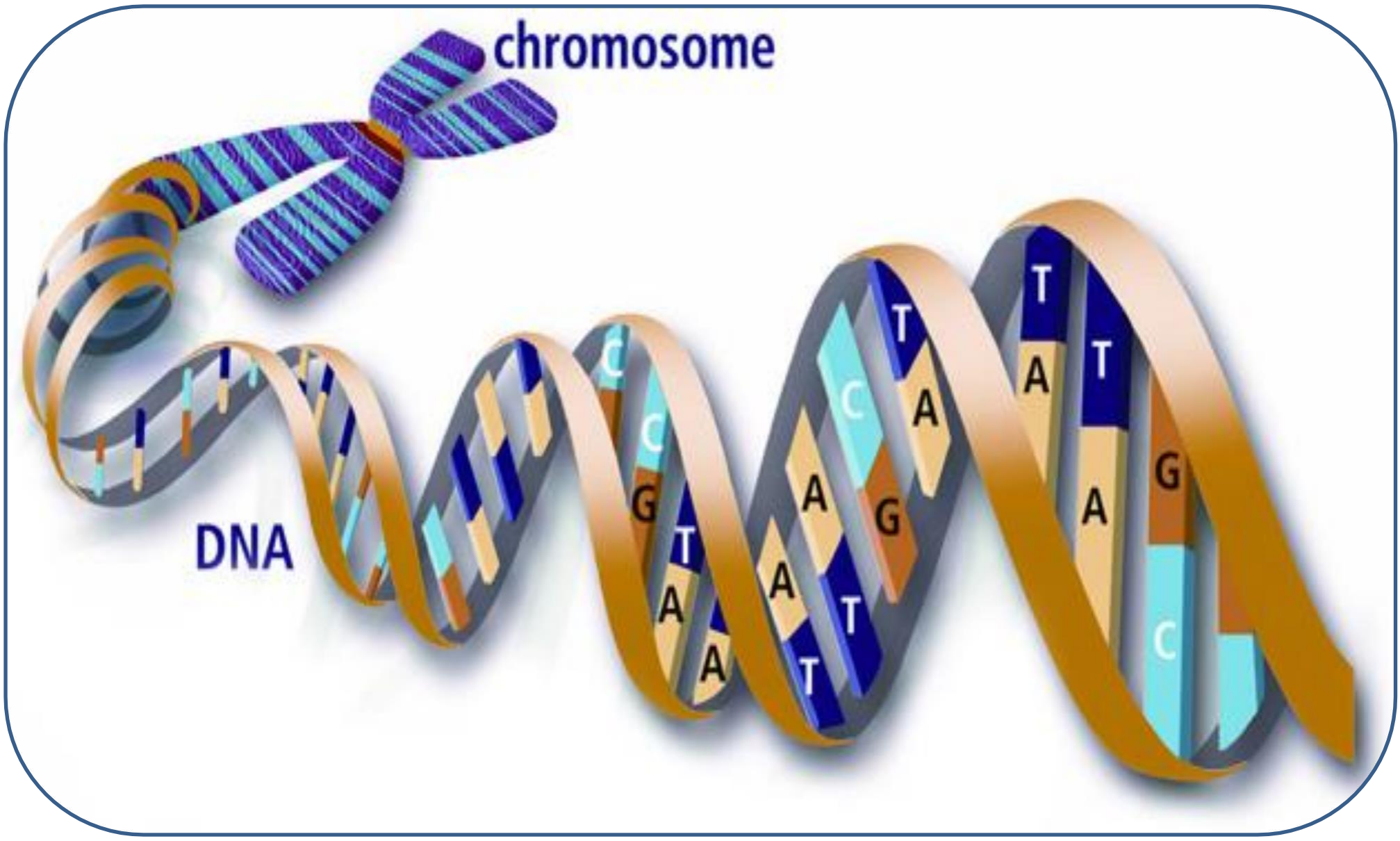
CHAPTER 20

Chromosomes and DNA



- **Exercise Short Answers**
- **Important Short Answers**
- **Exercise MCQ's**
- **Important Additional MCQ's**
- **Past MDCAT MCQ's**

Exercise Short Answers

Q:1 What are the major classes of RNA?

Ans: Three major classes of RNA are:

a. Messenger RNA
b. Transfer RNA
c. Ribosomal RNA

Q:2 What are the functions of RNA polymerase in transcription?

Ans: Functions of RNA polymerase in transcription:

Transcription is initiated when the enzyme RNA polymerase binds to a particular binding site called a promoter located at the beginning of the gene.

Q:3 How did Crick and his colleagues determine how man nucleotides are used to specify each amino acids?

Ans:

After Crick's initial experiments, Marshall Nirenberg, Philip Leader and Har Gobind Khorana tested all the 64 codons by making artificial mRNAs and triplet codons and using them to synthesize a protein or aminoacyl – tRNA complexes in cell free systems.

Q:4 What is anticodon?

Ans: Anticodon:

It is a three nucleotide sequence at end of transfer RNA molecule that is complementary to base pairs of an aminoacyl specifying codon in mRNA.

OR

A sequence of three nucleotides in tRNA that is complementary to mRNA is called anticodon.

Important Short Answers

Q:1 What are chromosomes? What a typical chromosome is made up of?

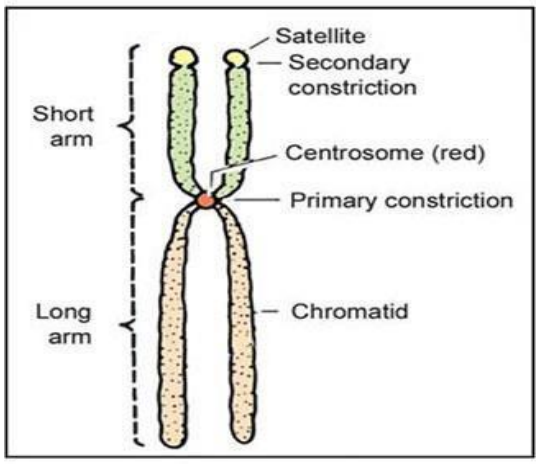
Ans: Chromosomes:

Chromosomes are thread like structures that appear inside the nucleus at the time of cell division.

- They were first observed by German embryologist Walther Fleming in 1882, when he was examining the rapidly' dividing cells of salamander larvae.

Chromosome is made up of:

Typically a chromosome is made of chromatids, centromere (primary constriction) and a secondary constriction.



Q:2 What is the number of chromosomes in Penicillium and ferns?

Ans:

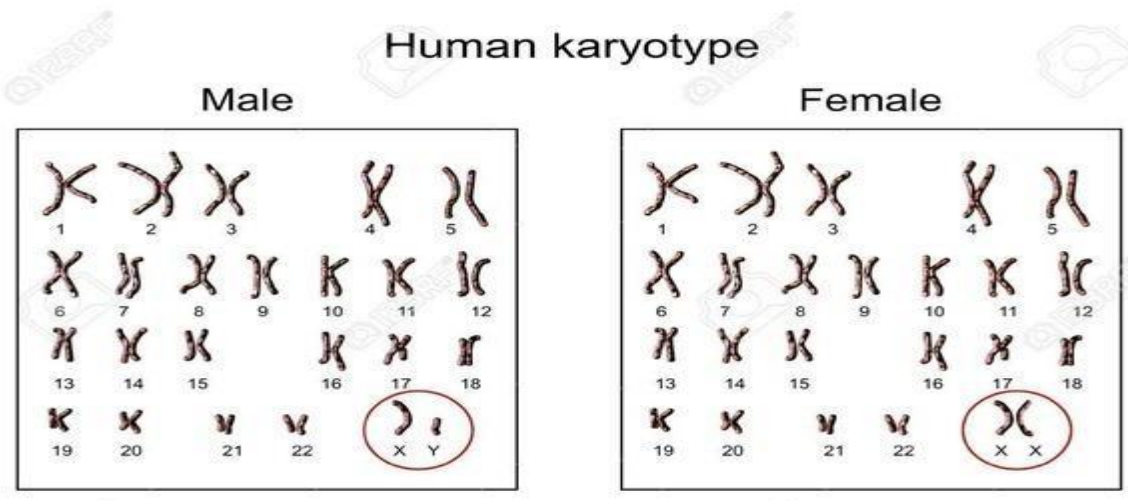
Penicillium, a fungus, has only one pair of chromosomes, while some ferns have more than 500 pairs.

Q:3What is Karyotype? What does it indicates?

Ans: Karyotype:

The particular array of chromosomes that an individual possesses is called its Karyotype.

