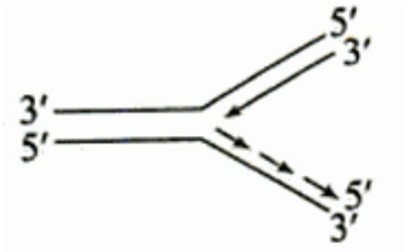
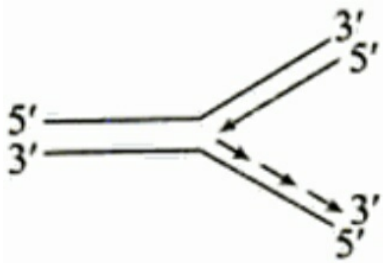
CBSE Test Paper 05

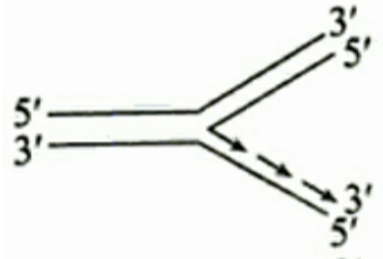
Ch-6 Molecular Basis of Inheritance

1. Gel electrophoresis is used for
   a. Isolation of DNA molecule
   b. Cutting of DNA into fragments
   c. Separation of DNA fragments according to their size
   d. Construction of recombinant DNA by joining with cloning vectors
2. The genetic and physical maps on genome was generated using information on
   a. Variable number of tendon repeats
   b. Amplification
   c. Junk DNA
   d. Polymorphism of restriction endonuclease recognition sites
3. Assertion: Regulation of lac operon by repressor is referred to as negative regulation.
   Reason: Lac operon is under the control of positive regulation as well.
   a. Assertion is correct but reason is incorrect
   b. Assertion is incorrect but reason is correct
   c. Both assertion and reason are correct
   d. Both assertion and reason are incorrect
4. Removal of introns and joining of exons in a defined order during transcription is called
   a. Splicing
   b. Inducing
   c. Looping
   d. Slicing
5. Which one represents the correct manner of DNA replication?
   a. 

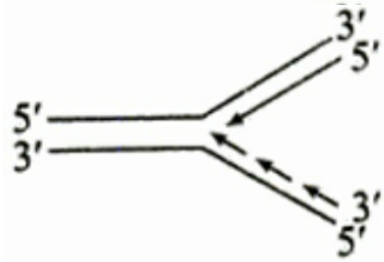
b.



c.



d.



6. When does DNA replication takes place in cell cycle of eukaryotes?
7. Describe an anticodon?
8. A change in a sequence of DNA occurs so that the mRNA codon reads AUC rather than AUU. Both of these code for the amino acid iso leucine. Argue that this is not a mutation.
9. In which direction is the new strand of DNA synthesized during DNA replication.
10. What is a terminator? What is its significance in transcription?
11. One of the codons on mRNA is AUG. Draw the structure of tRNA adaptor molecule for this codon. Explain the uniqueness of this tRNA.
12. Depending upon the chemical nature of template (DNA or RNA) and the nature of nucleic acids synthesized from it (DNA or RNA), list the types of nucleic acid polymerases.
13. How did Griffith explain the transformation of R-strain (non-virulent) bacteria into S-strain (virulent)?
14. How did Hershey and Chase differentiate between DNA and protein in their experiment while proving that DNA is the genetic material?
15. Describe Frederick Griffith experiment on Streptococcus pneumoniae. Discuss the conclusion he arrived at.

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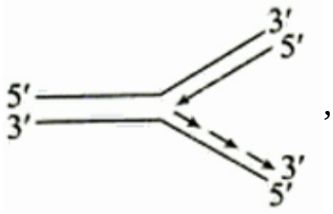
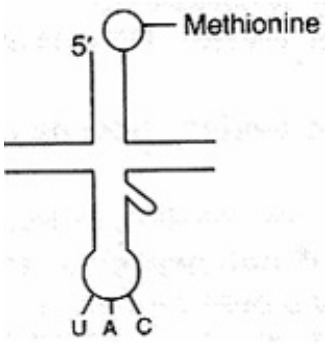
Answer

