Chapter 28

Molecular Basis of Inheritance

1. The final proof for DNA as the genetic material came from the experiments of
(a) Hershey and Chase
(b) Avery, MacLeod and McCarty
(c) Hargobind Khorana
(d) Griffith. *(NEET 2017)*

2. If there are 999 bases in an RNA that code for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?
(a) 11 (b) 33
(c) 333 (d) 1
(NEET 2017)

3. During DNA replication, Okazaki fragments are used to elongate
(a) the lagging strand towards replication fork
(b) the leading strand away from replication fork
(c) the lagging strand away from the replication fork
(d) the leading strand towards replication fork.
(NEET 2017)

4. Which of the following RNAs should be most abundant in animal cell?
(a) *t*RNA (b) *m*RNA
(c) miRNA (d) *r*RNA
(NEET 2017)

5. Spliceosomes are not found in cells of
(a) fungi (b) animals
(c) bacteria (d) plants.
(NEET 2017)

6. The association of histone H_1 with a nucleosome indicates that
(a) DNA replication is occurring
(b) the DNA is condensed into a chromatin fibre
(c) the DNA double helix is exposed
(d) transcription is occurring. *(NEET 2017)*

7. Taylor conducted the experiments to prove semi-conservative mode of chromosome replication on
(a) *Vinca rosea*
(b) *Vicia faba*
(c) *Drosophila melanogaster*
(d) *E. coli.* *(NEET-II 2016)*

8. The equivalent of a structural gene is
(a) muton (b) cistron
(c) operon (d) recon.
(NEET-II 2016)

9. Which of the following *r*RNAs acts as structural RNA as well as ribozyme in bacteria?
(a) 5S *r*RNA (b) 18S *r*RNA
(c) 23S *r*RNA (d) 5.8S *r*RNA
(NEET-II 2016)

10. A molecule that can act as a genetic material must fulfill the traits given below, except
(a) it should be able to express itself in the form of 'Mendelian characters'
(b) it should be able to generate its replica
(c) it should be unstable structurally and chemically
(d) it should provide the scope for slow changes that are required for evolution.
(NEET-II 2016)

11. DNA-dependent RNA polymerase catalyses transcription on one strand of the DNA which is called the
(a) template strand (b) coding strand
(c) alpha strand (d) antistrand.
(NEET-II 2016)

12. Which one of the following is the starter codon?
(a) UAA (b) UAG
(c) AUG (d) UGA
(NEET-I 2016)

13. Which of the following is required as inducer (s) for the expression of *Lac* operon?
(a) Lactose
(b) Lactose and Galactose
(c) Glucose
(d) Galactose
(NEET-I 2016)

14. A complex of ribosomes attached to a single strand of RNA is known as
(a) polypeptide (b) Okazaki fragment
(c) polysome (d) polymer.
(NEET-I 2016)

15. Which one of the following is not applicable to RNA?
(a) Heterocyclic nitrogenous bases
(b) Chargaff's rule
(c) Complementary base pairing
(d) 5' phosphoryl and 3' hydroxyl ends
(2015)

16. Balbiani rings are sites of
(a) polysaccharide synthesis
(b) RNA and protein synthesis
(c) lipid synthesis
(d) nucleotide synthesis. *(2015)*

17. Identify the correct order of organisation of genetic material from largest to smallest.
(a) Genome, chromosome, gene, nucleotide
(b) Chromosome, genome, nucleotide, gene
(c) Chromosome, gene, genome, nucleotide
(d) Genome, chromosome, nucleotide, gene
(2015)

18. Satellite DNA is important because it
(a) does not code for proteins and is same in all members of the population
(b) codes for enzymes needed for DNA replication
(c) codes for proteins needed in cell cycle
(d) shows high degree of polymorphism in population and also the same degree of polymorphism in an individual, which is heritable from parents to children.
(2015)

19. Gene regulation governing lactose operon of *E.coli* that involves the *lac* I gene product is
(a) negative and repressible because repressor protein prevents transcription
(b) feedback inhibition because excess of β-galactosidase can switch off transcription
(c) positive and inducible because it can be induced by lactose
(d) negative and inducible because repressor protein prevents transcription.
(2015 Cancelled)

20. 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 33%, T 33%
(b) G 8.5%, A 50%, T 24.5%
(c) G 34%, A 24.5%, T 24.5%
(d) G 17%, A 16.5%, T 32.5%.
(2015 Cancelled)

21. Which one of the following is wrongly matched?
(a) Transcription - Writing information from DNA to *t*RNA.
(b) Translation - Using information in *m*RNA to make protein.
(c) Repressor protein - Binds to operator to stop enzyme synthesis.
(d) Operon - Structural genes, operator and promoter.
(2014)

22. Transformation was discovered by
(a) Meselson and Stahl
(b) Hershey and Chase
(c) Griffith
(d) Watson and Crick. *(2014)*

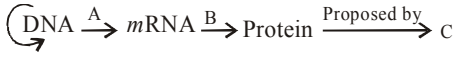
23. Select the correct option.

	Direction of RNA synthesis	Direction of reading of the template DNA strand
(a)	5′ – 3′	3′ – 5′
(b)	3′ – 5′	5′ – 3′
(c)	5′ – 3′	5′ – 3′
(d)	3′ – 5′	3′ – 5′

(2014)

24. Which of the following statements is not true of two genes that show 50% recombination frequency?
(a) The gene show independent assortment.
(b) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis.
(c) The genes may be on different chromosomes.
(d) The genes are tightly linked.
(NEET 2013)

25. The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks A to C.



(a) A - Transcription, B -Translation, C - Francis Crick
(b) A - Translation, B - Extension, C - Rosalind Franklin

(c) A - Transcription, B - Replication, C - James Watson
(d) A - Translation, B - Transcription, C - Ervin Chargaff *(NEET 2013)*

26. Which enzyme will be produced in a cell if there is a nonsense mutation in the *lac* Y gene?
(a) Transacetylase
(b) Lactose permease and transacetylase
(c) β-galactosidase
(d) Lactose permease *(NEET 2013)*

27. DNA $\xrightarrow{C}$ *m*RNA $\xrightarrow{B}$ Protein $\xrightarrow{\text{Proposed by}}$ A

The figure gives an important concept in the genetic implication of DNA. Fill the blanks A, B and C.
(a) A-Maurice Wilkins, B-Transcription, C-Translation
(b) A-James Watson, B-Replication, C-Extension
(c) A-Erwin Chargaff, B-Translation, C-Replication
(d) A-Francis Crick, B-Translation, C-Transcription
(Karnataka NEET 2013)

28. Satellite RNAs are present in some
(a) viroids (b) prions
(c) bacteriophages (d) plant viruses.
(Karnataka NEET 2013)

29. Which of the following is not a property of the genetic code?
(a) Non-overlapping (b) Ambiguous
(c) Degeneracy (d) Universal
(Karnataka NEET 2013)

30. Genes of interest can be selected from a genomic library by using
(a) cloning vectors
(b) DNA probes
(c) gene targets
(d) restriction enzymes.
(Karnataka NEET 2013)

31. In an inducible operon, the genes are
(a) usually not expressed unless a signal turns them"on".
(b) usually expressed unless a signal turns them "off".
(c) never expressed
(d) always expresser.
(Karnataka NEET 2013)

32. One of the most frequently used techniques in DNA fingerprinting is
(a) VNTR (b) SSCP
(c) SCAR (d) AFLP.
(Karnataka NEET 2013)

33. Removal of introns and joining of exons in a defined order during transcription is called
(a) looping (b) inducing
(c) slicing (d) splicing. *(2012)*

34. If one strand of DNA has the nitrogenous base sequence as ATCTG, what would be the complementary RNA strand sequence?
(a) TTAGU (b) UAGAC
(c) AACTG (d) ATCGU *(2012)*

35. Ribosomal RNA is actively synthesized in
(a) lysosomes (b) nucleolus
(c) nucleoplasm (d) ribosomes.
(2012)

36. 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
(2012)

37. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of
(a) *t*RNA (b) hnRNA
(c) *m*RNA (d) *r*RNA. *(2012)*

38. What are the structures called that give an appearance as 'beads-on-string' in the chromosomes when viewed under electron microscope?
(a) Genes (b) Nucleotides
(c) Nucleosomes (d) Base pairs *(2011)*

39. The unequivocal proof of DNA as the genetic material came from the studies on a
(a) bacterium (b) fungus
(c) viroid (d) bacterial virus.
(Main 2011)

40. Which one of the following does not follow the central dogma of molecular biology?
(a) Pea (b) *Mucor*
(c) *Chlamydomonas* (d) HIV *(2010)*

41. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?
(a) 5′ ——— CGTTCG ——— 3′
3′ ——— ATGGTA ——— 5′
(b) 5′ ——— GATATG ——— 3′
3′ ——— CTACTA ——— 5′

(c) 5′ ——— GAATTC ——— 3′
3′ ——— CTTAAG ——— 5′

(d) 5′ ——— CACGTA ——— 3′
3′ ——— CTCAGT ——— 5′ *(2010)*

42. The one aspect which is not a silent feature of genetic code, is its being
(a) degenerate (b) ambiguous
(c) universal (d) specific. *(2010)*

