Reg. No.										

MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH. EXAMINATIONS – FEBRUARY-MARCH 2022

SUBJECT : BIO 1051/BIO_1051: BIOLOGY FOR ENGINEERS (DTQ)

Friday, February 25, 2022

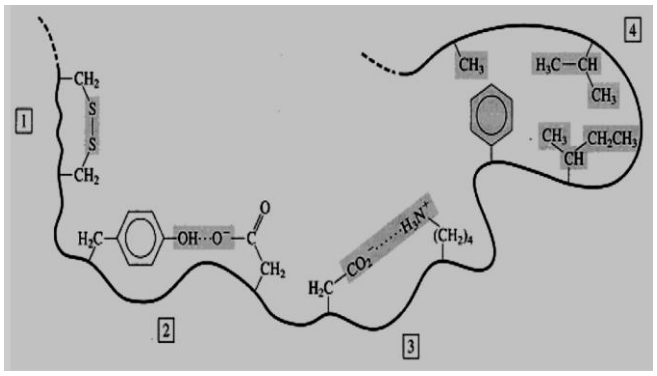
Time: 03:30 – 05:10 Hrs. Maximum Marks: 40

PART – B

1A. Consider the following reaction from glycolysis,
Fructose 6- phosphate + ATP → fructose 1, 6-bisphosphate + ADP
Calculate the equilibrium constant for the formation of fructose 1, 6-bisphosphate and ADP
Given the data below,
ATP → ADP + Pi $\Delta G'_o$ = - 30.5 KJ/mol
Fructose 1,6- bisphosphate → Fructose 6- phosphate + Pi $\Delta G'_o$ = - 16.0 KJ/mol
R = 8.314 J/mol.; T = 25^0 C

1B. How is it that we can ingest or inhale acidic or basic substances and not die? What is the regulatory system involved in keeping the pH of the blood maintained? What are the key elements involved in it?

1C.



Observe the figure alongside and answer the following questions:

a) Label the interactions mentioned in the figure 1, 2, 3 and 4.
b) If hydrophobic amino acids in the part 4 of the protein are modified to serine, would the protein folding be affected?
c) If the protein is heated, which bond will break first amongst the bonds mentioned in the figure? Why?

(3+3+4 = 10 marks)

2A. In a plant, purple flower color (P) is dominant over Yellow (p). This trait is controlled by gene (factor) that assorts independently. A homozygous purple flowered plant is crossed with a homozygous yellow flowered plant.

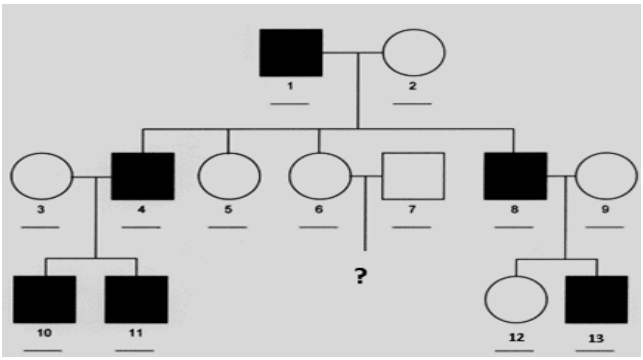
a) Draw a Punnett square for the above mentioned cross and also show the F2 generation.
b) Give the genotype of the parents and F1.
c) Give the genotype and the phenotype in a test cross for the same trait.

2B. In rabbits, coat color is a genetically determined characteristic. Some black females always produce black progeny, whereas in other case black females produce black progeny and white progeny.

a) Explain how these outcomes occur with all possible crosses.

b) Based on the data, is it possible to confirm whether the inheritance is X-linked or not?

2C. A pedigree chart is shown for a family showing the inheritance of brown hair trait, from parental to the second generation.



a) Determine the most likely mode of inheritance. Explain your reasoning.

b) Determine the genotype of individuals 1, 4, 5 and 12.

c) What percentage of children will be affected males for the couple 6 and 7?

(3+3+4 = 10 marks)

3A. Assume a fragment of DNA measuring 1.65 x 10^8 bp. Replication at a single replication fork occurs at the rate of 30 bp/sec in the leading strand and 30 bp/sec in the lagging strand. There are 2000 origin of replications. Now calculate the minimum time in seconds required to replicate the entire fragment.

3B. Imagine if there were 200 commonly occurring amino acids instead of 20. Given what you know about the genetic code, what would be the shortest possible codon length? Explain.

3C. Consider the dsDNA sequence given below, which encodes for a short stretch of protein. The shaded region is the promoter. Answer the following questions.

a) What is the sequence of processed mRNA, using this stretch of DNA?

b) Write the resulting sequence of amino acids and comment on the nature of the amino acids encoded by the resulting mRNA.

