RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SIXTH SEMESTER TAKE-HOME TEST / ASSIGNMENT, JULY 2020

THIRD YEAR [BATCH 2017-20]

Starting Date & Time : 05/07/2020 at 11 a.m. **MICROBIOLOGY (Honours)**

Closing Date & Time : 06/07/2020 at 11 a.m. **Paper : VII** Full Marks : 70

Group : A

Answer **any two** questions from question nos. 1 to 3: [2×10]

1. a) How can you correlate homologous recombination with repair of damaged DNA. Explain your answer with probable mechanism? [4]

   b) A *Neurospora* strain dependent for growth upon the addition of arginine to the medium (*arginine-less*) produces a new mutant colony which is arginine-independent. A cross is then made between a wild type strain and revertant strain.

   i) What would you expect if the new mutation is a true reversion ?

   ii) What results would you expect if the new mutation is a suppressor of *argininelessl* located on a different chromosome?

   iii) What result would you expect if the new mutation is a suppressor of argininelessl 20 recombination units away? [4]

   c) How can you provide evidences in support of gene conversion during homologous recombination? [2]

2. a) In the fluctuation test, Luria and Delbruck used bacterial mutation toward resistance to a virulent phage T1. What results would you have expected if they had used a temperate phage instead (e.g., lambda phage)? [2]

   b) How did McClintock prove that genes may be mobile instead of occupying a fixed site? [4]

   c) If ultraviolet irradiation causes mutations primarily through formation of thymine dimers along a single strand of DNA would you expect an increase or decrease in the frequency of A-A on the complementary strand? [2]

   d) Do you think MDR bacteria always arise by means of acquisition of transposons with antibiotic resistance genes? [2]

3. a) If the albino phenotype occurs in 1/10,000 individual in a population at equilibrium and albinism is caused by an autosomal recessive allele *a*, calculate the frequency of

   i) the recessive mutant allele

   ii) the normal dominant allele

   iii) heterozygotes in the population [3]

   b) You want to incorporate three nucleotides within a gene in three different places so that they will never creates any non-sense codons in *m* RNA . How will you proceed? [3]

c) How would you determine the nature of changes of nucleotides in DNA caused by a chemical under testing for its carcinogenicity? [4]

Answer **any one** question from question nos. 4 & 5: [1×5]

4. a) Design a genetic experiment to prove the existence of transposon in bacteria. [3]

   b) Are the mutations in a protooncogene or in a tumor suppressor gene equally harmful? Justify your answer. [2]

5. a) How can you prove genetically that early developmental events are programmed within mother's egg? [2]

   b) In a fluctuation test, out of twenty plates 13 plates showed no T1 resistant colonies. If the average number of bacterial cells $5.6 \times 10^{8,}$ what is the mutation rate? [3]

Answer **any one** question from question nos. 6 & 7: [1×10]

6. a) How virusoids differ from viroids?

   b) Write a short note on heterodimer and fibril model of prion propagation.

   c) Schematically present the molecular regulation of lytic and lysogenic cycle of Lambda phage infection.

   d) Hamilton's rule states that pro-social, altruistic behaviour will be selected for if **rb>c**, where **b** are the benefits to the recipient, **c** the costs to the donor, and **r** is the relatedness between them – explain with proper example.

   e) Given the fact that linearly related **b** and **c** should not violate Hamilton's rule, cite a hypothetical condition where this law can be infringed.

   f) "Key to the genetic advantage of reciprocal altruism is the ability to detect cheats"– Explain.

[1+2+2+2+1.5+1.5]

7. a) What is cytopathic effect?

   b) Schematically represent the genomic organization of Lambda phage and describe molecular functions of different proteins required for lysogenic to lytic switching.

   c) Zahavi's so-called Handicap Principle proposes that signals are honest because they are costly to produce.Theoretical studies have shown that signalling costs paid at the equilibrium are neither sufficient nor necessary to maintain signal honesty, and that honesty can evolve through differential benefits, as well as differential costs – Explain.

   d) There are several approaches to study the relationship between two persons A and B. Evolutionary psychologists focus on the genetic relation between A and B, and social psychologists study the social factors of human relationships. However, many anthropologists disagree strongly with the genetic claim. They argue while there is indeed a genetic basis to human social behavior, this does not mean that such behavior is genetically determined - Comment on this.

   e) Write a short note on speciation. What is coevolution? [1+2+2+2+ (2+1)]

