

BITS Pilani, Dubai Campus

Dubai International Academic City, Dubai

2ND Semester 2011-12 Comprehensive Examination

Course Name : INTRODUCTORY MOLECULAR BIOLOGY

Max Mark: 40 Marks

Course Number: BIOT C216

Date: 12.06.2012

Duration: 3 hours

Weightage: 40%

1. Answer the following :
 - a. How are Hemoglobin, DNA polymerase II and RNA polymerase similar? Explain any one structure in detail. [2.5]
 - b. What is the significance of [7MeG]? [0.5]
 - c. Consider the following sequences and briefly explain the appropriate repair mechanisms:
 - i. If following mutation occurs in original DNA of a eukaryote [2]
3' TTACCGGATGCAACTTACTGG 5'
5' AATGGCCTACGTTGAATGAGT3'
 - ii. If the following mutation occurs in original DNA of a prokaryote [2]
3' TTACCGGATGCAACTTACTGMeG5'
 - iii. If the following mutation occurs in original DNA of a eukaryote [2]
3' TTACCGGATGCAACT^TACTGG5'
5' AATGGCCTACGTTG AATGACC3'
 - d. Mention any two characteristics of restriction endonuclease with examples. [1]
2. a. Define the following terms with appropriate examples wherever necessary: [0.5 / each]
 - i. RNA – DNA hybridization
 - ii. D Loop
 - iii. SSB proteins
 - iv. Wobble hypothesis
 - v. Holoenzyme
 - vi. RNA editing
 - vii. Pseudogene
 - viii. Base Stacking
 - ix. Topoisomerases
 - x. Operon
- b. Describe schematically all the steps involved in translation (diagrams only). [3]
- c. The L-arabinose operon is an operon which produces enzymes to break down the monosaccharide sugar arabinose into D-xylulose-5-phosphate. If arabinose is present, it will bind to a protein called AraC to form a complex (called AraC-arabinose). The

binding of this complex to an operator is needed for RNA polymerase to bind to the promoter and transcribe the operon. Additionally, a second compound of CAP + cyclic AMP must bind to the DNA to fully initiate transcription of the L-arabinose operon. There is infrequent transcription without this CAP + cyclic AMP compound bound to the DNA.

Answer the following questions using the above information: [2]

i. The L-arabinose operon is _____.

A. Inducible B. Repressible C. Not enough information to determine

i. If arabinose and glucose are present, would you expect the L-arabinose operon to be on with frequent transcription.

A. Yes B. No C. Not enough information to determine

3. Briefly answer the following:

- a. A lab technician was playing around with the genetic code of yeast. He removed an enhancer region of the gene to make the other subunit of hemoglobin and moved it a thousand base pairs away from its original location. What effect will this have on expression of this gene? [1]
 - b. Johnny had come up with a research proposal where he had to investigate the highly evolved eukaryotic gene activity regulatory mechanisms. Describe in detail the first potential transcriptional control level he would study in his research. [3]
 - c. Many molecular biology techniques require that the scientist put a DNA sequence into a plasmid and then insert that plasmid into bacteria like *E. coli*. Not all of the *E. coli* are going to take in the plasmid. How can scientists determine which *E. coli* have taken in a plasmid? [1]
 - d. Differentiate between the following: [1.5 / each]
 - i. Termination of transcription in Prokaryotes and Eukaryotes.
 - ii. Transposons and Retro-Transposons
 - e. In comparing homologous DNA sequences of different species, there are more differences in intron sequences than in exon sequences of genes. Why would this be expected? In comparing exon and intron sequence variation among closely related species, what differences would you expect? [2]
4. a. 17 year old Jesse Gelsinger died while undergoing gene therapy, what was the mistake the doctors did back then however the scientists now have come up with technology which would avoid such a death from happening again. Elaborate on the new discovery. [3]
- b. Illustrate the different steps in Chromosome formation, mention the characteristics of the proteins involved in terms of controlling gene regulation in eukaryotes. [4]
- c. The -10 region of an *E. coli* promoter is an example of what is termed as a consensus sequence- namely, a base sequence from which other sequences having similar functions can be obtained by changing only one or two bases. Answer the following questions about consensus sequences. [2]
- i. What is the evolutionary significance of such a sequence?
 - ii. What is the biochemical significance of a conserved base, such as a conserved T in the -10 region?
- d. Which are two regions common to most prokaryotic promoters? [1]

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2nd SEMESTER 2011-2012

Test-1

Course Name: INTRODUCTORY MOLECULAR BIOLOGY

Date: 22.03.2011

Duration: 50minutes

Maximum Marks: 25

1. (a) What kind of supercoiling is introduced by DNA Gyrase? (1.0Marks)
(b) Mention the mutation with an example which leads to a non-functional protein. (2.0 Marks)
(c) Explain Induced mutations with an example. (2.0 Marks)

2. Answer the following:
 - a. Draw a labeled diagram showing the replication of DNA with leading strand and the lagging strand and use arrows to mark the directions of the synthesis of both the template and the newly synthesized strand. (2.0 Marks)
 - b. Using the above diagram mark all the enzymes involved in the replication of DNA and write about their significance in a tabular column. (5.0 Marks)

3. Elucidate the Scientist and the Experiment in which the “transforming principle” was first demonstrated. (5.0 Marks)

4. Answer the following:
 - a. Explain thymine dimerisation with a diagram. Mention the mutagen which causes dimerisation. (3.0 Marks)
 - b. Differentiate between DNA polymerase I and DNA polymerase III (2.0 Marks)

5. a. Mention the biological significance of telomeres and chromosome erosion. (1.0 Marks)

b. In the Hershey – Chase bacteriophage experiment, the conclusion of the experiment was that the DNA is the genetic material being transferred from the bacteriophage to the bacteria.

