Biology Class 12th NCERT Solutions

Chapter.11
Biotechnology: Principle and Processes
Class – XII
Subject –Biology

1. **Can you list 10 recombinant proteins which are used in medical practice? Find out where they are used as therapeutics (use the internet).**

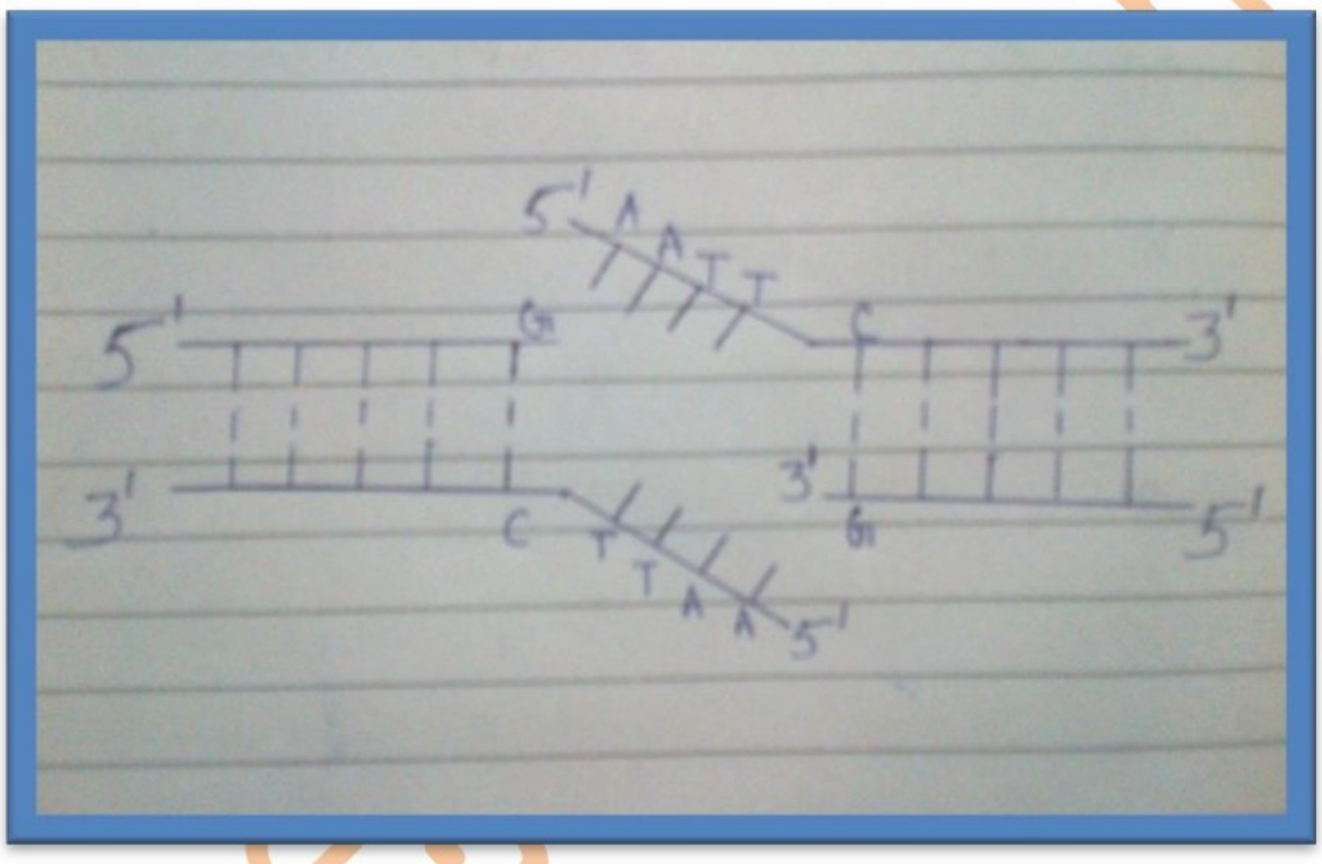
Answer.1

Recombinant proteins	**Therapeutic use**
DNAse	Mucoviscidosis
Interleukin	Cancer
Human growth hormone	Dwarfism
Glucocerebrosidase	Gaucher's disease
Human insulin	Diabetes
Tissue plasminogen activator	Myocardial infarction
Insulin-like growth factor	Childhood growth anabolic effects in adults
Erythropoietin	Stimulation of production of erythrocytes
Interferon	Treatment of infectious diseases like multiple sclerosis
Alpha-galactosidase A	Enzyme replacement therapy

2. **Make a chart (with diagrammatic representation) showing a restriction enzyme, the substrate DNA on which it acts, the site at which it cuts DNA and the product it produces.**

Answer.2

Restriction- Eco R1
Enzyme source- E.coli
Recognition- 5'—GAATTC
3'—CTTAAG
Sequence- 5'—G
3'—CTTAA
Products- AATTC-3'
G-5'



3. **From what you have learnt, can you tell whether enzymes are bigger or DNA is bigger in molecular size? How did you know?**

Answer.3

Proteins are made from amino acids which is joined through peptide bonds. In nature 20 different kinds of amino acids are found. Avg. Protein length is

around 300residues of amino acids. Some of like actin are made up of thousand actin molecules. DNA is made up of polymers of nucleotides. DNA polymers can be enormous molecules containing million of nucleotides. Like human chromosome is made up of 220 millions base pairs. So, DNA is bigger in molecular size.

