Exam Date & Time: 22-Oct-2019 (10:30 AM - 11:30 AM)

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

BIOLOGY FOR ENGINEERS

Biology for Engineers [BIO 1051 - 2018 -CHM]

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

MCQ

Answer all the questions.

Section Duration: 20 mins

1) You have a double stranded piece of DNA with 15% Guanine (G) . What is the percentage of Adenine (A)in this piece of DNA?

1) 15 2) 35 3) 70 4) Data insufficient (0.5)

Correct option is: 2

2) DNA to DNA copying is an important event in the life forms on earth. Which of the following statement(s) is/are true regarding this event?
a. takes place in a "conservative" manner
b. takes place in a "dispersive" manner
c. takes place in a "semi-conservative" manner
d. usually involves one origin of replication per chromosome in eukaryotes
e. takes place only in the 3' to 5' direction (0.5)

1) (a), (b), (c) and (d) 2) (c) and (d) 3) Only (c) 4) (a), (b) and (c)

Correct option is: 3

3) Why is an RNA primer necessary for DNA replication?

1) DNA polymerase can only add nucleotides to 3' end of an existing strand
2) DNA polymerase can only add nucleotides to 5' end of an existing strand
3) The RNA primer is necessary for the activity of DNA ligase
4) DNA polymerase requires RNA primer only in the leading strand for fast synthesis (0.5)

Correct option is: 1

4) Why can't DNA be parallel? Select the most convincing justification

1) Phosphodiester bonding would not be possible, as there is no 3' and 5' ends in the proposed model
2) Glyosidic linkage between nitrogen base and sugar is not possible, if it runs parallel
3) Enzymes can't act on a polymer which runs parallel
4) The hydrogen bonding would not be possible, as the base pairs would not be paired in the known way (0.5)

Correct option is: 4

5) Select the option which is correct regarding the Hershey and Chase experiment?
A. The vial DNA was labelled with radioactive nitrogen
B. Both bacterial DNA and RNA was labelled with radioactive phosphorus
C. The bacterial DNA was labelled with radioactive phosphorus
D. The virus-infected bacteria contained radioactive sulphur
E. They suggested the DNA copying mechanism by which DNA function as a genetic material (0.5)

1) Both C and E 2) Only E 3) Only C 4) All the above statements from A to E are wrong

Correct option is: 4

6) What is the tRNA anticodon for the DNA code 3'ATG5'? (0.5)

1) 5'UAC3 2) 5'AUG3' 3) 3'AUG5' 4) 3'UAC5

Correct option is: 3

7) Why DNA can not directly translate into protein? Select the option showin the correct statements
A. DNA is very tightly packed, so unwinding it every now and then will not be energy efficient.
B. Most of the regions of DNA do not code for a protein
C. Cellular infrastructure available in nucleus is not meant for protein synthesis
D. Enzymes can't be working inside the nucleus (0.5)

1) A, B and C 2) Only D 3) Both B and C 4) A, B, C and D

Correct option is: 1

8) If lactose and glucose are provided in the growth medium of a culture of bacteria what will happen to the operon? Select the option representing the correct sentences
1. Activator protein is not bound to DNA
2. Repressor protein lifted off at the operator site
3. cAMP is available for lactose metabolism
4. RNA polymerase keeps falling off at the operator site
5. Galactosidase, permease and transacetylase are not produced (0.5)
6. Only galactosidase is produced, but permease and transacetylase are not produced

1) 1,2,4 and 5 2) 3 and 5 3) 3 and 6 4) 2,3,4 and 6

Correct option is: 1

9) The lagging strand of a DNA molecule undergoing replication reads 3'-CGCATGTAGCGA-5'. What is the code of the DNA that is the template for the complementary leading strand of this segment?

1) 5'-CGCATGTAGCGA-3'	2) 3'-CGCATGTAGCGA-5'	3) 3'-GCGTACATCGCT-5'	4) 5'-GCGTACATCGCT-3'

(0.5)

Correct option is: 2

10) As an engineer, which of the following statements are logical with regard to DNA as the most efficient and stable material for storing information?
A DNA fragment can store different information simultaneously through alternate splicing
B. An mRNA produced from the upper strand and its complimentary lower strand will produce different proteins
C. The probability of an error in translation is reduced because of multiple codes for the same amino acid (0.5)
D. Cell is having an error checking and correcting facility during DNA to mRNA transcription