DNA sequence:

$^{5'}$AGACTGCTCATGCCGTTAGACCGTAAGCGGACCTGAC$^{3'}$

$^{3'}$TCTGACGAGTACGGCAATCTGGCATTCGCCTGGACTG$^{5'}$

(3+3+4 = 10 marks)

4A. Define the following terminologies and give an example for each.
Parasitism, Commensalism, Mutualism and Coevolution.

4B. Imagine that you are carrying out a Miller experiment, under the guidance of a Biology instructor.

a) In the course of your experiment, the instructor borrowed a vacuum pump from the physics department, to help your project. Why was this instrument required?

b) At the end of the experiment, what result do you expect to obtain: Proteins, Amino acids or Life forms? Explain why?

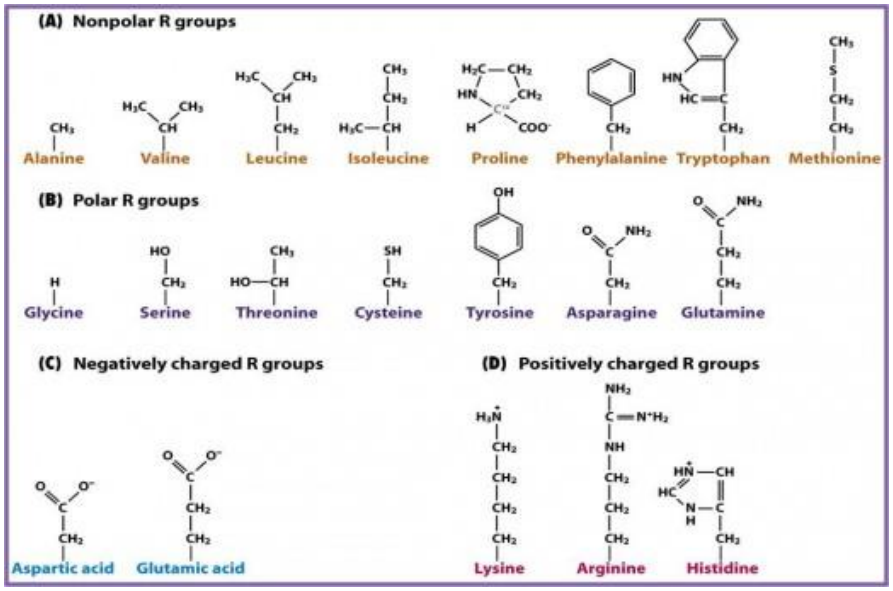
4C. Sickle cell anaemia is an inherited blood disorder marked by defective haemoglobin. Relate Sickle cell anaemia to evolution including many causes of variation, including radiation. Suggest how this could cause variation in human?

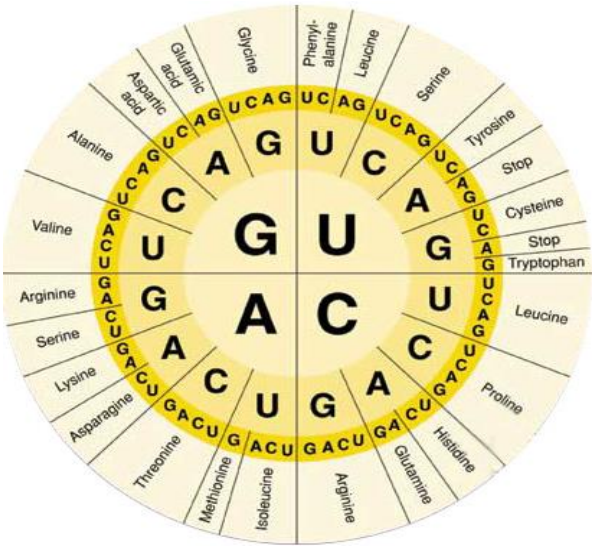
4D. A virus that contains only RNA as its genetic material is discovered and on infecting the host cells with this virus, it was found that the host cell makes lots of viral RNA molecules and various viral proteins. Upon further examination, you discover that the host genome now encodes viral proteins. On the basis of this information, answer the following questions:

a) Does the virus require any help from the host cell in its life cycle for replication? How?

b) There are several enzymes that help in the flow of information for the virus. Which of these enzymes are absent in the human host?

c) Vaccines for few viral diseases such as small pox/polio are still effective even after several years. However, certain diseases like Covid/Swine Flue requires the production of new vaccines after certain time. Why does this happen? Explain.





(2+3+2+3 = 10 marks)