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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: BIOLOGY FOR ENGINEERS [BIO 1001]

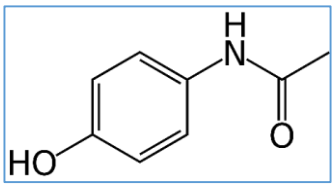
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

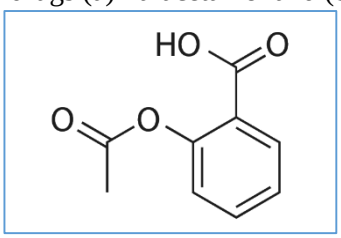
Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. We have the structure of two drugs (a) Paracetamol and (b) Aspirin **3**



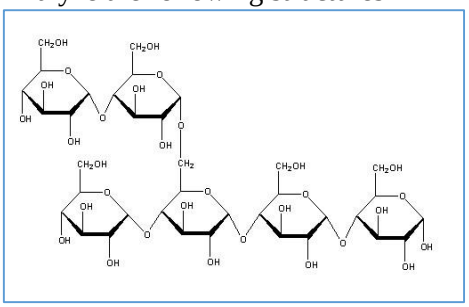
Paracetamol



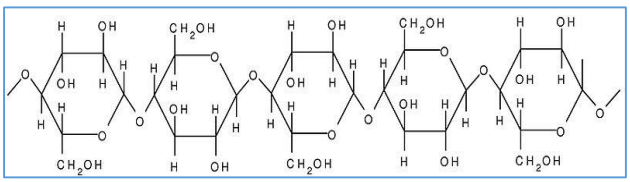
Aspirin

(a) Whether these drugs are soluble in water? Explain.
(b) Copy the structure into your answer sheet and label the hydrophilic and hydrophobic part.
(c) Whether these drugs are lipophilic? Explain.
(d) Whether these drugs can make ionic bonds, under suitable pH conditions? Explain.

1B. Analyze the following structures **3**



(A)



(B)

(a) Identify the major group of these biomolecules? Give a proper justification for your reasoning
(b) Are the linkages in the compounds (A) and (B) same or different? Explain
(c) Which compound is more stable? Why?

1C. Why is it debated that silicon based life forms are also possible, when compared with carbon based life forms? Which properties does silicon exhibit that are comparable to carbon? **2**

1D. The following reaction occurs during glycolysis in a cell. **2**

Fructose-6-phosphate ↔ glucose-6-phosphate K'eq = 1.97

a) Calculate ΔG_o' for the reaction at 25^0C.
b) Are ΔG_o' and ΔG are different or same? Justify.

Note: R= 8.314 kJ/mol. K, T= 298 K

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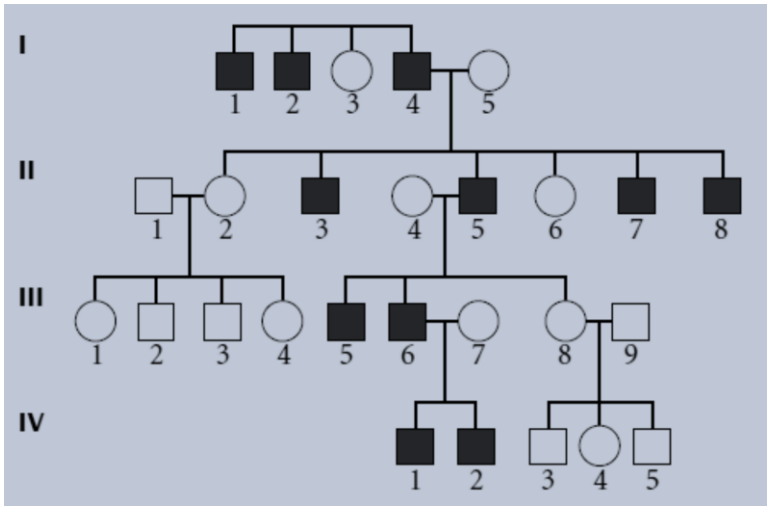
2A. Black and white coloration in cows is dominant to brown and white. Black and white cows were crossed over several years and the following progeny were produced: 8 black and white and 3 brown and white. What is the most probable genotype of each parent? What is the expected genotypic and phenotypic ratio expected for the progeny in the previous question? **2**