Group : B

Answer **any two** question from question nos. 8 to 10: [2×10]

8. a) When cloning a foreign DNA fragment into a plasmid, it is often useful to insert the fragment at a site that interrupts a selectable marker (such as the tetracycline-resistance gene of pBR^{322}). The loss of function of the interrupted gene can be used to identify clones containing recombinant plasmids with foreign DNA. With a bacteriophage vector it is not necessary to do this, yet one can easily distinguish vectors that incorporate large foreign DNA fragments from those that do not. How are these recombinant vectors identified? [4]

   b) In which way nonradioactive methods are useful for detecting a particular nucleic acid fragment from gene library? [2.5]

   c) Explain the purpose of adding SDS to protein samples for polyacrylamide gel electrophoresis. [1.5]

   d) 'A good host should lack RM system'—True or false—Justify. [2]

9. a) Suppose the restriction endonuclease HindIII cuts a 6.0 kb linear piece of DNA into two fragments; an 800 bp fragment and a 5200 bp fragment. NarI cuts the DNA also into two fragments; fragments 1200 and 4800 bp long. Relative to the HindIII cut site, there are two possible ways in which NarI could have cut the DNA. How can you determine the correct cleavage site for NarI with respect to HindIII? [2.5]

   b) Theoretically, gene expression is controlled by promoter. But when transgenes are expressed in unrelated or distantly related organisms, their coding sequences may markedly affect the level of their expression. Explain this fact. [2.5]

   c) Which DNA hybridization assay format is most useful when one wishes to: (i) detect the presence of a pathogen's DNA in an aqueous clinical sample; (ii) detect the presence and location of a gene segment in a restriction digest of genomic DNA; and (iii) detect the presence and localization of a pathogen's DNA within a cell? [3]

   d) Explain how the "sticky ends" that result from the action of restriction enzymes can be useful? [2]

10. a) A successful PCR experiment often depends on designing the correct primers. In particular, the Tm for each primer should be approximately the same. What is the basis of this requirement? [2]

   b) In the more common protocol for immunofluorescence detection of cellular proteins, an investigator uses two antibodies. The first binds specifically to the protein of interest. The second is labeled with fluorochromes for easy visualization, and it binds to the first antibody. In principle, one could simply label the first antibody and skip one step. Why use two successive antibodies? [2]

   c) How triparental mating does useful to make co-integrate vector from T_i plasmid? [2]

   d) A cell contains lots of RNA called RNA pool. You have been asked to isolate a specific mRNA from that RNA pool. Which specific procedure you supposed to use? Explain your answer. [2]

e) Comments on role of template independent DNA polymerase in the field of RDT. [2]

Answer **any one** question from question nos. 11 & 12: [1×7.5]

11. a) A 21 year old man in rural West Bengal develops effortless vomiting and profuse (8L/day) diarrhea 24 years after eating undercooked shellfish. He has no symptoms other than diarrhea and vomiting along with the manifestations of fluid and electrolyte loss caused by diarrhoea.
i) Name the most probable causal organism.
ii) Write a note on the pathogenesis of the disease with a special reference to its toxin. [1+3]

b) 66 year old person has a 5-month history of progressive weakness and a weight loss of 13 kg along with intermittent fever, chills and a chronic cough productive of yellow sputum, occasionally streaked with blood. Study of the sputum specimen showed acid-fast bacteria.
i) What is the mode of transmission of the pathogen?
ii) Which treatment regimen would you propose? [1+2.5]

12. a) Write down the differences between lepromatous and tuberculoid leprosy.
b) Amantadine can inhibit influenza A but not influenza B virus-Why.
c) What is the mode of action of azole drugs? [3+2.5+2]

Answer **any one** question from question nos. 13 &14: [1×7.5]

13. a) Two atopic twin brothers living in a farm are stung by a bee each. One develops hypersensitivity while the other does not. Explain what can be the cause logically. [4]

b) What is "Molecular Mimicry" in context to autoimmunity? [1.5]
c) Poison ivy rubbed on forearm develops localized inflammation after two days. Explain the cause. [2]

14. a) Complement system is not effective against protozoa. Why? [3]

b) A patient with idiopathic thrombocytopenic purpura (ITP) is often treated with a immunoglobulin injection. What is it? [2]

c) Can a big protein molecule made up of D-Amino acids be a good immunogen? [2.5]

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