

Chapter 11: Biotechnology: Principles and Processes

NCERT Exemplar · Class 12 · Biology

Multiple Choice Questions

Question 1

Rising of dough is due to:

A.

Multiplication of yeast

B.

Production of CO₂

C.

Emulsification

D.

Hydrolysis of wheat flour starch into sugars.

Answer

Correct option: B

Solution

Ans: Rising of dough is due to the presence of CO₂. Yeast present in the dough consumes the sugar present in the dough and releases carbon dioxide and ethanol. The released CO₂ gets trapped inside the dough due to the presence of gluten in it. Thus, the dough has risen.

Hence, option (b) is the correct choice.

Question 2

Which of the following enzymes catalyze the removal of nucleotides from the ends of DNA?

A.

endonuclease

B.

exonuclease

C.

DNA ligase

D.

Hind - II

Answer

Correct option: B

Solution

Ans: Exonuclease is the enzyme which removes nucleotides from the ends of the DNA.

Hence, option (b) is the correct choice.

Question 3

The transfer of genetic material from one bacterium to another through the mediation of a viral vector is termed as:

A.

Transduction

B.

Conjugation

C.

Transformation

D.

Translation

Answer

Correct option: A

Solution

Ans: The transfer of genetic material from one bacterium to another through the mediation of a viral vector is termed Transduction.

Hence, option (a) is the correct choice.

Question 4

Which of the given statements is correct in the context of visualizing DNA molecules separated by agarose gel electrophoresis?

A.

DNA can be seen in visible light

B.

DNA can be seen without staining in visible light

C.

Ethidium bromide stained DNA can be seen in visible light

D.

Ethidium bromide stained DNA can be seen under exposure to UV light

Answer

Correct option: D

Solution

Ans: While doing gel electrophoresis DNA is stained with Ethidium bromide and then after gel electrophoresis, they are seen under exposure to UV light. DNA cannot be seen in visible light either with staining or without staining.

Hence, option (d) is the correct choice.

Question 5

'Restriction' in Restriction enzyme refers to:

A.

Cleaving of the phosphodiester bond in DNA by the enzyme

B.

Cutting of DNA at specific position only

C.

Prevention of the multiplication of bacteriophage by the host bacteria

D.

All of the above

Answer

Correct option: D

Solution

Ans: The enzyme which is obtained from bacteria that can recognize specific base sequences in DNA and restrict (cut) the DNA at the specific site. Bacteria use restriction enzymes to protect themselves from a viral infections such as bacteriophages. When viruses infect the bacteria, the phage inserts its DNA into the bacterial cell for replication at that time the restriction enzyme prevents the replication of the phage DNA by cutting it into pieces. Because of this ability, they are named restriction enzymes. It hydrolyses a phosphodiester bond on one of the two DNA strands.

Hence, option (d) is the correct choice.

Question 6

Which of the following is not required in the preparation of a recombinant DNA molecule?

A.

Restriction endonuclease

B.

DNA ligase

C.

DNA fragments

D.

E.coli

Answer

Correct option: D

Solution

Ans: Restriction endonuclease recognize a specific site of a DNA sequence and cleaves the DNA at the target sequence.

DNA ligase attaches two DNA strands.

E. coli is a bacteria which is used in various experiments.

Hence, option (d) is the correct choice.

Question 7

In agarose gel electrophoresis, DNA molecules are separated based on recognizes their:

A.

Charge only

B.

Size only

C.

Charge to size ratio

D.

All of the above

Answer

Correct option: C

Solution

Ans: Gel electrophoresis is the method by which mixtures of DNA, RNA, or proteins are separated according to their molecular size.

Hence, option (c) is the correct choice.

Question 8

The most important feature in a plasmid to serve as a vector in a gene cloning experiment is:

A.

Origin of replication (ori)

B.

Presence of a selectable marker

C.

Presence of sites for restriction endonuclease

D.

