Question Paper

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER B.TECH END SEMESTER EXAMINATIONS, MARCH 2021

BIOLOGY FOR ENGINEERS [BIO 1051 - 2020 -CHM]

Marks: 50   **Duration: 180 mins.**
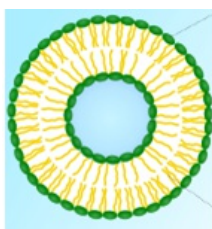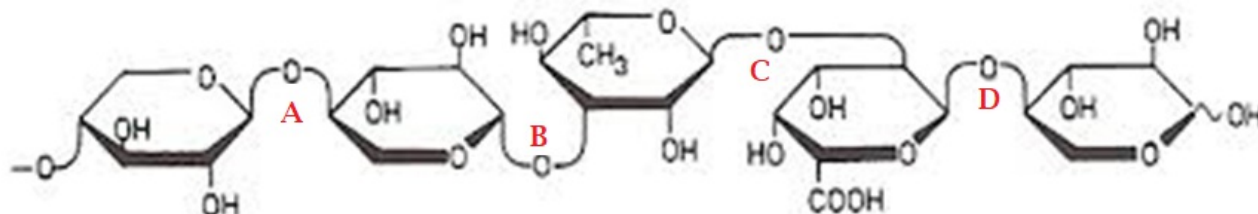
A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1)
A) Calculate the free energy of a reaction A → B; where K_{eq} = 10; concentration in the cell of A = 0.2 M; B = 0.05 M; (3)
R = 8.315 J/mol.K ; T = 298 K.

B) Given picture is a Cationic liposome that are made of positively charged lipids and are increasingly being researched for use in gene therapy. (3)
i) After adding liposomes to DNA, what kind of interaction and result can be expected?
ii) What is liposome made up of?
iii) Based on the arrangement of the molecule in the given picture can you depict in which environment (hydrophobic/hydrophilic) they have formed this micelle
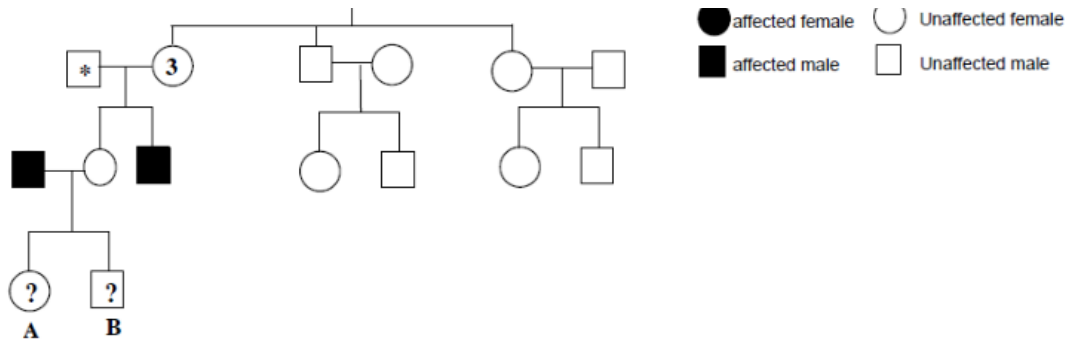

C) (4)

Above molecule is a structure of hemicellulose found in plants, unlike cellulose hemicellulose is not homogenous, it is made up of different sugar molecules. Identify the type of linkage labelled (A B C D) between the sugar molecules.

2)
A) A pea plant with Axial flowers is dominant over terminal flower and yellow seeds are dominant over green seeds. Double homozygous dominant is crossed with a recessive. On the basis of this cross answer the following questions: (3)

1. Represent the Parental generation and show the cross.

2. With the help of a Punnett square show the F2 generation (F1 selfing) and write the phenotypic ratio.

3. Draw the results of a test cross for the F1 generation. Write the genotypic ratio.

B) You are studying two traits using a mouse model. The mutant mice are small and lethargic whereas the normal mice are large and active. You cross a (3)
true breeding large and lethargic mouse with true breeding small and active mouse. All of the resulting F1 mice are small and lethargic.

1. What are the genotypes of the true breeding parental mice? Use the nomenclature outlined below. *For the size (i.e. large or small) use D or d to designate the alleles. For the activity (i.e. active or lethargic) use G or g to designate the alleles.*

2. You find that the two genes are linked. If the map distance between the two genes is 20 cM, out of a total of 400 offspring, how many will show the nonrecombinant/parental phenotypes?

