	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**Department: SCIENCE 2024 – 25** **SUBJECT: BIOLOGY**	**Date:20.08.2024**
Worksheet No: 4 **WITH ANSWERS**	**CHAPTER: MOLECULAR BASIS OF INHERITANCE**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC**	**ROLL NO.**

CASE STUDY-DNA

Read the following and answer the questions given below:

In prokaryotes, DNA is circular and present in the cytoplasm but in eukaryotes, DNA is linear and mainly confined to the nucleus. DNA or deoxyribonucleic acid is a long polymer of nucleotides. In 1953, the first correct double helical structure of DNA was worked out by Watson and Crick, based on the X-ray diffraction data produced by Maurice Wilkins and Rosalind Franklin. It is composed of three components, i.e., A phosphate group, a deoxyribose sugar and a nitrogenous base.

1.Name the linkage present between the nitrogen base and pentose sugar in DNA.
(a) Phosphodiester bond
(b) Glycosidic bond
(c) Hydrogen bond
(d) None of these

2. The double helix structure of DNA was proposed by
(a) James Watson and Francis Crick
(b) Erwin Chargaff
(c) Frederick Griffith
(d) Hershey and Chase

3. Assertion: The two strands of DNA helix have uniform distance between them.
Reason: A large sized purine always paired opposite to a small sized pyrimidine.

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

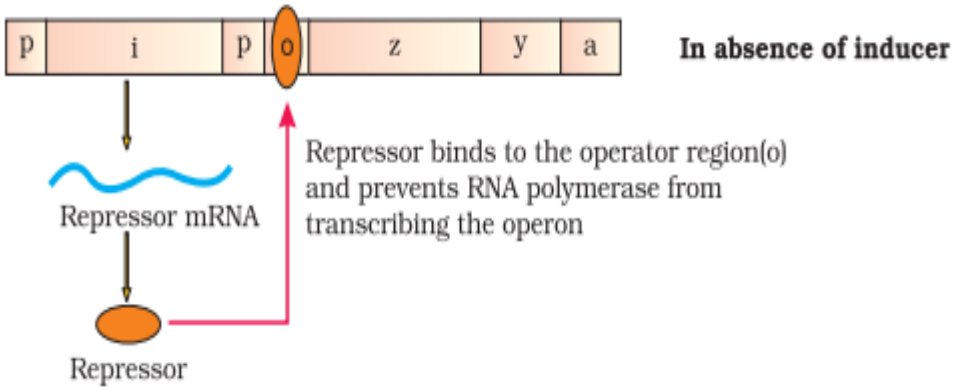
(b) Both assertion and reason are true but reason is not the correct explanation of the assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

4.The DNA of a certain organism has cytosine as 20% of its bases. What percentage of its bases would be thymine?

(a) 80% (b) 30%
(c) 20% (d) 10%

CASE STUDY-Lac Operon

The diagram given below illustrates the Lac operon, answer the questions in relation to it.



1.The inducer for Lac operon is

(a) Beta-galactosidase
(b) Permease
(c) Lactose
(d) Glucose

2. Identify the incorrect statement about the lac operon

(a) i gene codes for the activator of the lac operon.
(b) The z gene codes for beta-galactosidase (β-gal)
(c) The y gene codes for permease.
(d) The a gene encodes a transacetylase

3. The RNA polymerase binds to the---------- in the presence of the inducer

(a) Operator
(b) Structural genes
(c) Promoter
(d) i gene

4. Assertion: All the three gene products in lac operon are required for metabolism of Lactose.

Reason: The genes present in the operon are needed together to function in the same or related metabolic pathway.

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

Assertion and Reasoning (Objective type 1-mark question)

1.Assertion: A codon is unambiguous

Reason: Some amino acids are coded by more than one codon

(a) Both assertion and reason are true, and reason is the correct explanation of assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false.

2. Assertion: Amino acids are added one by one and translated into a polypeptide.

Reason: The ribosome moves from codon to codon along the mRNA

(a) Both assertion and reason are true, and the reason is the correct explanation of the assertion.
(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) Assertion is true but reason is false.
(d) Both assertion and reason are false

3.