43. Select the two correct statements out of the four (i –iv) statements given below about lac operon.
(i) Glucose or galactose may bind with the repressor and inactivate it.
(ii) In the absence of lactose the repressor binds with the operator region.
(iii) The *z*-gene codes for permease.
(iv) This was elucidated by Francois Jacob and Jacques Monod.
The correct statements are
(a) (ii) and (iii) (b) (i) and (iii)
(c) (ii) and (iv) (d) (i) and (ii).
(2010)

44. The 3′ - 5′ phosphodiester linkages inside a polynucleotide chain serve to join
(a) one DNA strand with the other DNA strand
(b) one nucleoside with another nucleoside
(c) one nucleotide with another nucleotide
(d) one nitrogenous base with pentose sugar.
(Main 2010)

45. The *lac* operon consists of
(a) four regulatory genes only
(b) one regulatory gene and three structural genes
(c) two regulatory genes and two structural genes
(d) three regulatory genes and three structural genes. *(Main 2010)*

46. In eukaryotic cell transcription, RNA splicing and RNA capping take place inside the
(a) ribosomes (b) nucleus
(c) dictyosomes (d) ER. *(Main 2010)*

47. Which one of the following statements about the particular entity is true ?
(a) Centromere is found in animal cells, which produces aster during cell division.
(b) The gene for producing insulin is present in every body cell.
(c) Nucleosome is formed of nucleotides.
(d) DNA consists of core of eight histones.
(Main 2010)

48. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a "triplet"?
(a) Hershey and Chase
(b) Morgan and Sturtevant
(c) Beadle and Tatum
(d) Nirenberg and Mathaei *(2009)*

49. Semi-conservative replication of DNA was first demonstrated in
(a) *Escherichia coli*
(b) *Streptococcus pneumoniae*
(c) *Salmonella typhimurium*
(d) *Drosophila melanogaster.* *(2009)*

50. Removal of introns and joining the exons in a defined order in a transcription unit is called
(a) tailing (b) transformation
(c) capping (d) splicing. *(2009)*

51. What is not true for genetic code?
(a) It is nearly universal.
(b) It is degenerate.
(c) It is unambiguous.
(d) A codon in *m*RNA is read in a non-contiguous fashion.
(2009)

52. 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 nucleotides is not always equal
(d) there are two strands which run parallel in the 5′ → 3′ direction. *(2008)*

53. Which one of the following pairs of nitrogenous bases of nucleic acids, is wrongly matched with the category mentioned against it?
(a) Guanine, Adenine - Purines
(b) Adenine, Thymine - Purines
(c) Thymine, Uracil - Pyrimdines
(d) Uracil, Cytosine - Pyrimidines *(2008)*

54. Polysome is formed by
(a) a ribosome with several subunits
(b) ribosomes attached to each other in a linear arrangement
(c) several ribosomes attached to a single *m*RNA
(d) many ribosomes attached to a strand of endoplasmic reticulum.
(2008)

55. Which one of the following pairs of codons is correctly matched with their function or the signal for the particular amino acid?
(a) AUG, ACG - Start/methionine
(b) UUA, UCA - Leucine
(c) GUU, GCU - Alanine
(d) UAG, UGA - Stop *(2008)*

56. One turn of the helix in a B-form DNA is approximately
(a) 2 nm (b) 20 nm
(c) 0.34 nm (d) 3.4 nm. *(2006)*

57. One gene-one enzyme hypothesis was postulated by
(a) Beadle and Tatum
(b) R. Franklin
(c) Hershey and Chase
(d) A. Garrod. *(2006)*

58. Antiparallel strands of a DNA molecule means that
(a) one strand turns clockwise
(b) one strand turns anti-clockwise
(c) the phosphate groups of two DNA strands, at their ends, share the same position
(d) the phosphate groups at the start of two DNA strands are in opposite position (pole).
(2006)

59. Which antibiotic inhibits interaction between *t*RNA and *m*RNA during bacterial protein synthesis?
(a) Tetracycline (b) Erythromycin
(c) Neomycin (d) Streptomycin
(2006)

60. Amino acid sequence, in protein synthesis is decided by the sequence of
(a) *r*RNA (b) *t*RNA
(c) *m*RNA (d) *c*DNA. *(2006)*

61. *E.coli* cells with a mustard *z* gene of the *lac* operon cannot grow in medium containing only lactose as the source of energy because
(a) the *lac* operon is constitutively active in these cells
(b) they cannot synthesize functional beta galactosidase
(c) in the presence of glucose, *E.coli* cells do not utilize lactose
(d) they cannot transport lactose from the medium into the cell. *(2005)*

62. Telomerase is an enzyme which is a
(a) simple protein (b) RNA
(c) ribonucleoprotein (d) repetitive DNA.
(2005)

63. Using imprints from a plate with complete medium and carrying bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. These imprints need to be used
(a) on plates with and without streptomycin
(b) on plates with minimal medium
(c) only on plates with streptomycin
(d) only on plates without streptomycin.
(2005)

64. Protein synthesis in an animal cell occurs
(a) only on the ribosomes present in cytosol
(b) only on ribosome attached to the nuclear envelope and endoplasmic reticulum
(c) on ribosome present in the nucleolus as well as in cytoplasm
(d) on ribosomes present in cytoplasm as well as in mitochondria. *(2005)*

65. Which one of the following makes use of RNA template to synthesize DNA?
(a) DNA polymerase
(b) RNA polymerase
(c) Reverse transcriptase
(d) DNA dependant RNA polymerase
(2005)

66. Which one of the following hydrolyses internal phosphodiester bonds in a polynucleotide chain?
(a) Lipase (b) Protease
(c) Endonuclease (d) Exonuclease
(2005)

67. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called?
(a) AAAT box (b) TATA box
(c) GGTT box (d) CAAT box
(2005)

68. After a mutation at a genetic locus the character of an organism changes due to change in
(a) protein structure
(b) DNA replication
(c) protein synthesis pattern
(d) RNA transcription pattern. *(2004)*

69. Which form of RNA has a structure resembling clover leaf?
(a) *r*RNA (b) hnRNA
(c) *m*RNA (d) *t*RNA *(2004)*

70. During transcription, if the nucleotide sequence of the DNA strand that is being coded is ATACG then the nucleotide sequence in the *m*RNA would be
(a) TATGC (b) TCTGG
(c) UAUGC (d) UATGC. *(2004)*

71. In mutational event, when adenine is replaced by guanine, it is a case of
(a) frame shift mutation
(b) transcription
(c) transition
(d) transversion. *(2004)*

72. The following ratio is generally constant for a given species:
(a) A + G / C + T (b) T + C / G + A
(c) G + C / A + T (d) A + C / T + G *(2004)*

73. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA ?
(a) A polypeptide of 24 amino acids will be formed.
(b) Two polypeptides of 24 and 25 amino acids will be formed.
(c) A polypeptide of 49 amino acids will be formed.
(d) A polypeptide of 25 amino acids will be formed. *(2003)*

74. What does "*lac*" refer to in what we call the lac operon ?
(a) Lactose
(b) Lactase
(c) Lac insect
(d) The number 1,00,000 *(2003)*

75. During translation initiation in prokaryotes, a GTP molecule is needed in
(a) formation of formyl-met-*t*RNA
(b) binding of 30S subunit of ribosome with *m*RNA
(c) association of 30S *m*RNA with formyl-met-*t*RNA
(d) association of 50S subunit of ribosome with initiation complex. *(2003)*

76. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop' codon ?
(a) UCG – start (b) UUU – stop
(c) UGU – leucine (d) UAC – tyrosine *(2003)*

77. During transcription, the DNA site at which RNA polymerase binds is called
(a) promoter (b) regulator
(c) receptor (d) enhancer. *(2003)*

78. Degeneration of a genetic code is attributed to the
(a) first member of a codon
(b) second member of codon
(c) entire codon
(d) third member of a codon. *(2003)*

79. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids ?
(a) 20 (b) 64
(c) 61 (d) 60 *(2003)*

80. In a DNA percentage of thymine is 20% then what will be percentage of guanine?
(a) 20% (b) 40%
(c) 30% (d) 60% *(2002)*

81. Transformation experiment was first performed on which bacteria?
(a) *E. coli*
(b) *Diplococcus pneumoniae*
(c) *Salmonella*
(d) *Pasteurella pestis* *(2002)*

82. Jacob and Monod studied lactose metabolism in *E. coli* and proposed operon concept. Operon concept is applicable for:
(a) all prokaryotes
(b) all prokaryotes and some eukaryotes
(c) all prokaryotes and all eukaryotes
(d) all prokaryotes and some protozoans. *(2002)*

83. In *E. coli*, during lactose metabolism repressor binds to:
(a) regulator gene (b) operator gene
(c) structural gene (d) promoter gene. *(2002)*

84. Out of 64 codons, 61 codons code for 20 types of amino acid. It is called
(a) degeneracy of genetic code
(b) overlapping of gene
(c) wobbling of codon
(d) universility of codons. *(2002)*

85. Which of the following reunites the exon segments after RNA splicing?
(a) RNA polymerase (b) RNA primase
(c) RNA ligase (d) RNA proteoses
(2002)

86. Which of the following enzymes are used to join bits of DNA?
(a) Ligase (b) Primase
(c) DNA polymerase (d) Endonuclease
(2002)