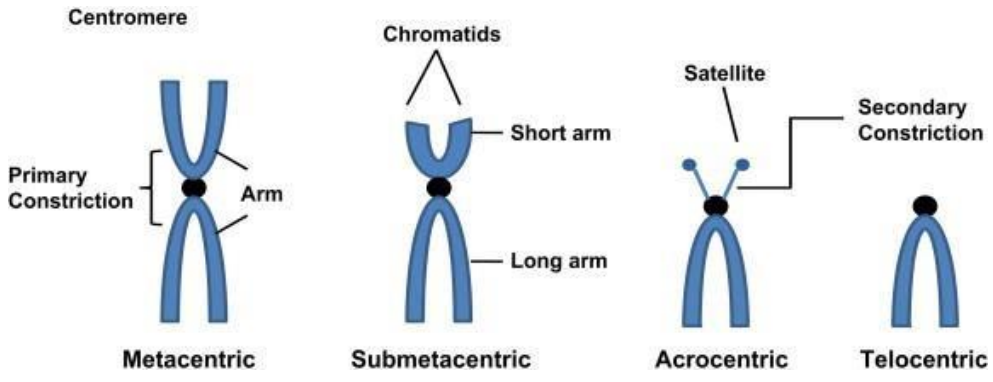
- They vary in size, staining properties, the location of centromere, the relative length of the two arms on either side of centromere, and the position of constricted regions along the arms.
- Karyotype show marked differences among species and sometimes even among individuals of same species.



Q:4 What are different types of Chromosomes depending upon location of centromere?

Ans: Types of Chromosomes depending upon location of centromere

The Chromosomes are called Telocentric, acrocentric sub metacentric and metacentric depending upon the location of centromere between the middle and tip of the chromosomes.



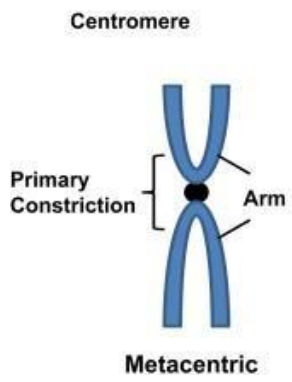
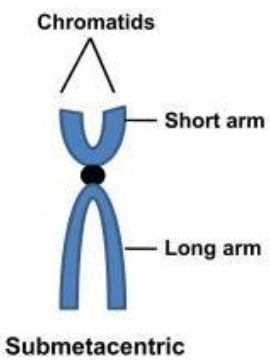
Q:5 Differentiate between Telocentric and Acrocentric chromosome.

Ans:

Telocentric chromosome	Acrocentric chromosome
• The chromosome in which centromere is located at one end and have only one arm is called telocentric chromosome.	• The chromosome in which centromere is located far away from the center and have a small arm and other large arm is called acrocentric chromosome.
• It has a single arm.	• It has a very short and a very long arm.
• It gives i shape to chromosome.	• It gives J shape to chromosome.
 Telocentric Chromosom	 Acrocentric Chromosome

Q:6 Differentiate between Metacentric and Sub metacentric chromosome.

Ans:

Metacentric chromosome	Sub metacentric chromosome
• The chromosome in which centromere is located at center and have two equal arms is called metacentric chromosome.	• The chromosome in which centromere is not located at center and have two unequal arms is called metacentric chromosome.
• The two arms have equal length.	• The two arms have unequal length.
• It gives V shape to chromosome.	• It gives L shape to chromosome.
 Metacentric	 Submetacentric

Q:7 What is the composition of chromosomes?

Ans: Composition of chromosomes:

Chromosomes are composed of DNA and protein. Mostly chromosomes are about:

- 40% DNA
- 60% protein

Q:8 How many nucleotides are contained in a typical human chromosome?

Ans:

A typical human chromosome contains about 140 million (1.4×10^8) nucleotides in its DNA.

Q:9 How much information is contained in one chromosome?

Ans:

The amount of information one chromosome contains would fill about 280 printed books of 1000 pages each, if each nucleotide corresponds to a word and each page had about 500 words on it.

Q:10 What is the length of a strand of DNA from a single chromosome?

Ans:

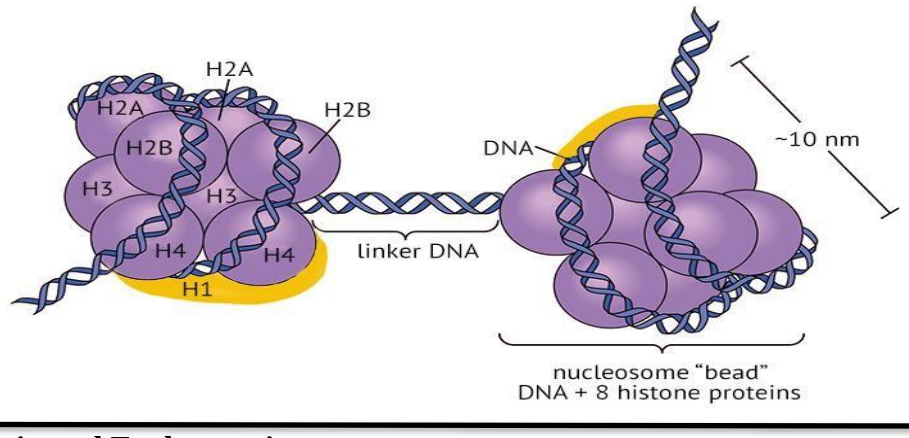
If the strand of DNA from a single chromosome were laid out in a straight line, it would be about 5 centimeter long.

Q:11 What are nucleosomes?

Ans: Nucleosomes:

Every 200 nucleotides, the DNA duplex is coiled around a core of eight histone proteins forming a complex known as a nucleosome.

- Unlike most proteins which have an overall negative charge, histones are positively charged due to an abundance of the basic amino acids, arginine and lysine.
- They are thus strongly attracted to the negatively charged phosphate groups of the DNA.



Q:12 Differentiate between Heterochromatin and Euchromatin.

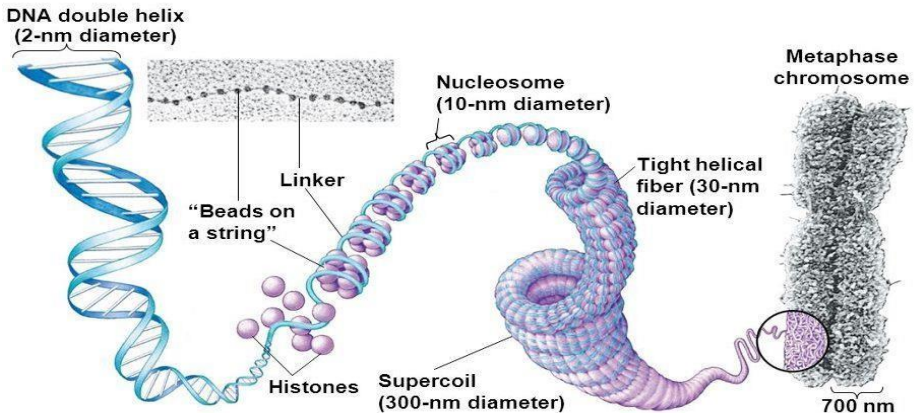
Ans:

Heterochromatin	Euchromatin
• Highly condensed portions of the chromatin are called hetero-chromatin. • Some part remains permanently condensed so the DNA is never exposed and is present in close configuration.	• Euchromatin is condensed only during cell division, when compact packaging facilitates the movement of the chromosomes. • At all other times, euchromatin is present in an open configuration and its genes can by expressed
• Heterochromatin is only present in eukaryotes.	• Euchromatin is present in both eukaryotes and prokaryotes.
• Heterochromatin is inactive.	• Euchroamtin is highly active.
• Heterochromatin is found at the periphery of nucleus.	• Euchromatin is found in the inner body of the nucleus.

Q:13 What are supercoils of DNA?

Ans: Supercoils of DNA:

The histone cores act as magnetic forms that promote and guide the coiling of the DNA. Further coiling occurs when the string of nucleosomes wraps up into higher order coils called supercoils.



Q:14 Define the chromosome theory of inheritance?

Ans: Chromosome theory of inheritance

According to this theory, the genes are physical units located on the chromosome.

- It means that one member of gene pair is located on one homologous chromosome and the other member of a gene pair is located on the other homologous chromosome.

Q:15Who repeated the experiments of Griffith?

Ans:

In 1944, in a classic series of experiments Oswald Avery along with Colin Macleod and Maclyn McCarty repeated Griffith's experiments and characterized what they referred to as the Transforming principle.

Q:16 What is transformation?