Draw the Hershey – Chase experiment in which the conclusion is that protein was the genetic material instead of DNA. (2.0 Marks)

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2nd SEMESTER 2011-2012

Quiz-II

Course Name: INTRODUCTORY MOLECULAR BIOLOGY

Date: 23.04.2012

Duration: 20 minutes

Maximum Marks: 7

1. Which of the enzymes listed below is involved in the repair of both thymine dimers and deaminate cytosine in E.coli.

(0.5 Marks)

- a. DNA Polymerase III
- b. Photolyase
- c. Uracil – N- glycosylase
- d. DNA Polymerase I
- e. AP Endonuclease

Sol:

2. A bacterium is said to be able to suppress a particular type of chain termination mutation – UAG codon. Explain in one sentence how this phenomenon occurs.

(1 Marks)

Sol:

3. The bacterium Histidine requiring mutant used in Ames test is

(0.5 Marks)

- a. *Salmonella enterica*
- b. *Salmonella typhi-murium*
- c. *Salmonella cholerae-suis*
- d. *Salmonella bongori*

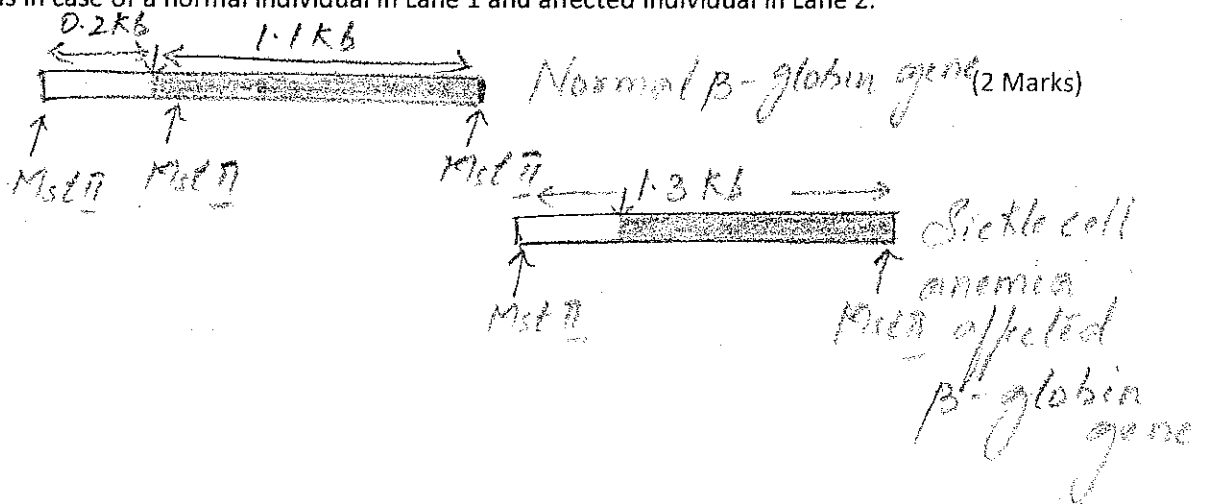
Sol:

4. Mention the two basic types of VNTR's and which type is important for DNA fingerprinting

(1.5 Marks)

Sol:

5. The figure below elucidates the β -globin gene with the Restriction fragment length polymorphisms associated with Sickle cell Anemia. In an individual suffering from Sickle cell Anemia, a base substitution mutation in the gene eliminates a target site recognized by the restriction enzyme MstII. Draw the Southern blot of the same showing the length and number of bands in case of a normal individual in Lane 1 and affected individual in Lane 2.



Sol:

6. _____ is an error prone mechanism of DNA repair.

(0.5 Marks)

7. What is the major function of RecA protein?

(1 Marks)

Sol:

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Course Name : INTRODUCTORY MOLECULAR BIOTECHNOLOGY

Max Mark: 8

Quiz-I

Course Number: BIOT C216

Date: 05.03.2012

2nd Semester 2011-2012

No of pages: 1

Name :
ID Number:

Section Number:

1. The DNA duplexes below are denatured and allowed to reanneal. Which of the following molecules would have the highest T_m (melting temperature)? Mention the reason why.

(1 Marks)

(a) 5' – ATATCATATGATATGTA – 3'
3' - TATAGTATACTATACAT – 5'

(b) 5' – CGGTACTCGTGCAGGT – 3'
3' - GCCATGAGCACGTCCA – 5'

Sol:

2. DNA is a _____ charged molecule.

(0.5 Marks)

3. Name two functions of proteins with Examples.

(1 Marks)

Sol:

4. What is the significance of the Major Groove in DNA double helix structure?

(0.5 Marks)

Sol:

5. Differentiate between Globular and Fibrous proteins (2 points).

(1 Marks)

Sol:

6. _____ help in proper folding of proteins.

(0.5 Marks)

7. In a double stranded DNA molecule, what is the relationship between:

(1 Marks)

(a) [A] + [G] and [C] + [T]

Sol:

(b) [A] + [T] and [C] + [G]

Sol:

8. Z-DNA is a _____ handed helix and has _____ base pairs per turn. (0.5 Marks)

9. Draw the structure of Nucleic Acid and elucidate bonds linking the molecule. (1 Marks)

Sol:

10. Mention two examples for amino acids that are :

(1 Marks)

(a) Positively Charged amino acids:

(b) Negatively Charged amino acids: