Exam Date & Time: 15-Feb-2019 (12:00 PM - 01:00 PM)

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

BIOLOGY FOR ENGINEERS [BIO 1051 - CHM]

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Marks: 15 **Duration: 60 mins.**

PART - A

Answer all the questions. Section Duration: 20 mins

1) Ankita prepared four logical statements regarding the test cross, a way to find the unknown genotype.

a. It tests whether an unknown individual is homozygous or heterozygous.
b. The test individual is crossed with a homozygous recessive individual.
c. If the test individual is heterozygous, the progeny will have a 1:1 ratio.
d. If the test individual is homozygous, the progeny will have a 3:1 ratio. (1)
e. Test cross results are consistent with Mendel's model of inheritance for unlinked genes.

What are the correct statements regarding test cross prepared by Ankita?

1) All are true 2) a,b,c and e 3) b,c,d and e 4) a,b,c, and d

2) Companies such as Amazon are looking for new ways to handle items in their warehouses that have a wide variety of shapes and sizes, so a flexible, versatile gripper that self-modifies to handle the variety of objects is of great interest.
Which of the following mechanism is the best option for them to engineer with?

1)	They should copy the gecko foot structure and the body of such robots can be painted with amino acids, so that the peptide bond formed will provide a strong grip	2) They must use gecko like mechanisms, because the gum secreted by gecko facilitates uniform interaction through van der walls forces	3) They must use the suction cup mechanism of gecko's foot that facilitates van der walls interactions and even distribution of sticky secretions. Thus the design will utilize simultaneous interaction of van der walls forces	4) They should work on an analogue to the gecko's setal stalks and spatulae, which also present a small contact area when unloaded, but flatten out for a much larger contact area when pulled in the preferred direction

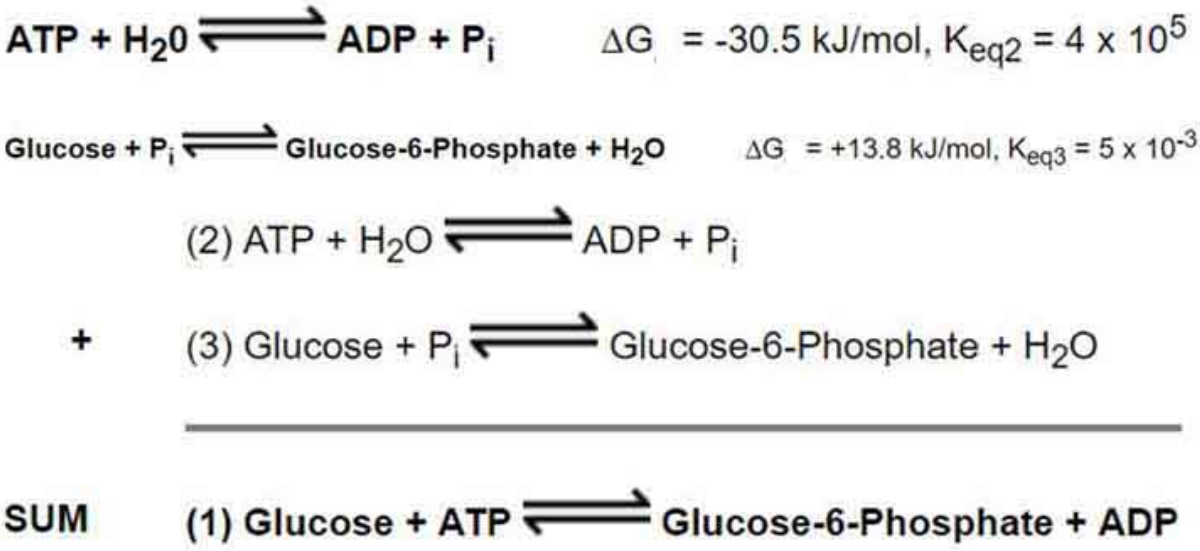
(1)

3) Sushmitha heated a protein sample in a boiling water bath. Which of the following least likely to be changed?
1. Primary structure
2. Secondary structure
3. Tertiary structure
4. Quaternary structure

(1)

1)	Only the primary structure	2) All structures except quaternary	3) Secondary, Tertiary and Quaternary	4) Only the secondary structure as it depends on H bonds

4) Evaluate the following reactions and choose the most correct statement (1)
(Pi = Inorganic phosphate)



1) The reactions illustrated here are wrong as we can't couple these reactions. Reason being the first one is Delta G negative and other is Delta G positive

2) In a coupled reaction, energy required by one process is supplied by another process. Here glucose + phosphate becomes glucose.6.phosphate. This is an endergonic reaction and the energy is supplied to this reaction by another exergonic reaction i.e. ATP which can become ADP+energy

3) These reactions can't be coupled as the Keq for each of this reaction is different

4) In a coupled reaction energy required by one process is supplied by another process.Here glucose + phosphate becomes glucose.6.phosphate. The illustrated reactions can be coupled, however the sum of the reaction mentioned is wrong

5) Which of the following statements are relevant and correct with regard to factors based on the outcome of the Mendel, Morgan and recombination experiments?