87. Exon part of *m*RNAs have code for
(a) protein (b) lipid
(c) carbohydrate (d) phospholipid.
(2002)

88. Change in sequence of nucleotide in DNA is called as
(a) mutagen (b) mutation
(c) recombination (d) translation.
(2002)

89. *m*RNA is synthesised on DNA template in which direction
(a) $5' \rightarrow 3'$ (b) $3' \rightarrow 5'$
(c) both (a) and (b) (d) any. *(2001)*

90. In negative operon,
(a) co-repressor binds with repressor
(b) co-repressor does not bind with repressor
(c) co-repressor binds with inducer
(d) camp have negative effect on *lac* operon.
(2001)

91. Gene and cistron words are sometimes used synonymously because
(a) one cistron contains many genes
(b) one gene contains many cistrons
(c) one gene contains one cistron
(d) one gene contains no cistron. *(2001)*

92. Types of RNA polymerase required in nucleus of eukaryotes for RNA synthesis
(a) 1 (b) 2
(c) 3 (d) 4. *(2001)*

93. Method of DNA replication in which two strands of DNA separate and synthesize new strands
(a) dispersive (b) conservative
(c) semi-conservative (d) non conservative.
(2000)

94. Which of the following is initiation codon?
(a) UAG (b) AUC
(c) AUG (d) CCU *(2000)*

95. Anticodon occurs in
(a) *t*RNA (b) *m*RNA
(c) *r*RNA (d) DNA. *(2000)*

96. Length of one loop of B-DNA
(a) 3.4 nm (b) 0.34 nm
(c) 20 nm (d) 10 nm. *(2000)*

97. In three dimensional view the molecule of *t*RNA is
(a) L-shaped (b) S-shaped
(c) Y-shaped (d) E-shaped. *(2000)*

98. Similarity in DNA and RNA is that
(a) both are polymer of nucleotides
(b) both have similar pyrimidine
(c) both have similar sugar
(d) both are genetic material. *(2000)*

99. The *Pneumococcus* experiment proves that
(a) bacteria do not reproduce sexually
(b) RNA sometime controls the production of DNA and proteins
(c) DNA is the genetic material
(d) bacteria undergo binary fission. *(1999)*

100. In operon concept, regulator gene functions as
(a) inhibitor (b) repressor
(c) regulator (d) all of these.
(1999)

101. Initiation codon in eukaryotes is
(a) GAU (b) AGU
(c) AUG (d) UAG. *(1999, 1994)*

102. DNA is mainly found in
(a) nucleolus (b) nucleus only
(c) cytoplasm only (d) none of these.
(1999)

103. In prokaryotes, the genetic material is
(a) linear DNA without histones
(b) circular DNA without histones
(c) linear DNA with histones
(d) circular DNA with histones. *(1999)*

104. In DNA, when AGCT occurs, their association is as per which of the following pair?
(a) AT-GC (b) AG-CT
(c) AC-GT (d) All of these
(1999)

105. The eukaryotic genome differs from the prokaryotic genome because
(a) the DNA is complexed with histone in prokaryotes
(b) the DNA is circular and single stranded in prokaryotes
(c) repetitive sequences are present in eukaryotes
(d) genes in the former case are organized into operons. *(1999)*

106. What base is responsible for hot spots for spontaneous point mutations?
(a) 5-bromouracil (b) 5-methylcytosine
(c) Guanine (d) Adenine *(1998)*

107. Genes that are involved in turning on or off the transcription of a set of structural genes are called
(a) redundant genes
(b) regulatory genes
(c) polymorphic genes
(d) operator genes. *(1998)*

108. DNA elements, which can switch their position, are called
(a) cistrons (b) transposons
(c) exons (d) introns. *(1998)*

109. The codons causing chain termination are
(a) AGT, TAG, UGA
(b) UAG, UGA, UAA
(c) TAG, TAA, TGA
(d) GAT, AAT, AGT. *(1997)*

110. DNA synthesis can be specifically measured by estimating the incorporation of radio-labelled
(a) thymidine (b) deoxyribose sugar
(c) uracil (d) adenine. *(1997)*

111. The RNA that pick up specific amino acid from amino acid pool in the cytoplasm to ribosome during protein synthesis is called
(a) *r*RNA (b) RNA
(c) *m*RNA (d) *t*RNA. *(1997)*

112. Which of the following step of translation does not consume a high energy phosphate bond?
(a) Peptidyl transferase reaction
(b) Aminoacyl *t*RNA binding to A-site
(c) Translocation
(d) Amino acid activation *(1997)*

113. Which of the following serves as a terminal codon?
(a) UAG (b) AGA
(c) AUG (d) GCG *(1996)*

114. The maximum formation of *m*RNA occurs in
(a) ribosome (b) nucleoplasm
(c) cytoplasm (d) nucleolus. *(1996)*

115. Radio-tracer technique shows that DNA is in
(a) multi-helix stage (b) single-helix stage
(c) double-helix stage (d) none of these. *(1996)*

116. The wild type *E.coli* cells are growing in normal medium with glucose. They are transferred to a medium containing only lactose as sugar. Which of the following changes take place?
(a) The *lac* operon is induced.
(b) *E.coli* cells stop dividing.
(c) The *lac* operon is repressed.
(d) All operons are induced. *(1995)*

117. The *lac* operon is an example of
(a) repressible operon
(b) overlapping genes
(c) arabinose operon
(d) inducible operon. *(1995)*

118. An environmental agent, which triggers transcription from an operon, is a
(a) depressor
(b) controlling element
(c) regulator
(d) inducer. *(1995)*

119. If the sequence of bases in DNA is ATTCGATG, then the sequence of bases in its transcript will be
(a) GUAGCUUA (b) AUUCGAUG
(c) CAUCGAAU (d) UAAGCUAC. *(1995)*

120. If the DNA codons are ATG ATG ATG and a cytosine base is inserted at the beginning, then which of the following will result?
(a) CAT GAT GATG
(b) A non-sense mutation
(c) C ATG ATG ATG
(d) CA TGA TGA TG *(1995)*

121. In split genes, the coding sequences are called
(a) exons (b) cistrons
(c) introns (d) operons. *(1995)*

122. Anticodon is an unpaired triplet of bases in an exposed position of
(a) *t*RNA (b) *m*RNA
(c) *r*RNA (d) both (b) and (c). *(1995)*

123. '*Lac* operon' in *E. coli*, is induced by
(a) 'I' gene (b) promoter gene
(c) β-galactosidase (d) lactose. *(1994)*

124. Initiation codon in eukaryotes is
(a) GAU (b) AGU
(c) AUG (d) UAG. *(1994)*

125. There are special proteins that help to open up DNA double helix in front of the replication fork. These proteins are
(a) DNA ligase
(b) DNA topoisomerase I
(c) DNA gyrase
(d) DNA polymerase I. *(1994)*

126. In protein synthesis, the polymerization of amino acids involves three steps. Which one of the following is not involved in the polymerisation of protein ?
(a) Termination (b) Initiation
(c) Elongation (d) Transcription
(1994)

127. Nucleosome core is made of
(a) H_1, H_2A, H_2B and H_3
(b) H_1, H_2A, H_2B, H_4
(c) H_1, H_2A, H_2B, H_3 and H_4
(d) H_2A, H_2B, H_3 and H_4. *(1993)*

128. Initiation codon of protein synthesis (in eukaryotes) is
(a) GUA (b) GCA
(c) CCA (d) AUG. *(1993)*

129. The transforming principle of *Pneumococcus* as found out by Avery, MacLeod and McCarty was
(a) *m*RNA (b) DNA
(c) protein (d) polysaccharide.
(1993)

130. Who proved that DNA is basic genetic material?
(a) Griffith (b) Watson
(c) Boveri and Sutton
(d) Hershey and Chase *(1993)*

131. Because most of the amino acids are represented by more than one codon, the genetic code is
(a) overlapping (b) wobbling
(c) degenerate (d) generate. *(1993)*

132. During DNA replication, the strands separate by
(a) DNA polymerase
(b) topoisomerase
(c) unwindase/helicase
(d) gyrase. *(1993)*

133. The process of translation is
(a) ribosome synthesis
(b) protein synthesis
(c) DNA synthesis
(d) RNA synthesis. *(1993)*

134. A DNA with unequal nitrogen bases would most probably be
(a) single stranded (b) double stranded
(c) triple stranded (d) four stranded.
(1993)

135. Nucleotide arrangement in DNA can be seen by
(a) X-ray crystallography
(b) electron microscope
(c) ultracentrifuge
(d) light microscope. *(1993)*

136. Experimental material in the study of DNA replication has been
(a) *Escherichia coli*
(b) *Neurospora crassa*
(c) *Pneumococcus*
(d) *Drosophila melanogaster*. *(1992)*

137. Khorana first deciphered the triplet codons of
(a) serine and isoleucine
(b) cysteine and valine
(c) tyrosine and tryptophan
(d) phenylalanine and methinonine. *(1992)*

138. *Escherichia coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have
(a) different density and do not resemble parent DNA
(b) different density but resemble parent DNA
(c) same density and resemble parent DNA
(d) same density but do not resemble parent DNA. *(1992)*

139. The process of transfer of genetic information from DNA to RNA/formation of RNA from DNA
(a) transversion (b) transcription
(c) translation (d) translocation.
(1991)

