Molecular Basis of Inheritance

Assertion & Reason Type Questions

consists of two statements, one is Assertion (A) and the other is Reason (R). Select the correct answer to these questions from the codes a, b, c and d as given below.

a. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

b. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c. Assertion is true but Reason is false.

d. Assertion is false but Reason is true.

Q 1. Assertion (A): Sequences of bases in one polynucleotide chain of DNA can determine the sequence of bases in the other chain.

Reason (R): In a DNA, amount of adenine equals that of thymine and amount of guanine equals that of cytosine, i.e., A = T and C = G.

Answer : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. Although A = T and CG, there is no any restriction or sequence of bases in one polynucleotide chain. Since A is always linked to T and C go G as determined from the above evidences, sequence of bases in one of political should determine the sequence of bases in the other political of the double helix.

Q 2. Assertion (A): tRNA acts as an adapter molecule.

Reason (R): tRNA recognizes codon sequence of mRNA during translation.

Answer : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. tRNA is an adaptor molecule because it adapts amino acid to bring it to protein synthesis site in activated form and not because it recognises the codon on mRNA.

Q 3. Assertion (A): Same tRNA can recognise more than one codons differing only at the third position.

Reason (R): The specificity of a codon is particularly determined by the first two bases.

Answer : (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. It has been shown, for instance that the same tRNA can recognise more than one codons differing only at the third position. This pairing is not very stable and is allowed due to wobbling in base pairing at this third position. This kind of wobbling allows economic of the number of tRNA molecules, since several codons meant for same amino acid are recognised by same tRNA. For instance, anticodon CGC can recognise codons GCU, GCC and GCA.

Q 4. Assertion (A): Ribosomal RNA is synthesised in the nucleus of the cell.
Reason (R): It is translated with the enzyme RNA polymerase-III.

Answer : (c) Assertion is true but Reason is false.

Q 5. Assertion (A): UAA, UAG and UGA terminate protein synthesis.
Reason (R): They are not recognised by tRNA.

Answer : (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. Synthesis of polypeptide terminates when a nonsense codon of mRNA reaches the A-site. There are three nonsense codons-UAA, UAG and UGA. These codons are not recognised by any of th tRNAs. Therefore, no more aminoacyl tRNA reaches the A-site. The P-site tRNA is hydrolysed and the completed polypeptide is released in the presence of release factor. Thus termination occurs.

Q 6. Assertion (A): Ribosomes attached to endoplasmic reticulum release proteins into lumen of ER.
Reason (R): Such proteins are used for formation of hydrolytic enzymes or are modified.

Answer : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. Polyribosomes attached to membranes of endoplasmic reticulum produce proteins which either pass into their lumen or become integrated into the membranes. The proteins released into the lumen generally reach Golgi apparatus for modifications like formation of hydrolytic enzymes and glycosylation (addition of sugar residues). The modified proteins are packed in vesicles for export or formation of lysosomes, cell wall, enzymes, plasma membrane, etc.

Q7. Assertion: In a DNA molecule, A–T rich parts melt before G–C rich parts.
Reason: In between A and T there are three H–bond, whereas in between G and C there are two H-bonds. [AIIMS 2010, 2015]

Q8. Assertion: The two chains of DNA have anti-polarity.
Reason: In one chain of DNA, ribose sugar at 5′ end consists of a free phosphate moiety while at the other end the ribose has a free 3′ OH group.

Q9. Assertion: Adenine cannot pair with cytosine.
Reason: Adenine and cytosine do not have a perfect match between hydrogen donor and hydrogen acceptor sites. Hence, they cannot pair.

Q10. Assertion: The sugar phosphate backbone of two chains in DNA double helix show anti-parallel polarity.
Reason: The phosphodiester bonds in one strand go from a 3′ carbon of one nucleotide to a 5′ carbon of adjacent nucleotide, whereas those in complementary strand go vice versa.

Q11**. Assertion:** DNA is considered to be better genetic material than RNA for most organisms.
Reason: 2′-OH group present in DNA makes it labile and less reactive.

Q12**. Assertion:** Histones are basic proteins of major importance in packaging of eukaryotic DNA. DNA and histones comprise chromatin forming the bulk of eukaryotic chromosome.
Reason: Histones are of five major types H1, H2A, H2B, H3 and H4. [AIIMS 2000]

Q13**. Assertion:** DNA is associated with proteins.
Reason: DNA binds around histone proteins that form a pool and the entire structure is called a nucleosome. [AIIMS 2013]

Q14**. Assertion:** Histones are basic in nature.
Reason: Histones are rich in the amino acids lysine and arginine.