Its size

Answer

Correct option: A

Solution

Ans: The most important feature in a plasmid to serve as a vector in thatene cloning experiments is the origin of replication (ori). It is a sequence from where replication starts. When a piece of DNA is linked to this ori it replicates the DNA and makes multiple copies within the host cell as well as it also controls the copy number of the linked DNA.

Hence, option (a) is the correct choice.

Question 9

While isolating DNA from bacteria, which of the following enzymes is not required?

A.

Lysozyme

B.

Ribonuclease

C.

Deoxyribonuclease

D.

Protease

Answer

Correct option: C

Solution

Ans: Deoxyribonuclease is the enzyme that is not used while isolating DNA from bacteria.

Lysozyme is used for breaking the membranes which surround DNAs.

Ribonuclease is used for removing RNA.

Protease is used for removing protein.

Hence, option (c) is the correct choice.

Question 10

Which of the following contributed in popularising the PCR (polymerase chain reactions) technique?

A.

Easy availability of DNA template

B.

Availability of synthetic primers

C.

Availability of cheap deoxyribonucleotides

D.

Availability of 'Thermostable' DNA polymerase

Answer

Correct option: D

Solution

Ans: Thermostable DNA is obtained from *Thermus aquaticus* bacteria. It remains active at high temperatures thus helping in the denaturation of DNA during PCR.

Hence, option (d) is the correct choice.

Question 11

An antibiotic resistance gene in a vector usually helps in the selection of:

A.

Competent bacterial cells

B.

Transformed bacterial cells

C.

Recombinant bacterial cells

D.

None of the above

Answer

Correct option: B

Solution

Ans: Antibiotic resistance genes in a vector usually help in the selection of transformed cells i.e, they act as a selectable marker. Selectable markers help in identifying the transformed cells. Generally, antibiotics such as Chloramphenicol, tetracycline, ampicillin are considered useful selectable markers.

Hence, option (b) is the correct choice.

Question 12

Significance of 'heat shock' method in bacterial transformation is to facilitate:

A.

Binding of DNA to the cell wall

B.

Uptake of DNA through membrane transport proteins

C.

Uptake of DNA through transient pores in the bacterial cell wall

D.

Expression of antibiotic resistance gene

Answer

Correct option: C

Solution

Ans: Heat shock method in bacterial transformation is to facilitate uptake of DNA through transient pores in the bacterial cell wall.

In this method presence of bivalent cation like Ca^{+2} creates transient pores in the cell wall allowing the uptake of foreign DNA from the surrounding.

Hence, option (c) is the correct choice.

Question 13

The role of DNA ligase in the construction of a recombinant DNA molecule is:

A.

Formation of phosphodiester bond between two DNA fragments

B.

Formation of hydrogen bonds between sticky ends of DNA fragments

C.

Ligation of all purine and pyrimidine bases

D.

None of the above

Answer

Correct option: A

Solution

Ans: DNA ligase is an enzyme that facilitates the joining of sticky ends of two DNA strands by the formation of phosphodiester bonds.

Hence, option (a) is the correct choice.

Question 14

Which of the following bacteria is not a source of restriction endonuclease?

A.

Haemophilus influenzae

B.

Escherichia coli

C.

Entamoeba coli

D.

Bacillus amyloliquefaciens

Answer

Correct option: C

Solution

Ans: Entamoeba coli is a protozoa. Therefore, it's not a source of restriction endonuclease.

Hence, option (c) is the correct choice.

Question 15

Which of the following steps are catalysed by Taq DNA polymerase in a PCR reaction?

A.

Denaturation of template DNA

B.

Annealing of primers to template DNA

C.

Extension of primer end on the template DNA

D.

All of the above

Answer

Correct option: C

Solution

Ans: Extension of primer end on the template DNA catalysed by Taq DNA polymerase in a PCR reaction.

Hence, option (c) is the correct choice.

Question 16

A bacterial cell was transformed with a recombinant DNA molecule that was generated using a human gene. However, the transformed cells did not produce the desired protein. Reasons could be:

A.

