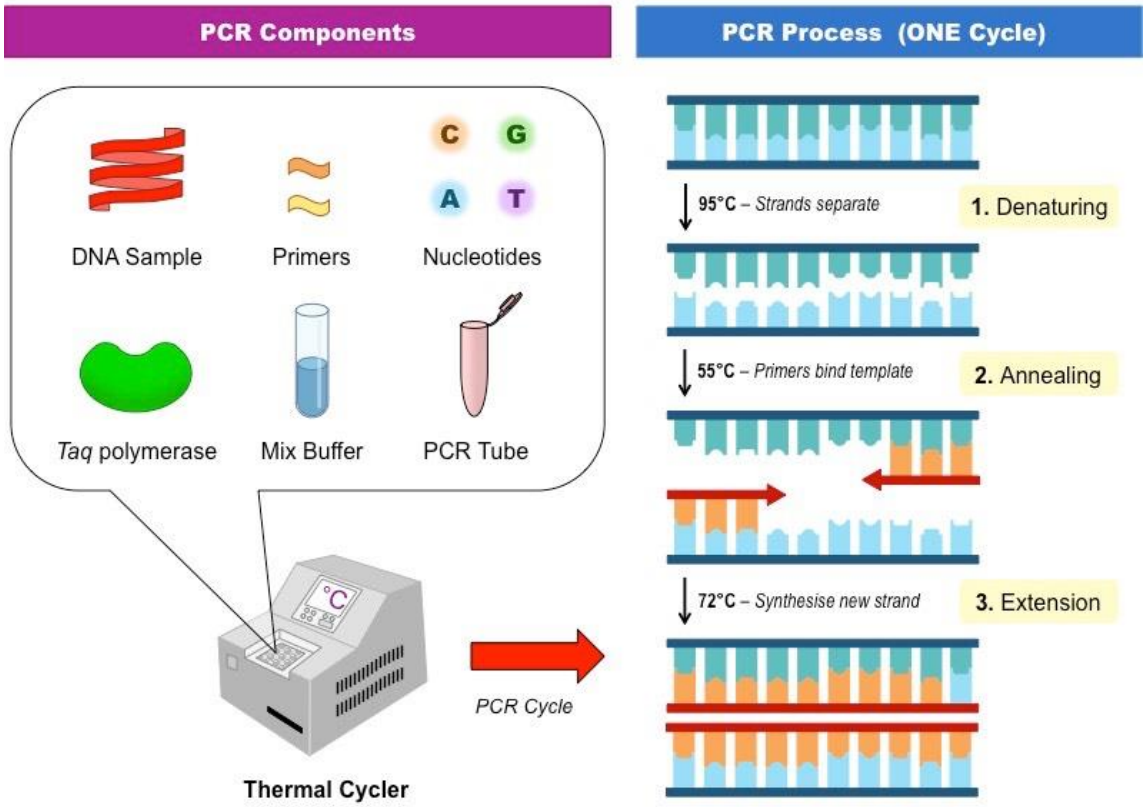
CBT NOVEMBER 2023
CLASS – XII: BIOLOGY

GENERAL INSTRUCTION :

SCORE AND REVIEW OF ALL THE QUESTIONS WILL BE PROVIDED IN THE EMAIL TO ALL THE STUDENTS ON NEXT DAY AND AFTER CLOSING OF QUIZ TIME.
IMPORTANT : ALL THE STUDENTS SHOULD FILL THE CORRECT SCHOOL NAME FROM DROP DOWN BUTTON

SECTION 2: PCR
Chapter: Biotechnology - Principles & Processes
Topic covered: POLYMERASE CHAIN REACTION

Polymerase chain reaction (PCR), a technique used to make numerous copies of a specific segment of DNA quickly and accurately. The polymerase chain reaction enables investigators to obtain the large quantities of DNA that are required for various experiments and procedures in molecular biology, forensic analysis, evolutionary biology, and medical diagnostics.
PCR was developed in 1983 by Kary B. Mullis, an American biochemist who won the Nobel Prize for Chemistry in 1993 for his invention. PCR reactions can complete many rounds of replication, producing billions of copies of a DNA fragment, in only a few hours.
The concept of temperature-dependent amplification emerged following the identification of thermostable Taq DNA polymerase. DNA amplification through the PCR, polymerase chain reaction, is a temperature-dependent procedure. The thermocycler is the name of the device used in the PCR method. The basic steps are: Denaturation, Annealing AND Extension .
PCR is needed in almost every biotechnology process for the amplification and study of the DNA of various organisms.
Now Answer following Questions based on your understanding:



Q.1: Which of The following primers are utilized in the polymerase chain reaction procedure:

a) Single-stranded DNA oligonucleotide
b) Double-stranded DNA oligonucleotide
c) Double-stranded RNA oligonucleotide
d) Single-stranded RNA oligonucleotide.

