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MANIPAL INSTITUTE OF TECHNOLOGY

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A Constituent Institution of Manipal University

III SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2017

SUBJECT: CELL AND MOLECULAR BIOLOGY [BIO 2101]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A.	**a)** You receive a letter in the mail from ACDC (Association for Cloning Dead Celebrities), asking for a Rs.1000 donation to support the cloning of a famous movie star, Neha, who died in a plane crash in 1994 and no remains of her were found. Your friend, who is a huge fan of Neha, sees the letter and promptly transfers Rs.1000 to ACDC. Do you think your friend made a wise decision? Explain your answer. **b)** A few months later, you watch a documentary on organ transplants, where a woman named Rosie claims to have received Neha's left kidney during a kidney transplant in 1993. Briefly outline the steps by which Neha could be cloned with the help of Rosie. **c)** ACDC clones Neha with some assistance from Rosie. However, the clone has a short stature (typical of a known mitochondrially inherited disorder), whereas Neha was much taller. Is Rosie a fraud or could there be another explanation? **d)** ACDC finds out that Neha had some of her eggs frozen in a fertilization clinic. Could the nucleus of one of these unfertilized eggs be used to clone Neha? Why or why not? **e)** Your friend thinks that ACDC should give Rosie a second chance. What steps could one take so that this time the clone has the same stature as Neha's?	**4M**
1B.	What is the need for two gap phases in a cell cycle?	**3M**
1C.	What is meant by protein tagging and what is the significance of this process?	**3M**
2A.	Griffith performed a series of experiments where he infected mice with two different strains of pneumonia-causing bacteria (*S. pneumonia*): the *smooth/virulent*, disease causing S strain and the harmless *rough/ non-virulent* R strain. You have three unknown samples *(A/ B/ C)* of *S. pneumonia* and want to characterize them. You inject these samples into mice both individually and in combination. You then obtain blood samples from the injected mice and culture the bacteria present. You also record whether the mice live or die. Your observations are summarized in the following table.	**4M**

Set 1	Sample injected	Response of the mice	Type of strain recovered from mice
1	A	Dead	Live S strain
2	B	Live	None
3	C	Live	Live R strain
4	A + B	Dead	Live S strain
5	A + C	Dead	Live R and live S strains
6	B + C	Dead	Live R and live S strains

a) Assuming that each sample (A, B, and C) contained only one type of bacterial strain, what type of S. pneumonia is found in each sample? Choose from *live smooth/virulent,*

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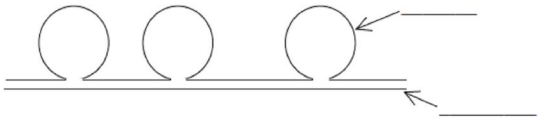
	heat-killed smooth/virulent, live rough/non-virulent, or heat-killed rough/non-virulent. Provide an explanation for your classification. (i) Sample A: (ii) Sample B: (iii) Sample C:	
2B.	B form of DNA is the most common form, present in most DNA at neutral pH and physiological salt concentrations. Still A and Z forms of DNA also exist. What is the need for the multiple forms of DNA?	**3M**
2C.	You are working in lab that studies the adrenaline response. Many athletes come to your lab looking for a drug that will give them an extra kick-just like adrenaline. You know that adrenaline (also known as epinephrine) works in the "flight or fight" response and that it can trigger action potentials in cardiac muscle, but you need to learn more. You find out that epinephrine results in an overall increase in calcium ion levels within the cytoplasm of muscle cells. Given this fact, what do you think is required to restore the cardiac muscle cell back to its resting state?	**3M**
3A.	How does kinesin related motor proteins differ from the dynein related motor proteins?	**4M**
3B.	Highly repetitive DNA does not code for proteins but still it is very common in eukaryotic chromosomes. If highly repetitive DNA does not code for proteins, why is it present in eukaryotic genomes?	**3M**
3C.	There is a human gene that encodes a protein identical to one of the proteins produced by a virus. You isolate a fragment of DNA that includes the shared gene, heat the fragment to separate the two DNA strands and allow the human DNA to base pair with the viral RNA. You find the following hybrid molecule using electron microscopy.  i) Label which strand is human DNA and which is viral RNA in the picture. ii) Why can some regions form complementary base pairs, while other regions cannot? iii) If you were to isolate mature mRNA from the human cell and allow it to base pair with the viral RNA, would you see the same type of hybrid molecule? Explain your thinking.	**3M**
4A.	What leads a cell to commit programmed cell death?	**4M**
4B.	Elaborate on internal ribosomal entry sites?	**3M**
4C.	How does the primary components of prokaryotic and eukaryotic translational apparatus differ?	**3M**
5A.	With the help of a diagram explain how genes are organized on a human chromosome.	**4M**
5B.	How can genetic material be introduced to a bacterial cell by transduction?	**3M**
5C.	Duchenne muscular dystrophy (DMD) is an X-linked recessive disorder caused by mutations in the gene encoding dystrophin, a protein involved in maintaining membrane integrity in muscle cells. The dystrophin gene spans roughly 2.5 Mb and is spliced to form a 14 kb mRNA transcript consisting of 79 exons. a) Is dystrophin is a typical human gene in terms of its size and exon count? b) The DMD phenotype results from mutations that disrupt the reading frame of the dystrophin mRNA. What is the impact of such mutations on the dystrophin protein?	**3M**