140. An octamer of 4 histones complexed with DNA forms
(a) endosome
(b) nucleosome
(c) mesosome
(d) centromere. *(1990)*

141. In the genetic dictionary, there are 64 codons as
(a) 64 amino acids are to be coded
(b) 64 types of *t*RNAs are present
(c) there are 44 nonsense codons and 20 sense codons
(d) genetic code is triplet. *(1990)*

142. DNA replication is
(a) conservative and discontinuous
(b) semi-conservative and semi-discontinuous
(c) semi-conservative and discontinuous
(d) conservative. *(1989)*

143. Genetic code consists of
(a) adenine and guanine
(b) cytosine and uracil
(c) cytosine and guanine
(d) all the above. *(1988)*

Testprep Kart

Answer Key

1.	(a)	**2.**	(b)	**3.**	(c)	**4.**	(d)	**5.**	(c)	**6.**	(b)	**7.**	(b)	**8.**	(b)	**9.**	(c)	**10.**	(c)
11.	(a)	**12.**	(c)	**13.**	(a)	**14.**	(c)	**15.**	(b)	**16.**	(b)	**17.**	(a)	**18.**	(d)	**19.**	(d)	**20.**	(a)
21.	(a,d)	**22.**	(c)	**23.**	(a)	**24.**	(d)	**25.**	(a)	**26.**	(c)	**27.**	(d)	**28.**	(d)	**29.**	(b)	**30.**	(b)
31.	(a)	**32.**	(a)	**33.**	(d)	**34.**	(b)	**35.**	(b)	**36.**	(a)	**37.**	(a)	**38.**	(c)	**39.**	(d)	**40.**	(d)
41.	(c)	**42.**	(b)	**43.**	(c)	**44.**	(c)	**45.**	(b)	**46.**	(b)	**47.**	(b)	**48.**	(d)	**49.**	(a)	**50.**	(d)
51.	(d)	**52.**	(b)	**53.**	(b)	**54.**	(c)	**55.**	(d)	**56.**	(d)	**57.**	(a)	**58.**	(d)	**59.**	(c)	**60.**	(c)
61.	(b)	**62.**	(c)	**63.**	(c)	**64.**	(d)	**65.**	(c)	**66.**	(c)	**67.**	(b)	**68.**	(a)	**69.**	(d)	**70.**	(c)
71.	(c)	**72.**	(c)	**73.**	(a)	**74.**	(a)	**75.**	(c)	**76.**	(d)	**77.**	(a)	**78.**	(d)	**79.**	(b)	**80.**	(c)
81.	(b)	**82.**	(c)	**83.**	(b)	**84.**	(a)	**85.**	(c)	**86.**	(a)	**87.**	(a)	**88.**	(b)	**89.**	(a)	**90.**	(a)
91.	(c)	**92.**	(c)	**93.**	(c)	**94.**	(c)	**95.**	(a)	**96.**	(a)	**97.**	(a)	**98.**	(a)	**99.**	(c)	**100.**	(b)
101.	(c)	**102.**	(b)	**103.**	(b)	**104.**	(a)	**105.**	(b)	**106.**	(c)	**107.**	(d)	**108.**	(b)	**109.**	(b)	**110.**	(a)
111.	(d)	**112.**	(a)	**113.**	(a)	**114.**	(d)	**115.**	(c)	**116.**	(a)	**117.**	(d)	**118.**	(d)	**119.**	(d)	**120.**	(a)
121.	(a)	**122.**	(a)	**123.**	(c)	**124.**	(c)	**125.**	(b)	**126.**	(d)	**127.**	(d)	**128.**	(d)	**129.**	(b)	**130.**	(d)
131.	(c)	**132.**	(c)	**133.**	(b)	**134.**	(a)	**135.**	(a)	**136.**	(a)	**137.**	(b)	**138.**	(a)	**139.**	(b)	**140.**	(b)
141.	(d)	**142.**	(b)	**143.**	(d)														

EXPLANATIONS

1. (a)

2. (b) : 1 codon consists of 3 bases. Therefore, a deletion on 901 position will affect 33 codons.

3. (c) : Lagging strand is a replicated strand of DNA which is formed in short segments called Okazaki fragments. Its growth is discontinuous. The direction of growth of the lagging strand is 3' → 5' though in each Okazaki fragment it is 5' → 3'.

4. (d) : *r*RNA (ribosomal RNA) is the most abundant of all types of RNA (70-88%). Hence, it will be present in highest amount. Percentage of *t*RNA and *m*RNA is 15% and 2-5% respectively. miRNA (micro RNA) are 21-22 bp long RNA that bring degeneration of *m*RNA.

5. (c) : Spliceosomes helps in removal of introns. They will not occur in prokaryotes because prokaryotes do not have introns and thus, processing does not require splicing of *m*RNA.

6. (b) : Histones help in packaging of DNA. In eukaryotes, DNA packaging is carried out with the help of positively charged basic proteins called histones. Histones are of five types – H_1, H_2A, H_2B, H_3 and H_4. H_1 is attached over the linker DNA. Histone contains a large proportion of the positively charged (basic) amino acids, lysine and arginine in their structure. DNA is negatively charged due to the phosphate groups on its backbone. The result of these opposite charges is strong attraction and therefore, high binding affinity between histones and DNA.

7. (b) : Taylor *et al* (1957) conducted experiment on *Vicia faba* (broad bean) to prove semi-conservative replication of DNA. He fed dividing cells of root tips of *Vicia faba* with radioactive ^3H containing thymine instead of normal thymine and found that all the chromosomes became radioactive. Labelled thymine was then replaced with normal one. Next generation came to have radioactivity in one of the two chromatids of each chromosome while in subsequent generation radioactivity was present in 50% of the chromosomes. This is possible only if out of the two strands of a chromosome, one is formed a fresh while the other is conserved at each replication.

8. (b) : Cistron (or gene) is a length of DNA that contains the information for coding a specific polypeptide chain or a functional RNA molecule (*i.e.*, transfer RNA or ribosomal RNA). Hence, cistron is a unit of function. Currently such a gene is called structural gene.

9. (c) : 23S *r*RNA acts as structural RNA as well as ribozyme in bacteria.

10. (c) : Genetic material should be structurally and chemically stable otherwise its expression will change and leading to loss of several metabolic functions, etc.

11. (a) : The strand of DNA on which RNA polymerase binds to catalyse transcription is called template strand. It is also known as master or antisense strand. It has the polarity of 3′ → 5′.

12. (c) : Polypeptide synthesis is signalled by two initiator codons or start codons *i.e.*, AUG (methionine codon) and rarely by GUG (valine codon).

13. (a) : In *Lac* operon, lactose is an inducer. It binds with suppressor and inactivates it. It allows RNA polymers access to the promoter and transcription proceeds.

14. (c)

15. (b) : Chargaff's rules are applicable only for double stranded DNA molecule. These are not applicable for single stranded DNA or RNA molecules. Chargaff's rules state that DNA helices contain equal molar ratios of A and T, G and C. This is because in a ds DNA molecule, complementary base pairing occurs between A and T, and C and G base pairs. This complementary base pairing is not possible in case of single stranded RNA molecule. Thus, Chargaff's rules are not applicable to RNA.

16. (b) : In certain development stages the polytene chromosomes bear conspicuous swellings called chromosome puffs. The larger swellings are called Balbiani rings. In the region of a puff or Balbiani ring, the DNA strands uncoil, become active and produce number of copies of *m*RNA. The *m*RNAs may remain temporarily stored in the puff and they may undergo transcription to form proteins. Thus, Balbiani rings are the sites of RNA and protein synthesis.

17. (a) : In genome all the genes are contained in a single set of chromosomes. The instructions in our genome are present in the form of DNA. DNA has a complicated structure in the form of a double helix. Single strands of DNA are coiled up into structures called chromosomes. Within the chromosomes, segments of DNA are "read" together to form genes. Thus, a gene is a segment of DNA or chromosome situated at a specific locus (gene locus) which carries coded information associated with a specific function

and can undergo crossing over as well as mutation. A nucleotide is the basic unit of DNA made up of a pentose sugar, phosphoric acid and a nitrogenous base.

18. (d) : Satellite DNA is that part of repetitive DNA which has long repetitive nucleotide sequences in tandem that forms a separate fraction on density ultracentrifugation. DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times. These repetitive DNA sequences are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA. Depending on base composition (A:T rich or G:C rich), length of segment, and number of repetitive units, the satellite DNA is classified into many categories, such as micro-satellites, mini-satellites etc. These sequences normally do not code for any proteins, but they form a large portion of human genome. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting. Since DNA from every tissue (such as blood, hair-follicle, skin, bone, saliva, sperm etc.) from an individual show the same degree of polymorphism, they become very useful identification tool in forensic applications.

19. (d) : The control of expression of *lac* operon is negative (as it is turned off normally) and inducible. Inducible operon is an operon which remains switched off normally but becomes operational in the presence of an inducer (lactose, actually allolactose a metabolite of lactose, in case of *lac* operon). The inducible operon generally functions in catabolic pathways. In the presence of an inducer, the repressor has a higher affinity for the inducer than for the operator gene. When lactose is added, a few lactose molecules are carried into the cell by the enzyme lactose permease as small amount of this enzyme is present in the cell even when the operon is not working. These few lactose molecules are converted into allolactose molecules which act as an inducer and bind to the repressor (a product of regulator gene). The repressor-inducer complex fails to join with the operator gene, thus it is turned on.