Assertion: Replication and transcription occur in the nucleus but translation occurs in the cytoplasm.

Reason: mRNA is transferred from the nucleus into the cytoplasm where ribosomes and amino acids are available for protein synthesis.

a. Both Assertion and Reason are true
b. Both Assertion and Reason are true
c. Assertion is true, but Reason is false
d. Both Assertion and Reason are false

MCQs 1-mark question

1. Pyrimidines in DNA are:
(a) Adenine and guanine
(b) Cytosine and thymine
(c) Adenine and thymine
(d) Thymine and uracil

2. Each new amino acid is added to a growing protein by

(a) an ionic bond
(b) an RNA bond
(c) a peptide bond
(d) a hydrogen bond

3.In a DNA strand the two nucleotides are linked together by:

(a) glyosidic bonds (b) phosphodiester bonds

(c) peptide bonds (d) hydrogen bonds

4.A nucleoside differs from a nucleotide. It lacks the:

(a) base (b) sugar

(c) phosphate group (d) hydroxyl group

5.Both deoxyribose and ribose belong to a class of sugars called:

(a) trioses (b) hexoses

(c)pentoses (d) polysaccharides

6.The fact that a purine base always paired through hydrogen bonds with a pyrimidine base leads to, in the DNA double helix:

(a) the antiparallel nature (b) the semiconservative nature

(c) uniform width throughout DNA (d) uniform length in all DNA

7.The net electric charge on DNA and histones is:

(a) both positive (b) both negative

(c) negative and positive, respectively (d) zero

8.The promoter site and the terminator site for transcription are located at:

(a) 3′ (downstream) end and 5′ (upstream) end, respectively of the transcription unit

(b) 5′ (upstream) end and 3′ (downstream) end, respectively of the transcription unit

(c) the 5′ (upstream) end

(d) the 3′ (downstream) end

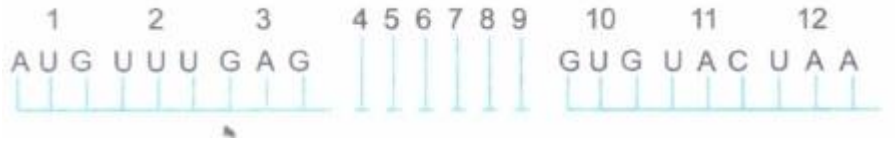
9.Which of the following statements is the most appropriate for sickle cell anemia?

(a) It cannot be treated with iron supplements (b) It is a molecular disease

(c) It confers resistance to acquiring malaria (d) All of the above

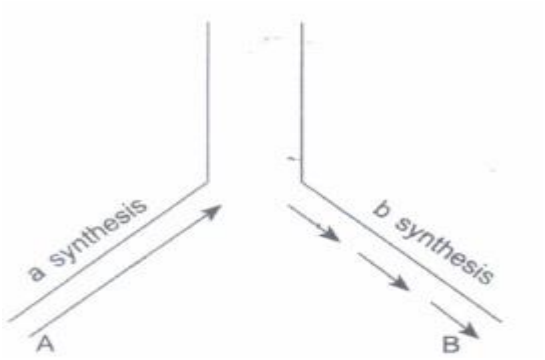
2 Marks questions

1. A hypothetical mRNA with 12 codons is shown below



(a) How many amino acids will be coded by this? Justify your answer.
(b) Mention the dual functions of the codon, AUG.

2. A DNA replication fork is shown below. Answer the following questions based on that.



(i) Why does DNA replication occur in such small forks?
(ii) What is a synthesis and b synthesis?
(iii) Mention the polarity at A and B.

3.Differentiate between introns and exons.

4. Explain the dual function of AUG codon. Give the sequence of bases it is transcribed from and its anticodon.
5. Write any four salient features of genetic code?

6. Explain how DNA is packed in Prokaryotes.

7.With the help of a flow chart illustrate the components of DNA.

8.If the length of E. coli DNA is 1.36 mm, calculate the number of base pairs in E. coli?

9. a) Listed below are some amino acids and their corresponding mRNA triplets.

