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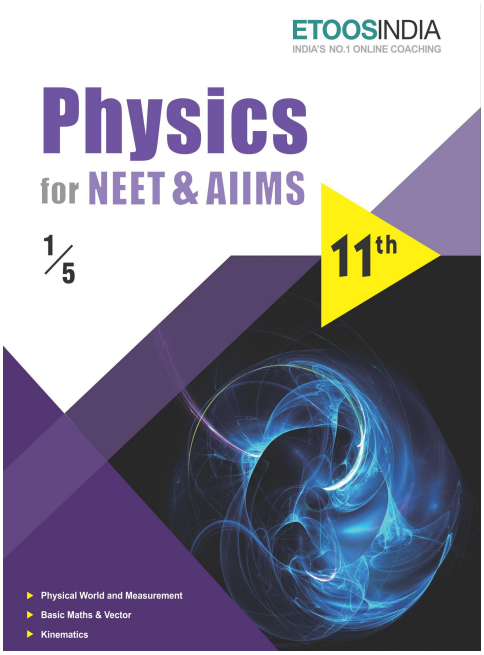
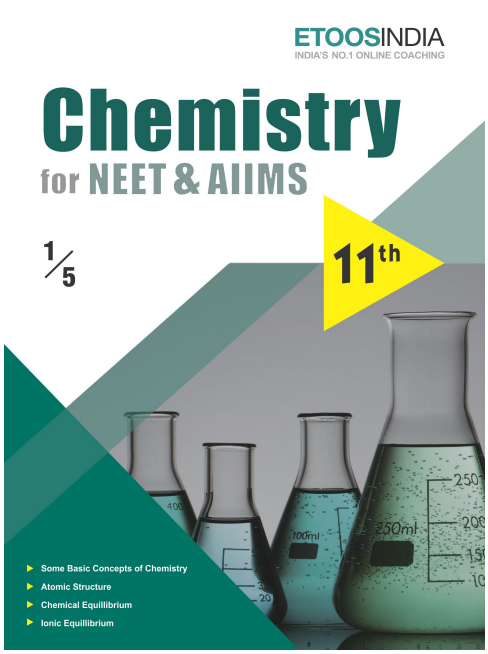
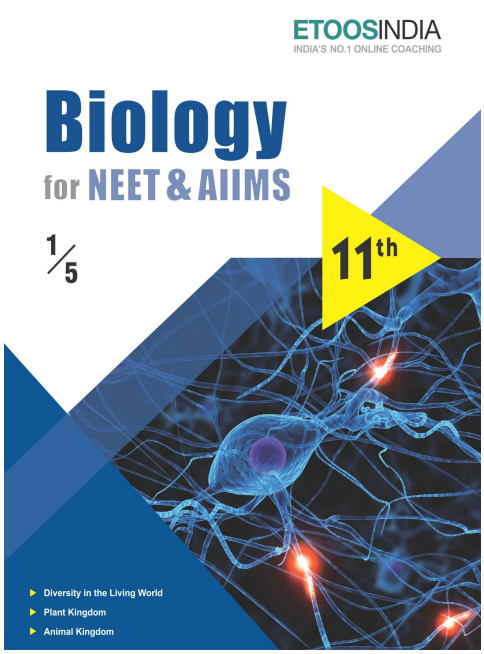
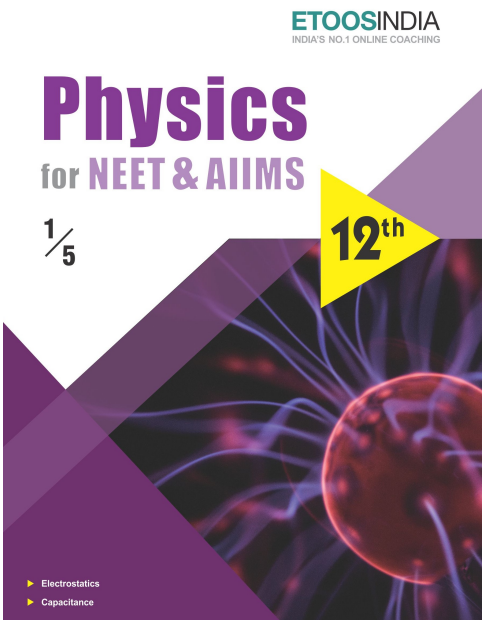
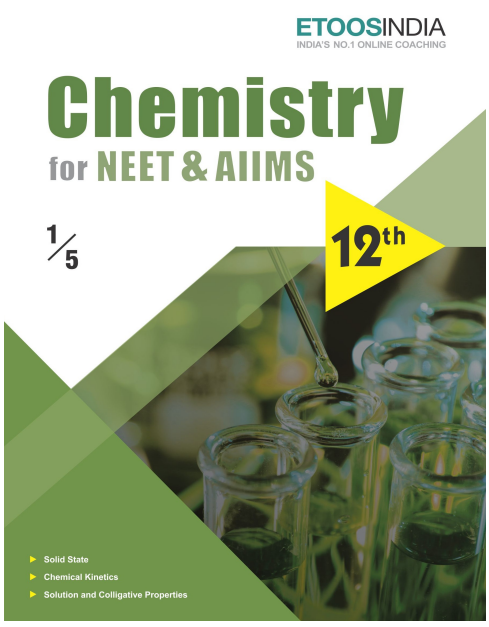
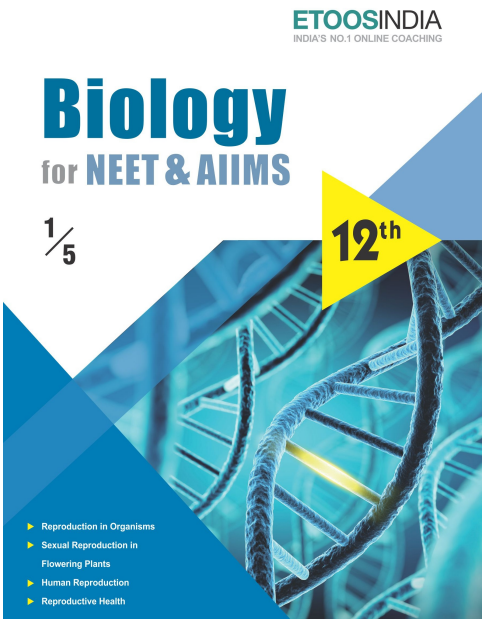