20. (a) : According to Chargaff's rule, the amount of adenine is always equal to that of thymine and the amount of guanine is always equal to that of cytosine, *i.e.*, A = T and G = C. Also, the purines and pyrimidines are always in equal amounts, *i.e.*, A + G = T + C. Now, given dsDNA has 17% cytosine and hence guanine will be also 17%. So, A + T must be 66%, therefore, percentage of adenine or thymine would be 66/2 = 33%.

21. (a, d) : Transcription is the process in living cells in which the genetic information of DNA is transferred to *m*RNA as first step of gene expression. An operon consists of structural genes, promoter, operator and regulator gene.

22. (c) : Transformation was first studied by S.F. Griffith in 1928 while studying *Streptococcus pneumoniae*. He found that R-Type non virulent bacteria pick up virulence from heat killed virulent S-type bacteria and transform into virulent forms. It was this experiment which indicated presence of a 'transforming principle' which was later found out to be DNA, by Avery *et al.*

23. (a) : RNA polymerase initiates and extends the RNA (chain elongation) and functions always in 5′ to 3′ direction. The structural component of DNA has 3′ to 5′ polarity. It is also called template DNA strand or antisense (–) strand.

24. (d)

25. (a) : The expression of the genetic material occurs normally through the production of proteins. This involves two consecutive steps. These are transcription and translation. The DNA codes for the production of messenger RNA (*m*RNA) during transcription. Messenger RNA carries coded information to ribosomes. The ribosomes read this information and use it for protein synthesis. This process is called translation. F.H.C. Crick described this undirectional flow of information in 1958 as the 'central dogma of molecular biology'.

26. (c) : A nonsense mutation is the one which stops polypeptide synthesis due to the formation of termination or non-sense codon. In *lac* operon, sequence of structural genes is Z, Y, and A, which respectively code for β-galactosidase, lactose permease and transacetylase. If the gene Y has nonsense mutation, gene expression will stop at it, resulting in non-expression of both gene Y and successive gene A. Thus, only β-galactosidase enzyme will be produced.

27. (d) : *Refer to answer 25.*

28. (d) : Plant viruses often contain parasites of their own, referred to as satellites. Satellite RNAs are highly dependent on their helper virus for both replication and encapsidation. Their size vary from 194 to 1500 nucleotides (approx.) The larger satellites

contain open reading frame and express proteins, whereas smaller satellites do not produce functional proteins.

29. (b) : Genetic code is non-ambiguous. Non-ambiguous code means that there is no ambiguity about a particular code. One codon specifies only one amino acid and not any other. There are 64 codons. Out of 64, 3 are stop codons or nonsense codons, *i.e.*, these do not code for any amino acid and rest 61 code for one of the 20 amino acids. Neither of them code for more than one amino acids except GUG which normally code for valine but in certain conditions it also codes for N-formyl methionine as initiation codon.

30. (b) : Gene bank or genomic library is a complete collection of cloned DNA fragments which comprises the entire genome of an organism. Molecular probes are small DNA segments that are used to detect the presence of complementary sequences in nucleic acid samples in genomic library. These are usually formed of 200-500 nucleotide sequences. These segments or probes are labelled either with radioactive or with nonradioactive compound. Probes with DNA sequence complementary to the gene to be isolated are used. They bind with the desired gene, making it visible and help in isolating it from the library.

31. (a) : *Refer to answer 19.*

32. (a)

33. (d) : Introns, which occur principally in eukaryotes, are transcribed into messenger RNA (*m*RNA) but are subsequently removed from the transcription before translation. In certain cases, removal of the introns is an autocatalytic process (self-splicing) whereby the RNA itself has the properties of an enzyme.

34. (b) : In RNA, thymine is substituted with uracil thus, the RNA strand complementary to DNA strand ATCTG will be UAGAC.

35. (b) : Nucleolus is the centre for synthesis of ribosomal RNA (*r*RNA) that form ribosomal subunits. Ribosomal proteins migrate to the nucleolus from their assembly sites in the cytoplasm and are packaged into ribonucleoproteins. These return to the cytoplasm where they become mature ribosome particles.

36. (a) : A transcription unit is a part of DNA that is able to transcribe a complete RNA. It consists of a promoter region (where RNA polymerase binds to start transcription), the structural gene (coding region) and the terminator region (that signals release of RNA polymerase and newly formed RNA strand).

37. (a) : In eukaryotes, RNA polymerase enzymes (Type I, II, III) catalyze the synthesis of RNA using as a template either an existing DNA strand or an RNA strand. Type I is responsible for synthesis of *r*RNA, type II for *m*RNA and type III for *t*RNA synthesis.

38. (c) : Nucleosomes appear as 'beads-on-string' in the chromosome when viewed under electron microscope. The beads in 'beads-on-string' arrangement are complexes of histones and DNA. The bead plus the connecting DNA that leads to the next bead from the nucleosome. Nucleosome is the fundamental unit of organization on which the higher-order packaging of chromatin is built. The bead of each nucleosome contains eight histone molecules in which two copies each of H_2A, H_2B, H_3 and H_4 are found.

39. (d) : The unequivocal proof that DNA is the genetic material came from the experiments of Alfred Hershey and Martha Chase (1952). They worked with viruses that infect bacteria called bacteriophages.

40. (d) :

$$\text{DNA} \xrightarrow{\text{Transcription}} m\text{RNA} \xrightarrow{\text{Translation}} \text{Protein}$$

This one-way flow of information from DNA to *m*RNA and then to protein is called the central dogma of molecular biology by F.H.C. Crick (1958). But later on two American workers H. Temin and D. Baltimore reported that DNA is also formed from RNA in retroviruses, *e.g.*, HIV. This is called reverse transcription or Teminism, *i.e.*,

$$\text{DNA} \underset{\text{Reverse transcription}}{\overset{\text{Transcription}}{\rightleftharpoons}} m\text{RNA} \xrightarrow{\text{Translation}} \text{Protein}$$

This reverse transcription occurs under the influence of reverse transcriptase enzyme. So, HIV viruses does not follow central dogma.

41. (c) : Palindromic nucleotide sequences in the DNA molecule are groups of bases that form the same sequence when read in both forward and backward direction. In the given question, only option (c) represents a palindromic sequence, that can be easily cut at about the middle by some particular restriction enzyme.

42. (b) : *Refer to answer 29.*

43. (c) : The two French scientists, Jacob and Monod proposed the *lac* operon of *E. coli*. The *lac* operon (an inducible operon) contains a promoter, an operator, a regulator gene and three structural genes *z*, *y*, and *a*, coding for the enzyme β-galactosidase, β-galactoside permease, and β-galactoside

transacetylase, respectively. β-galactoside permease "pumps" lactose into the cell, where β-galactosidase cleaves it into glucose and galactose. The function of the transacetylase is still not clear. The *lac* regulator gene, designated the *i* gene, codes for a repressor. In the absence of the inducer (*i.e.*, lactose, actually allolactose), the repressor binds to the *lac* operator sequence, preventing RNA polymerase from binding to the promoter and transcribing the structural genes. The inducer of the operon, allolactose, is derived from lactose in a reaction that is catalyzed by β-galactosidase. Once formed, allolactose binds to the repressor, causing it to be released from the operator; in doing so, it induces transcription of the *z*, *y* and *a* structural genes. CAP is activator called catabolic activator protein. It exerts a positive control in *lac* operon because in its absence RNA polymerase is unable to recognise promotor gene. CAP activates *lac* genes only when glucose is absent. Such enzymes whose synthesis can be induced by adding the substrate are known as inducible enzymes and the genetic systems responsile for the synthesis of such an enzyme are known as inducible operons.

44. (c) : The phosphodiester bonds is formed between the phosphate group, which is connected to carbon 5′ of the sugar residue of one nucleotide, and carbon 3′ of the sugar residue of the next nucleotide.

45. (b) : *Refer to answer 43.*

46. (b) : Unlike in prokaryotes where transcription and translation take place in the same compartment, in eukaryotes primary transcript is first processed in the nucleus and then transported outside of the nucleus. Since the primary transcripts of the eukaryotes contains both the expressing genes (exons) and non-expressing genes (introns), it undergoes splicing of introns and later capping and tailing at 5′-end and 3′-end respectively.

47. (b) : Insulin gene is found in every body cell but is not expressed in all cells. It is nucleosome which consists of a core of eight histones. DNA is composed of nucleotides. Centriole is found in animal cells, which produces aster during cell division.

48. (d) : Genetic code was deciphered in 1960's by Crick, Ochoa, Nirenberg, Mathaei and Khorana.

49. (a) : Mathew Meselson and Franklin Stahl (1958) conducted various experiments using isotopically labelled DNA of *Escherichia coli* to provide evidence in favour of semi-conservative mode of DNA replication.

50. (d) : *m*RNA is not made directly in a eukaryotic cell. It is transcribed as heterogeneous nuclear RNA (hnRNA) in the nucleus. hnRNA contains introns and exons. The introns are removed by RNA splicing leaving behind the exons,which contain the information. The exonic regions of RNA are joined together to produce a single chain RNA required for functioning as translational template.