2B. A student group were fascinated by the two characters found in apple size (bigger vs. smaller) and its softness (Hard Vs. Soft). Assume that the inheritance of these characters are following a typical Mendelian fashion **2**

a) How can they conduct an experiment to determine which is dominant and which is recessive trait in each case?

b) From the results of F2 generation of the dihybrid cross, is it possible to find whether the genes for these characters are located in same chromosome or different chromosomes? Explain how?

2C. Analyze the following inheritance pattern represented in the form of a pedigree chart of the inheritance of a character coded as 'E'. **3**



(a)What is the probability of Individual IV-3 having a male child showing the 'E' character? Justify.

(b) What will the most likely pattern of inheritance? Justify

(c) Why Individual III-2 and III-3 are not expressing the E character, while III-5 and III-6 are expressing?

(d) Individual IV-3 is aged 27 and IV-5 is aged 28. Neethu is confused whether she should marry IV-3 or IV-5? But she is afraid of the inheritance of E character. Is there any justification for her worry? Help her in choosing between 3 or 5.

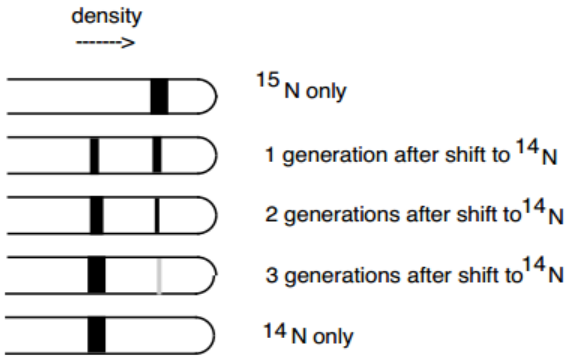
2D. John is an enthusiastic engineering student. He went to visit an industry in Mumbai. He found a particular plant growing in that industry area which is having the ability to purify the air in addition to aesthetics value. On observing the structure of the tree, he saw the following structural aspects contribute to the property of the plant to purify air: lot of broad leaves with many microscopic hairs (wooly leaves) on it. Also, the leaves have a brick red scent flowers. **3**

(a) Has his observation reached genotypic or phenotypic level? Why?

(b) How the broad leaf and microscopic hairs helps the plant to purify the air in the industrial area? Explain.

(c) Suggest a design for a bio inspired device using the property of the tree to purify air using its broad and wooly leaves.

3A.



A group of scientists replicated the method used by Meselson and Stahl experiment to determine the mode of replication of a certain bacterium species. The course of change in medium was as follows: **2**

(1) a heavy density label, [^{15}N] NH_4Cl (Many generations) followed by

(2) Normal density [^{14}N] NH_4Cl.

Results after DNA extraction in CsCl is depicted in the figure alongside. What is the mode of replication according to the results? Explain with reasons.

3B. Avery Experiment and Hershey & Chase experiment proved that DNA is the hereditary genetic material. If RNA or protein were the universal genetic material , how would it have affected the: **2**

a) Avery experiment and

b) Hershey and Chase experiment.

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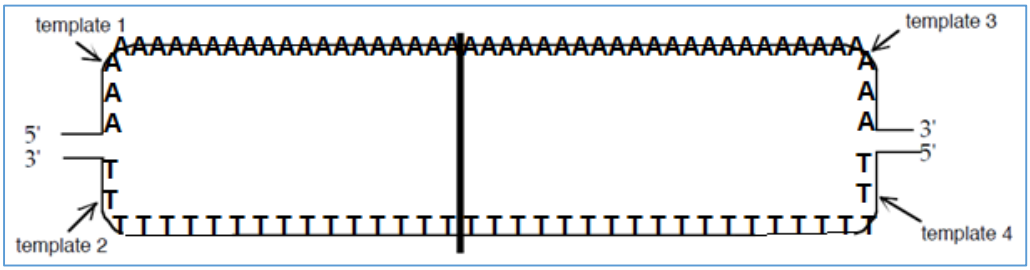
3C. Given below is an illustration of a DNA region undergoing replication process, the middle bar represents the origin of replication. **3**



(a) Draw this figure in the answer script and label the direction in which the process moves ahead.
(b) Label the 5' and 3' ends of the products, in the diagram.
(c) In a hypothetical experiment, if the newly synthesized discontinuous strands generated from DNA replication process are not converted to long strands, which enzyme might be malfunctioning in the replication process?