ETOOS Comprehensive Study Material For NEET & AIIMS

CHAPTER 06

MOLECULAR BASIS OF INHERITANCE

"One of the deepest functions of a living organisms is to look ahead... to produce future".

"FRANCOIS JACOB (1920-2013)"

INTRODUCTION

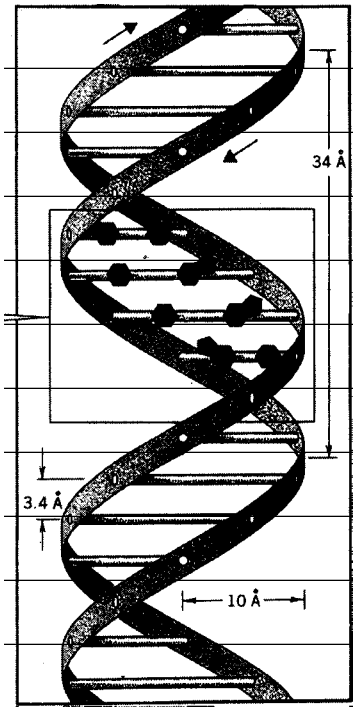
In previous chapter, you have learnt the inheritance patterns and genetic basis of such patterns. Factors/Genes were first detected and analyzed by Mendel and subsequently many other scientists, by following their patterns of transmission from generation to generation.Over the next hundred years, the nature of the putative genetic material was investigated culminating in the realisation that DNA-dexyribonucleic acid-is the genetic material at least for the majority of various organisms. This is the substance which controls the inheritance of traits from one generation to the next and it is also able to express its effect through the formation and functioning of traits.

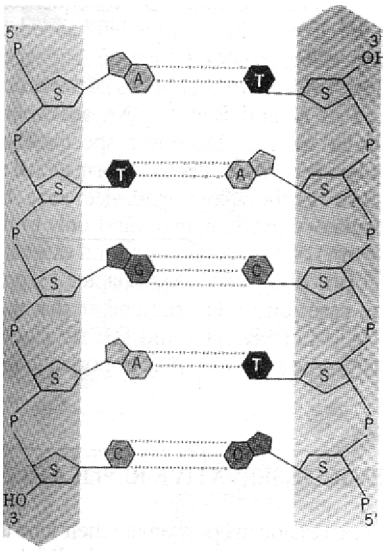
Nucleic acid is of two types in all living system i.e., deoxyribonucleic acis (DNA) and ribonucleic acid (RNA). DNA is a genetic material in all organism except some viruses. RNA is a genetic material in riboviruses. In others, RNA also functions as messenger which carry genetic information, an adapter for picking up amino acids, structural and catalytic molecule in some cases.