Answer: a)

Feedback: In order to create a primer, two single-stranded oligonucleotide is created. By binding to the denatured DNA, the primers created in this way cause polymerase to begin synthesis in the 5′ to 3′ orientation. DNA primers are typically used because they are more temperature stable in biochemistry and molecular biology laboratory procedures that call for in vitro DNA synthesis, such as DNA sequencing and polymerase chain reaction.

Q. 2: What organisms are utilized to extract the polymerase for PCR?

a) Escherichia coli
b) Human being
c) Saccharomyces cerevisiae
d) Thermus aquaticus

Answer: d)

Feedback : Typically, DNA polymerase I from Thermus aquaticus is used for amplification. Taq polymerases are thermostable, which means they are resistant to high temperatures because this creature dwells in hot springs.

Q.3: What temperature causes the DNA double helix to denature?

a) 54o C
b) 74 o C
c) 94 o C
d) 37 o C

Answer:: c)

Feedback : *The mixture is heated to 94 °C to initiate the polymerase chain reaction. The hydrogen bonds between the nucleotide bases dissolve at this temperature, splitting the two DNA strands.*

Q.4: Assertion: RT-PCR test is used to detect Corona virus in the given sample. Reason: Corona virus replicates by reverse transcription.

a) Both assertion and reason are true and reason in the correct explanation of assertion
b) Both assertion and reason are true but reason is not the correct explanation of assertion
c) Assertion in correct but the reason is incorrect
d) Both Assertion and reason are incorrect.

Answer: a)

Feedback :*In order for a virus like the COVID-19 virus to be detected early in the body using real time RT–PCR, scientists need to convert the RNA to DNA. This is a process called 'reverse transcription'. They do this because only DNA can be copied — or amplified — which is a key part of the real time RT–PCR process for detecting viruses.*

SECTION 3: BIOREACTORS

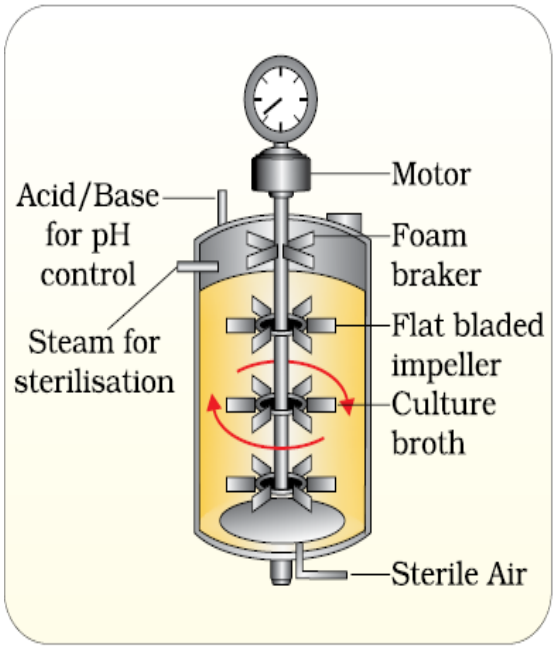
Chapter: Biotechnology - Principles & Processes

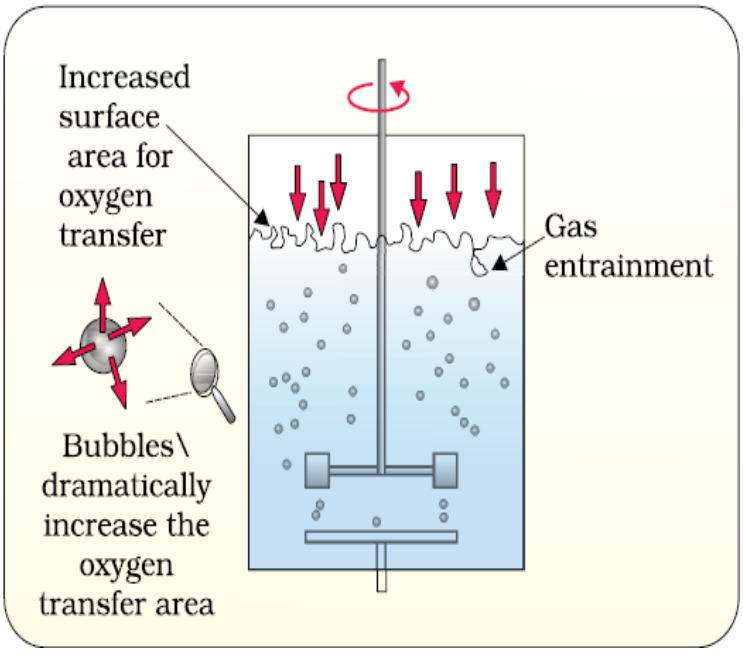
Topic covered: Obtaining the Foreign Gene Product

By definition, a bioreactor is a vessel in which a biological reaction or change takes place. The biological systems involved include enzymes, microorganisms, animal cells, plant cells, and tissues. The bioreactor is a place where an optimum external environment is provided to meet the needs of the biological reaction system so that a high yield of the bioprocess is achieved. Obviously, there are complicated interactions between the biological system and the physical and chemical aspects of this process. A variety of bioreactor types and configurations have thus been exploited and developed along with the advances in the understanding of biological systems. In addition, it is necessary to control the bioreactor's operating parameters in order to favor the desired functions of the living cells or enzymes. Dissolved oxygen concentration, pH, temperature, mixing, and supplementation of nutrients all need to be controlled and optimized.

