KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.Tech.
Year : II

28 JAN 2024

Course : BIOT 206
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"
[20Q. × 1 = 20 marks]

Encircle the most appropriate answer.

1. Vernon Ingram at Cambridge showed that sickle cell hemoglobin differs from normal hemoglobin by change of one amino acid in the b chain: at position 6, the glutamic acid residue found in wild type hemoglobin is replaced by valine. This showed for the first time that:
   a. Mutant form of hemoglobin causes sickle cell anemia
   b. Genes control amino acid sequences of proteins
   c. Gene therapy to change the mutant form to wild type form is necessary to cure anemia
   d. Genes control enzymes that control the phenotype of organisms

2. Suppose in a pulse chase experiment was carried out to determine the direction of protein synthesis for beta globin and alpha globin proteins. For beta globin protein, radioactivity length of peptide increased from NH2 terminus to COOH terminus. For alpha globin protein, radioactivity length of peptide decreased from NH2 terminus to COOH terminus. What can be said about the direction of protein synthesis?
   a. Direction of protein synthesis goes from COOH terminus to NH2 terminus always
   b. Direction of protein synthesis goes from NH2 terminus to COOH terminus always
   c. Direction of protein synthesis is from COOH terminus to NH2 terminus in alpha globin
   d. Direction of protein synthesis is from NH2 terminus to COOH terminus in alpha globin

3. Consider four bonds:
   A. Bond between water molecules in ice
   B. Bond between sodium and chlorine in sodium chloride salt
   C. Bond between hydrogen molecules in hydrogen gas
   D. Phosphodiester bond in DNA

   Which of the following correctly represents bonds from lower to higher bond length?
   a. D to B to A to C
   b. A to B to C to D
   c. B to D to A to C
   d. B to D to C to A

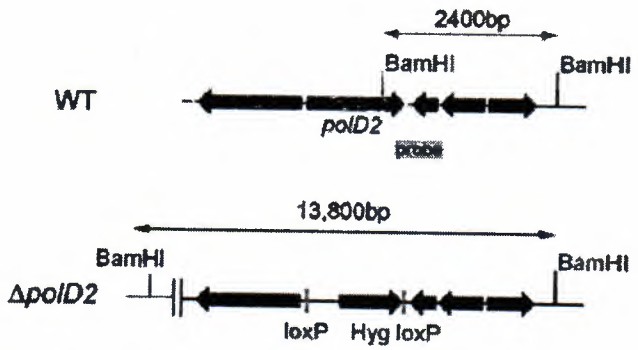
4. An archaea was brought from moon. It had a very different physiology and biochemistry. Its DNA was isolated and subjected to mica experiment. After running the gel bands were observed that were 7, 8, 14, 15 and 16 base pairs long. The band at 15 base pairs was especially strong. What is the periodicity of the newly isolated DNA from the novel archaea?
   a. 8 base pairs b. 15 base pairs c. 7.5 base pairs d. 14 and 16 base pairs

5. What about the topoisomerase is **TRUE**?
   a. Topoisomerase II does not require the use of ATP
   b. Topoisomerases have threonine in their active site
   c. Reverse gyrase adds negative supercoiling to DNA
   d. Topoisomerases can be used to increase or decrease plectonomic writhe

6. CD4
   a. Has four domains each of which is a beta sandwich
   b. Has TIM domain
   c. Has a number of zinc finger domains that bind to a large DNA region
   d. Has LEF-1 domain that has alpha helix inserted into minor groove

7. Murine leukemia virus
   a. Has a DNA genome and is a retrovirus
   b. Has a switch of pseudoknot between Gag and Pol encoding mRNA
   c. Has a switch whose structure was determined using Xray crystallography
   d. Has a switch that takes up electron to turn itself on

8. The following figure is a genomic map of wild type and polD2 knockout regions of Mycobacterium smegmatis genome:



A possible Southern Blot strategy was designed to distinguish the two strains. DNA would be isolated from both strains from their cultures. Genomic DNA would be extracted cut with BamHI and Southern blot would be run using the probe shown in the figure. What would you anticipate?
   a. Wild type and knock out would produce bands of equal length in Southern Blot
   b. PolD2 knock out would produce a longer band than wild type
   c. PolD2 knock out would produce a shorter band than wild type
   d. Band will only be observed for wild type strain

9. Which of the following is **TRUE**?
   a. EMSA detects RNA-DNA interaction
   b. Yeast 2 hybrid assay detects DNA-protein interaction
   c. SELEX assay detects specific protein-protein interaction
   d. 3C assay detects long range DNA-DNA interaction

10. Human genome, consisting of 3.2 giga base pairs, was pair sequenced. Fragments of length 1kb, 5kb and 100kb were created. What is true about pair end sequencing?
   a. Both ends of each fragment are sequenced
   b. This technique does not help resolve repeat region distinction
   c. In this technique shotgun sequencing cannot be applied
   d. Besides DNA, RNA and proteins can also be sequenced