Amino acid	mRNA triplet
Phenylalanine	UUU
Lysine	AAG
Arginine	CGA
Alanine	GCA

Which DNA sequence would be needed to produce the following polypeptide sequence?
Alanine- Arginine- Lysine- Phenylalanine

(a) CGT GCT TTC AAA	(b) CGT GCT TTC TTT	(c) CGU GCU UUC AAA	(d) CGU GCU UUC TTT

b) Identify the non-sense codons among the following.

(a) AUG	(b) GUG	(c) UAA	(d) UGG

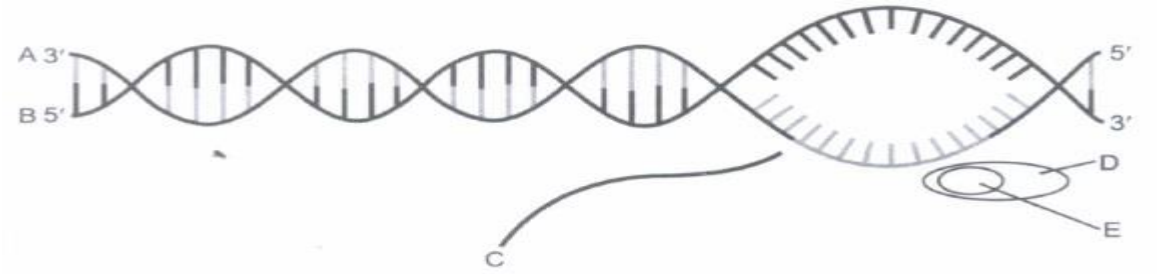
3 Marks questions

1. (a) Explain briefly the functions of the three types of ribosomes.

   (b) Why is tRNA called an adaptor molecule.

2. (a) In human genome which one of the chromosomes has the most genes and which one has the fewest?
   (b) Scientists have identified about 1.4 million single nucleotide polymorphs in human genome. How is the information of their existence going to help the scientists?

3.



A particular stage in the transcription of a bacterium is given above. Answer the following questions:
(a) Name the stage in the process.
(b) Identify A, B, C, D and E in the diagram.

4.Fill in the following table:

DNA									
mRNA	G	G	U	G	U	A	A	U	U
anticodon									
amino acid									

5.RNA splicing is an important step in the process of transcription in eukaryotes. What is the role of this process?

6. With the help of a labelled diagram explain the structure of nucleosome.

5 Marks questions

1. Explain the replication process of DNA. Explain the role of the enzymes, and substrates involved in DNA replication.
2. (a) Draw a schematic representation of the structure of a transcription unit and show the following in it:
   (i) Direction in which the transcription occurs

   (ii) Polarity of the two strands involved

   (iii) Template strand

(iv)Terminator gene

(b) Mention the function of promoter gene in transcription.

3.In a maternity clinic, for some reasons the authorities are not able to hand over the two new-borns to their respective real parents. Name and describe the technique that you would suggest to sort out the matter

4. With the help of example explain negative regulation in the regulation of gene expression.

5. State any three salient features of the double helix structure of DNA.

6.Explain how DNA is packed to form the double helix structure in Eukaryotes.

Previous Years Board Questions

1. Recently a girl baby has been reported to suffer from haemophilia. How is it possible? Explain with the help of a cross.
2.How did Morgan explain linkage of genes?

3. (a) Mention the contributions of the following scientists:

(i) Maurice Wilkins and Rosalind Franklin

(ii) Erwin Chargaff

4. Draw a double stranded dinucleotide chain with all the four nitrogen bases. Label the polarity and the components of the dinucleotide.

5. (a) State the arrangement of different genes that in bacteria is referred to as operon.

(b) Draw a schematic labelled illustration of lac operon in a 'switched on' state.

(c) Describe the role of lactose in lac operon.

6 (a) Briefly explain the Transforming principle experiment.

(b) How did Alfred Hershey and Martha Chase arrive at the conclusion that DNA is the genetic material?
7.(a) Explain the Meselson and Stahl's experiment.

(b) Illustrate the result with diagrams.