Because of the rapid advances in recombinant DNA technology and genome sequencing, the same product or biological process may be achieved by different biological systems: microorganisms, plant cells, animal cells, or enzymes. With the understanding of the biological system and its requirements on its physical and chemical environment, a proper bioreactor type can be selected.

(Source: Si-Jing Wang, Jian-Jiang Zhong, in Bioprocessing for Value-Added Products from Renewable Resources, 2007)





Q. 5: Which of the following statements are correct with respect to a bioreactor?
(i) It can process large volumes of culture
(ii) It provides optimum temperature and pH
iii) It is a completely automated tool
(iv) It is a compact thermal cycler.

a) i and ii
b) ii , iii and iv
c) only i
d) ii and iv

Answer: a)

Feedback: *Bioreactors are considered as vessels in which raw materials are biologically converted into specific products by microbes, plant and animal cells or their enzymes. To produce large quantities of these products, bioreactors are used where large volumes (100-1000 liters) of culture can be processed. The bioreactor provides the optimal conditions for obtaining the desired product by providing optimum growth conditions such as temperature, pH, substrate, vitamins, oxygen, and salts.*

Q.6: Stirred-tank bioreactors have advantages over shake flasks because they Provide high temperature and pH

a) Provide better aeration and mixing properties
b) Do not allow entry of CO2
c) Easy to operate
d) Provide better aeration and mixing properties

Answer: d)

Feedback *:Stirred-tank bioreactor is used for processing large volumes of culture. It is a cylindrical tank with a curved base to facilitate the mixing of the reactor contents. The stirrer facilitates even mixing and oxygen availability throughout the bioreactor.*

Q.7: Assertion: Bioreactors are used for the large scale production of the desired products.
Reason: Bioreactor designing only needs complete information of biological systems.

a) Both assertion and reason are true and reason in the correct explanation of assertion
b) Both assertion and reason are true but reason is not the correct explanation of assertion
c) Assertion in correct but the reason is incorrect
d) Both Assertion and reason are incorrect.

Answer: c)

Feedback: *The Reason is wrong as to design an appropriate bioreactor for a particular bioprocess, intensive studies on the biological system, such as cell growth, metabolism, genetic manipulation, and protein or other product expression, are needed to understand the cells' requirement on their physical and chemical environment.*

SECTION 4: GENETICALLY ENGINEERED INSULIN
Chapter: Biotechnology and Its Applications
Topic: BIOTECHNOLOGICAL APPLICATIONS IN MEDICINE

Recombinant Insulin:

Insulin is prepared by recombinant DNA (rDNA) technology for medicinal purposes on a large scale. It was first produced in 1983 by an American Biotech company. The trademark name is Humulin® and it is licensed to Eli Lilly, the company which manufactured it for the first time.

Genes, which code for functional A and B peptides of insulin, were inserted in the plasmids of non-pathogenic *E.coli* strains. Both the chains are produced separately and joined afterwards by disulphide linkages.

Biopharming to produce insulin is being researched. Scientists have succeeded to insert insulin genes in safflower plants. It will help in reducing production cost.