Human gene may have intron which bacteria cannot process

B.

Amino acid codons for humans and bacteria are different

C.

Human protein is formed but degraded by bacteria

D.

All of the above

Answer

Correct option: A

Solution

Ans: Bacterial cell was transformed with a recombinant DNA molecule that was generated using a human gene. However, the transformed cells did not produce the desired protein because the human gene may have an intron that bacteria cannot process. Any nucleotide sequence in a gene is removed by splicing during the maturation of RNA which is called an intron. Hence, option (a) is the correct choice.

Question 17

Which of the following should be chosen for best yield if one were to produce a recombinant protein in large amounts?

A.

Laboratory flask of largest capacity

B.

A stirred-tank bioreactor without in-lets and out-lets

C.

A continuous culture system

D.

Any of the above

Answer

Correct option: C

Solution

Ans: To grow something it requires a growth media and for producing recombinant protein in large amounts continuous culture system is a must.

Hence, option (c) is the correct choice.

Question 18

Who among the following was awarded the Nobel Prize for the development of PCR technique?

A.

Herbert Boyer

B.

HargovindKhurana

C.

Kary Mullis

D.

Arthur Kornberg

Answer

Correct option: C

Solution

Ans: Karry Mullis invented a technique called Polymerase Chain Reaction (PCR) by which large amounts of DNA can be formed from small amounts.

Hence, option (c) is the correct choice.

Question 19

Which of the following statements does not hold true for restriction enzyme?

A.

It recognises a palindromic nucleotide sequence

B.

It is an endonuclease

C.

It is isolated from viruses

D.

It can produce the same kind of sticky ends in different DNA molecules

Answer

Correct option: C

Solution

Ans: Restriction enzymes are isolated from bacteria, not from viruses.

Hence, option (c) is the correct choice.

Very Short Answer Questions**Question 1**

How is the copy number of the plasmid vector related to the yield of the recombinant protein?

Solution

Ans: Higher number of plasmid vectors results in the yield of a higher number of recombinant proteins.

Question 2

Would you choose an exonuclease while producing a recombinant DNA molecule?

Solution

Ans: No, I would not choose exonuclease while producing a recombinant DNA molecule because it removes nucleotides from the ends of the DNA, and thus it cannot help in producing circular DNA.

Question 3

What does H in 'd' and 'III' refer to in the enzyme HindIII?

Solution

Ans: No, I would not choose exonuclease while producing a recombinant DNA molecule because it removes nucleotides from the ends of the DNA, and thus it cannot help in producing circular DNA.

Question 4

Restriction enzymes should not have more than one site of action in the cloning site of a vector. Comment.

Solution

Ans: Restriction enzymes should not have more than one site of action in the cloning site of a vector because the presence of more than one recognition site will create many fragments of DNA which will complicate the process.

Question 5

What does 'competent' refer to in competent cells used in transformation experiments?

Solution

Ans: DNA is a hydrophilic molecule and so it cannot pass through the cell membrane thus the cell is made competent (pores are created) by treating suitable divalent ions. As a result, bacterial cells take up the DNA through the pores in the cell wall.

Question 6

What is the significance of adding proteases at the time of isolation of genetic material (DNA).

Solution

Ans: The significance of adding proteases is that it helps in removing protein during the process of obtaining pure DNA

Question 7

While doing a PCR, 'denaturation' step is missed. What will be its effect on the process?

Solution

Ans: During PCR, if denaturation is missed then primers will not join the template and this will halt the further process i.e., no extension, no amplification and at the end, large numbers of DNA cannot be made.

Question 8

Name a recombinant vaccine that is currently being used in a vaccination program.

Solution

Ans: Hepatitis B vaccine is currently being used in a vaccination program.

Question 9

Do biomolecules (DNA, protein) exhibit biological activity in anhydrous conditions?

Solution

Ans: Biomolecules such as DNA, protein do not exhibit biological activity in anhydrous conditions as they may get damaged under anhydrous conditions and proteins get denatured.