Molecular Basis of Inheritance

DNA

- Discovered by - **Meischer.** DNA was first identified by Friedrich Mrischer in 1869. He named it as Nuclein. Altmann found these substances to be acidic in nature and hence named it as nucleic acid.
- In DNA pentose sugar is deoxyribose sugar and four types of nitrogen bases A,T,G,C
- **Wilkins** and **Franklin** studied DNA molecule with the help of X-Ray crystallography.





- With the help of this study, **Watson** and **Crick** (1953) proposed a double helix molel for DNA. For this model Watson, Crick and Wilkins were awarded by Noble Prize in 1962.
- According to this model, DNA is composed of two polynucleotide chains.
- Both polynucleotide chains are complementary and antiparallel to each other.
- In both strand of DNA direction of phosphodiester bond is opposite. i.e. If direction of phosphodiester bond in one strand is 3'-5' then it is 5'-3' in another strand.
- Both strand of DNA held together by hydrogen bonds. These hydrogen bonds are present between nitrogen bases of both strand.
- Adenine binds to thymine by two hydrogen bonds and cytosine binds to guanine by three hydrogen bonds.
- **Chargaff's equivalency rule -** In a double stranded DNA amount of purine nucleotides is equals to amount of pyrimidine nucleotides.

  Purine = Pyrimidine

  $[A] + [G] = [T] + [C]$

  $$\frac{[A]+[G]}{[T]+[C]} = 1$$

- **Base ratio** = $\frac{A+T}{G+C}$ = constant for a given species.

Types of DNA :–

On the basis of direction of twisting, there are two types of DNA.

1. **Left handed DNA :–**

Anticlockwise twisting e.g. Z-DNA - discovered by Rich. Phosphate and sugar backbone is zig-zag. Units of Z-DNA are dinucleotides (purine and pyrimidine in alternate order)

Helix length – 5.6 A^0

Diameter – 18.4 A^0

No. of base pairs – 12 (6 dimers)

Distance between 2 base - pairs – 3.75 A^0

2. **Right Handed DNA -**

Clockwise twisting e.g. The DNA for which Watson and Crick proposed model was 'B' DNA.

DNA	Helix Length	No. of base pairs	Distance between two pairs	Diameter
'A'	28 A^0	11 pairs	2.56 A^0	23 A^0
'B'	34 A^0	10 pairs	3.4 A^0	20 A^0
'C'	31 A^0	9.33 pairs	3.32 A^0	19 A^0
'D'	24.24 A^0	8 pairs	3.03 A^0	19 A^0

- **Palindromic DNA** – Wilson and Thomas

$\longrightarrow$

CC GG T A C C G G

GG CC A T G G C C

$\longleftarrow$

Sequence of nucleotides same from both ends.

ETOOS KEY POINTS

- DNA molecule is Dextrorotatory while RNA molecule is Laevorotatory.
- **C – value** = Total amount of DNA in a haploid genome of organism

Packaging of DNA Helix -

Taken the distance between two consecutive base pairs as 0.34 nm $(0.34 \times 10^{-9}\ m)$, if the length of DNA double helix in a typical mammalian cell is calculated (simply by multiplying the total number of bp with distance between two consecutive bp, that is $6.6 \times 10^9\ bp \times 0.34 \times 10^{-9}\ m/bp$), it comes out ot be approximately 2.2 metres. A length that is far greater than the dimension of a typical nucleus (approximately 10^{-6m}). How is such a long polymer packaged in a cell?

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

Etoos Tips & Formulas

1. GENE EXPRESSION

→ One gene-one enzyme hypothesis was given by Beadle & Tatum.
→ According to this, each gene produces a particular type of enzyme.
→ They worked on Neurospora crassa.
→ Prototroph : It is the wild type Neurospora which can easily grow on minimal nutrient medium.
→ Auxotroph : These are the nutritional mutants which are unable to grow on minimal nutrient medium.
→ Later on one gene-one enzyme hypothesis has been modified into one gene-one polypeptide hypothesis.