51. (d) : The relationship between the sequence of amino acids in a polypeptide and nucleotide sequence of DNA or *m*RNA is called genetic code**.** The genetic code is continuous and does not possess pause after the triplets. So a codon in *m*RNA is a non-contiguous fashion. If a nucleotide is deleted or added, the whole genetic code will read differently.

52. (b) : A DNA molecule has two unbranched complementary strands which are spirally coiled. The two chains are antiparallel *i.e.*, they run parallel but in opposite direction. One chain has the polarity 5′ → 3′ whereas, other has 3′ → 5′. Both are held together by hydrogen bonds between their bases *i.e.*, A = T and G ≡ C and the amount of adenine is equal to thymine and guanine equals to cytosine. The base ratio A + T / G + C may vary from one species to another but is constant for a given species. The purine and pyrimidines are always in equal amount (A + G = T + C) but A + T is not necessarily equal to G + C.

53. (b) : The two DNA chains are held together by hydrogen bonds between their nitrogenous bases. Adenine (A), a purine of one chain lies exactly opposite thymine (T), a pyrimidine of the other chain. Similarly, cytosine (C), a pyrimidine lies opposite guanine (G), a purine. Three hydrogen bonds occur between cytosine and guanine (C ≡ G) at positions 1′, 2′, and 6′ and two hydrogen bonds between adenine and thymine (A = T) at positions 1′ and 6′.

54. (c) : Ribosomes may occur in rosettes or helical groups called polyribosomes or polysomes (Gk. *Poly* – many, *soma* – body). The different ribosomes of a polyribosome are connected with a 10 – 20 Å thick strand of messenger or *m*RNA and its maintenance requires energy. Polyribosomes are formed during periods of active protein synthesis when a number of copies of the same polypeptide are required.

55. (d) : AUG codes for methionine and is initiation or start codon which starts the synthesis of polypeptide. UAA (ochre), UAG (amber) and UGA (opal) do not specify any amino acid so they are called termination codons. CUU, CUC, CUA and CUG codes for leucine whereas GCU, GCC, GCA and GCG codes for alanine.

56. (d) : DNA or deoxyribose nucleic acid is the largest macromolecule made of the helically twisted two antiparallel polydeoxyribonucleotide strands held together by hydrogen bonds. The two strands of DNA are together called DNA duplex. It has a diameter of 20Å. One turn spiral has a distance of 34 Å. It contains 10 deoxyribonucleotides in each strand so that the distance between two adjacent nucleotides is 3.4 Å.

57. (a) : In 1948, Beadle and Tatum proposed one-gene one-enzyme hypothesis which states that a gene controls metabolic machinery of the organism through synthesis of an enzyme. This laid the foundation of biochemical genetics. Beadle and Tatum were awarded Nobel Prize in 1958. This one gene one enzyme theory has been changed to one gene one polypeptide hypothesis proposed by Yanofsky. *i.e.*, one gene synthesizes one polypeptide and many polypeptides form one enzyme.

58. (d) : DNA is a type of nucleic acid that forms genetic material in many organisms. It consists of a long polymer of nucleotides which transcribes the coded information in the form of a triplet code of nucleotides in *m*RNA. It is a double helical molecule. The two strands of DNA run in opposite directions to one another with the hydrogen bonds between them. One strand of DNA has 5′-3′ direction and the other strand has 3′-5′ direction. So they are antiparallel. This direction is determined by the presence of a free phosphate or OH group at the end of the strand. If the strand has phosphate group at the the 5′ end and with a free OH group at the 3′ end.

59. (c) : Neomycin is a broad spectrum antibiotic which was first isolated from a strain of *Streptomyces feadiae*. It is effective against Gram positive as well as Gram negative bacteria. Its mechanism of action is by selective inhibition of protein synthesis on the 70S (prokaryotic) ribosome by inhibiting the interaction of *m*RNA and *t*RNA during translation process.

60. (c) : Messenger RNA or *m*RNA has been named so because it carries the coded information from DNA for the synthesis of proteins. It carries the coded information in a number of base triplets called codons. It is transcribed on DNA by the enzyme RNA polymerase. Hence, its base sequence is complementary to DNA on which it has been synthesized. In eukaryotes each gene transcribes its own *m*RNA, therefore the number of *m*RNAs corresponds to the number of genes. *r*RNA is a type of RNA that forms structural and functional components of ribosomes. *t*RNA is a class of RNA having structures with triplet nucleotide sequences that are complementary to the triplet nucleotide coding sequences of *m*RNA. It binds with amino acids and transfers them to ribosomes.

61. (b)

62. (c) : Telomerase is a ribonucleoprotein molecule that is enzymatic in nature. It uses a special mechanism for the synthesis of DNA at telomeric ends. The DNA repeat sequence of telomere has one G rich strand and other C rich strand. The G rich strand has a single stranded overhand. This overhand works as a primer and for its elongation uses as template the RNA component of telomerase enzyme. Thus telomerase synthesizes only the G rich strand of telomeres.

63. (c) : Streptomycin is broad spectrum (active against both Gram-positive and Gram-negative bacteria) and was the first really effective drug against tuberculosis, but its use is limited by the development of resistant strains and by toxic side-effects. The bactericidal action of streptomycin, as with other aminoglycoside antibiotics (*e.g.*, neomycin) is through selective inhibition of protein synthesis on 70S ribosomes.

To check resistance of mutants against streptomycin they must be grown on plates with streptomycin.

Only those bacterial colonies will propagate from the master that are resistant to the antibiotic.

64. (d) : The mitochondria contains its own set of ribosomes which synthesize proteins, so protein synthesis occures both in mitochondria and cytoplasm.

65. (c) : *Refer to answer 40.*

66. (c) : Endonucleases hydrolyse the internal phosphodiester bond. Exonucleases cleave the terminal nucleotides. Lipase digest fats and proteases break down proteins.

67. (b) : After 25 bases from start of transcription point are TATA boxes. After 40 bases from TATA boxes appears CAAT boxes. Both of these sequences serve as recognitions sites in eukaryotic promoters. Transcription in eukaryotic genes is a far more complicated process than in prokaryotes.

68. (a) : A mutation involves a change in the sequence of nucleotides in a nucleic acid molecule. This change will express itself in the form of a change in the sequence of aminoacids in the protein molecule synthesized through the information, encoded in nucleic acid segment. Therefore mutations at molecule level can be studied both by the study of

the sequence of amino acids in a protein and also by the study of sequence of nucleotides in a segment of nucleic acid.

69. (d) : Transfer RNA (*t*RNA) are species of RNA responsible for the transfer of specific amino acids to the growing end of a polypeptide chain during translation. R.Holly in 1965 gave clover leaf model of *t*RNA for yeast alanyl *t*RNA. It has four major sites - AAbinding site, anticodon, site, TUC loop and DHU loop. The chain is having unpaired base sequence CCA at 3′ end and G at 5′ end.

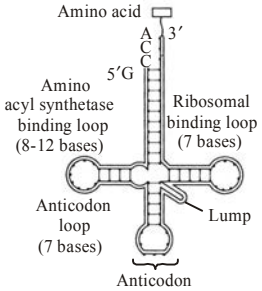


Fig. : Clover leaf model of *t*RNA structure

70. (c) : During transcription RNA synthesis from a DNA template takes place. It involves rewriting of the code without a change in its language. In *m*RNA, adenine pairs with uracil because thymine is not present *m*RNA. So the nucleotide sequence in *m*RNA would be–

DNA template	A	T	A	C	G
*m*RNA	U	A	U	G	C

71. (c) : Transition mutant is one in which a purine is substituted by a different purine, or a pyrimidine by a different pyrimidine. Such a change involves a base pair change between a G–C pair and an A–T pair in the DNA whereas transversion results when one nitrogen base is replaced by another different type *e.g.*, C-G and A-T. Transcription is the formation of *m*RNA on DNA templete.

72. (c) : *Refer to answer 52.*

73. (a) : UGA, UAG and UAA are three non sense (or termination) codon which do not code for any amino acid. If in a gene encoding a polypeptide of 50 amino acid, 25th codon is mutated to UAA or any of the termination codon, then the chain will be terminated at that place because it will become difficult for *t*RNA to bring amino acid from amino acid pool. So in that case a polypeptide of 24 amino acid will be formed.

74. (a) : In *lac* operon, *lac* refers to lactose. The *lac* operator is a part of the structural genes (*lac* Z, *lac* Y, *lac* A and *lac* I). It is responsible for the uptake and initial catabolism of lactose.

$$\text{Lactose} \xrightarrow{\beta\text{-galactosidase}} \text{Glucose} + \text{Galactose}$$

75. (c) : The initiation of polypeptide chain in prokaryotes is always brought about by the amino acid methionine but it has to be formylated to form *t*RNA f^{met}. Then methionine binds with *t*RNA f^{met} to form f-^{met}-*t*RNA f^{met}. This f^{met}-*t*RNA fmet complex binds with the *m*RNA-30S subunit complex using initiation factors IF-2 and IF-1 and GTP.

76. (d) : Codon UAC is correctly matched as it codes for amino acid tyrosine. UCG codes for serine, UUU codes for phenylalanine and UGU codes for cysteine. Start codon is AUG and stop codons are UAA, UAG and UGA.

