WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2021-22

MCBADSE02T-Microbiology (DSE1/2)

Biomathematics and Biostatistics

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Question No. 1 is Compulsory and answer any *four* from the rest

1.   Answer any *four* questions from the following: 2×4 = 8

   (a) Define the terms in biostatistics — (i) variable, (ii) frequency.

   (b) What do you mean by second order reaction? Give one example of a first order reaction.

   (c) What are the common measures of central tendency?

   (d) What is pH? Give the mathematical expression of pH.

   (e) What is the significance of K_m?

   (f) What will be the value of V_o, if $[S] = 4K_M$?

   (g) Define half-life of a radioisotope.

2. (a) Define pseudo first order kinetics with suitable example.   2

   (b) Differentiate first order kinetics and pseudo first order kinetics by showing mathematical expression in each case.   3

   (c) Degradation of isocitrate by isocitrate lyase is a first order reaction with a rate constant of 0.045 / min at 300 K. If there is initially 0.04 moles of isocitrate, calculate the moles of isocitrate remaining after 5 minutes of reaction.   3

3. (a) Suppose, 1 ml of Enzyme A, having protein content of 2 mg/ml, converts 100 μmol of substrate into product in 5 minutes. 1 ml of Enzyme B, having protein content of 4 mg/ml, converts 100 μmol of substrate into product in 5 minutes. Compare and contrast between the total activity and specific activity of the enzyme samples.   2

   (b) The effect of an inhibitor on an enzyme was tested and the experiment gave the results below.   4

   Plot the data and determine, by inspection of the graph, what type of inhibition is involved? (No graph paper will be provided to the students)

[S] μM	V (μmol/min) with 0.0 nM Inhibitor	V (μmol/min) with 25 nM Inhibitor	V (μmol/min) with 50 nM Inhibitor
0.4	0.22	0.21	0.20
0.67	0.29	0.26	0.24
1.00	0.32	0.30	0.28
2.00	0.40	0.36	0.32

(c) Hexokinase catalyses the phosphorylation of glucose and fructose by ATP. K_M for glucose and fructose are 0.18 mM and 1.8 M respectively. For which substrate does hexokinase have greater affinity and why?   2

4. (a) A batch culture of *E. coli* has a cell density of 0.5×10^3 cells/ml. What will be the cell density of the culture after 1 hour and 40 minutes? (Given: generation time of *E. coli* = 20 minutes)   4

(b) How many moles of sodium acetate and acetic acid must you use to prepare 1 L of a 0.1 mol/L buffer with pH 5.0?   3

(c) Define median.   1

5. (a) 'Coupled reactions are thermodynamically favourable' — Justify the statement with suitable example.   2

(b) Calculate Pearson's correlation coefficient of the following data: 4

% marks in Biochemistry	80	81	83	89	86
% marks in Physiology	90	91	97	100	99

(c) Ca^{45} has a half-life of 163 days. Calculate (i) the decay constant in terms of day^{-1} and sec^{-1}. (ii) the % of initial radioactivity remains in a sample after 90 days.   2

6. (a) Write down the significance of t-test.   2

(b) The mean generation time of 15 wild type *E. coli* was 18.6 minutes (SD = 2.2), whereas the mean generation time of 12 mutant species was found to be 17.7 minutes. Is the mean generation time significantly higher in the wild types than the mutants? (Given $t_{0.05(25)} = 1.708$ for one-tail *t* score; SD = Standard Deviation)   4

(c) Write down the basic difference between Binomial distribution and Poisson distribution.   2

7. (a) What is Standard error of mean? Calculate the standard error of mean if sample size is 24 and σ is 3.   2

(b) Compute the Standard Deviation from the mean of the zone diameter of antibiotic resistance observed in the agar cup antibiotic assay of 60 different antibiotic plates: 4

Inhibition zone diameter (mm)	11.6-13.0	13.1-14.5	14.6-16.0	16.1-17.5	17.6-19.0
Frequency	7	13	20	14	6

(c) What is 'degrees of freedom'?   2

8. (a) Illustrate positive and negative co-relation graphically with example.   3

(b) What is Null hypothesis?   2

(c) How chi-square test becomes so popular in biological studies?   3

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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