2. REGUIATION OF GENE EXPRESSION

→ The 'ON' or 'OFF' mechanism of non-constitutive genes, as per requirement is called gene regulation.'
→ In 1961, F.Jacob and J. Monad proposed Operon model for the regulation of gene action in Â£. coli.
→ An operon is a part of DNA, which acts as single regulated unit having one or more structural genes, one operator gene, one promotor gene and one regulator gene.
→ Operons are of two types :-
(i) Inducible operon (e.g. Lac operon)
(ii) Repressible operon (e.g. Tryptophan operon)
→ In lac operon, a polycistronic structural gene in regulated by a common promoter and regulatory genes.
→ Lactose is the substrate for the enzyme β-galactosidase and it regulates switching on & off the operon. Hence it is called inducer.
→ A very low level of expression of lac operon has to be present in the cell all the time, otherwise lactose cannot enter the cells.
→ The repressor of the operon is synthesised (all the time constitutively) from the i-gene.
→ Glucose or galactose cannot act as inducers for lac operon. The lac operon would be expressed in the presence of lactose till the level of glucose remain low in cell.
→ Regulation of lac operon by repressor is ref erred to as negative regulation.

The Lac Operon

In eukaryotes, the regulation could be exerted at
(i) transcriptional level (formation of primary transcript)
(ii) processing level (regulation of splicing)
(iii) transport of mRNA from nucleus to the cytoplasm
(iv) translational level

3. HUMAN GENETICS

→ Study of inheritance of genetic characters and aspects like genetic improvements among humans is known as human genetics .
→ In human direct genetical studies are not possible. For this different indirect methods are used. Pedigree analysis one such important method.
→ Study of the family history for the inheritance of particular trait in several generation of a family is called the pedigree analysis.

4. POPULATION GENETICS:

→ Study of gene frequency in a population is called population genetics.
→ Gene frequency : It is the proportion of different alleles of a gene in a population.
→ Hardy-Weinberg law :
→ In a large, randomly mating population, the frequency of a gene remain constant from generation to generation when factors like selection, mutation & migration are absent.
→ According to this law, $p + q = 1$

SOLVED EXAMPLE

Ex.1 Which site of a t-RNA molecule hydrogen bonds to a m-RNA molecule
(A) Codon
(B) Anticodon
(C) 5' end of the t-RNA molecule
(D) 3' end of the t-RNA molecule
Sol. **(B)** : Anticodon arm is responsible for recognizing and binding codons in the m-RNA.

Ex.2 Removal of introns and joining the exons in a defined order in a transcription unit is called
(A) Splicing **(B)** Tailing
(C) Transformation **(D)** Capping
Sol. **(A)** : Spliceosomes cut introns from hn-RNA and exons are joined by RNA ligase. It is called splicing.

Ex.3 Semiconservative model of DNA replication was proposed by which workers in eukaryotes
(A) Taylor, Woods and Hughes, 1957
(B) Messelson and Stahl, 1957
(C) Nirenberg and Khorana, 1967
(D) Watson and Crick, 1952
Sol. **(B)**

Ex.4 In the double helix model of DNA, how far is each base pair from the next base pair
(A) 3.4 nm **(B)** 0.34 nm
(C) 2.0 nm **(D)** 34 nm
(E) 0.034 nm
Sol. **(B)**

Ex.5 If the DNA codons are ATG ATG ATG and a cytosine base is inserted at the begining, which of the following will result
(A) A non-sense mutation
(B) CA TGA TGA TG
(C) CAT GAT GAT G
(D) C ATG ATG ATG
Sol. **(C)**

Ex.6 The chemical knives of DNA are

Or

Enzyme that cleaves nucleic acids within the polynucleotide chain is known as
(A) Ligases **(B)** Polymerases
(C) Endonucleases **(D)** Transcriptase
Sol. **(C)** : Endonucleases enzymes cut DNA at specific desired place so it is called chemical knives of DNA.

Ex.7 Nucleotides are building blocks of nucleic acids. Each nucleotide is a composite molecules formed by
(A) (Base-sugar)n **(B)** Base-sugar-OH
(C) Base-sugar-phosphate **(D)** Sugar-phosphate
Sol. **(C)** : Nucleotides are the building blocks or monomeric units. Each nucleotide contain Nitrogen bases (Purines and pyrimidines), pentose sugar (5c) and phosphoric acid.

Ex.8 Which one of the following also acts as a catalyst in a bacterial cell
(A) 23 sr RNA **(B)** 5 sr RNA
(C) sn RNA **(D)** hn RNA
Sol. **(A)** : 23 S rRNA is catalytic RNA.