1) B, C and D 2) A, B and C 3) A, B and D 4) A, C and D

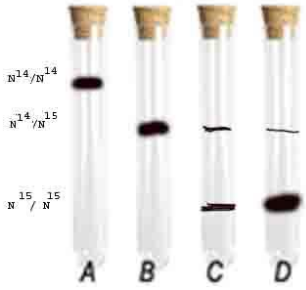
Correct option is: 2

DESCRIPTIVE

Answer all the questions. Section Duration: 40 mins

ANSER ALL QUESTIONS

11) Ms Ramya is an undergraduate student working with DNA replication mechanisms. She develops bacterial cultures in ^{14}N medium for several generations. Now she stops the supply of ^{14}N and started supplying ^{15}N. This bacteria replicates through semiconservative mode (2)
(A) How the bands will appear in the following centrifugal tubes with $CsCl_2$ as the medium (label on the figure) A = before transfering to ^{15}N , B= After 1 round of replication, C= After 5 rounds of replication and D= After 1000000 rounds of replication (0.5 Marks)



(0.5 Mark)

(B)You are replacing $CsCl_2$ with water in the above centrifugal tubes. Now how the bands will appear? (0.5 Marks)

(C) Assume a fragment of DNA measuring 1.65×10^8 bp. Replication at a single replication fork occurs at the rate of 30 bp/sec in the leading strand and 30 bp/sec in the lagging strand. There are 2000 origin of replications. Now calculate the minimum time in seconds required to replicate the entire fragment. (0.5 Marks)

1.65×10^8 bp/30X2000 = 1.65×10^8 bp/(6×10^4 bp/s) = 2750 s for leading strand

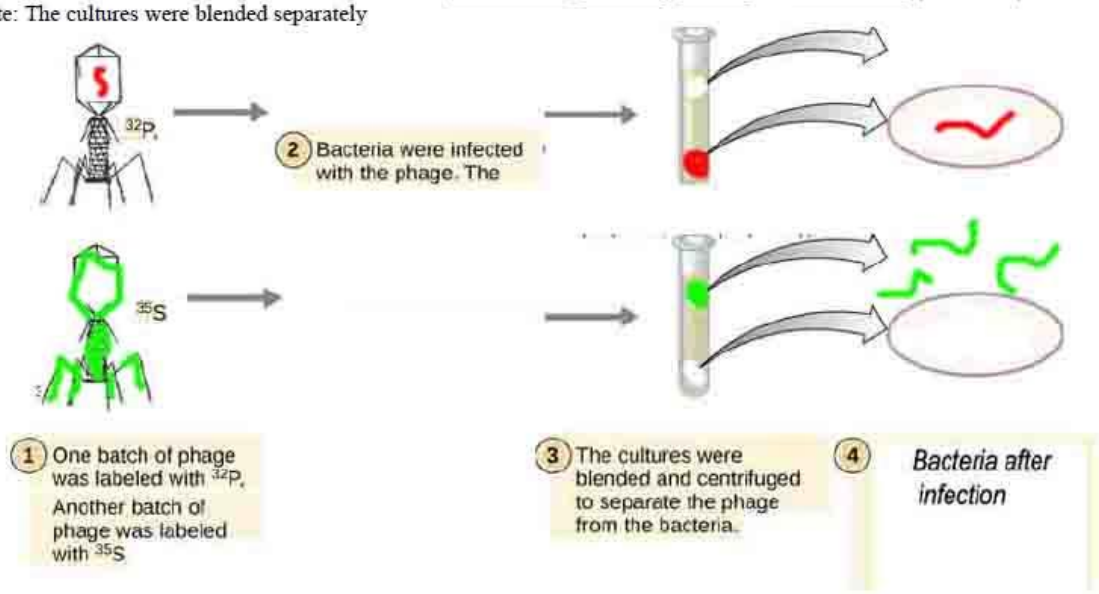
Lagging strand also takes 2750 s for completion (lagging replicates at the same speed here)

The leading and lagging strand replication occurs simultaneously. Therefore Ans = 2750 S

(D) The helicase is not working properly. How it will affect the replication machine? (0.5 Marks)

DNA will not unwind and therefore the replication will not occur

12) (A) Analyze the following figure illustrating Hershey and Chase experiment. Here virus used was double stranded DNA virus. You need to label the regions where you will find radioactivity. Use **red color for radioactive phosphorus** and **green colour for radioactive sulfur**. You need to label in **both viruses**, **centrifugal tubes** and **the bacteria** (1.5 Marks) Please note: The cultures were blended separately

