases? Why are they often mutagenic? (3+2)

18. a) Justify the statement: (2×2)
        i) All animal cells carry safely a "suicidal bag" within
        ii) Golgi complex has an important role in cellular secretion
    b) Mitochondria and chloroplast are the organelles for ATP generation. What are the structural and functional similarities in both of these organelles? (3)
    c) What do you mean by N-linked and O-linked protein glycerylation ? Where do they happen inside the cell? (1+1+1)

19. a) Addition of DNA prepared from wild type cells for thymidine kinase(TK^+) to a culture of TK^- cells resulted in the formation of a few TK^+ colonies. How did the colonies form? (2)
    b) Telomeric DNA contains several tandem repeats. Explain the molecular basis of their origin. (3)
    c) How do the increased concentrations of ethidium bromide bring changes in the sedimentation velocity of supercoiled DNA in a cesium chloride gradient? (3)
    d) Show numerically the mechanism of conversion of twist of a cccDNA into write and vice versa. (2)

20. a) The two fatty acid tails attached to a typical membrane lipid are generally mixture of cis and trans types. Explain the reason. (2)
    b) Association and/ or integration of membrane proteins with lipid bilayer can be of various types – give examples. (4)
    c) Write a brief note on detergents and their uses in solubilising membrane proteins. (4)

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