Ex.9 Read the following four statements (A - D)
A. In transcription, adenosine pairs with uracil
B. Regulation of lac operon by repressor is referred to as positive regulation
C. The human genome has approximately 50,000 genes
D. haemophilia is a sex-linked recessive disease
How many of the above statements are right
(A) Two **(B)** Three
(C) Four **(D)** One
Sol. **(A)** : Regulation of lac operon by repressor is referred as negative regulation. Human genome has approximately 30000 genes.

Ex.10 A triplet codon means
(A) A sequence of three nitrogen bases on mRNA
(B) A sequence of three nitrogen bases in tRNA
(C) A sequence of three bases in rRNA
(D) The presence of only three bases in mRNA
Sol. **(A)**

Ex.11 The one aspect which is not a salient feature of genetic code, is its being
(A) Specific **(B)** Degenerate
(C) Ambiguous **(D)** Universal
Sol. **(C)**

Ex.12 Which one-of the following is not a part of a transcription unit in DNA
(A) The inducer **(B)** A terminator
(C) A promoter **(D)** The structural gene
Sol. **(A)** : Transcription unit consists of promoter, structural gene and terminator.

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are
(A) G 17%, A 16.5% , T 32.5%
(B) G 17%, A 33% , T 33%
(C) G 8.5%, A 50%, T 24.5%
(D) G 34%, A 24.5%, T 24.5%

2. Which of the following RNAs picks up specific amino acid (from amino acid pool) in the cytoplasm to ribosome during protein synthesis
or
Which from of RNA has a structure resembling clover leaf
(A) tRNA (B) mRNA
(C) rRNA (D) All of these

3. Read the following statements and choose the correct option
A. Nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage
B. Phosphate group is linked to 5'-OH of a nucleoside through phosphoester linkage
C. Two nucleosides are linked through 3'-5' N-glycosidic linkage
D. Negatively charged DNA is wrapped around positively charged histone octamer to form nucleosome
E. The chromatin that is more densely packed and stains dark is called euchromatin
(A) A, B and C alone are wrong
(B) D alone is wrong
(C) C and E alone are wrong
(D) A alone is wrong
(E) A, B and D alone are wrong

4. The substance that acts as connecting link between two generation is
(A) Ribonucleic acid
(B) Deoxyribonucleic acid
(C) Nucleoplasm
(D) Ribonucleic acid + Deoxyribonucleic acid

5. Which one of the following peak absorption of ultraviolet light by heterocyclic bases (Nitrogen bases)
(A) 1500 nm (B) 26 nm
(C) 75 nm (D) 260 nm

6. The enzyme that breaks H_2 bonds in DNA is
(A) Helicase (B) Topoisomerase
(C) Ligase (D) Polymerase

7. Exon part of m-RNAs has code for
(A) Protein (B) Lipid
(C) Phospholipid (D) Carbohydrate

8. It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for genetic material. This is written by
(A) Meselon and Stahl (B) Archibold Garrod
(C) Severo Ochoa (D) Waston and Crick

9. DNA elements, which can switch their position, are called
(A) Exons
(B) Introns
(C) Cistrons
(D) Transposons/Jumping genes

10. The specific DNA sequence where EcoRI cuts is
or
Which of the following plaindromic sequence is recognized by EcoRI
(A) ATTCGA / CGAATT (B) GAATTC / CAAGTT
(C) GCTTAA / TAAGCT (D) GTTCAA / CTTAAG

11. The enzyme DNA polymerase was discovered by
(A) Kornberg (B) Okazaki
(C) Waston and Crick (D) Jacob and Monod

12. What is false about t RNA
(A) It binds with an amino acid at it 5' end
(B) It has five double stranded regions
(C) It has a codon at one end which recognizes the anticodon on messenger RNA
(D) It looks like clover leaf in the three dimensional structure

13. c-DNA can be formed by
(A) Transaminase
(B) DNA ligase
(C) RNA dependent DNA polymerase (Reverse Transcriptase)
(D) DNA dependent DNA polymerase

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. In prokaryotes, the process of replication is catalysed by the following enzymes. Identify which of the enzymes is best coordinate with the role
(A) Helicase– Joins the ends of DNA segments
(B) DNA polymerase I – Synthesis DNA
(C) DNA polymerase II – Erases primer and fills gaps
(D) Primase – Synthesis RNA primers