Ans: Transformation:

Transformation is the transfer of genetic material from one cell, to another and can alter the genetic up of the recipient cell.

Q:17 Why Hershey and Chase are famous for?

Ans:

In 1952 by Alfred Hershey and Martha Chase experimented with bacteriophages T2 and provided additional evidence supporting Avery's conclusion.

Q:18 What are the main components of DNA?

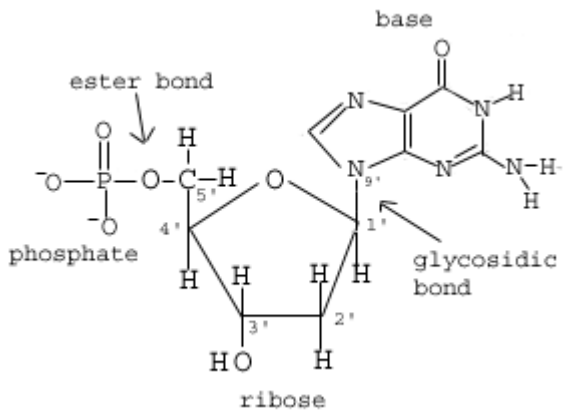
Ans: Main components of DNA:

- Phosphate (PO4) groups
- Five carbon sugar
- Nitrogen containing bases called purines (adenine, A, and guanine, G) and pyrimidines (thymine, T and cytosine, C, RNA contains uracil, U instead of T).

Q:19 What is the structure of a typical nucleotide?

Ans:

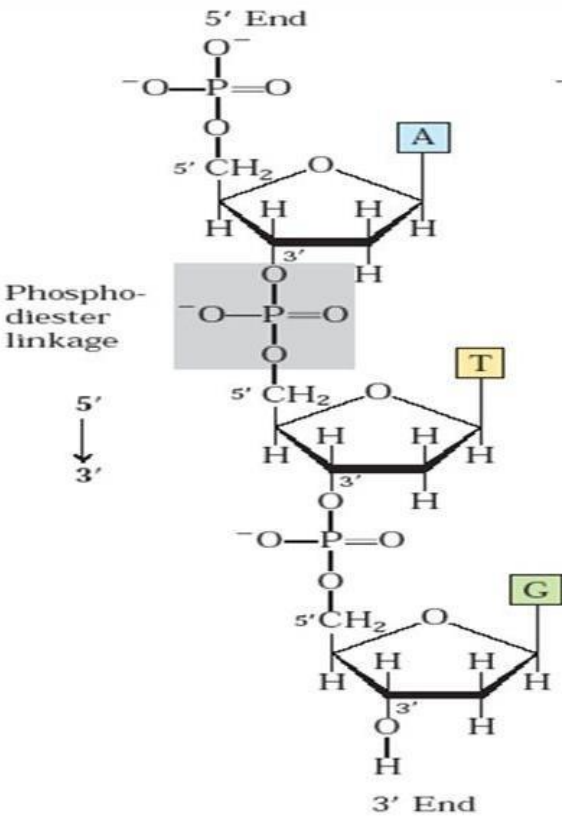
In a typical nucleotide, nitrogen base is attached to carbon number 1 of a pentose sugar and phosphate group is attached to carbon number 5 of the sugar. In addition a free hydroxyl (-OH) group is attached to the 3 carbon atom.



Q:20 What is phosphodiester bond or linkage?

Ans: Phosphodiester bond or linkage:

- The reaction between phosphate group of one nucleotide and hydroxyl group of another nucleotide is a dehydration synthesis, eliminating a water molecule.
- This reaction eliminates a water molecule and forming a covalent bond that links the two nucleotides.
- The linkage is called a phosphodiester bond because the phosphate group is now linked to the two sugars by means of a pair of ester (C-O-P-O-C) bonds.



Q:21 Who prepared the X-ray diffraction of DNA?

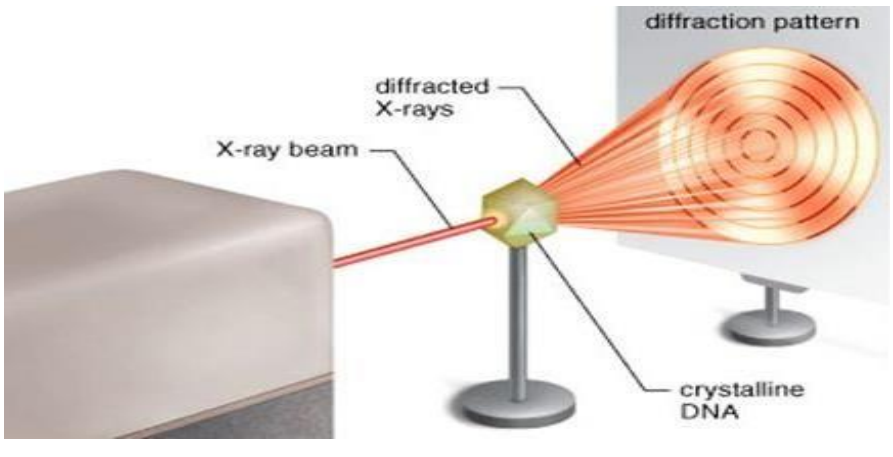
Ans:

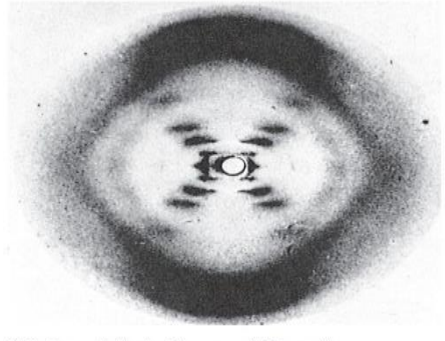
Rosalind Franklin prepared this X-ray diffraction pattern of DNA in the laboratory of British Biochemist Maurice Wilkins, who prepared DNA fibers.

Q:22 What is X-ray diffraction?

Ans: X-ray diffraction:

In this analysis a molecule is bombarded with a beam of X-rays. When individual rays encounter atoms their path is bent or diffracted and the diffraction pattern is recorded on the photographic film. When carefully analyzed this pattern gives three dimensional structure of a molecule.





(b) Franklin's X-ray diffraction photograph of DNA

Q:23 What does X-ray diffraction of DNA suggest?

Ans:

The diffraction pattern prepared suggested that the DNA molecule had a shape of a helix with a diameter of 2nm and a complete helical turn every 3.4 nm.

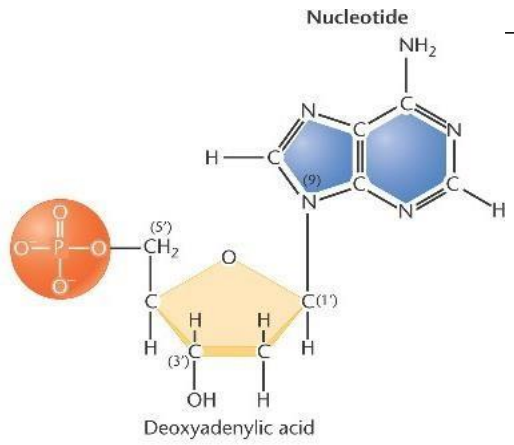
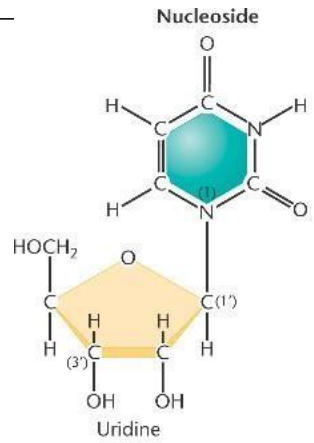
Q:24 What is the work of Chargaff?

Ans:

Erwin Chargaff showed that the amount of adenine in DNA always equals the amount of thymine, and the amount of guanine always equals the amount of Cytosine.

Q:25 Differentiate between Nucleotide and Nucleoside.

Ans:

Nucleotide	**Nucleoside**
• Nucleotide is made up of a Nitrogen base, Pentose sugar and Phosphate group.	• Nucleoside is made up of Nitrogen base and Pentose sugar.
• It is a basic unit/building block of nucleic acid (DNA, RNA).	• It is not a basic unit/building block of nucleic acid (DNA, RNA).
• **Examples:** ATP, ADP, AMP etc.	• **Examples:** Adenosine, Guanosine, Thyamine etc.
 Deoxyadenylic acid	 Uridine

Q:26 Who proposed the double helical structure of DNA?

Ans:

In 1953, James Watson and Francis Crick, proposed structure of the DNA molecule.

Q:27 What was work of Meselson - Stahl?