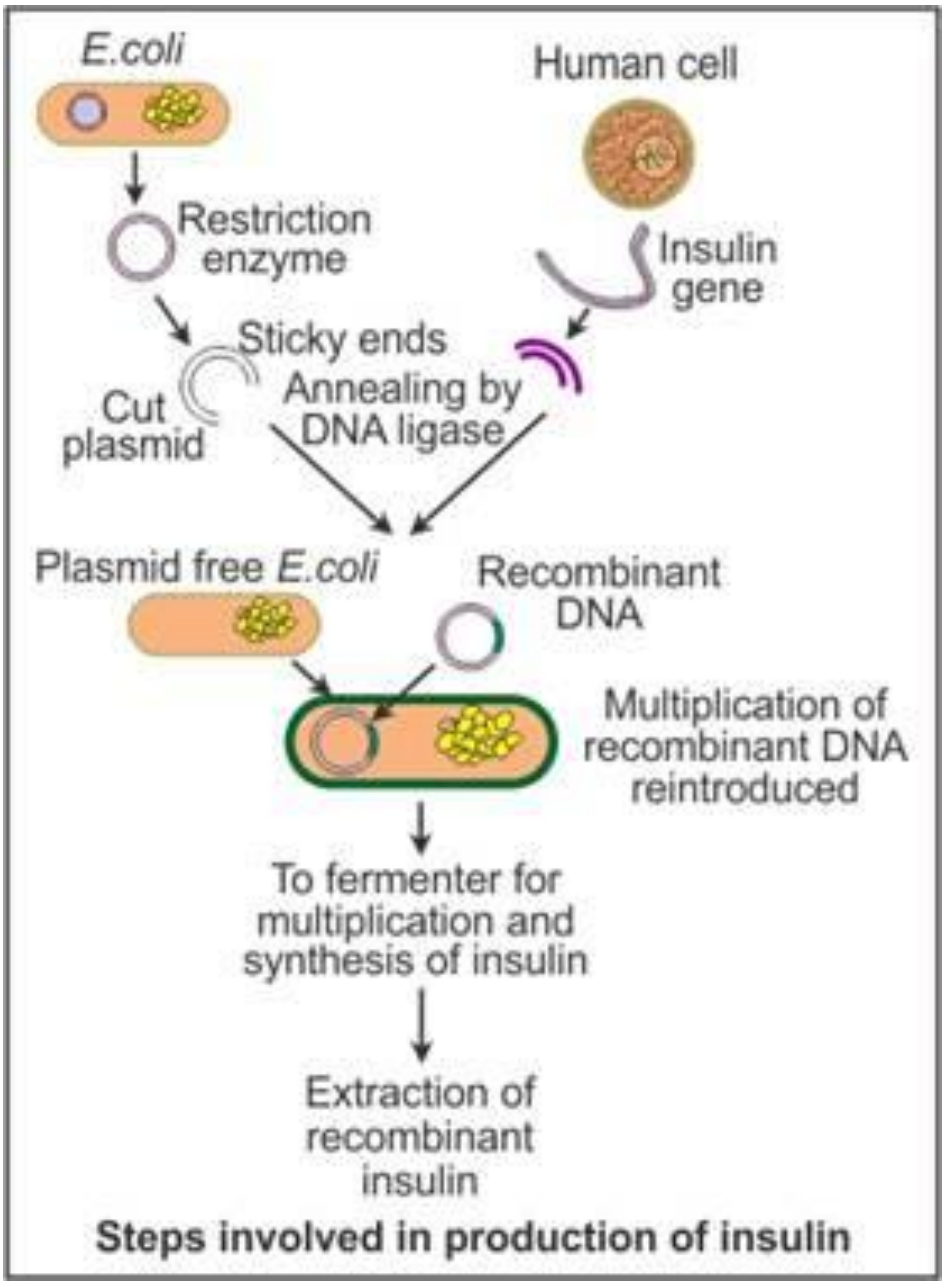
The Need for Preparing Genetically Engineered Insulin:

Insulin has been used for many years to treat diabetes. Diabetes is well managed by taking insulin. Earlier insulin was extracted from the pancreas of killed cattle and pigs. It had shortcomings. It used to stimulate allergic reactions and other immune

responses due to its foreign origin in some people. Another challenge was to cater to the ever increasing demand and large scale production.

Difference Between Natural and Recombinant Insulin

Insulin is a protein hormone synthesised by the **β** cells of the pancreas. It is produced as a prohormone, i.e. Preproinsulin. The signal peptide cleaves to give proinsulin. Proinsulin has to be further processed to become functional. Proinsulin contains another peptide chain known as 'C' peptide in addition to 'A' and 'B' peptides, which are required for its functionality. From proinsulin, the C peptide is removed at the time of maturation. The genetically engineered insulin does not contain the C peptide.



Q.8: In mammals insulin is secreted as

a) enzyme
b) lipid
c) RNA
d) pro-hormone

Answer: d)

Feedback: *Insulin is a pro-hormone secreted in mammals by the pancreas. This pro-hormone need to be processed to become a fully mature and functional hormone. Insulin allows the absorption of glucose I blood.*

Q.9: The polypeptide chains present in insulin is connected by _____ bonds.

a) ionic
b) covalent
c) disulphide
d) hydrophobic interactions

Answer: c)
Feedback: *The polypeptide chains present in insulin is connected by disulphide bonds. These disulphide bonds are formed between two cysteine residues. In total insulin consists of 3 disulphide bonds.*

Q.10: C-peptide is removed during _____ phase of insulin.

a) initiation
b) maturation
c) termination
d) elongation

Answer: b)
Feedback: *C-peptide is removed during the maturation phase of insulin production. C-peptide consists of 30 amino acids and it joins two insulin polypeptide chains in pro-insulin. It is released as a by-product of insulin formation.*