11. What about restriction enzyme digestion is **TRUE**?
    a. Restriction enzymes can be 4, 6, 8 or any other length cutter
    b. Same restriction enzyme can sometimes cut blunt end other times sticky ends
    c. Restriction enzymes cannot be purified through protein purification techniques
    d. Restriction enzyme always cut through a specific DNA even if there is methylation marks

12. Which of the following is true about the human genome?
    a. There are more exonic genes than microsatellites
    b. Intron are usually shorter than exons
    c. Less than 2 percent of the genome consisting of genes coding exons
    d. Intergenic DNA encodes for less than 50 percent of the genome

13. Which of the following is true about nucleosome assembly after DNA replication?
    a. All the older nucleosomes are released from DNA and enter the local pool of nucleosomes
    b. H3.H4 remain bound to the daughter duplex DNA while H2A.H2B enter the local pool of nucleosomes
    c. H2A.H2B remain bound to the daughter duplex DNA while H3.H4 enter the local pool of nucleosomes
    d. All the older nucleosomes are retained in the daughter duplex DNA

14. Which of the following statements is **CORRECT**?
    a. Histone contains high percentage of negatively charged residues.
    b. Histone fold domain mediates assembly of histone only intermediates.
    c. While forming histone octamer, H3.H4 tetramer assembles after joining with H2A.H2B dimers.
    d. Histone tail is found in the C-termini.

15. What is **TRUE** about processivity?
    a. All enzymes in the nature have processivity component
    b. DNA polymerase's processivity is likely increased by DNA clamp loader
    c. DNA polymerase's processivity is likely increased by sliding clamp
    d. Incorporation assay is used to measure DNA processivity of enzymes

16. What is **NOT** true about the anticancer agents that target DNA replication
    a. They can target topoisomerase and block DNA backbone reforming activity
    b. They can act as interstrand crosslinks
    c. They can act as nucleoside analogues
    d. They can act on DNA glycosylases that break N-glycosyl bonds

17. SeqA is NOT
    a. A protein like dnaA that binds to the 13 mer repeat
    b. A protein that binds to hemimethlated GATC sequences
    c. A protein that prevents further methylation of the hemimethylated sites
    d. A protein that prevents reinitiation from recently initiated sites

18. Which of the following is **NOT** a part of telomere or telomerase?
    a. 7-8 nucleotide long T and G rich DNA sequences that are repeats
    b. Short RNA called TER (telomerase RNA)
    c. Enzyme that forms DNA from RNA template called reverse transcriptase
    d. 7-8 nucleotide long RNA sequences with T and G that are repeats

19. Which of the following is a distinguishing key enzyme of base excision repair?
    a. DNA glycosylase that cleaves DNA damage that is flipped out
    b. DNA ligase that repairs DNA phosphodiester bond
    c. DNA polymerase that fills in gaps
    d. Exonuclease that chews up DNA from damaged end.

20. Non homologous end joining repair
    a. Is found in all organisms including all bacteria and eukarya
    b. Often faithfully repairs DNA damage
    c. Is more mutagenic than Homologous Recombination that uses sister copy as template
    d. Absolutely does not use homologies for repair

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Indicate by checking (√) of each question you have answered in the cover page of main answer book.

SECTION "B"
[5Q. × 3 = 15 marks]

Attempt *ANY FIVE* questions.

1. Draw and distinguish phosphoester, phosphoanhydrite and phosphodiester bonds.
2. Describe protein-protein interaction and interface.
3. Describe RNAase P.
4. Describe pulsed field electrophoreis. How is it different from polyacrylamide gel electrophoresis?
5. Describe the difference between euchromatin and heterochromatin. Describe the difference between zigzag and solenoid model. [1.5 +1.5]
6. What is the structure and function of sliding clamp loader?
7. How is DNA damage measured?

SECTION "C"
[5Q. × 5 = 25 marks]

Attempt ANY *FIVE* questions.

8. What are hydrophobic forces? Why is the substrate of DNA and RNA polymerizing reactions triphosphates and not diphosphates or monophosphates? [2.5 + 2.5]
9. Describe the three forms of DNA in detail.
10. Describe Western Blotting and EMSA.
11. A new locust species was discovered in the Himalayas. Describe its possible genomic structure.
12. Describe histone-modifying complexes.
13. Mechanistically describe the difference between helicase loading and activation.
14. Describe translesional synthesis and polymerases with examples.

SECTION "D"

[2Q. × 7.5 = 15 marks]

Attempt *ANY TWO* questions.

15. a. What would the outcomes of Messelsen and Stahl experiment if DNA replication were conservative? [2.5]
    b. What did Oswald T Avery add to Griffith's experiment? [2.5]
    c. What is Janssen's hypothesis? [2.5]

16. Describe Northern Blotting. With figures describe the conventional dideoxy Sanger sequencing method. [2.5 + 5]

17. a. What are telomere-binding proteins and what is their function? [2.5]
    b. What is the function of topoisomerases in replication? [2.5]
    c. What are the roles of finger, palm and thumb domains of the DNA polymerase? [2.5]