Ans: Meselson – Stahl's work:

The three hypothesis of DNA replication were evaluated by Mathew Meselson and Franklin Stahl of the California Institute of Technology in 1958.

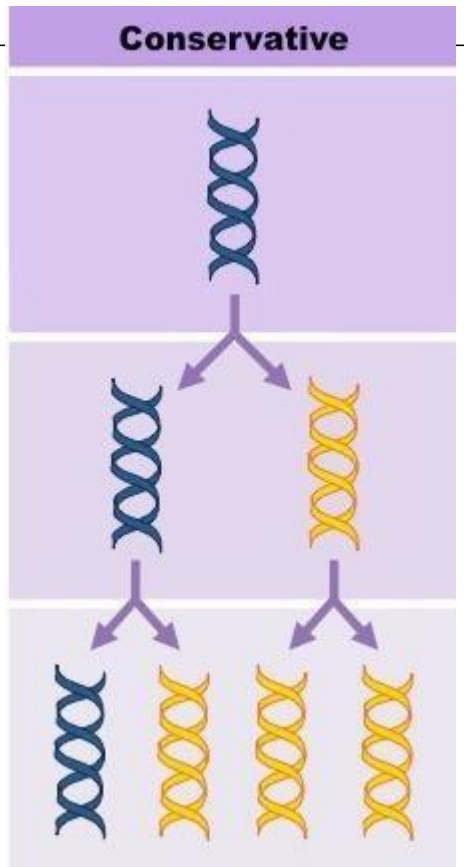
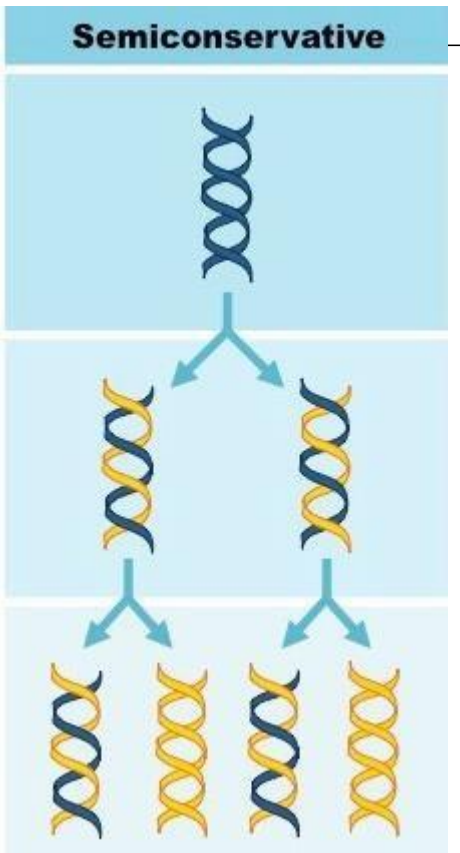
These three models are as follows:

- Conservative model of DNA replication
- Semi-conservative model of DNA replication
- Dispersive Replication of DNA

Q:28 Define Replication. Differentiate between Conservative and Semi-conservative model of replication.

Ans: Replication:

The process by which DNA of a living organism gives rise to a copy of itself is called DNA replication.

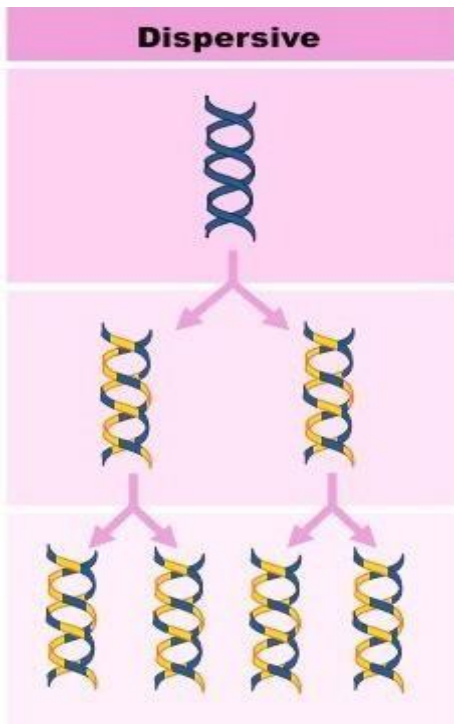
Conservative model of replication	Semi-conservative model of replication
• In this model whole of the parental DNA is conserved. • The conservative model stated that the parental double helix would remain intact and generate DNA copies consisting of entirely new molecules.	• In this model half of the parental DNA strands are conserved. • In semi conservative replication, the two strands of the duplex separate out each acting as a model or mold, along which new nucleotides are arranged thus giving rise to two new duplexes.
• Both primary and secondary structures of DNA are conserved.	• Only primary structure is conserved while secondary structure diminishes.
• It is not acceptable model of DNA replication.	• It is acceptable model of DNA replication.
	

Q:29 What is Dispersive Replication of DNA?

Ans: Dispersive Replication of DNA:

The dispersive model predicted that parental DNA would become dispersed throughout the new copy so that each strand of all the daughter molecules would a mixture of old and new DNA.

- During this type of replication parental DNA completely disperse in daughter strands.
- It is not acceptable model of DNA replication.



Q:30 What are the role of DNA polymerase I, II and III?

Ans: Role of DNA polymerase I, II and III:

- **DNA polymerase I** is a relatively small enzyme that plays a supporting role in DNA replication.
- **DNA polymerase II** plays a role in DNA repair.
- **DNA polymerase III** is a dimmer and catalyzes replication of one DNA strand. Polymerase III progressively threads the DNA through the enzyme complex moving it at a rapid rate of some 1000 nucleotides / second.

Q:31 What is the direction of replication on growing DNA strand?

Ans: Direction of replication on growing DNA strand:

Replication always procedes 5→3 direction on a growing DNA strand because DNA polymerase III can add nucleotides only to the 3 end of a DNA strand.

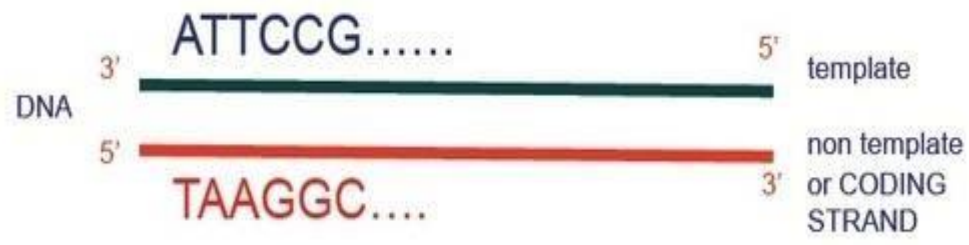
Q:32 What is the role of DNA ligase?

Ans: Role of DNA ligase:

DNA ligase, attaches the repaired fragments of the lagging strand.

Q:33 Differentiate between Template strand and Coding strand.

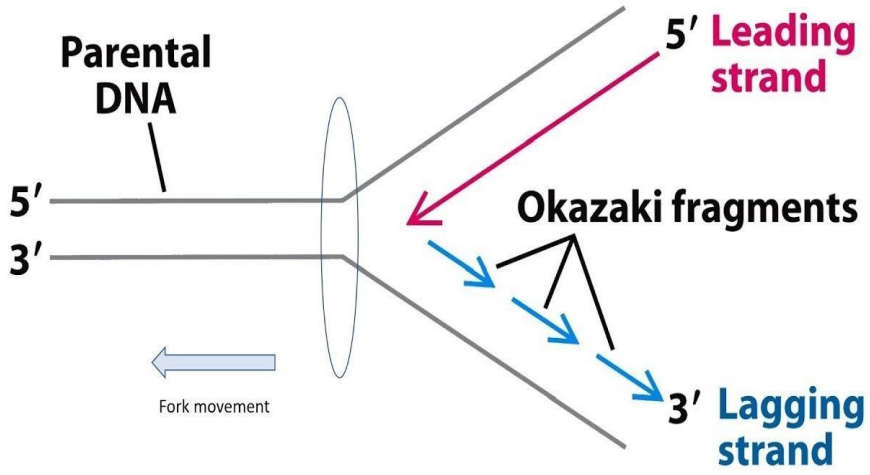
Ans:

Template strand	Coding strand
• One of the DNA strands which is transcribed called template.	• The opposite strand which is not transcribed is called coding strand.
• It is also called as antisense/anticoding strand.	• • It is also called as sense strand.
• RNA polymerase copies this strand that will become complementary and match with sequence of sense strand that is needed.	• This is the strand whose exact sequence is required in mRNA.
	