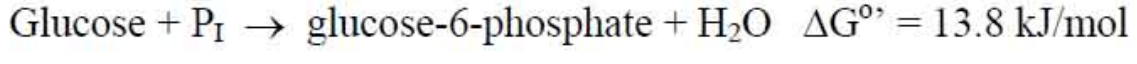
1. When factors are found on different chromosomes they assort independently and are said to be unlinked.
2. When factors are close together on the same chromosome, they are said to be linked. That means the alleles, or factor versions, already together on one chromosome will be inherited as a unit more frequently than not. (1)
3. We can see if two factors are linked or how close to each other, by using data from crosses to calculate the recombination frequency.
4. By finding recombination frequencies for many factor pairs, we can make a map that show the order and relative distances of the factors on the chromosome.

1) Statements 1,2 and 3
2) Statements 2,3 and 4
3) Statements 1, 2 and 4
4) All the statements are true

PART - B

Answer all the questions.

1) Engineers have created an artificial cell which uses the following reaction for glucose metabolism.

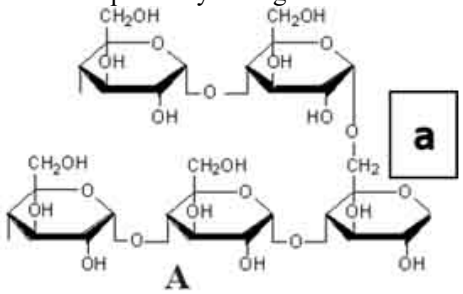


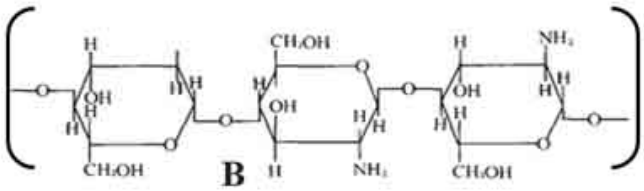
(a) Calculate the equilibrium constant for the above reaction. Assume temperature is at $25^{O}C$ Value of K = 0.008314 kJ mol^{-1} K^{-1} (0.5 Mark) (2)
(b) Using the above equilibrium constant, Ms Priya wanted to maintain the concentration of glucose and Pi as 4.8 mM. What will be the concentration of glucose 6 phosphate ? (1 mark)
(c) Analyze the concentration obtained for glucose 6 phosphate. According to you, whether the above concentration represents a reasonable route for energy production? Justify (0.5 Mark)

2) In Drosophila, two autosomal genes (factors) have alleles as follows: Gray body color (G) is dominant over black (g); Full wings (A) is dominant over vestigial (a). Following cross was performed, and results are shown below (2)
True breeding Parents: gray, full wings ✕ black, vestigial

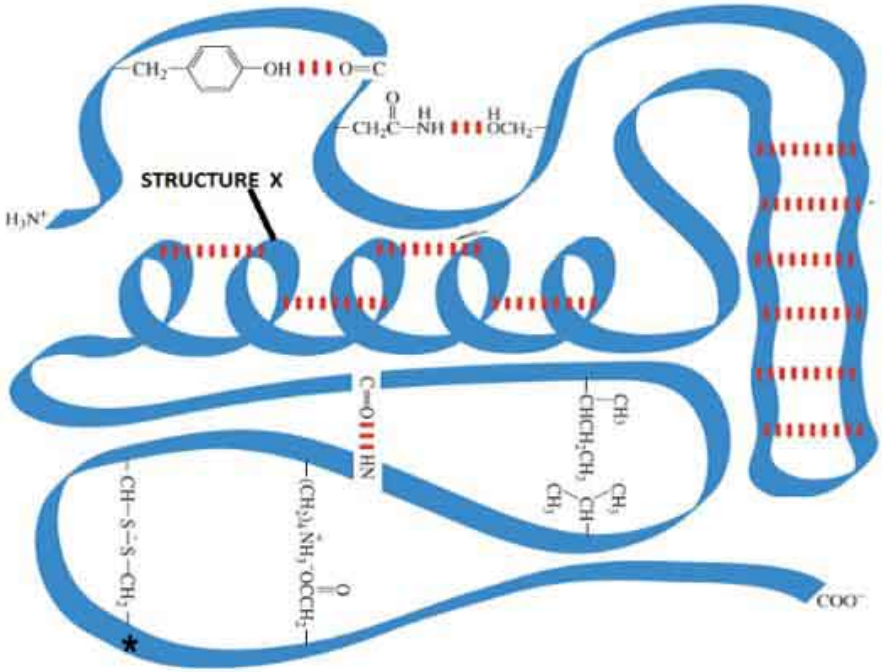
Offspring F2: 2700 gray, full wings; 902 gray, vestigial; 899 black, full wings; 302 black, vestigial
(a) Whether these factors are located on same chromosome or different chromosome? Justify (1 Mark)
(b) Construct a punnett square explaining the cross in F2 (2 Mark)
(c) What is the genotype and phenotype of F1 in this cross? (1 Mark)