Question 10

What modification is done on the Ti plasmid of *Agrobacterium tumefaciens* to convert it into a cloning vector?

Solution

Ans: *Agrobacterium tumefaciens* has the ability to infect plant cells and then transfer a DNA sequence (Ti plasmid) and cause a crown gall disease.

This plasmid vector is disarmed and then used as a cloning vector for delivering genes of interest to plants and animals.

Short Answer Questions

Question 1

What is meant by gene cloning?

Solution

Ans: Gene cloning is a process by which multiple copies of a specific gene can be produced. This is done by:

Selecting specific gene

The selected gene is ligated to a vector.

Recombinant DNA or rDNA is produced.

This rDNA is now transformed into a bacterial cell.

As bacteria reproduce, their colony increases and each progeny will have that rDNA.

Thus, the number of copies of genes increases.

Question 2

Both a wine maker and a molecular biologist who had developed a recombinant vaccine claim to be biotechnologists. Who in your opinion is correct?

Solution

Ans: Biotechnology is a branch of science in which living organisms are used to produce products for humankind. So, yes, both winemakers and molecular biologists are biotechnologists.

Question 3

A recombinant DNA molecule was created by ligating a gene to a plasmid vector. By mistake, an exonuclease was added to the tube containing the recombinant DNA. How does this affect the next step in the experiment i.e. bacterial transformation?

Solution

Ans: When a DNA molecule is created by ligating a gene to a plasmid vector then it becomes a circular DNA, if by mistake exonuclease is added to the tube it will not affect the process because now DNA is not having a free end and thus exonuclease will not get a substrate to show its action.

Question 4

Restriction enzymes that are used in the construction of recombinant DNA are endonucleases which cut the DNA at 'specific-recognition sequence'. What would be the disadvantage if they do not cut the DNA at specific-recognition sequence?

Solution

Ans: Restriction enzymes that are used in the construction of recombinant DNA are endonucleases which cut the DNA at 'specific-recognition sequence' because specific-recognition sequence in the DNA

provide sticky ends at which recombination of genes takes place which further leads to replication of selected gene and if endonucleases fail to cut the DNA at specific-recognition sequence the recombination will fail to occur.

Question 5

A plasmid DNA and a linear DNA (both are of the same size) have one site for a restriction endonuclease. When cut and separated on agarose gel electrophoresis, plasmid shows one DNA band while linear DNA shows two fragments. Explain.

Solution

Ans: A plasmid DNA and linear DNA have one site for a restriction endonuclease, when cut and separated on agarose gel then circular DNA opens up to resemble a single linear DNA and linear DNA divides into two fragments after cleavage. Thus, circular DNA shows one band and linear DNA shows two bands.

Question 6

How does one visualise DNA on an agarose gel?

Solution

Ans: While doing gel electrophoresis then the gel is added with a compound called Ethidium Bromide which stains the DNA so when DNA fragments are separated then it is put under UV radiation, fluorescence gives orange light. Thus, DNA fragments appear as orange bands in the presence of Ethidium Bromide and UV light.

Question 7

A plasmid without a selectable marker was chosen as a vector for cloning a gene. How does this affect the experiment?

Solution

Ans: The function of the selectable marker is to identify and eliminate non-transformant DNA and selectively allow the growth of transformants. So, in the absence of a selectable marker, it is not possible to segregate transformants and non-transformants.

Question 8

A mixture of fragmented DNA was electrophoresed in an agarose gel. After staining the gel with ethidium bromide, no DNA bands were observed. What could be the reason?

Solution

Ans: A mixture of fragmented DNA was electrophoresed in an agarose gel. After staining the gel with ethidium bromide, no DNA bands were observed the following possible reasons can be behind this:

- Maybe DNA gets contaminated because of the accidental addition of nuclease enzymes.
- Maybe electrodes are put on the wrong side i.e., anode towards the loading well. As DNA is negatively charged, it moves back towards the anode.
- Maybe the quantity of ethidium bromide was not sufficient.