Q:34 What are Okazaki fragments?

Ans: Okazaki fragments:

- Okazaki fragments are formed during DNA replication. It is short segment of DNA.
- These Okazaki fragments are attached y ligase enzyme.
- It is formed by DNA polymerase III from 5′ 3′ direction, when replication takes place away from replication fork.
- They are about 100 200 nucleotides long in eukaryotes and 1000 2000 nucleotides long in prokaryotes.



Q:35 What is the role of the enzyme primase in replication?

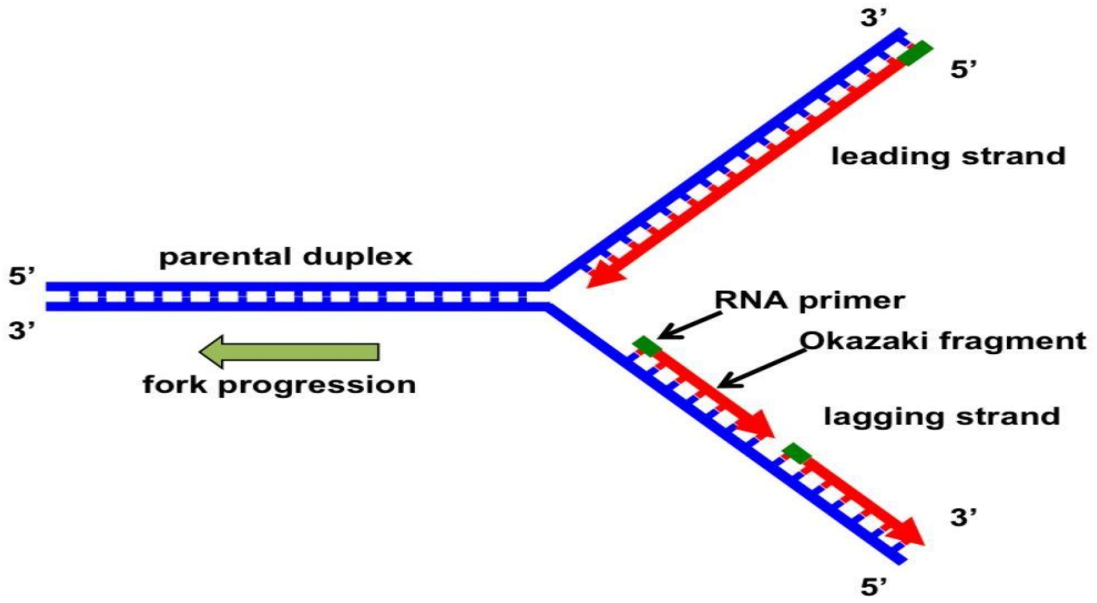
Ans: Role of primase enzyme:

- To initiate replication the primase constructs an RNA primer, (a sequence of about 10 RNA nucleotides complementary to the parent DNA
  template). DNA polymerase III recognizes the primer and adds DNA nucleotides to it to construct DNA strand.
- The RNA nucleotides in the primer are then replicated by DNA nucleotides.
- Replication cannot be replicated without primer.

Q:36 Differentiate between Leading strand and Lagging strand.

Ans:

Leading strand	Lagging strand
• The strand of DNA that is assembled toward the replication fork is called leading strand.	• The strand of DNA that is assembled away from the replication fork is called lagging strand.
• Leading strand exhibits continuous replication.	• Lagging strand exhibits discontinuous replication.
• Okazaki fragment cannot be formed in leading strand synthesis.	• Okazaki fragment can be formed only in leading strand synthesis.
• DNA-ligase is not required for leading strand synthesis.	• DNA-ligase is required for lagging strand synthesis.
• DNA replication on the leading strand needs to be primed only once.	• DNA replication on lagging strand synthesis requires new primers often to accommodate repetitive initiation events.



Q:37 What is Alkaptonuria?

Ans: Alkaptonuria:

- It is disorder in which the patients produced urine that contained homogentisic acid. This substance oxidized rapidly when exposed to air, turning the urine black.
- In normal individuals, homogentisic acid is broken down into simpler substances.

Q:38 Why Beadle and Tatum are famous for?

Ans:

Beadle and Tatum performed experiment on Neurospora, fungus, and concluded that each gene encodes the structure of one enzyme. This is also called one gene one enzyme hypothesis.

Q:39 What do you know about One-gene / One polypeptide hypothesis?

Ans: One-gene / One polypeptide hypothesis:

- Beadle and Tatum conclude that gene produce their effects by specifying the structure of enzyme. This relationship was termed as one gene one enzyme.
- But many enzymes contain multiple proteins and polypeptides subunits, each encoded by a separate gene. Thus this relationship is today more commonly referred to as one gene / one polypeptide.

Q:40 Why Sanger was famous for?

Ans: Work of Sanger:

- In 1953, Frederick Sanger, described the complete sequence of amino acids of insulin.
- Sanger's achievement was significant, as it was demonstrated for the first time that proteins consisted of definable sequences of amino acids.

Q:41 Why Vernon Ingram is famous for?

Ans: Work of Vernon Ingram:

- Vernon Ingram in 1956 discovered the molecular basis of sickle cell anaemia.
- He showed that sickle cell anaemia is caused by a change from glautamic acid to valine at position 6 in one chain of haemoglobin.

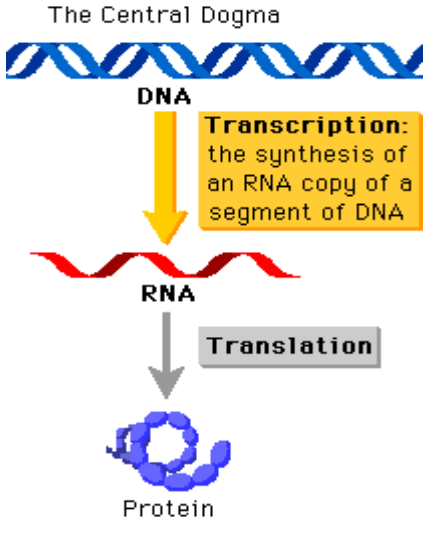
Q:42 What is meant by Central dogma?

Ans: Central dogma:

The mechanism of reading and expressing of genes is referred as central dogma.

It consists of two main steps:

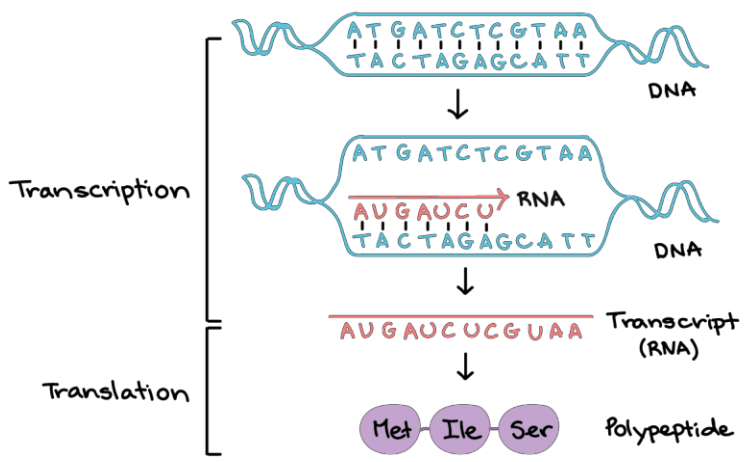
i. Transcription: Synthesis of mRNA from DNA.
ii. Translation: Synthesis of protein at ribosomes using information from mRNA.



Q:43 Compare Transcription and Translation.

Ans:

Transcription	**Translation**
• The synthesis of mRNA from the DNA is called transcription. OR • The process by which the nucleotide sequence of the mRNA is translated into an amino acid sequence in the polypeptide is called translation.	• The synthesis of proteins from mRNA is called translation.
• RNA is involved in this process.	• Only DNA is used to synthesize RNA.
• RNA polymerase enzyme catalyzes this process.	• This process is started by start codon i.e, AUG.
• This process is termed by stop signal i.e, series of GC base pairs followed by series of AT base pairs.	• This process is stopped by stop codons i.e, UAA, UAG and UGA.



Q:44 What is Promotor?

Ans: Promoter:

Transcription is initiated when the enzyme RNA polymerase binds to a particular binding site called a promoter located at the beginning of the gene.

Q:45 What is the stop signal for transcription?

Ans: Stop signal for transcription:

The simplest stop signal is a series of GC base pair followed by a series of AT base pairs. The RNA forms a GC hairpin followed by four or more U ribonuleotides. The hairpin causes RNA polymerase to stop synthesis.

Q:46 What is core enzyme?