3) (A) A group of students were working with two compounds A and B respectively for their experimental purpose which are depicted by the figure below (2)

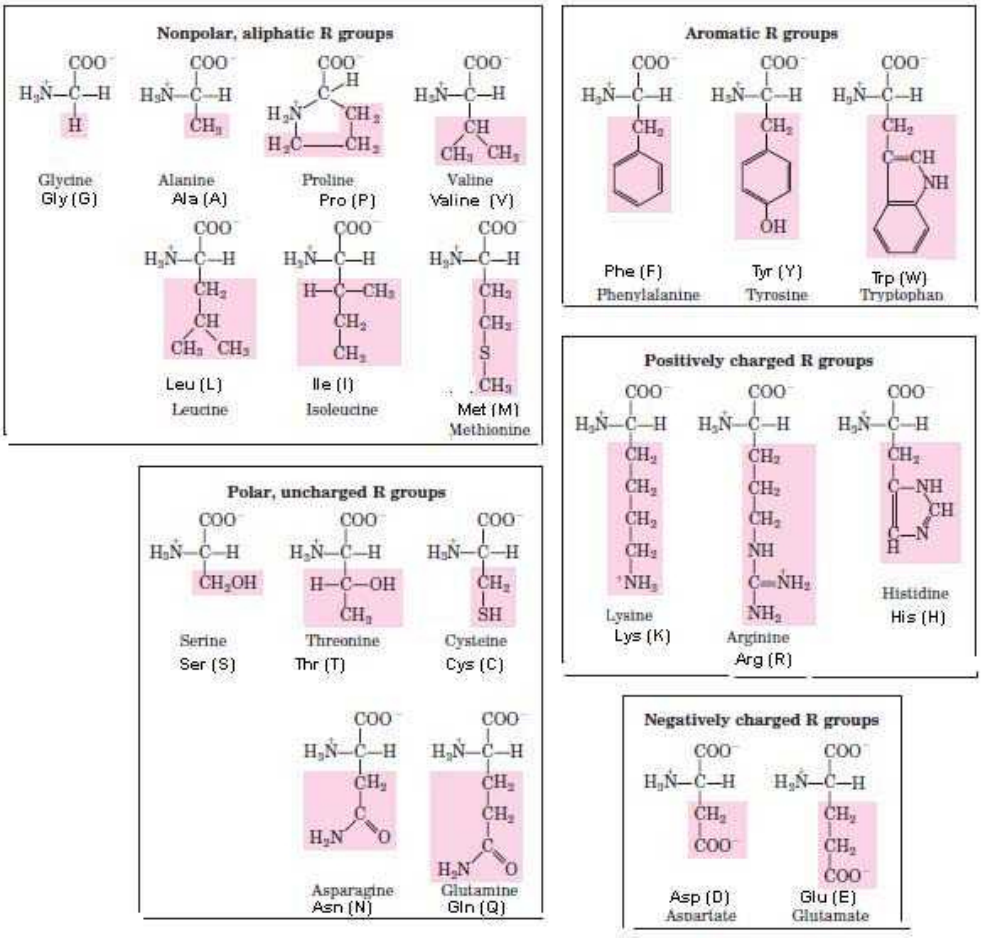




(a) What is the linkage depicted by the boxed 'a' in the figure? (0.5 Marks)
(b) Will an enzyme hydrolysing compound A be able to work on compound B? Give reasons. (0.5 Marks)
(B) Analyse the following protein structure and answer the questions



(i) What is the type of structure labelled as 'X'? (0.5 Marks)
(ii) If we change the amino acid present at the position * indicated in the figure with isoleucine, what will happen to the protein structure and function? (0.5 Marks)