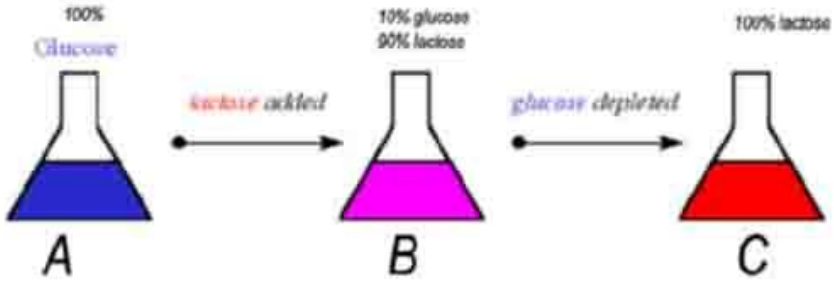


(B) Ms Pooja used double stranded RNA virus in the above experiment. What will be the experimental outcome? (0.5 Marks)

Double stranded RNA virus has a positive strand and a negative strand. It is not integrating into host DNA. Hence the radioactivity will be noticed initially inside and later outside of the cell. The sulphur radioactivity will always be outside.

13.

Given below is a bacterial culture in three different conditions, A, B and C



(A) Fill the following table regarding lac operon (1 Mark)

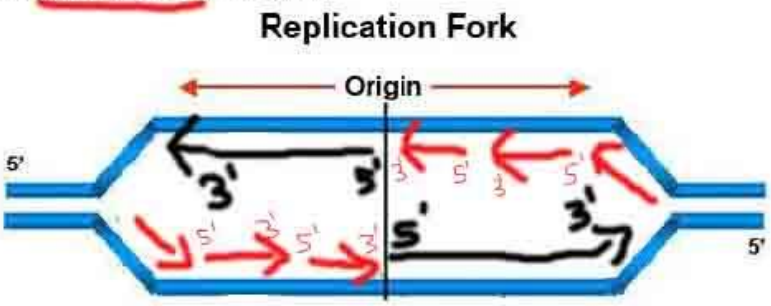
Culture→	A	B	C	Justification
cAMP Level (Choose from low or high)	Low	Low	High	In the absence of glucose cAMP builds up
Number of mRNA from operon (Choose from 0, 10 and 5000)	0	10	5000	In the complete absence of glucose, operon actively express

(B). What molecule is used to signal low glucose levels to the Lac operon regulatory system? (0.5 Mark)
(C). Which condition we can expect a conformational change to the repressor protein? (0.5 Mark)

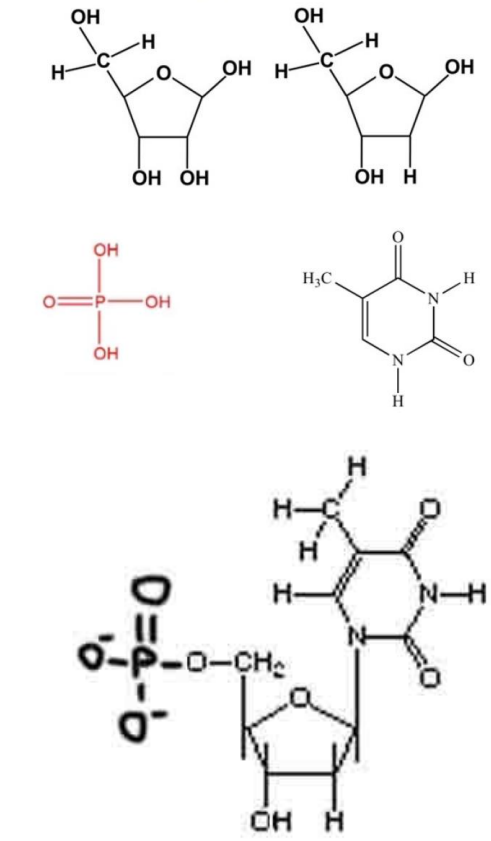
(B) cAMP

(c) Presence of lactose

14) A. Given below is a replication fork. Complete the figure by illustrating (a) leading strands (0.5 Mark) (b) okazaki fragments (0.5 Mark)



B. Given below are the components of nucleic molecule. Using this construct a monomer for DNA molecule (0.5 mark) and label the phosphodiester bond (0.5 Mark)



Ans

15) **A**. Given below is a DNA molecule.

Using this, (i) construct a working mRNA molecule (1 Mark)
(ii) What is the amino acid near to carboxyl terminus of the protein (0.5 Mark)

(i)

5'CAP AUG CUU UCG UAU UAC UGG AGC AUA AUG CUU UCG UAU UAC GAA AGC UGA AAAAAAAAAAA3'

(ii) AGC→Serine

(B) If the tRNA anticodon sequence is 5'GCA3', determine the amino acid it carries? (0.5 Marks)

This tRNA will bind to mRNA 3'CGU5' ie 5'UGC3' →**Cysteine**