Ans: Core enzyme:

When sigma subunit is detached from other subunits of RNA polymerase then enzyme is called core enzyme.

Q:47 Differentiate between Codon and Anticodon.

Ans:

Codon	Anticodon
• A sequence of 3 nucleotides along strand of mRNA is called codon.	• A sequence of 3 nucleotides along strand of tRNA is called anticodon.
• Codon could be present in both RNA and DNA.	• Anticodon is always present on RNA and never in DNA.
• Codons are sequentially arranged in nucleic acid strands. • **Examples:**	• Anticodons are discretely present in cells with amino acids attached or not. • **Examples:**
AUG (start codon) UAG, UAA, UGA (stop codon)	UAC (anticodon of start codon) UAC (anticodon of stop codon i.e. UAG)

Q:48 How many binding sites are found in in promoter of prokaryote and eukaryote?

Ans:

- In prokaryote within promoter there are two binding sites TTGACA also called -35 sequence and TATAAT also called -10 sequence, which have affinity for the RNA polymerase.
- In Eukaryotes these sites are at -25 and -70 sites.

Q:50 Why a cap and a tail is added to mRNA?

Ans:

A cap and a tail is added to mRNA so that the molecule may remain stable during long journey to ribosome.

Q:51 What is genetic code?

Ans: Genetic code:

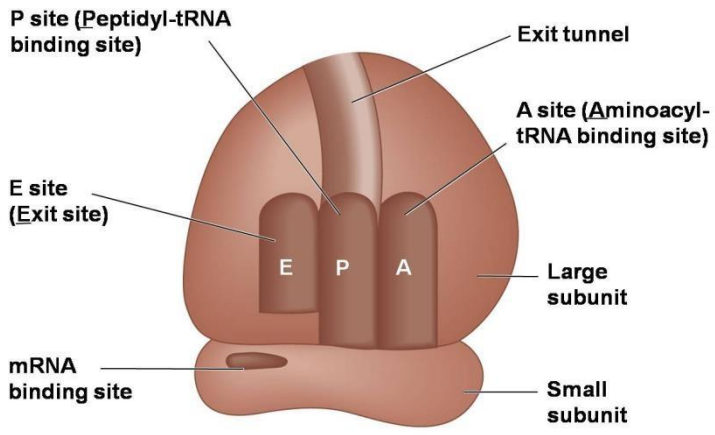
Genetic code is a combination of 3 nucleotides in DNA, which specify a particular amino acid.

Example:

- AUG (methionine)
- UGG (tryptophan)

Q: 52 Differentiate between Peptidyl site and Aminoacyl site on initiation complex at the time of translation.

Ans:

Peptidyl site	Aminoacyl site
• "P" or peptidyl site present on larger ribosomal subunit is used to form peptide bond between the adjacent amino acids. • It is present in between A site and E site on larger ribosomal subunit.	• "A" or aminoacyl site present on larger subunit is the one where successive amino acids bearing tRNAs will bind. • It is present before P site on larger ribosomal subunit.
	

Q:52 What is RNA polymerase? Give its role in transcription.

Ans: RNA polymerase:

RNA polymerase form RNA strands from ribonucleotides.

OR

The RNA polymerase enzyme synthesisze RNA from 5′ to 3′ direction.

Role of RNA polymerase enzymes:

- In prokaryotes there is only one type of RNA which is responsible for the synthesis of all three types of RNAs viz rRNA, mRNA and tRNA.
- In eukaryotes there are three types of RNA polymerases namely:
  i. **RNA polymerase I,** which synthesize rRNA
  ii. **RNA polymerase II,** which synthesize mRNA
  iii. **RNA polymerase III,** which synthesize tRNA

Q:53 Differentiate between DNA and RNA polymerase.

Ans:

DNA polymerase	RNA polymerase
• DNA polymerase forms a DNA strand from Deoxyribonucleiotides.	• RNA polymerase forms RNA strands from ribonucleotides.
• DNA polymerase starts to function from a 3′ end of the DNA strand.	• RNA polymerase can start to function at anywhere of the DNA strand from 3′ end to 5′ end direction.

Q:54 Differentiate between DNA replication in Prokaryotes and Eukaryotes.

Ans:

DNA replication in Prokaryotes	DNA replication in Prokaryotes
• Duration of DNA replication in prokaryotes is smaller. • In prokaryotes, a single replication sites are present in circular DNA molecule.	• Duration of DNA replication in eukaryotes is larger than prokaryotes. • In eukaryotes, multiple replication sites are present in the single DNA molecule.
• In prokaryotes, DNA replication involves three types of polymerase enzymes namely, DNA polymerase I, DNA polymerase II and DNA polymerase III.	• In contrast, DNA replication of eukaryotes involves four types of polymerase enzymes namely, α, β and δ.
• Functional variety of DNA polymerase is diverse in prokaryotes.	• Functional variety of DNA polymerase is specific in eukaryotes.
• In eukaryotes, many replication forks are formed.	• In eukaryotes, many replication forks are formed.

Q.55 Differentiate between translation f Prokaryotes and Eukaryotes.

Ans:

Prokaryotic translation	Eukaryotic translation
• As there is no nuclear envelop prokaryotic translation takes place close to the genetic material.	• Eukaryotic translation takes place in the cytoplasm and never inside the nucleus due to the presence of nuclear envelope.
• No such steps like protein capping and RNA splicing take place in prokaryotic translation.	• Protein capping and RNA splicing take place before translation in eukarotes.
• Translation starts as the dismantling of the DNA and synthesizing of mRNA strand take place in prokaryotes.	• Eukaryotic translation starts after completion of mRNA synthesis and protein capping with splicing.
• Involved ribosomal subunits in prokaryotic translation are 30S and 50S.	• Involved ribosomal subunits in eukaryotic translation are 40S and 80S.
• Initiation amino acid in prokaryotes is N-formyl methionine.	• Initiation amino acid in eukaryotes is methionine.

Q:56 Differentiate between mRNA and tRNA.

Ans:

	mRNA	tRNA
Number of strands	Single stranded	Single stranded
Location	In nucleus and cytoplasm (mainly ribosomes)	Only in ribosomes
Amount	3-4%	80%
Functions	It is made on the DNA template. It carries coded instructions (codons) from nucleus to ribosomes for the synthesis of proteins.	Forms part of ribosome structure. Helps in locating mRNA correctly on ribosome surface.

Q:57 Define Mutation?

Ans: Mutation:

Mutation is defined as permanent change in the cell DNA.

- **It includes changes in:**
  - Nucleotides sequence
  - Alteration of gene position
  - Gene loss
  - Duplication
  - Insertion of a foreign sequence
- **Mutations are of the two types:**
  - Chromosomal aberrations and
  - Point mutations

Q:58 Differentiate between Chromosomal aberrations and Point mutations.

Ans:

Chromosomal aberrations	**Point mutations**

• The change in number or structure of chromosomes is called chromosomal aberration.
• Chromosomal aberration involve:
  • Presence of an extra chromosome
  • Loss of chromosome from the diploid number of chromosomes
  • Changes like deletion, insertions, inversions etc. in the parts of chromosomes
• **Example:** Down's syndrome and Klinefilter's syndrome etc.
	• The mutational changes producing alterations in the sequence of DNA molecule, which affect the message itself, are called point mutation.
	• Point mutation occur due to:
	  • Spontaneous pairing errors that occur during DNA replication.
	  • Other results from damage to the DNA caused by mutagens, usually radiations and chemicals.
	• **Example**: Sickle cell anaemia and phenylketonuria etc.

Q:59 What is Sickle cell anaemia?

Ans: Sickle cell anaemia:

- In Sickle cell anaemia a point mutation leads to the change of amino acid glutamic acid into valine at position 6 from N terminal end in haemoglobin B chain.
- This reduces its ability to carry oxygen.

Q:60 What is Phenylketonuria?

Ans: Phenylketonuria:

- In phenylketonuria, phenylalanine is not degraded because of defective enzyme phenylalanine hydroxylase.
- Phenylalanine consequently accumulates in the cells leading to mental retardation as the brain fails to develop in infancy.