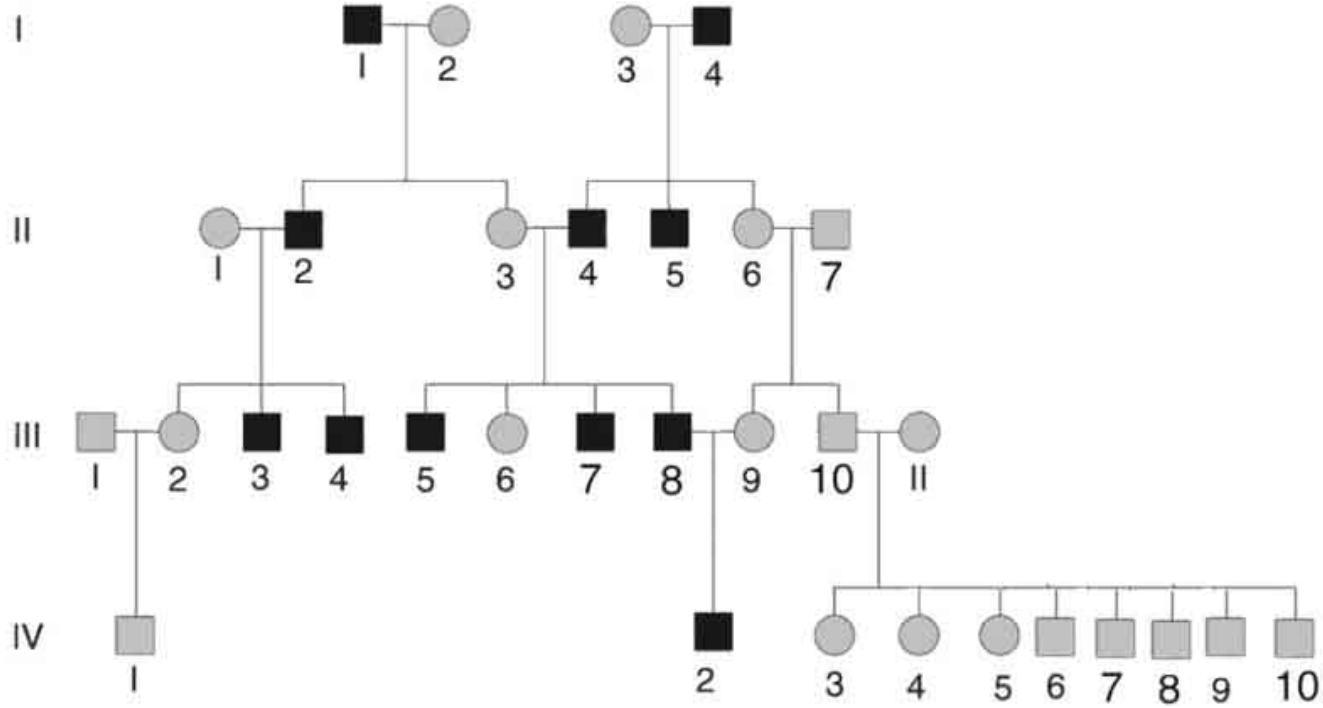


4) In a fly red body phenotype is dominant to the yellow body phenotype and smooth wings are dominant to crinkled wings. Use the symbol B and W for dominant factors and b and w for recessive factors. Both factors are not sex linked.

a) What will be the phenotype(s) of F1 progeny if you cross a true-breeding yellow-bodied,smooth-winged female with a true-breeding red-bodied, crinkle-winged male? (0.5 Marks)
b) You crossed several pairs of F1 siblings.
(i) What is the expected ratio of phenotypes in the offspring in the following order? (0.5 Marks)
Red smooth: red crinkled: yellow smooth: yellow crinkled
(ii) The actual data is as shown below. Is this data is same as per you expectation?Justify your reasoning. (1 Mark) (2)

body	wing surface	Number
red	smooth	310
yellow	smooth	142
red	crinkled	131
yellow	crinkled	23

5) A family was found to have a special hair phenotype called "curly spiral". The pedigree chart of the family is given below. (2)
Use the symbol "Q" for dominant factor and 'q' for the recessive factor.



(a)What is the reason that all males are not exhibiting the curly sprial phenotype in this family ? (0.5 Marks)
(b) What is the most probable mode of inheritance? (0.5 mark)
(c) How will you represent the genotype of individual IV 2? (0.5 Marks)
(d) Individual IV-1 marries IV-3. What is the probability of their son exhibiting the "curly sprial" phenotype? (0.5 Marks)

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