2. The eukaryotic differs from the prokaryotic genome because
(A) Repetitive sequences are present in eukaryotes.
(B) Genes in the former case are organized into operons
(C) The DNA is complexed with with histones in prokaryotes
(D) The DNA is circular and single stranded in prokaryotes

3. The double helix model of Waston and Crick is known as
(A) C-DNA (B) B-DNA
(C) Z-DNA (D) D-DNA

4. Find out the wrong statement
(A) Mobile genetic elements, transposons were visualized by Barbara McClintock
(B) Udder cell, a somatic cell is used to produce the cloned sheep nuclear transplantation method
(C) In pedigree analysis, a person immediately affected by an action is called propositus
(D) Dr. Ian Wilmut produced a cloned sheep called Dolly
(E) DNA ligase are used to cleave a DNA molecule

5. Who among the following did not provide experimental proof for the semiconservative model of DNA replication
(A) Meselson & Stahl (B) Cairns
(C) Waston & Crick (D) Taylor

6. mRNA carries the genetic information from DNA to the

or

Which of the following is the site of translation of the mRNA
(A) Chloroplasts (B) Ribosomes
(C) Mitochondria (D) Lysosomes

7. During DNA replication in prokaryotes DNA is anchored
(A) Chromosome (B) Mesosome
(C) Nucleolus (D) Ribosome

8. DNA is acidic due to
(A) Sugar (B) Phosphoric acid
(C) Purine (D) Pyrimidine

9. RNA is not found in
(A) Chromosome (B) Plasmmaalemma
(C) Nucleous (D) Ribosome

10. The length of DNA molecule greatly exceeds the dimensions of the nucleus in eukaryotic cells. How is this DNA accommodated
(A) Deletion of non-essential genes
(B) Super-coiling in nucleosomes
(C) DNAase digestion
(D) Through elimination of repetitive DNA

11. The two polynucleotide chains in DNA are
(A) Parallel (B) Discontinuous
(C) Antiparallel (D) Semiconservative

12. In DNA of certain organisms, guanine constitutes 20% of the bases. What percentage of the bases would be adenine
(A) 0% (B) 10%
(C) 20% (D) 30%
(E) 40%

13. Base composition in RNA is
(A) A + T = G + C (B) A + G = T + C
(C) A + U = G + C (D) A + G = U + C

14. Left handed DNA among following is
(A) DNA (B) A DNA
(C) C DNA (D) B DNA

15. Which of the following be named for DNA produced from RNA
(A) A–DNA (B) B –DNA
(C) C–DNA (D) Z–DNA

16. hn-RNA undergoes two additional processing. Out of which, in one of them an unusual nucleotide (methyl guanosine triphosphate) is added to the 5'-end of hnRNA. This is known as
(A) Capping (B) Tailing
(C) Splicing (D) Termination

17. If a segment of an mRNA molecule has the sequence 5' GUACCGAUCG 3', which of the following could havbe been the template DNA molecule
(A) 5' GCUAGCCUAG 3' (B) 5'GUACCGAUGC 3'
(C) 5' CATGGCTAGC 3' (D) 5' CGATCGGTAC 3'

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Match the following

Column - I	Column - II
A. tRNA	1. Linking of amino acids
B. mRNA	2. Transfer of genetic information
C. rRNA	3. Nucleolar organising region
D. Peptidyl transferase	4. Transfer of amino acid from cytoplasm of ribosome

	A	B	C	D
(A)	4	2	3	1
(B)	1	4	3	2
(C)	1	2	3	4
(D)	1	3	2	4

2. Identify the correct match between the codons and coding functions

Column - I	Column - II
A. AUG	1. Phenylalanine
B. UAA	2. Methionine
C. UUU	3. Tryptophan
D. UGG	4. Termination

(A) A - 1, B - 4, C - 2, D - 3
(B) A - 2, B - 4, C - 1, D - 3
(C) A - 4, B - 3, C - 2, D - 1
(D) A - 4, B - 1, C - 3, D - 2
(E) A - 2, B - 3, C - 4, D - 1

3. Match the following.

Column - I	Column - II
A. VNTR	P. Largest gene
B. Introns and Exons	Q. DNA fingerprinting
C. Dystrophin	R. Bulk DNA
D. Satellite	S. Splicing

(A) A - R; B - S; C - P; D - Q
(B) A - Q; B - S; C - P; D - R
(C) A - Q; B - P; C - S; D - R
(D) A - S; B - P; C - Q; D - R