Exercise MCQ's

❖ **Encircle the correct answer from the multiple choices:**

1) mRNA is synthesized by:
a) DNA polymerase b) RNA polymerase c) RNA ligase d) None of above

2) Which of the following are nonsense codons?
a) AUG b) UAA c) CUA d) All of the above

3) Enzymes are responsible for assembly of:
a) Nucleic acid b) Protein c) Carbohydrates d) All a, b and c

4) In bacteria the newly synthesized mRNA is released in:
a) Nucleus b) Cytoplasm c) Mitochondria d) Both a and b

Answer key:

1	b	**2**	b	**3**	d	**4**	b

Additional Important MCQ's

❖ **Encircle the correct answer from the multiple choices:**

Chromosomes

1) In 1882, chromosomes were discovered:
a) Walther Flaming b) W.S. Sutton c) T.H. Morgan d) Salamander larvae

2) Walther Fleming discovered Chromosomes in the dividing cells of:
a) Frog larvae b) Sea urchin larvae c) insect larvae d) Salamander larvae

3) Chromosomes appear inside the nucleus at the time of:
a) Cell division b) Cell elongation c) Cell maturation d) Cell differentiation

4) The number of chromosomes in corn is:
a) 40 b) 26 c) 20 d) 80

5) The number of chromosomes in frog is:
a) 6 b) 26 c) 40 d) 46

6) The number of chromosomes in mouse is:
a) 6 b) 32 c) 26 d) 40

7) Number of chromosome present in honey bee are:
a) 6 b) 20 c) 32 d) 40

8) A sugarcane cell has _____ chromosomes:
a) 20 b) 32 c) 40 d) 80

9) Centromere represents:
a) Primary constriction b) Secondary constriction c) Tertiary constriction d) Quaternary constriction

10) The particular array of chromosomes that an individual possesses is called:
a) Genotype b) Phenotype c) Wild type d) Karyotypes

11) Morphological characteristics of chromosomes are collectively called:
a) Holophyte b) Karyokinesis c) Karyotypes d) Neotype

12) The chromosome having centromere in the center are called:
a) Telocentric b) Acrocentric c) Sub-metacentric d) Metacentric

13) V-shaped chromosomes are called:
a) Sub-metacentric b) Telocentric c) Metacentric d) Acrocentric

14) Most of chromosomes consist DNA:
a) 90% b) 20% c) 40% d) 70%

15) Unlike most proteins, histones are ……
a) Positively charged b) Negatively charged c) Neutral d) Discharged

16) Highly condensed portions of chromatin are called:
a) Homochromatin b) Euchromatin c) Heterochromatin d) Achromatin

17) Chromosomal part which uncoils, during inter phase is called:
a) Euchromatin b) Heterochromatin c) Chromatid d) Satellite DNA

18) The base pairs in human genome are:
a) 2 million b) 3 billion c) 4 billion d) 5 billion

19) How many million nucleotides are in DNA of human typical chromosome:
a) 140 b) 160 c) 180 d) 200

20) Nucleosome occur every:
a) 50 nucleotides b) 100 nucleotides c) 150 nucleotides d) 200 nucleotides

21) Every 200 nucleotides, the DNA duplex is coiled around a core of eight histone proteins forming a complex:
a) Euchromatin b) Heterochromatin c) Nucleosome d) Polysome

22) Chromosome is made of:
a) 2 chromatids +1 centromere +secondary constriction
b) 1 chromated + 1 centromere + primary constriction
c) 2 chromatids + 1 centromere + primary constriction
d) 2 chromatids + 2 centromere + secondary constriction

23) Chromosomes are composed of:

a) 40% protein and 60% DNA
b) 50% protein and 50% DNA
c) 70% protein and 30% DNA
d) 60% protein and 40% DNA

24) Histones have abundance of amino acids:

a) Valine and lysine b) Arginine and lysine c) Valine and arginine d) Histidione and threonine

25) Which is incorrect about nucleosome:

a) 2 turns of DNA coiled round histones
b) 8 histones as acidic proteins
c) 200 nucleotides in one nucleosome
d) None of these

DNA as heredity material

26) A central role for chromosomes in heredity was first suggested in 1900 by:

a) Karl Correns b) W.S. Sutton c) T.H. Morgan d) F. Griffith

27) Chromosomal theory of inheritance was first of all formulated by:

a) Karl Correns b) W.S. Sutton c) T.H. Morgan d) F. Griffith

28) Transfer of genetic material from one cell to other that can alter genetic makeup of recipient cell is:

a) Transformation b) Translation c) Transcription d) Replication

29) Which is incorrect?

a) Chromosomes 1st observed by walther Fleming
b) Chromosomal theory of inheritance 1st formulated by Walter Sutton
c) 1st evidence of hereditary nature of DNA provided by Friedrich Meischer
d) Sex chromosomes discovered by Thomas Hunt Morgan

30) Hershey and Chase labeled the DNA with radio isotopes:

a) P^{32} b) S^{35} c) S^{32} d) P^{35}

31) In semi-conservative replication:

a) Sequence of original duplex is conserved after one round of replication
b) Generate DNA copies of entirely new molecules
c) Parental DNA become completely dispersed
d) Each strand of daughter molecules will be a mixture of old and new

32) Which of the following can kill mice if injected separately?

a) Live R type pneumococcus
b) Heat killed R type pneumococcus
c) Live S type pneumococcus
d) Heat killed S type pneumococcus

DNA Structure

33) The basic structure of nucleic acids was determine by:

a) Weston and Crick b) Maurice Wilkins c) P.A. Levene d) Vernon Ingram

34) Who discovered DNA?

a) P.A.Levene b) Frederick Griffith c) Friedrich Miescher d) Rosalind Franklin

35) X-Ray diffraction pattern of DNA was prepared by:

a) Rosalind Franklin b) Maurice Wilkins c) Watson d) Crick

36) DNA was discovered in:

a) 1869 b) 1864 c) 19961 d) 1971

37) Repeating units in DNA are called:

a) Histone (Nucleosomes) b) Nucleoside c) Nucleotide d) Amino acids

38) DNA completes a helical turn every …… nm and has …… base pairs.

a) 0.34, 12 b) 2, 12 c) 3.4, 10 d) 3.4, 12

39) The two strands in DNA are coiled ……. to each other:

a) Parallel b) Antiparallel c) Both a & b d) None of these

40) DNA contains:

a) Purines (A and G) pyrimidines (U and C)
b) Purines (T and C) pyrimidines (A and G)
c) Purines (A and C) pyrimidines (U and G)
d) Purines (A and G) pyrimidines (T and C)

41) In DNA:

a) A forms two bonds with T b) G forms three bonds with C c) A forms three bonds with T d) Both a and b

42) DNA has a helical shape with the diameter of:

a) 3 nm b) 4 nm c) 2 nm d) 5 nm

DNA Replication

43) DNA polymerase is extracted from:

a) Virus b) Bacteria c) Fungi d) Protist

44) In what direction can a DNA polymerase work when catalyzing the addition of nucleotide monomers to build a:

a) From the 5′ toward the 3′ end of the new strand being assembled
b) From the 3′ toward the 5′ end of the started being assembled
c) From replication centers in two directions called replication forks
d) In both directions if DNA ligase is present

45) The strand that elongates towards the replication fork:

a) Leading b) Lagging c) Okazaki d) Primer

46) Each Okazaki fragment is synthesized by:

a) DNA polymerase b) DNA polymerase-I c) DNA polymerase-II d) DNA polymerase-III

47) The true E.Coli replicating enzyme is:

a) DNA polymerase I b) DNA polymerase II c) DNA polymerase III d) All of these

48) DNA synthesis is:

a) Unidirectional b) Bidirectional c) Nondirectional d) Multidirectional

49) Rate of DNA replication by DNA polymerase is:

a) 2000 nucleotides / sec b) 1000 nucleotides / sec c) 150 nucleotides / sec d) 1050 nucleotides / sec

50) Replication always proceeds in a direction:

a) 3' → 5' b) 5' → 3' c) Both directions d) None of these

51) Which statement is correct?

a) Leading strand elongates away from the replication fork
b) Lagging strand elongates towards the replication fork
c) Lagging strand is constructed discontinuously
d) Both a and b

52) In prokaryotes there are:

a) Three types of DNA polymerases
b) One type of RNA polymerase
c) Three types of RNA polymerase
d) Both a and b

What is Gene?