Question 9

Describe the role of CaCl_2 in the preparation of competent cells?

Solution

Ans: CaCl_2 provides the divalent ion i.e., Ca^{2+} which creates transient pores on the bacterial cell wall which then facilitates the entry of foreign DNA in the bacterial cell. So, because of divalent ions, the cell becomes competent and it increases the efficiency of uptake of DNA through the pores.

Question 10

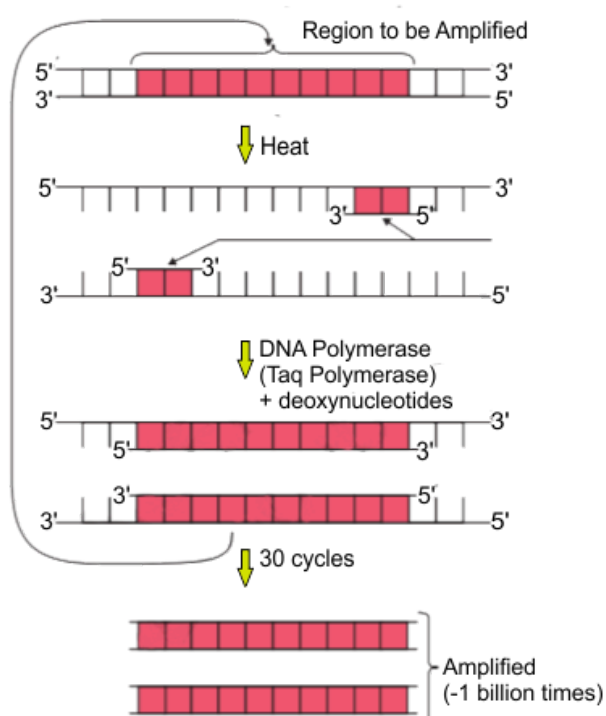
What would happen when one grows a recombinant bacterium in a bioreactor but forgets to add an antibiotic to the medium in which the recombinant is growing?

Solution

Ans: If antibiotics are not added in the growing medium then the bacteria do not have any pressure to create antibiotic-resistant genes as they are easily surviving and as a result, desirable genes would not produce.

Question 11

Identify and explain steps 'A', 'B' and 'C' in the PCR diagram given below.



Solution

Ans:

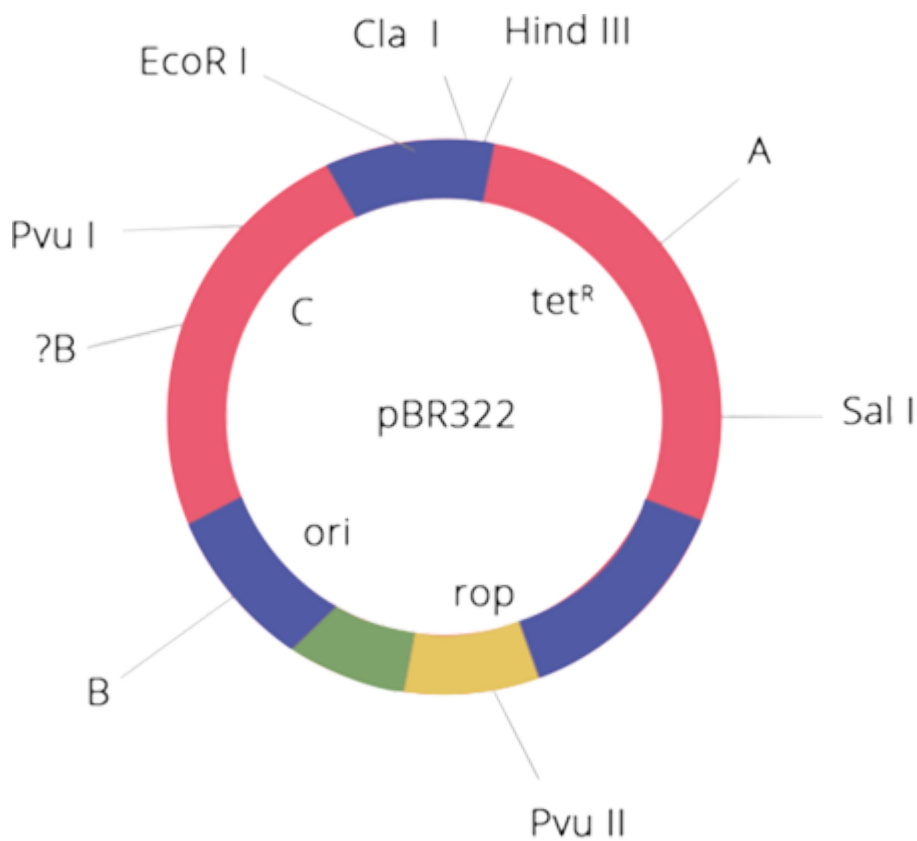
A: Denaturation- Strands of DNA are separated into single strands by breaking hydrogen bonds between base pairs.