Q15**. Assertion:** DNA acts as a genetic material in all organisms.
Reason: It is a single-stranded biomolecule.

Q16**. Assertion:** In Griffith's experiment, a mixture of heat-killed virulent bacteria R and live non-virulent bacteria S, lead to the death of mice.
Reason: 'Transforming principle' got transferred from heat killed R strain to S strain and made it virulent.

Q17**. Assertion:** Template or antisense strand, having $3' \rightarrow 5'$ polarity takes part in transcription.
Reason: Non-template or sense strand, having $5' \rightarrow 3'$ polarity, does not take part in transcription.

Q18**. Assertion:** The uptake of DNA during transformation is an active, energy requiring process.

Reason: Transformation occurs only in those bacteria, which possess the enzymatic machinery involved in the active uptake and recombination.

Q19**. Assertion:** Killer strain of Paramecium aurelia can kill sensitive strain.
Reason: If sensitive strain is provided kappa particle, it becomes killer.

Q20**. Assertion:** Scaffold proteins are nonhistone chromosomal proteins.
Reason: They are rich in lysine and arginine.

Q21**. Assertion:** Viruses having RNA genome have shorter life span and mutate faster.
Reason: RNA is unstable and thus mutates faster.

ANSWER KEY 7 to 21

Q7 **:** (c) In a DNA molecule, A-T rich parts melt before G-C rich parts because there are two H-bond between A and T whereas in between G and C, there are three H-bond.

Q8 **:** (a) The two chains of DNA have anti-parallel polarity this is because one chain has free phosphate moiety at 5′-end of the sugar and another chain has free phosphate moiety at 3′-end.

Q9 **:** (a) In DNA, the code letters are A, T, G, and C, which stand for the chemicals adenine, thymine, guanine, and cytosine, respectively. In base pairing, adenine always pairs with thymine, and guanine always pairs with cytosine.

Q10 **:** (a) **Q**11 **:** (c) **Q**12 **:** (a) **Q**13 **:** (a)

Q14 **:** (a) Histones contain 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.

Q15 : (d) DNA is the hereditary material found in the nucleus of eukaryotic cells and the cytoplasm of prokaryotic cells that determines the composition of the organism. There is another type of genetic material found in cells and viruses known as ribonucleic acid (RNA). DNA is double stranded as well as single stranded biomolecule.

Q16 : (d) When bacteria Streptococcus pneumoniae are grown on a culture plate, some produce smooth shiny colonies (S) while others produce rough colonies (R). This is because the S strain bacteria have a mucous (polysaccharide) coat, while R strain does not. Mice infected with the S strain (virulent) die from pneumonia infection but mice infected with the R strain do not develop pneumonia. In Griffith's experiment, some 'transforming principle', transferred from the heat-killed S strain, had enabled the R strain to synthesize a smooth polysaccharide coat and become virulent which must be due to the transfer of the genetic material. This is known as transformation.

Q17 : (b)

Q18 : (a) Transformation does not involve passive entry of DNA molecules through permeable cell walls and membranes. It does not occur 'naturally' in all species of bacteria, only in those species possessing the enzymatic machinery involved in the active uptake and recombination processes. Even in these species, all cells in a given population are not capable of active uptake of DNA. Only competent cells, which possess a so – called competence factor are capable of serving as recipients in transformation.

Q19 : (b) Paramecium aurelia has two strains : killer and sensitive. The killer strain is able to kill the sensitive strain protist by means of chemical paramecin, secreted by minute cytoplasmic particles called kappa particle. The sensitive strain protists do not have kappa particles. The sensitive strain can also become killer if it receives sufficient kappa particles.

Q20 : (c) Structural nonhistone chromosomal proteins are called scaffold proteins as they constitute the core axis of the chromosome. They contain very little lysine and arginine but instead possess abundant tyrosine and tryptophan types of amino acids.

Q21 : (a) Unlike DNA, RNA is usually singlestranded. Additionally, RNA contains ribose sugars rather than deoxyribose sugars, which makes RNA more unstable and more prone to degradation. RNA is synthesized from DNA by an enzyme known as RNA polymerase during a process called transcription. Viruses having RNA have shorter life span and mutate at faster rate.