53) In sickle cell anemia a point mutation leads to the change of amino acid i.e. glutamic acid:

a) Arginine b) Lysine c) Valine d) Alanine

54) In sickle cell anemia disease, a single thymine is replaced with an adenine in the DNA that codes for:

a) Arginine b) Lysine c) Valine d) Alanine

55) In 1953, F.Sanger described the complete sequences of Amino Acids of:

a) Myoglobin b) Keratin c) Insulin d) Globulin

Central dogma and RNA Types

56) How many different kinds of transfer RNAs are in Human Cell:

a) 20 b) 25 c) 45 d) 54

57) Anticodes (Anticodons) are present on:

a) mRNA b) tRNA c) rRNA d) DNA

58) Amino acid attachment site of tRNA is:

a) G-end b) 2′ end c) 3′ end d) 5′ end

59) Central dogma is:

a) Transfer of information from DNA to mRNA
b) Basic mechanism of reading and expressing genes
c) Transfer of information from RNA to proteins
d) Synthesis of all three types

Transcription

60) Copying of mRNA from DNA is called:

a) Translation b) Transduction c) Transformation d) Transcription

61) mRNA is synthesized by:

a) DNA polymerase b) DNA ligase c) RNA polymerase d) Endonuclease

62) RNA polymerase II synthesizes:

a) mRNA b) tRNA c) rRNA d) cDNA

63) Which strand of DNA is transcribed:

a) Coding b) Sense c) Template d) Both strand

64) The stop signal GC series of base pairs is the part of:

a) DNA b) mRNA c) tRNA d) rRNA

65) In eukaryotes newly synthesized mRNA:

a) Travels a large distance from nucleus to cytoplasm
b) Is directly released into the cytoplasm
c) Contains a cap and tail
d) Both a and c

66) Strand of DNA which is not transcribed is called:

a) Antisense b) Template c) Coding d) None of these

Genetic Code

67) Genetic code is combination of …… nucleotides:

a) 2 b) 4 c) 5 d) 3

68) Every gene starts with initiation codon AUG which normally encodes, the amino acid:

a) Arginine b) Citrulline c) Lysine d) Methionine

69) Which one of the following is initiation/start codon:

a) AUG b) GUA c) UGA d) GAC

70) One of the given does not code for any amino acid:

a) AUG b) ACU c) GUA d) UAA

71) Which of the following is non-sense codon?

a) UGA b) UGG c) AUG d) AUC

72) Which is not stop signals?

a) UAA b) UUU c) UAG d) UGA

73) Which 3 codons are nonsense codons?

a) UAA,UAU,UUA b) UGA,UAG,UAA c) UGG,UGA,UAU d) UGG,UAA,UAG

74) Methionine is specified by:

a) Stop codon b) AUG c) Start codon d) Both b and c

75) In mitochondria UGA is/specifies as:

a) Stop codon b) Tryptophan c) Initiation codon d) Methionine

76) Three nucleotide sequences on tRNA that specifies an amino acids is:

a) Codon b) Anticodon c) Nonsense codon d) Genetic code

Translation

77) The sequence of nucleotides that determine the amino acid sequence of a protein is called:

a) Allele b) Multiple alleles c) Chromosomes d) Gene

78) Initiation complex in translation is composed of:

a) Ribosome and aminoacyl-tRNA b) Ribosome and tRNA c) tRNA and aminoacyl-tRNA d) None of these

Mutation

79) Change in the nature of gene is known as:

a) Incomplete dominance b) Mutation c) Pleiotropy d) Polygeneic trait

80) This condition appears as a result of point mutation:

a) Down syndrome b) Turner syndrome c) Klinefilter syndrome d) Sickle cell anemia

81) Phenylketonuria is a well-known example of:

a) Point mutation b) Insertion c) Inversion d) Deletion

82) Examples of chromosomal aberrations are:

a) Sickle cell anemia b) Phenylketonuria c) Down's syndrome d) Both a and b

83) Phenylketonuria is due to deficiency of:

a) Phenylalanine b) Phenylalanine hydroxylase c) Phenylene d) All of these

84) Point mutations are represented as:

a) Presence of an extra chromosome
b) Loss of chromosome
c) Alteration in sequence of DNA nucleotide
d) Insertions and inversion of genes

85) Molecular basis of sickle cell anaemia was found by:

a) F. Sanger b) Beadle and Tatum c) Vernone Ingram d) Mendal

86) In sickle cell Hb, which chain is affected?

a) Alpha chain b) Beta Chain c) Both of these d) None of these

Answer Key:

1	a	**2**	d	**3**	a	**4**	c	**5**	b	**6**	d	**7**	c	**8**	d	**9**	a	**10**	d
11	c	**12**	d	**13**	c	**14**	c	**15**	a	**16**	c	**17**	a	**18**	c	**19**	a	**20**	d
21	c	**22**	a	**23**	d	**24**	b	**25**	b	**26**	a	**27**	b	**28**	a	**29**	c	**30**	a
31	a	**32**	c	**33**	c	**34**	c	**35**	a	**36**	a	**37**	c	**38**	c	**39**	c	**40**	d
41	d	**42**	c	**43**	b	**44**	a	**45**	a	**46**	d	**47**	c	**48**	b	**49**	b	**50**	b
51	c	**52**	d	**53**	c	**54**	c	**55**	c	**56**	c	**57**	b	**58**	c	**59**	b	**60**	d
61	c	**62**	a	**63**	c	**64**	a	**65**	d	**66**	c	**67**	d	**68**	d	**69**	a	**70**	d
71	a	**72**	b	**73**	b	**74**	d	**75**	b	**76**	b	**77**	d	**78**	b	**79**	b	**80**	a
81	a	**82**	d	**83**	b	**84**	c	**85**	c	**86**	b								

Past MDCAT MCQ's

2008

1) In what direction, can a DNA polymerase work when catalyzing the addition of nucleotide monomers to build a strand of DNA?

a) From the 5' toward the 3' end of the new strand being assembled
b) From the replication centers in two directions called replication forks
c) From the 3' to the 5' end of the strand being assembled
d) In both directions if DNA ligase is present.

2) Which of the following has 40 chromosomes?

a) Corn b) Frog c) Sugarcane d) Mouse

3) The two strands in DNA are coiled to each other:

a) Parallel b) Both A, C c) Antiparallel d) None of these

2009

4) If DNA strand is GCTATGG mRNA strand synthesized from it would be:

a) CGAUACC b) CGATACC c) CGTATGC d) CGUTCC

5) The reaction between the phosphate group of one nucleotide and hydroxyl group of another is a synthesis in DNA molecule:

a) Dehydration b) Oxidation c) Rehydration d) Reduction

6) Enzyme which attaches the Okazaki fragments in lagging strand is called:

a) Restriction endonuclease b) DNA helicase c) Primase d) DNA ligase

7) In phenylketonuria, phenylalanine is not degraded because of defective enzyme:

a) Phenylalanine hydrogenase b) Phenylalanine oxidase c) Phenylalanine phosphate d) None of these

2010

8) Sickle cell Anemia is an example of which type of chromosomal defect?

a) Chromosomal rearrangement b) Chromosomal aberration c) Transposition of gene d) Point mutation

9) The karyotype of an individual is …… of chromosomes:

a) Number
b) Number, types and chemical composition
c) Types
d) Number and types

10) The process of replication of DNA begins at:

a) One place only without any specific sequence of DNA
b) One or more places without any specific sequence of DNA
c) Any place with the uncoiling of two strands of DNA
d) One or more places where there is a specific sequence of nucleotides

11) Amino acid attaches at which site of RNA:

a) Anticodon site
b) 3'-site with terminal OH
c) Ribosomes recognition site
d) Activation enzyme recognition site

2011

12) The combination of a pentose sugar with a base result in a compound is known as:

a) Nucleotide b) Nucleic Acid c) Nucleoside d) Polynucleotide

13) One of the pyrimidine bases is absent in DNA:

a) Uracil b) Cytosine c) Thymine d) Adenine

2012

14) Which of the following combination of base pair is absent in DNA?

a) A–T b) A–U c) C–G d) T–A

2013

15) Phenylketonuria is an example of:

a) Polyploidy b) Inversion c) Transmutation d) Point mutation

2014

16) If the genetic code is made up of three nucleotides, then total possible genetic codes will be:

a) 4 b) 64 c) 20 d) 61

17) In translation the terminating codon is:

a) GUA b) UUG c) UAA d) AGU

2015

18) Number of base pairs in one turn of DNA is:

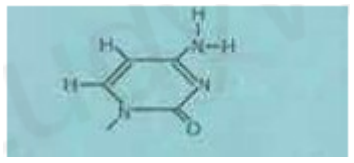
a) 10 b) 34 c) 2 d) 54

2017

19) When X-rays are passed through crystalline DNA, it shows helix making one twist every:

a) 2nm b) 34nm c) 3.4nm d) 4nm

20) Following is the structure of:



a) Uracil b) Guanine c) Thyamine d) Cytosine

Answer key:

1	b	**2**	d	**3**	c	**4**	b	**5**	a
6	d	**7**	b	**8**	d	**9**	d	**10**	d
11	b	**12**	c	**13**	a	**14**	b	**15**	d
16	b	**17**	c	**18**	a	**19**	c	**20**	d