77. (a) : Promoter is region on a DNA molecule upstream from the coding sequence, area to which RNA polymerase initially binds prior to the initiation of transcription. The promoter,or at least part of it, determines the nature of the polymerase that associates with it. Certain consensus sequences within the promoter region seem to be particularly important in the binding of RNA polymerase, and these are known as CAAT and TATA boxes. The promoter region extends from some 40 nucleotides to about five nucleotides upstream from the start of the gene-coding region, the CAAT and TATA boxes being located within the promoter region as short six or seven nucleotide sequence.

78. (d) : In a triplet for a particular amino acid more than one word (synonyms) can be used. This phenomenon is described by saying that the code is degenerate. A degenerate code would be one where there is one to one relation between aminoacids and the codons that 44 codons out of 64 will be useless or nonsense codons. A code is degenerate because of the third base of the codon. It has been shown that the same *t*RNA can recognize more than one codons differing only at the third position. For example GCU, GCC and GCA all code for alanine amino acids.

79. (b) : *Refer to answer 29.*

80. (c) : In a DNA, the percentage of thymine is 20%. So, as it pairs with adenine, it is also 20%. So the guanine and cytosine together forms 60% of DNA and hence, guanine is 30%.

81. (b) : Transformation involves transfer of genetic material of one bacterial cell into another bacterial

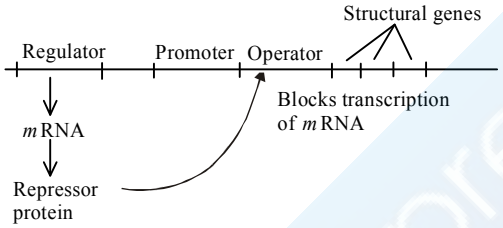
cell by some unknown mechanism and it converts one type of bacterium into another type.

This was first studied by Griffith (1928) in *Diplococcus pneumoniae* and hence is known as Griffith effect.

82. (c) : Operon model was given by Jacob and Monod (1961) for regulation of protein synthesis in prokaryotes. In bacteria, the genes that contain the information for assembling the enzymes for a metabolic pathway are usually clustered together on the chromosome in a functional complex called an operon.

Regulation of protein synthesis in eukaryotes is explained by gene battery model given by Britten and Davidson.

83. (b) : In the *lac* operon of *E.coli* due to the activity of regulator gene synthesis of repressor molecules occurs. These repressor molecules get attached to the operator gene and thus check *m*RNA synthesis and because of this no protein synthesis occurs.



84. (a) : *Refer to answer 29.*

85. (c) : RNA polymerase enzyme catalyses the synthesis of RNA. It is single in prokaryotes. There are three types of RNA polymerases in eukaryotes– I for 28S, 18S and 5.8S RNA, II for *m*RNA and snRNA and III for *t*RNA, 5SRNA and scRNA.

Primase is an RNA polymerase that is used to initiate DNA synthesis. RNA ligase reunites the exon segment after RNA splicing.

86. (a) : Ligases are used to join bits of DNA. Primase is an RNA polymerase, used to initiate DNA synthesis. DNA polymerase enzyme catalyses the synthesis of DNA. Endonuclease, causes the splicing of the intron carrying the coding sequence of the same endonuclease.

87. (a) : DNA transcribes to form *m*RNA. Its function is to carry coded information from DNA for the synthesis of proteins. The RNA consists of a coding region called exon and non-coding region called introns. The exons are thus the functional part that have code for proteins.

88. (b) : *Refer to answer 68.*

89. (a) : *m*RNA is synthesized on DNA template in 5′ – 3′ direction. Synthesis of *m*RNA exhibits several features that are synonymous with DNA replication. RNA synthesis requires accurate and efficient initiation, elongation proceeds in the 5′ – 3′ direction (*i.e.*, the polymerase oves along the template strand of DNA in the 5′ – 3′ direction), and RNA synthesis requires distinct and accurate termination. Transcription exhibits several features that are distinct from replication.

90. (a) : The tryptophan operon (trp operon) in bacteria is a repressible operon. Here, repressor is inactive and it becomes active as DNA binding protein only when complexed with a co-repressor (tryptophan). In absence of tryptophan, the operator site is open to binding by RNA polymerase, which transcribes the structural genes of tryptophan operon, leading to production of enzymes that synthesize tryptophan. When tryptophan becomes available, the enzymes of tryptophan synthetic pathway are no longer needed and tryptophan (co-repressor)-repressor complex blocks transcription. The regulation of this operon is also a negative control.

91. (c) : A gene is a hereditary unit consisting of a sequence of DNA and occupying a specific position or locus within the genome. Gene activity ultimately affects the phenotype of the organism possessing the gene. Thus gene is a physical and functional unit of genetic information. A cistron is a unit of genetic function. In prokaryotes there is one gene one enzyme correspondence. It means that in these organisms genes and cistrons are equivalent.

92. (c) : *Refer to answer 85.*

93. (c) : The method of DNA replication is semi-conservative. According to the semi-conservative model proposed by Watson and Crick, each strand of the two double helices formed would have one old and one new strand. So, the parental identity is conserved upto half extent and hence DNA replication is semi-conservative.

94. (c) : *Refer to answer 55.*

95. (a)

96. (a) : B-DNA is an antiparallel double helix. The double strand or duplex is coiled plectonemically in right handed fashion around a common axis like a rope stair case twisted in a spiral. The coiling produces alternate major and minor grooves. One turn of spiral has a distance between two adjacent nucleotides is 3.4 Å.

97. (a) : 3-D model of *t*RNA looks like flattened L-shaped molecule.

*t*RNA acts as adoptor molecule which carries amino acids to the site of protein synthesis (*i.e.*, ribosomes). Most accepted model for *t*RNA structure is 'clover leaf model.

98. (a) : Deoxyribonucleic acid and ribonucleic acid as the name suggests are made up of several nucleotide monomers. Each nucleotide consists of pentose sugar, phosphate group and nitrogenous bases. DNA has deoxyribose sugar whereas RNA has ribose sugar. The bases in DNA molecule are A, T, G and C whereas in RNA, thymine is absent and instead uracil is found.

99. (c) : Transformation was first discovered by Griffith (1928), in *Pneumococcus* (*Streptococcus pneumoniae*), that causes pneumonia.
Griffith injected a group of mice with nonencapsulated, rough (R), pneumococci; a second group with heat-killed encapsulated pneumococci cells, and a third group a mixture consisting of a few living nonencapsulated, rough pneumococci derived from a type S culture, and heat-killed encapsulated cells (S type). Griffith observed that the mice in the first two groups were not infected, and the mice in the third group died within a few days. The mice of the third group should have survived as the organisms which could kill them had been killed, and the cell of R type were incapable of causing disease. However, the mice died, and living virulent encapsulated cells of the type S were recovered from their dead bodies. It was observed by Griffith, that killed encapsulated pneumococci had liberated some substance which favoured non-capsulated cells (R type) to produce a capsular substance.

This substance in later experiments was proved to be DNA. These experiments showed that DNA is the genetic material.

100. (b) : Regulator gene is a gene whose function is to control the transcriptional activity of other genes, either adjacent or distant in the genome. In the case of the *lac* operon of *E.coli* the regulator gene *lac i* produces a protein product that represses the operator gene of the operon. In bacteria the same regulator gene may affect a series of non-adjacent operons.

101. (c) : *Refer to answer 55.*

102. (b) : DNA is mainly found in nucleus. It is associated with RNA and proteins to form compact chromosomes. But some amount of DNA is also found in chloroplasts and mitochondria. This DNA is called extra-chromosomal DNA.

103. (b) : The genetic material of prokaryotes is circular and single stranded DNA. It has no association of histones. The eukaryotic genetic material is linear and double stranded DNA. It is associated with histone proteins to form nucleosome unit.

104. (a) : DNA molecule has four bases - adenine, guanine, cytosine and thymine. Adenine always pairs with thymine and guanine pairs with cytosine. Their association is A-T and G-C.

105. (b) : Genome refers to the total sets of chromosomes carried by each cell of the organism. In prokaryotes the genetic material is circular and single stranded DNA. It has no association of histones. The eukaryotic genetic material is linear and double stranded DNA. It is associated with histone proteins to form nucleosome unit.

106. (c) : Mutations are rare events in nature and are then described as spontaneous mutations. Some of these mutations originate from mistakes in normal duplication of DNA. Transitions may be produced by tautomeric shift or ionization of bases which leads to mistaken, A – C base pairing and more frequently mistaken G – T base pairing. Guanine pairs with the rare enol form of thymine and is thus considered as hot spot for spontaneous point mutations.

107. (d) : Operator genes are a region of DNA sequence capable of interacting with a specific repressor molecule and in doing so it affects the activity of other genes downstream from it.

108. (b) : Transposons are portable genetic elements which can insert themselves at random into a plasmid or any chromosome independently of the host cell recombination system. It was discovered by Barbara Mc Clintock (1940) in maize and termed as jumping genes. Later Headges and Jacob termed them as transposons.
Introns are nontranslated sequences within the coding sequence of a gene. Such sequences are transcribed into hnRNA but are then spliced out and are not represented in the message. The non-intron sequences of the gene are referred to as exons.
Cistron sequence of nucleotides in a DNA molecule code for one particular polypeptide chain.