1. c. Separation of DNA fragments according to their size, **Explanation:** Gel electrophoresis is used to separate macromolecules like DNA, RNA and proteins. DNA fragments are separated according to their size. Proteins can be separated according to their size and their charge (different proteins have different charges). This is an important tool to study the genome of an individual.
2. d. Polymorphism of restriction endonuclease recognition sites, **Explanation:** The sequence of chromosome 1 was completed only in May 2006 (this was the last of the 24 human chromosomes – 22 autosomes and X and Y – to be sequenced). The challenging task was assigning the genetic and physical maps on the genome. This was generated using information on polymorphism of restriction endonuclease recognition sites, and some repetitive DNA sequences known as microsatellites.
3. c. Both assertion and reason are correct, **Explanation:** An operon is a cluster of coordinately regulated genes. It includes structural genes (generally encoding enzymes), regulatory genes (encoding, e.g. activators or repressors) and regulatory sites (such as promoters and operators).
   The type of control is defined by the response of the operon when no regulatory protein is present.
   The inducer–repressor control of the lac operon is an example of **negative control**, in which expression is normally blocked.
   In contrast, the CAP-cAMP system is an example of **positive control**, because expression of the lac operon requires the presence of an activating signal.
4. a. Splicing, **Explanation:** The mRNA produced by transcription of DNA consists of exons and introns. The removal of introns and joining of exons to obtain mature mRNA is called splicing. It is followed by capping and tailing.

5. b. 

, **Explanation: D**uring replication of DNA, in one strand (3’ to 5’) replication takes place continuously and in other strands, it is in a small segment and joined together by DNA ligase enzyme.
6. During Mitosis, DNA is replicated during the S phase (Synthesis phase) of Interphase. Interphase is basically the daily life cycle of the cell. Cells spend most of their life in Interphase before Mitosis occurs (M phase).
7. anticodon is a nucleotide triplet at one end of a tRNA molecule that recognizes a particular complementary codon on an mRNA molecule.
8. If one defines a mutation as a change in genetic material resulting resulting in a different phenotypic expression, then this is not a mutation.
9. New strand of DNA is synthesized in $5' \rightarrow 3'$ direction.
10. The terminator is a component of transcription unit, which defines the end of the process of transcription. It is a code on the mRNA for which the tRNA has no anticodon and so the polypeptide chain breaks.
11. This tRNA is specific for methionine. It acts as initiator tRNA.



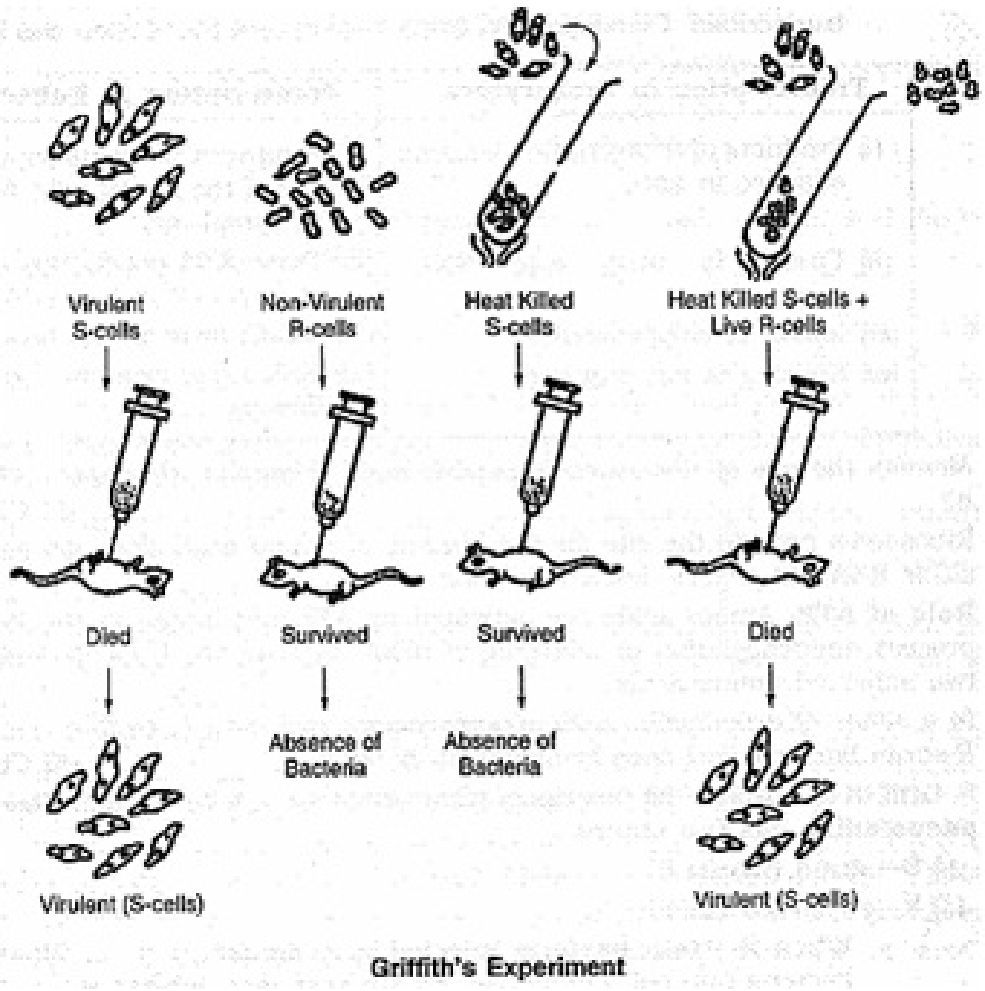
12. (i) DNA dependent DNA polymerase. Uses DNA template to catalyze the polymerization deoxynucleotides.
    (ii) DNA-dependent RNA polymerase. Catalyze transcription of all types of RNA (in bacteria).
    (iii) DNA dependent RNA polymerase - I transcribes rRNAs.
    (iv) DNA dependent RNA polymerase-II transcribes precursor of mRNA (hnRNA)
    (v) DNA dependent RNA polymerase-III transcribes tRNA. The last three polymerases are in eukaryotes.
13. influenza pandemic after World War I, by using two strains of the Streptococcus