B: Annealing- It is a heat treatment process of DNA in which a cycle of reaction of heating and cooling is done.

C: Extension- By using DNA polymerase copy of the DNA strand is made.

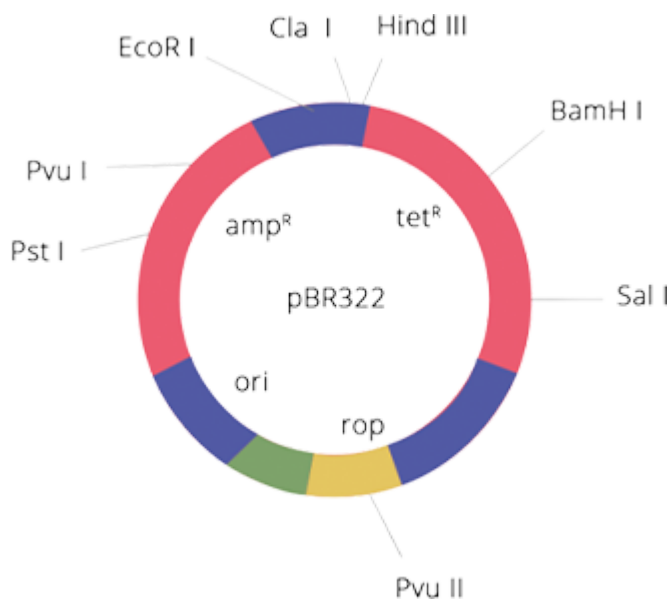
Question 12

Name the regions marked A, B and C.



Solution

Ans:



A- shows tetracycline resistance site

B- shows restriction site Pst I

C- shows ampicillin resistance site

Long Answer Questions

Question 1

For a, visualizes specific recognition selection of recombinants, insertional inactivation of antibiotic marker has been superseded by insertional inactivation of a marker gene coding for a chromogenic substrate. Give reasons.

Solution

Ans: Selection of recombinants due to inactivation of antibiotics is a very difficult process because it requires simultaneous plating on two plates having different antibiotics. So, alternative selectable markers were developed which differentiate recombinants from non-recombinants based on their ability to produce color in the presence of a chromogenic substrate. In an enzyme beta-galactosidase. This results in the inactivation of the enzyme, which is referred to as insertional inactivation. The presence of chromogenic substrate gives blue color colonies if the plasmid in the bacteria does not have an insert. The presence of insert results into insertional inactivation of the alpha-galactosidase and colonies do not produce any color these are identified as recombinant colonies

Question 2

Describe the role of *Agrobacterium tumefaciens* in transforming a plant cell.

Solution

Ans: *Agrobacterium tumefaciens* is a pathogen of several dicot plants which has the ability to insert a piece of DNA called 'T-DNA' to transform normal cells into tumour cells to produce a certain chemical which is needed by the pathogen.