4. What would be the molar concentration of human DNA in a human cell? Consult your teacher.

Answer.4

The molar concentration of human DNA in a human diploid cell will be approximately:
No: of human chromosome in human cell = 46
So,
468 x 6.023 x10^{23}
=2.77x10^{18} moles.
Hence, the molar conc. will be approximately 2.77 x 10^{18}

5. Do eukaryotic cells have restriction endonucleases? Justify your answer.

Answer.5

Eukaryotic cells do not have restriction nuclease. Restriction enzymes restrict the infection of bacteria by some viruses like bacterio phages by degrading the viral DNA without affecting viral DNA.

6. **Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?**

Answer.6

Stirred tank bioreactors provide a better agitation system, oxygen delivery system, foam system, pH control system, temperature control system and provide a better provision for cleaning and sterilization.

7. **Collect 5 examples of palindromic DNA sequences by consulting your teacher. Better try to create a palindromic sequence by following base-pair rules.**

Answer.7

Palindromic DNA sequences are a group of letters that form the same word when read from both forward and backward.
Like,

5’ – GAATTC – 3’
3’ – CTTAAG – 5’

8. **Can you recall meiosis and indicate at what stage a recombinant DNA is made?**

Answer.8

The linkage of antibiotic resistance gene with the plasmid vector with the plasmid with the enzyme DNA ligase, which acts on cut DNA molecules

and joins their ends. This makes a new combination of circular autonomously replicating DNA created in vitro and this is known as recombinant DNA.

9. Can you think and answer how a reporter enzyme can be used to monitor transformation of host cells by foreign DNA in addition to a selectable marker?

Answer.9

There are many methods of introducing the ligated DNA into recipient cells, after making them "component" to receive and take up DNA present in its surrounding. So if a recombinant DNA bearing gene for resistance to an antibiotic is transferred into E.coli cells, the host cells become transformed into ampicillin resistant cells. Since due to ampicillin resistance gene,one is able to select a transformed call in the presence of ampicillin.

When we insert a piece of alien DNA into a cloning vector and transfer it into a bacterial, plant or animal cell, the alien DNA gets multiplied. The whole process involves the use of restriction endonucleases, DNA ligase, appropriate plasmid or viral factors to isolate and ferry the foreign DNA into host organisms.

10. Describe briefly the followings:

a) Origin of replication
b) Bioreactors
c) Downstream processing

Answer.10

a) Origin of replication: When a piece of DNA gets integrated into the genome of the recipient, it may multiply and be inherited along with the host DNA. This happens because the alien piece of DNA has become part of a chromosome, which has the ability to replicate. In a chromosome there is a specific DNA sequence called the origin of replication, which is responsible for initiating replication. Hence, for the multiplication of any alien piece of DNA in an organism it needs to be a part of a chromosome(s) which has a specific sequence known as "origin of replication". Thus, an alien DNA is linked with the origin of replication, so that, this alien piece of DNA can replicate and multiply itself in the host organism.

b) Bioreactors: Bioreactors are vessels in which raw materials are biologically converted into specific products, individual enzyme, etc., using microbial plants, animal or human cells. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen).

c) Downstream processing: After the biosynthetic stage, the products are subjected through a series of processes, such as separation and purification, before it is ready for marketing as a finished product. These processes are referred to as downstream processing.

11. Explain briefly

a) PCR

b) Restriction enzymes and DNA

c) Chitinase

Answer.11

a) PCR: PCR means polymerase chain reaction. In this reaction multiple copies of gene of interest is synthesised in vitro using two sets of primers and the enzyme DNA polymerase. The enzyme extends the primers using the nucleotides provided in the reactuion and the genome DNA as template. The segment of DNA can be amplified to approximately billion ties if the process of replication of DNA is repeated many times.

b) Restriction enzymes and DNA: Restriction enzymes are also called molecular scissors. By the use of restriction enzymes it is possible to cut DNA sequence. It acts on both the strands and produce a break. When restriction enzymes make a cut in DNA strand, it will leave a single stranded portion at ends. These are overhanging called sticky ends. Sticky ends can make H-bonds with their complementary cut counterparts by DNA ligase.

c) Chitinase: It is a type of enzyme which is treated with animal or plant tissue to break the cell open to release DNA along with other macromolecules such as RNA, proteins etc.

12. Discuss with your teacher and find out how to distinguish between

a) Plasmid DNA and Chromosomal DNA

b) RNA and DNA

c) Exonuclease and Endonuclease

Answer.12

a) Plasmid DNA and Chromosomal DNA

Plasmid DNA	Chromosomal DNA
It carries genes for sexuality, antibiotic resistance but not any vital genes	It carries vital genes
It can replicate independently Without main genome	It can't replicate without main genome.
Cells can survive without them	Cells can't survive without them

b) RNA and DNA

RNA	DNA
It is single stranded	It is double stranded
It contains ribose sugar	It contains deoxyribose sugar
It is not the genetic material in humans	It is the genetic material in humans
Uracil is present in place of thymine	Thymine is present in place of uracil

c) Exonuclease and endonuclease

Exonuclease	Endonuclease
It remove nucleotides from the ends of DNA	It makes cut at specific position within the DNA
Its activity results in nucleosides	Its activity results in oligonucleotides