pneumoniae bacterium. The smooth strain (S strain) had a polysaccharide capsule and was virulent when injected, causing pneumonia and killing mice in a day or two. The capsule is a slimy on the cell's surface that allows the bacteria to resist the human immune system. The rough strain (R strain) did not cause pneumonia when injected into mice (it was avirulent) since it lacked a capsule. When the virulent S strain was heated to kill it, and then injected into mice, it produced no ill effects. However, when dead S strain mixed with live R strain was injected into the mouse, the R/S mouse died. Griffith Observations: After isolating bacteria from the blood of the R/S mice, Griffith discovered that the previously a virulent R bacteria had acquired capsules. The bacteria isolated from the mice infected with the mixture of live type II R and heat killed type III S were now all of the type III S strain, and maintained this phenotype over many generations. Griffith hypothesized that some "transforming principle" from the heat killed type III S strain converted the type II R strain into the virulent type III S strain.

14. To confirm the constituent of genetic material, Harshey and Chase conducted the bacteriophage experiment. Normally T_2 bacteriophage joins the walls of E. coli by means of its tail fibre which releases lysozyme to rupture the bacterial cell wall. Some bacteriophase were grown in medium that contained radioactive phosphorus (32_P) and others were grown in medium that contained radioactive sulphur (32_S). The bacteriophages grown in the presence of (32_P) contained radioactive DNA, because DNA contains phosphorus and not the protein. Similarly the bacteriophages grown on (32_S) contained radioactive protein but not radioactive DNA because sulphur is a constituent of amino acids. These two types of cells (phages) were made to infect normal bacterial cells in two samples. It was found that phages grown in radioactive phosphorus passed there radioactivity to daughter cells, while the phages containing radioactive sulphur did not transfer their radioactivity to daughter phages.
15. Bacterial Transformation
    - It was performed by Frederick Griffith (1928) on the bacteria Streptococcus pneumoniae (bacteria responsible for causing pneumonia)
    - This bacteria has two strains - S - type (Smooth, virulent and mucus coat with) - can cause pneumonia.

      R - type (rough, avirulent, without mucus coat) cannot cause pneumonia.
    - Mice infected with S-type of cells die from pneumonia.

- Mice infected with R-type of cells do not develop pneumonia.
- Griffith observed that heat killed S-cells didn't kill the mice.
- When a mixture of heat heat-killed and live R-cells was injected then mice died. Moreover, he recovered living S bacteria from the dead mice.



Griffith's Experiment

- Thus he concluded that some transforming material transferred from the heat killed S-type cells had enabled the R-type cells to synthesise mucus coat and become virulent and this must be due to the transfer of genetic material
- Oswald Avery, Colin Mac Leod and Maclyn Mc Carty (1933-44) later discovered that DNA from the heat killed S-cells had transformed the R-strain of Bacteria.
- They conducted biochemical characterization of transforming principle by using proteases, RNases and DNases.
- They observed that proteases and RNases did not affect transformation, but DNase inhibited the transformation. They concluded that DNA is the genetic material.