BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI - Second Semester 2017-18

BIO F111 – General Biology - Mid-Sem Test (*Closed Book*); Date: 09/03/2018; Duration: 90 min; Max Marks: 50 (25%)

Instructions: **1.** Write correct tut section no. & tut instructor's name. **2.** The Q paper carries 3 sections. Do not jumble the answers of one section with another. Jumbled answers may not be evaluated. **3.** Answer to the point and underline the important words. **4.** In questions requiring justification, marks would be awarded *only if* you give proper justification.

Okay, friends, let's start. Mentally repeat, "I believe in myself", and get going. Bon Voyage!

-Section A- 17 Marks

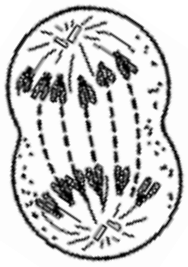
A1. (i) *Life's diversity is huge, and this prevents our world from becoming monotonous!* But many features are common too, including certain metabolic pathways. Now the question is: Out of Alcoholic fermentation, Krebs cycle, and Glycolysis, which process is common to all living cells? Justify your answer briefly. [2]
(ii) In Bollywood films of 1970s and 80s, we often saw that the hero (usually an honest police officer) chased the villain, but as soon as the villain was about to be caught, *he consumed cyanide and collapsed on the spot.* As an enthusiastic student of biology (*Yes, you read it right!*), comment briefly on the specific biochemistry involved. [2]

A2. Your friend argues that glucose is the only source of energy for cells. However, as an enthusiastic student of biology (*again!*), you tell her that other types of biomolecules can also be used for the purpose. To convince her, you draw a flowchart showing the metabolic interconnections. Represent a simplified but specific flowchart in your answer copy. [3]

A3. (i) You are on a sea expedition. (*Captain Couragious!*) You encounter a unique animal there (*Wow!*), collect its cell samples and observe them under a microscope. Now tell us the number of chromosomes present if you see 32 sister chromatids in a normal diploid cell of the animal at metaphase I of Meiosis I? Justify your answer briefly. [2]
(ii) *Enough of animals!* Now it's time to focus on yourself a bit. (*Not a bad idea!*) Now tell, how many individual double-stranded DNA molecules would a normal human cell have on completion of S phase? Justify briefly. [2]

A4. This exam is of one and a half hours duration. *But you (as well as we) are well aware of the time it took for the preparation!* Similarly, before a cell divides, a lot of time goes in preparing for division. (*Welcome to the cell cycle!)* Now, we are giving you a statement. You have to identify and correct the mistake(s) in the statement w.r.t. G1 phase, providing appropriate justification. The statement is: "*In general, this is the phase of the cell cycle when the size of the cell is constant and it contains a replicated genome.*" [2]

A5. *Let's have a diagram-based question.* Look at the figure on the right and answer the questions given below. [2 + 2]
(i) What possible stage(s) of cell division is/are represented here? (Hint: *There may be more than one possibility.*)
(ii) With proper justification, mention what the *2n* for this cell is in non-dividing phase. (Hint: *Aren't we generous? Again, more than one value will be there, in case you got the hint in the first part.*)



-Section B- 17 Marks

B1. *Identify the claimers in each case:* [4x1=4]
(i) As an important cellular organelle, I help modify certain polymers. My absence from the cell will make these polymers go crazy, and they might lose their direction.
(ii) I'm the guardian organelle in a cell who, like an anti-virus software, checks and helps destroy the foreign substances entering the cell.
(iii) I'm an organelle, not membrane-bound, am composed of two biomolecule types and assist in converting one form of code in the cell to another.
(iv) Like the wall of China, I help defend certain cells from the attack of foreign invaders as well as harsh weather.

B2. Let's visit a doctor's clinic. (*No, we don't suppose you are unwell!*) In the clinic, cells have been obtained from a patient suffering from viral infection. The DNA extracted from these cells consisted of two forms: double-stranded human DNA and single-stranded viral DNA. The base compositions of these two forms of DNA were as follows: [3]

	A	C	G	T
Form 1	22.1%	27.9%	27.9%	22.1%
Form 2	31.3%	31.3%	18.7%	18.7%

Which form was the viral DNA, and which form was the human DNA? Explain your reasoning briefly.

B3. Elemental analysis was conducted on three samples, A, B and C, of bio-macromolecules – protein, DNA and polysaccharide – and the results are given in the table below. Identify, with proper reasoning, which sample corresponds to which of the three biomolecules. If information is insufficient to conclude, state so. [3]

Sample	% Carbon	% Hydrogen	% Oxygen	% Nitrogen	% Sulfur	% Phosphorus
A	27	49	24	0	0	0
B	29	49	13	8	1	0
C	35	21	26	14	0	4

B4. *Take some mental jiggles*. For each case given below, state True/False & justify in either case with proper reasoning.
(i) Appearance of mitochondria in evolutionary history must have given rise to a new cell type. [1]
(ii) The membranes of majority of cell organelles are similar in nature to outer plasma membrane. [1]
(iii) The reproduction process usually performed by Sea Star fish is due to meiosis. [1]
(iv) A haploid or a triploid cell cannot perform meiosis. [1]

B5. *It's calculation time, friends!* Given that a human somatic cell contains about 2 meters of DNA molecules in total when joined length to length. Calculate the average length of each DNA molecule. Will this average length be different before and after S phase? Justify briefly. [3]

-Section C- 16 Marks

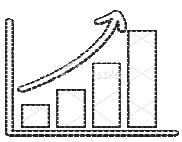
C1. We wish to share an interesting fact with you. *All of us may be carrying many viruses in our bodies, but our immune system is unable to detect them!* Why this could be so? Justify briefly. [3]

C2. (i) Imagine you are exploring a rather inhospitable planet (*We know you are a very adventurous person!)*, which has "oceans" filled with a hydrophobic liquid. Surprisingly, there are living organisms in these oceans whose cytoplasm is hydrophobic to a similar degree. These organisms have membranes made primarily of phospholipids arranged in a bilayer. What is the most probable orientation of these phospholipids? Draw the bilayer *and* justify your answer. [3]
(ii) A bacterium residing in your body is expelled to a very cold environment (*Imagine you are in freezing Ladakh!*). What adjustments might the bacterium make to maintain the same level of membrane fluidity as before? [2]

C3. *Feeling hungry?* So, let's talk about vegetables. Brinjal and potato belong to the same genus *Solanum*, but to two different species. What defines them as separate species? [2]

C4. (i) *We see there's no question about photosynthesis. So, here's one.* In 1804, Theodore de Saussure observed that the total weights of oxygen and dry organic matter produced by plants is greater than the weight of carbon dioxide consumed during photosynthesis. Where does the extra weight come from? Elaborate briefly. [2]
(ii) The light reactions of photosynthesis produce ATP. Then, explain briefly why plant cells still need mitochondria? [3]

C5. *This is the last one.* Shown on the right is a graph of student attendance in classes (on X axis) vs academic performance in that course (on Y axis). Write the hypothesis corresponding to this observation.
(*See we made you accept the truth!*) [1]



Goodbye. *And yes, the quote for today is:* ***You can't win every game; but it's great that you tried!***