4. Match the following in column - I with column - II and choose the correct combination

Column - I	Column - II
A. Termination	1. Aminoacyl synthetase
B. Translation	2. Okazaki fragments
C. Transcription	3. GTP dependent release factor
D. DNA replication	4. RNA polymerase

(A) A- 1; B - 3; C - 1; D - 4
(B) A- 1; B - 4; C - 2; D - 3
(C) A- 3; B - 1; C - 4; D - 2
(D) A- 4; B - 2; C - 1; D - 3
(E) A- 2; B - 4; C - 1; D - 3

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Exercise # 4

PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. During replication of DNA, its two strands separate. Each of these serves as a templete for the formation of new strand. Such type of replication is called [CBSE AIPMT 2000]
(A) non-conservative (B) semi-conservative
(C) flexible (D) conservative

2. 'Signal hypothesis' for the biosynthesis of secretory type of proteins was proposed by [CBSE AIPMT 2000]
(A) Camillo Golgi (B) Blobel and Sabatini
(C) Baltimore (D) Sheeler and Bianchi

3. Due to discovery of which of the following is 1980's the evolution was termed as RNA world ? [CBSE AIPMT 2001]
(A) mRNA, tRNA, rRNA synthesis proteins
(B) In some viruses, RNA is genetic material
(C) Some RNAs have enzymatic property
(D) RNA is not found in all cells

4. E.coli about to replicate was placed in a medium containing radioactive thymidine for five minutes. Then it was made to replicate in a normal medium. Which of the following observation shall be correct ? [CBSE AIPMT 2001]
(A) Both the strands of DNA will be radioactive
(B) One strand radioactive
(C) Each strand half radioactive
(D) None is radioactive

5. Gene and cistron words are sometimes used synonymosuly because [CBSE AIPMT 2001]
(A) one cistron contains many genes
(B) one gene contains many cistrons
(C) one gene contains one cistron
(D) one gene contains no cistron

6. In which direction mRNA is synthesised on DNA template ? [CBSE AIPMT 2001]
(A) $5' \rightarrow 3'$ (B) $3' \rightarrow 5'$
(C) both (A) and (B) (D) any of above

7. In negative operon [CBSE AIPMT 2001]
(A) co-repressor binds with repressor
(B) co-repressor does not bind with repressor
(C) co-repressor binds with inducer
(D) cAMP has negative effect on lac operon

8. Sequence of which of the following is used to know the phylogeny ? [CBSE AIPMT 2001]
(A) mRNA (B) rRNA
(C) tRNA (D) DNA

9. In E. coli, during lactose metabolism repressor binds to [CBSE AIPMT 2002]
(A) regulator gene (B) operator gene
(C) structural gene (D) promoter gene

10. Jacob and Monod studied lactose metabolism in E. coli and proposed Operon concept. Operon concept applicable for [CBSE AIPMT 2002]
(A) all prokaryotes
(B) all prokaryotes and some eukaryotes
(C) all prokaryotes and all eukaryotes
(D) all prokaryotes and some protozoans

11. In a DNA percentage of thymine is 20. What is the percentage of guanine ? [CBSE AIPMT 2002]
(A) 20% (B) 40%
(C) 30% (D) 60%

12. Which statements is correct bacterial transduction ? [CBSE AIPMT 2002]
(A) Transfer of some genes from one bacteria to another bacteria through virus
(B) Transfer of genes from one bacteria to another bacteria by conjugation
(C) Bacteria obtained its DNA directly
(D) Bacteria obtained DNA from other external source

13. Nucleus of a donor embryonal cell/somatic cell is transferred to an enucleated egg cell. Then after the formation of organism what, shall be true ? [CBSE AIPMT 2002]
(A) Organism will have extra-nuclear genes of the donor cell
(B) Organism will have extra-nuclear genes of recipient cell
(C) Organism will have extra-nuclear genes of both donor and recipient cell
(D) Organism will have nuclear genes of recepient cell

MOCK TEST

1. Beads on string like structures of A are seen in B, which further condense to form chromosomes in C stage of cell division

	A	B	C
(A)	Chromonema	Chromatin	Metaphase
(B)	Chromatin	Chromatid	Metaphase
(C)	Chromonema	Chromosome	Anaphase
(D)	Chromonema	Chromatid	Anaphase