C) You are analysing the following human pedigree. Assume that the individual marked with an asterisk (*) does not carry any allele associated with the (4)
affected phenotype and that no other mutation spontaneously occurs.

a. What is the most likely mode of inheritance of this disease?

b. List all possible genotypes of the following individuals in the pedigree # 1 and # 2

c. What is the probability of Individual A being affected? Give reasoning

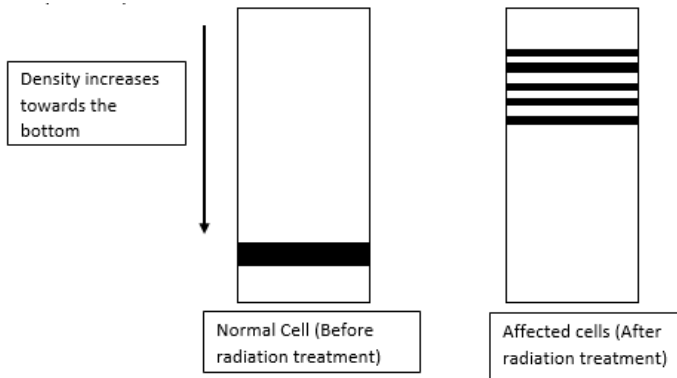d. What is the probability of Individual B being affected? Give reasoning.

affected female   Unaffected female

affected male   Unaffected male

? A   ? B

3)

A) A bacteria was under study to test the effects of radiation on replication process. Due to long duration of exposure to radiation, the cell division process was affected. On analysis on a density gradient, the bands obtained are depicted in the figure alongside. Interpret the results and give reasons for the observed results. (3)

Density increases towards the bottom

Normal Cell (Before radiation treatment)

Affected cells (After radiation treatment)

B) Given below is a mature mRNA sequence which is able to produce a protein (3)

7mGCGCAUGGGGCGGUCAGCAGUCAGCCGAGUCGCGUGAAAAAA

(a)Copy the mRNA sequence into your answer sheet label the 5' and 3' ends and mark the start codon and stop codon.

(b) Predict the protein sequence from this mRNA.

(c)Label the N terminal and C terminal ends of the protein.

C) Assume you are performing one round of DNA replication in a test tube using single stranded linear DNA as the template and the appropriate DNA primer. Complete the following table for <u>one round</u> of DNA replication. (4)

Protein/Enzyme	Requirement for **one round** of replication either YES or NO. Justify
DNA Polymerase	
DNA Helicase	
Topoisomerase	
DNA Ligase	

4) Fill the table with appropriate community interaction and write an example for each. (3)

A)

	0	+	-
0			
+			
-			

B) Imagine that you are carrying out a Miller experiment, under the guidance of a Biology instructor. (3)

1. In the course of your experiment, the instructor borrowed a vacuum pump, to help your project. Why this instrument is required?

2. At the end of the experiment, what result do you expect to obtain? Explain why?

C) i)Determine the bioinspiration that can be drawn from the following: (4)

(a)Spider web (b) Sun flower

ii)"Evolution as a tool for the life systems to improve the existing form of life" justify?
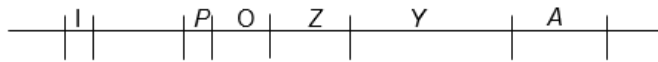
5)

A) The phloem tissue is involved in the transport of nutrients while xylem is involved in water transport. What is the benefit for the phloem vessel to be made of living cells while the xylem to have of dead cells? (3)

B) HIV is a retrovirus. It uses the reverse transcriptase to synthesize DNA and the DNA is then integrated into human chromosome. This enables the viral (3)

B) HIV is a retrovirus. It uses the reverse transcriptase to synthesize DNA and the DNA is then integrated into human chromosome. This enables the viral (5) DNA to replicate by using the host machinery. HIV is interesting to scientists because of high mutation rates. Because of high mutation rates, many of the times we can't target them by using a drug. But, DNA replication has excellent repairing mechanisms. Then how the HIV gets mutated? Explain a process in its life cycle that is more susceptible for mutations.

C) (4)

1. Which of the DNA regions represented above will encode for proteins?

2. Whether the *lac* repressor be bound to operator in bacteria cell that is growing in low glucose and high lactose?

3. A bacteria has got mutant lac repressor that cannot bind to the operator region. Then what will be the fate of operon

4. The region P of lac-operon is mutated will the cell will survive in presence of only lactose

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