Biology Molecular Basis of Inheritance

1. Group the following as nitrogenous bases and nucleosides: Adenine, Cytidine, Thymine, Guanosine, Uracil and Cytosine.

Ans: Nitrogenous Bases – Adenine, Uracil and Cytosine, Thymine; Nucleosides – Cytidine, guanosine.

2. If a double stranded DNA has 20 per cent of cytosine, calculate the per cent of adenine in the DNA.

Ans: In a DNA molecule, the number of cytosine molecule is equal to guanine molecules & the number of adenine molecules are equal to thymine molecules. As a result, if a double stranded DNA has 20% of cytosine, it has 20% of guanine. The remaining 60% includes both adenine & thymine which are in equal amounts. So, the percentage of adenine is 30%.

3. If the sequence of one strand of DNA is written as follows:
5′ – ATGCATGCATGCATGCATGCATGCATGC – 3′
Write down the sequence of complementary strand in 5′ —> 3′ direction.

Ans: If the sequence of one strand of DNA is written as follows:
5′ – ATGCATGCATGCATGCATGCATGCATGC – 3′
The sequence of the complementary strand in 5′ —> 3′ direction will be:
5′ – GCATGCATGCATGCATGCATGCATGCAT – 3′

4. If the sequence of the coding strand in a transcription unit is written as follows: 5-ATGCATGCATGCATGCATGCA TGCATGC-3′
Write down the sequence of mRNA.

Ans: mRNA: 5′ -A U G CAU G CAU G C AU G CA UGCAUGCAUGC-3′.

5. Which property of DNA double helix led Watson and Crick to hypothesise semi-conservative mode of DNA replication? Explain

Ans: The antiparallel, double-stranded nature of the DNA molecule led Watson and Crick to hypothesise semi-conservative mode of DNA replication. They suggested that the two strands of DNA molecule uncoil and separate, and each strand serves as a template for the synthesis of a new (complementary) strand alongside it. The template and its complement, then form a new DNA double strand, identical to the original DNA molecule. The sequence of bases which should be present in the new strands can be easily predicted because these would be complementary to the bases present in the old strands. A will pair with T, T with A, C with G, and G with C. Thus, two daughter DNA molecules identical to the parent molecule are formed and each daughter DNA molecule consists of one old (parent) strand and one new strand. Since only one parent strand is conserved in each daughter molecule, this mode of replication is said to be semiconservative. Meselson and Stahl and Joseph Taylor, later proved it by experiments.

6. Depending upon the chemical nature of the template (DNA or RNA) and the nature of nucleic acids synthesized from it (DNA or RNA), list the types of nucleic acid polymerases.

Ans: (i) DNA dependent DNA polymerase – synthesis.
(ii) DNA dependent RNA polymerase – synthesis.
(iii) RNA dependent DNA polymerase – Retroviral nucleic acid.
(iv) RNA dependent RNA polymerase – cDNA synthesis.

7. How did Hershey and Chase differentiate between DNA and protein in their experiment white proving that DNA is the genetic material?

Ans: Alfred Hershey and Martha Chase (1952) worked with viruses that infect bacteria called bacteriophages. In 1952, they chose a bacteriophage known as T2 for their experimental material.
They grew some viruses on a medium that contained radioactive phosphorus (p32) and some others on medium that contained radioactive sulphur (s35). Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein

because DNA contains phosphorus but protem does not. Similarly, viruses grown on radioactive sulphur contained radioactive protein but not radio'active DNA because DNA does not contain sulphur.
Radioactive phages were allowed to attach to E. coli bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge. ,
Bacteria which was infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria. Bacteria that were infected with viruses that had radioactive proteins were not radioactive. This indicates that proteins did not enter the bacteria from the viruses. DNA is therefore the genetic material that is passed from virus to bacteria.

8. Differentiate between the followings:
(a) Repetitive DNA and Satellite DNA
(b) mRNAand tRNA
(c) Template strand and Coding strand
Ans: (a) The main differences between repetitive DNA and satellite DNA are as following:
(b) The main difference between mRNA and tRNA are as following:
(c) The main difference between template strand and coding strand are as follows :

9. List two essential roles of ribosome during translation.
Ans: Two essential roles of ribiosomes during translation are ;o
(i) they provide surface for binding of mRNA in the groove of smaller sub unit of ribosome.

(ii) As larger sub unit of ribosome has peptidy transferase on its 'P' site, therefore, it helps in joining amino acids by forming peptide bonds. .

10. In the medium where E. coli was growing, lactose was added, which induced the lac operon. Then why does lac operon shut down some time after addition of lactose in the medium?

Ans: Lac operon is switched on, on adding lactose in medium, as lactose acts as inducer and makes repressor inactive by binding with it. When the lac operon system is switched on, β-galactosidase is formed, which converts lactose into glucose and galactose. As soon as all the lactose is consumed, repressor again becomes active and causes the system to switch off (shut down).

11. Explain (in one or two lines) the function of the followings:

(a) Promoter

(b) tRNA

(c) Exons

Ans: Promoter: It is one of the three components of a transcription unit that takes part in transcription. It is located at the start 5' end and provides site for attachment of transcription factors (TATA Box) and RNA polymerase. tRNA: It takes part in the transfer of activated amino acids from cellular pool to ribosome for their taking part in protein formation. Exons: In eukarytoes, DNA is mosaic of exons and introns. Exons are coding sequences of DNA which are transcribed and translated both.

12. Why is the Human genome project called a mega project?

Ans: Human genome project is called a mega project because

(i) it required bioinformatics data basing and other high speed computational devices for analysis, storage and retrieval of information.

(ii) it generated lot of information in the form of sequence annotation.

(iii) it was carried out in number of labs and coordinated on extensive scale.

13. What is DNA fingerprinting? Mention its application.

Ans: DNA fingerprinting or DNA typing is a technique of determining

nucleotide sequences of certain areas (VNTRs) of DNA which are unique to each individual. Each person has a unique DNA fingerprint. Unlike a conventional fingerprint that occurs only on the fingertips and can be altered by surgery, a DNA fingerprint is the same for every cell, tissue and organ of a person. It cannot be changed by any known treatment. Applications of DNA fingerprinting are as follows:

- Paternity disputes can be solved by DNA fingerprinting.
- DNA fingerprinting technique is being used to identify genes connected with hereditary diseases.
- It is useful in detection of crime and legal pursuits.
- It can identify racial groups, their origin, historical migrations and invasions.

14. Briefly describe the following:
(a) Transcription
(b) Polymorphism
(c) Translation
(d) Bioinformatics

Ans: Transcription : It is DNA directed synthesis of RNA in which the RNA is transcribed on 3*—>5’ template strand of DNA in 5’—>3’ direction.
Polymorphism: Variation at genetic level arisen due,to mutation, is called polymorphism. Such variations are unique at particular site of DNA, forming satellite DNA. The polymorphism in DNA sequences is the basis of genetic mapping and DNA finger printing.
Translation : Protein synthesis from mRNA, tRNA, rRNA.