Thus, the tumour-inducing Ti plasmid is now modified into a cloning vector which is no more pathogenic to the plants but is still able to use the mechanism of delivering genes of interest into a variety of plants.

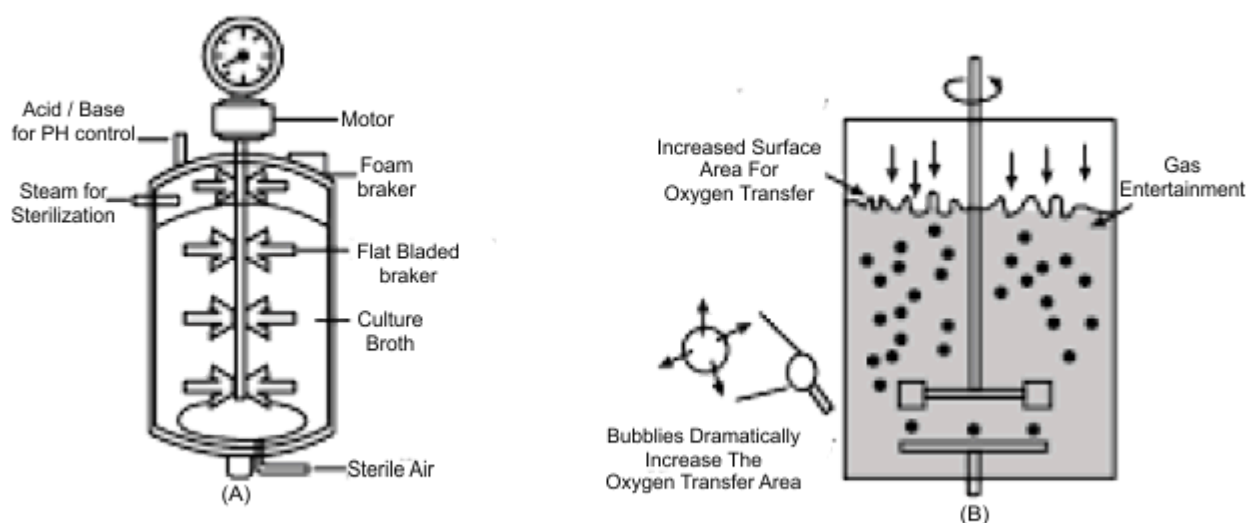
Question 3

Illustrate the design of a bioreactor. Highlight the difference between a flask in your laboratory and a bioreactor which allows cells to grow in a continuous culture system.

Solution

Ans: Bioreactors are the large vessels in which raw materials are converted into specific products by biological means. The most common type of bioreactor is the stirring type. It is cylindrical in shape with a curved base to facilitate the mixing of the materials in the reactor. It has an agitator system, oxygen delivery system, foam control system, temperature control system. A sampling port (a small volume of products are collected periodically) is present.

On the other side, a flask in the laboratory cannot be used for producing rDNA on a large scale and it cannot be used to grow culture continuously.



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The NCERT Class 12 Biology Exemplar for Chapter 11 Biotechnology: Principles and Processes is a valuable resource for studying for your CBSE Class 12 Biology test and graduate admission exams. This study guide includes exemplar questions from the NCERT exemplar book, key questions from previous year's question papers, sample papers, worksheets, and exercises.

The NCERT Class 12 Biology Exemplar for Chapter 11 gives you the opportunity to practice several types of questions that may be given in exams. MCQ'S, kindly fill in the blanks, true or false questions, such as the following, etc are popular types of questions that you should practice in order to perform well in exams, particularly entrance exams.

What is Biotechnology?

Biotechnology can be described as the effective use of biology to the development of products and technologies that benefit humans. The rise of genetic engineering and the development of vaccinations aided in the development of modern biotechnology. Waste management, energy production, and therapeutics are just a few of the industries where it's used.

The following are some of the most important biotechnology applications:

- Genetic Engineering
 - Insertional activation
 - Recombinant DNA technology
 - Cloning in Plants
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