109. (b) : *Refer to answer 55.*

110. (a) : Autoradiography is the study of labelled precursors like ^{3}H by knowing the movement of radioactivity with the help of photographic films and emulsions at short intervals.
Radioactive material like tritiated thymidine which is formed by replacing normal hydrogen of thymidine with H^3 (heavy isotope of hydrogen). Thymidine only is used for this purpose because RNA will not be labelled by this.

111. (d) : Transfer RNA or *t*RNA help in transfer of amino acids to ribosomes *m*RNA complex to form the polypeptide chain. It has four key regions a carrier and recognition end, enzyme site and ribosome site. This recognition end has three anticodons with the help of which amino acids are identified. *r*RNA forms 67% of 70S ribosomes and 50% of 80S ribosomes.

*m*RNA carries the coded information from DNA for the synthesis of proteins.

112. (a) : Protein synthesis or translation consists of ribosomes, amino acids, *m*RNA, *t*RNAs and aminoacyl *t*RNA synthetases. The ribosomes have two binding sites namely aminoacyl site or A-site and peptide site or P-site. The starting amino acid methionine lies at the P-site of the ribosome. The next incoming *t*RNA is called amino acyl *t*RNA, it is bound to A-site. A peptide bond is formed between COOH group of the *t*RNA at P-site and NH_2 group of aminoacyl *t*RNA. This is facilitated by the enzyme peptidyl transferase and does not require high energy phosphate bonds.

113. (a) : *Refer to answer 55.*

114. (d) : Nucleolus is a plasmosome body that is formed around the nucleolus organizer and is located in the secondary constriction on that chromosome. It is made up of RNA and proteins. The associated nucleolar chromatin contains DNA. It forms *m*RNA that has low molecular weight. Ribosomes are mainly concerned with proteins synthesis. They are sites for synthesis of *r*RNA and *t*RNA is synthesized in the cytoplasm.

115. (c) : ^{14}C and ^{3}H are incorporated in bases like thymidine, uridine and amino acids to study the structure of DNA and proteins. Radio tracer technique shows that DNA is in double helical form.

116. (a) : When *E.coli* bacteria are transfered to medium containing lactose, then the *lac* opeon is indueed. The *lac* opeaon consists of 3 structural gene (*lac* Z, *lac* Y and *lac* A). It involves the synthesis of β-galactosidase enzyme in *E.coli*, which hydrolyses lactose into glucose and galactose.

117. (d) : *Refer to answer 43.*

118. (d) : Inducer is a metabolite (or analogue of similar chemical structure), usually of low molecular weight, which promotes the production of an enzyme. Inducers are often substrates for the enzymes they induce, *e.g.* lactose in case of the synthesis of β-galoctosidase in *lac* operon.

119. (d) : In transcription, *m*RNA is formed from DNA template and thymine of DNA is replaced by uracil of RNA. Uracil pairs with adenine.

DNA	A	T	T	C	G	A	T	G
	|	|	|	|	|	|	|	|
*m*RNA	U	A	A	G	C	U	A	C

(transcript)

120. (a) : Nonsense mutation is a mutation which interconverts a nonsense to or from a sense-coding triplet, resulting in an abnormally foreshortened or elongated polypeptide chain. But in this example cytosine is added at the beginning so CAT GAT GATG will result.

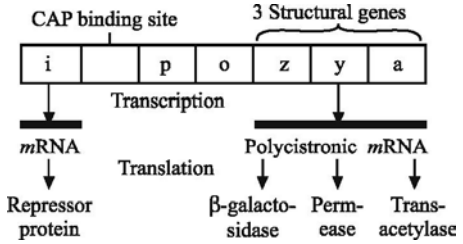
121. (a) : Split gene are those genes that consist of continuous sequence of nucleotide (coding sequence) interrupted by intervening sequences. Most eukaryotic genes are split as are genes of some animal viruses. The continuous coding sequences are called exons and the intervening non-coding sequence are called introns. These introns are not represented in *m*RNA transcribed from the gene and are not utilized for the synthesis of proteins.

122. (a) : Anticodon is the sequence of three nucleotides in a transfer RNA molecule that pairs with a complementary sequence of three nucleotides (codon) on a molecule of messenger RNA. *t*RNA has clove like shape or L shape (three dimensional). It has G at 5′ end CCA at 3′ end. CCA at 3′ end is meant for attaching to a specific amino acid (AA-binding site). On the opposite side lies an anticodon that is complementary to a specific codon of *m*RNA. The two are called recognition sites.

123. (c) : *Lac* operon in *E. coli* is induced by β-galactosidase an enzyme meant for hydrolysis of lactose in glucose and galactose.

$$\text{Lactose} \xrightarrow{\beta\text{-galactosidase}} \text{Glucose} + \text{Galactose}$$

These enzymes are called as inducible enzymes, because the synthesis of such enzymes are induced by adding substrate such as lactose by 10, 000 times.



124. (c) : *Refer to answer 55.*

125. (b) : DNA is a double helical molecule and it opens to form a replication fork for its replication. The two strands of DNA are joined with the help of H-bonds between the strands. Topoisomerases are specialized to cause nicks or breaks in the double helix and helps separate the DNA stands. Helicase unwinds

the DNA helix from that nick caused by the topoisomerase and this seperates the two strands.
DNA gyrase introduces negative supercoils in DNA strands of prokayotes.
DNA polymerase adds nucleotides units to the 3′ end of a DNA chain. DNA ligase joins the ends of DNA.

126. (d) : Transcription is the mechanism of copying the message of DNA on RNA with the help of enzyme RNA polymerase. It is meant for taking the coded information from DNA to the site where it is required for protein synthesis.
Translation or protein synthesis is a complicated process involving several steps such as – activation of amino acid, transfer of amino acid to *t*RNA, initiation of polypeptide synthesis, elongation of polypeptide chain and, termination of polypeptide chain.

127. (d) : Nucleosome core is made up of H_2A, H_2B, H_3 and H_4. It is about 7-10 nm in diameter, consisting of histones around which a DNA strand, about 120 base pair long is wrapped in chromosomes.

128. (d) : *Refer to answer 55.*

129. (b) : The transforming principle of *Pneumococcus* as found out by Avery, MacLeod and McCarty was DNA. In 1944, Avery, MacLeod and McCarty repeated Griffith's experiment successfully. They separated the proteins, carbohydrates and DNA of S III strains and separately mixed them in the pure cultures of R II. Only DNA could bring about transformation of R II type into S III and not the proteins or the carbohydrates.

130. (d) : Hershey and Chase proved that DNA is a basic genetic material. Hershey and Chase, 1952, by using P^{32} and S^{35} with a T-2 type phage concluded that DNA is the genetic material.

131. (c) : Certain amino acids are identified by more than one codons. This phenomenon is called as degeneracy *e.g.*, only AUG codes for methionine and UGG tryptophan.

132. (c) : During DNA replication, the strands separate by unwindase/helicase. The molecule is unwound by DNA unwinding proteins called helicases. The helicases II and III get attached to logging strand and protein to the leading strand. The formation of bands is avoided by single stranded DNA binding proteins (SSB).

133. (b) : The process of translation is protein synthesis. Emil Fischer, a German chemist established that the proteins are polymers of amino acids. There are some twenty amino acids involved in protein synthesis. In translation, the message coded by DNA on *m*RNA is translated into a specific protein.

134. (a) : A DNA with unequal nitrogen bases would most probably be single stranded. Nitrogenous bases are unequal in number in single stranded DNA, because they do not possess complementary base pairs.

135. (a) : Nucleotide arrangement in DNA can be seen by X-ray crystallography. Watson and Crick, 1953 proposed the double helical model for DNA. They were awarded Nobel prize in 1962. This model was developed by them on the basis of several previous observations including the *d*-helix of Pauling, 1951 and X-ray reflection studies of Franklin and Gosling, 1953.

136. (a) : Experimental material in the study of DNA replication has been *Escherichia coli*. *E. coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have different density and do not resemble parent DNA. Meselson and Stahl, 1958 by using ^{14}N and ^{15}N confirmed that the replication of DNA in *E. coli* is semi-conservative in nature.

137. (b) : Khorana synthesised a chain of alternate nucleotide GUGUGUGUGU. He found that it stimulated synthesis of a peptide having alternate valine-cysteine-valine-cysteine.

138. (a) : *Refer to answer 136.*

139. (b) : The process in living cells in which the genetic information of DNA is transferred to a molecule of mesenger RNA (*m*RNA) is the first step in protein synthesis. Transcription takes place in the cell nucleus or nuclear region and is regulated by transcription factors.

140. (b) : An octamer of 4 histones complexed with DNA forms nucleosome. The association of histones with DNA is very characteristic. It involves the formation of linear array of spherial structures called nucleosomes. These structures contains four pairs of histones (H_2A, H_2B, H_3 and H_4) in a ball; around which is wrapped a stretch of about 150 base pairs of DNA.

141. (d) : *Refer to answer 29.*

142. (b) : *Refer to answer 93.*

143. (d) : The genetic information is transferred from DNA to *m*RNA to protein. The proteins are made up of some 20 amino acids whose sequence is hidden in the sequence of nucleotides of *m*RNA. Hence, genetic code consists of all 20 amino acids. Thus genetic code is the relationship of amino acids sequence in a polypetide and nucleotide/base sequence in *m*RNA antisense strand and DNA.