Hints for some answers

MCQ's 1to 9

1-b	2-c	3-b	4-c	5-c	6-c	7-c	8-b	9-b

Hints for 2-mark questions

3.Introns are non-coding sequence of protein, absent in a mature processed mRNA

Exons are coding sequence of protein, present in a mature processed mRNA

4) AUG for methionine & Start codon, Sequence of base (DNA) –TAC, anticodon---UAC

5) (i) Triplet in nature (ii) Non-ambiguous (iii) no punctuation (comma) (iv) Universality – any 4

Hints for 3-mark questions

2.a) Chromosome 1 has most gene 2968and Y has fewest 231

b) Disease-associated sequences and tracing human history

4.

DNA									
mRNA	G	G	U	G	U	A	A	U	U
anticodon	C	C	A	C	A	U	U	A	A
amino acid	Gly			Val			Ile		

5. maturation of hnRNA to mRNA----- removal of introns -----exons are joined in a defined order

6.i) There is a set of positively charged proteins called Histones

ii)Histones are organized to form a unit of 8 molecules called histone octamer

iii)The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called Nucleosome

iv)Nucleosome is the basic repeating structural (and functional) unit of chromatin

v)The Nucleosome in the chromatin is packed to form Chromatin Fibers

5 Marks Questions-Hints

1.Diagram refer fig. 6.8 pg. 107, (i) Deoxyribose nucleotides needed for formation of new DNA strands are present in nucleoplasm (ii) The RNA primer attaches itself to the old strand and attracts the enzymes (DNA polymerase III) which add new nucleotides through base complementation (iii) Helicase----unwinding (iv) DNA ligase—join the fragments of okazaki

2a) A transcription unit in DNA is defined primarily by the three regions in the DNA:
(i) A Promoter (ii) The Structural gene (iii) A Terminator

b) i) provides binding site for RNA polymerase

ii)It also defines the template and coding strand

3.DNA finger printing also known as DNA profiling. Description please refer to the notes

5. i) Two nucleotides are joined by 3'-5' Phosphodiester linkage to form Dinucleotide.

ii)The two chains are coiled in a right-handed fashion; the pitch of the helix is 3.4nm with roughly 10b.p

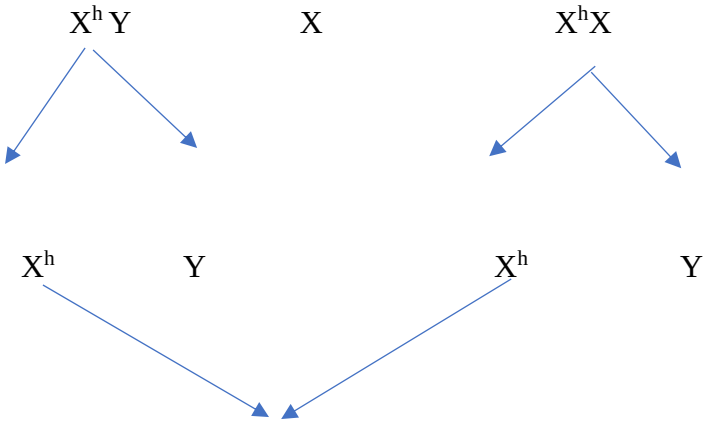
iii) The two strands of DNA (called DNA duplex) are antiparallel and complementary, one in 5'->3' direction and the other in 3"->5" direction

Previous Board Questions -Hints

1.i) Father haemophilic and mother carrier

ii)Not possible in real life as male doesn't usually live till he reaches puberty

iii) Father Mother



$X^h X^h$ (haemophilic daughter)

2. PARENTALS – 98.7% NON-PARENTALS- 1.3%

Brown, White males & females Brown, Red males & females

Yellow, White males & females Yellow, Red males & females

F2 ratio deviated from 9:3:3:1 situated on (X – CHROMOSOME)

Linkage – Physical association of genes on a chromosome. They are inherited as a single unit

3.i) Based on the X-ray diffraction produced by Maurice Wilkins and Rosalind Franklin, Watson and Crick proposed the Double Helix model for the structure of DNA

ii) Erwin Chargaff proposed that for the double stranded DNA, the ratio between A & T and G & C are constant and equal to one.

Prepared by: *Ms Agnes Aranha*	*Checked by:* *HoD Science*