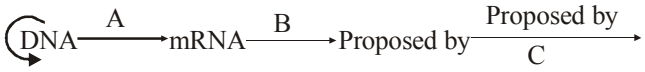
2. Microsatellites are

(A) Repetitive DNA sequences (B) ESTs
(C) YAC (D) BAC
(E) UTR

3. In the DNA molecule

(A) The proportion of adenine in relation to thymine varies with the organism
(B) There are two strands which run antiparallel-one in 5` → 3` direction and other in 3`→ 5`
(C) The total amount of purine nucleotides and pyrimidine nucleotieds is not always equal
(D) There are two strands which run parallel in the 5`→ 3`direction

4. The diagram shows an important concept inthe genetic implication of DNS. Fill in the blanks A to C.



(A) A-Transcription, B - Translation, C-Francis Crick (B) A-Translation, B - Extension, C-Rosalind Frankline
(C) A-Transcription, B- Replication, C-James Watson (D) A-Translation, B- Transcription, C-Ervin Chargaff

5. If the total of adenine and thymine in a double standed DNA is 55 %, the amount of guanine is this DNA willbe

(A) 45 % (B) 27.5% (C) 25% (D) 22.5%
(E) 40%

6. Read the following statements and choose the correct option

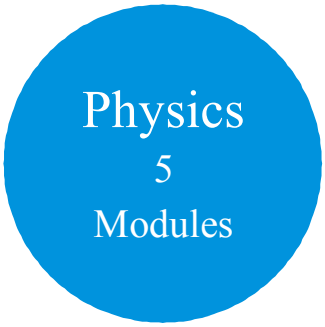
A. Nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage.
B. Phosphate group is linked to 5' -OH of a nucleoside through phosphoester linkage
C. Two nucleoside are linked through 3'-5' N-glycosidic linkage
D. Negatively charged DNA is wrapped around positively charged histone octamer to form nucleosome.
E. The chromatin that is more densely packed and stains dark is called euchromatin.

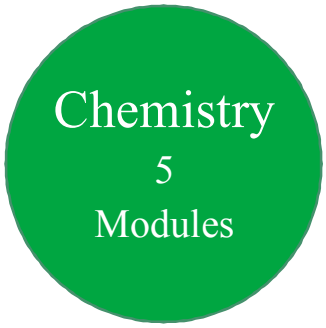
(A) A,B and C alone are wrong (B) D alone is wrong
(C) C and E alone are wrong (D) A lone is wrong
(E) A,B and D alone are wrong.

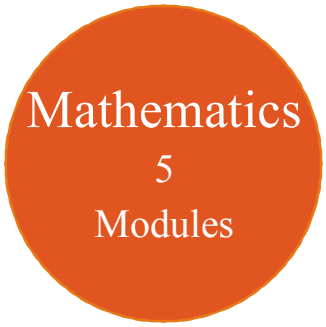
7. The result of which of the following reaction experiments carrid out by Avey et. on Streptococcus pneumoniae has proved conclusively that DNA is the genetic material ?

(A) Live 'R' strain + DNA from 'S' strain + RNA ase
(B) Live 'R' strain + DNA from 'S' strain +DNA ase
(C) Live 'R' strain + Denatured DNA of 'S' strain + protease
(D) Heat killed 'R' strain +DNA from 'S' strain + DNA ase

11th Class Modules Chapter Details







PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

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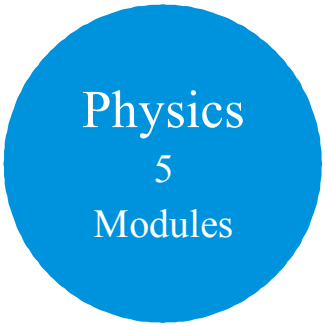

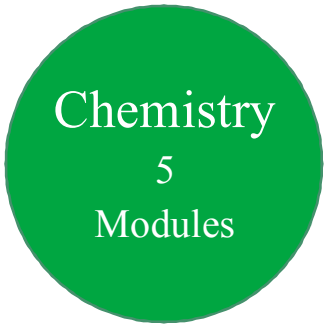

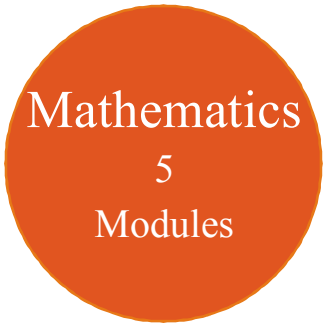

PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

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2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

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2. Biodiversity and Conservation
3. Environmental Issues

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