3D. We have a protein sequence of Met-Arg-Ser-Leu-Glu. Which mRNA will likely to synthesize this protein? **2**

A. 3'AUGCGUAGCUUGGAGUGA-5'
B. 3'-AGUGAGGUUCGAUGCGUA-5'
C.5'-AUGCGUAGCUUGGAGUGG-3'
D.1'-AUGCGUAGCUUGGAGUGA-3'
E.3'-AUGCGUAGCUUGGAGUGA-1'

3E. We have a non-functional mRNA, which is given below. Engineer this mRNA to make it functional by adding or deleting a nucleotide, without changing the amino acid sequence. **1**

5'AUGGUAAUGGUAAUGGUAAUGG3'

4A. Biological systems are designed as modular units and such a design contributes to the unique function of them. Now answer the following: **2**

(i) "DNA is a modular unit on which evolution acts". How it is logically possible?

(ii) Construct a fully functional biological unit using the following modules: Cell level process, Metabolic pathway, Protein fold, RNA sequence, Protein sequence, Protein Domain, Protein interaction, DNA sequence, Regulated metabolism.

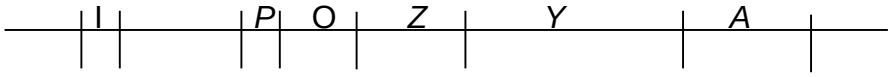
4B. Living systems interacts with each other. Can you find the following relationships in living systems? Explain **3**
(a) +/+ (b) +/- (c) +/0

4C. Logically answer the following **3**

(a) A duck can swim in water, but its feathers do not become wet.
(b) How the design of bullet train was upgraded by using bioinspiration?
(c) What will happen if Miller experiment is conducted on Moon's atmospheric conditions?

4D.  What adaptations does the shore-bird (depicted in the figure) have for its feeding habits? **2**

5A. (*I* = *lac* repressor gene; *Z*, *Y*, *A* = *lac* operon structural genes; *P* = *lac* promoter; *O* = *lac* operator) **3**



Give above is an illustration of lac operon in an *E. coli* culture.

(a) If the media contains glucose and fructose, but no lactose, whether the operon will be working or not? Why?

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(b) If the region P is amplified (i.e. multiple P genes), in what way will it affect the expression of lac operon (in the presence of only lactose as nutrient source)?

(c) What will happen if we remove the region P?

5B. a) The flu vaccine has to be administered frequently and the vaccines have to be designed newly keeping in consideration the genetic composition of new viral strains. Why do the flu vaccines change so frequently? **3**

b) Vaccines have helped in eradication of deadly diseases like small pox. How does vaccination work in protecting human beings against these diseases?

5C. a) Xylem is a dead tissue, while phloem is a living tissue. Why has the plant adapted with a dead tissue to transport water? **2**

b) A student pours some coconut oil to the base of a potted plant. Whether it rises up in the xylem? Explain your answer

5D. a) For cloning experiments, plasmid vectors are used with genes that act as markers for selection. In the course of these experiment, if the antibiotic resistance gene is lost from the vector, how will it affect the cloning experiment? **2**

b) In a cross between two heterozygous parent (Ss and Ss), carrying the sickle cell trait, what will be the probability of a child with sickle cell disease expressed only at low oxygen condition?

PERIODIC TABLE OF THE ELEMENTS

1 H 1.0079																	2 He 4.0026
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.011	7 N 14.007	8 O 16.00	9 F 19.00	10 Ne 20.179
11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.938	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 *La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.02	89 †Ac 227.03	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 § (277)	§Not yet named