

Biotechnology

Long Answer Questions

Q.1 Define biotechnology? Explain its background.

Ans: Definition (Board 2014)

Biotechnology is defined as the use of living organisms in processes for the manufacture of useful products or for services.

Background

(a) Old Biotechnology

Although the term biotechnology is new, the discipline itself is very old. Fermentation and other such processes which are based on the natural capabilities of organisms, are commonly considered as old biotechnology.

(b) Modern Biotechnology

Genetic engineering i.e. the artificial synthesis, modification, removal, addition and repair of genetic material (DNA) is considered as modern biotechnology. It is done to alter the characteristics of organisms.

(c) Isolation of enzymes of DNA Synthesis

The work on genetic engineering started in 1944 when it was proved that DNA carries the genetic information.

Scientists isolated the enzymes of DNA synthesis and then prepared DNA outside cells.

(d) Cutting and Pasting of DNA

In 1970s, scientists were able to cut and paste the DNA of organisms.

(e) Preparation of insulin and human growth hormone

In 1978, scientists prepared human insulin by inserting the insulin gene in bacteria. Human growth hormone was also synthesized in bacteria.

(f) Human Genome Project

In 1990, the **Human Genome Project** was launched to map all the genes in human cell. The complete map of human genome was published in 2002.

Q.2 Since when have humans been using microorganisms?

Ans: Humans began using microorganisms as early as 4000 BC for making wine, vinegar, cheese, yogurt etc. Some of these processes have become a part of every home that we may even hesitate to refer them as biotechnology.

Q.3 What do you know about Dolly?

Ans: In Scotland, in 1997, an embryologist Ian Wilmut produced a sheep (Dolly) from the body cell of an adult sheep.



Q.4 Write down scope and importance of biotechnology in three different fields. (B-2014)

Ans: In recent years, biotechnology is growing as a separate science. It has attracted the attention of many intellectuals from diverse fields like agriculture, medicine, microbiology and organic chemistry.

The scope for biotechnology is so wide that it is difficult to recognize the limits.

The following are some areas of the application of biotechnology:

1. Biotechnology in the field of medicine./Write the scope and importance of biotechnology in the field of medicine (Board 2014)

(a) Synthesis of insulin and interferon

In the field of medicine, biotechnologists synthesized insulin and interferon (antiviral protein) from bacteria and released for sale.

(b) Vaccines and Antibodies

A large number of vaccines and antibodies; human growth hormone and other medicines have also been produced.

(c) Synthesis of enzymes

Various enzymes are being synthesized for medicinal as well as industrial use.

(d) Gene therapy and forensic medicines

Gene therapy (treatment through genes) has become important in recent years.

Biotechnology also proved much beneficial in forensic medicines. The study of DNA helps in the identification of criminals.

2. Biotechnology in the field of food and agriculture

(a) In Food Production

Fermented foods (e.g. pickles, yogurt), malted foods (e.g. powdered milk: a mixture of barley, wheat flour and whole milk), various vitamins and dairy products are produced by using microorganisms.

(b) In Wine and beer Production

Wine and beer are produced in beverage industry. Biotechnology has also revolutionized research activities in the area of agriculture.

(c) Transgenic Plants and Animals

Transgenic (organisms with modified genetic set-up) plants are being developed, in which desirable characteristics are present e.g., more yields and resistance against diseases, insects and herbicides.

Transgenic goats, chickens, cows give more food and milk etc. Many animals like mice, goats, cows etc. have been made transgenic to get medicines through their milk, blood or urine.

3. Biotechnology and environment

(a) Biotechnology and environment issues

Biotechnology is also being used for dealing with environmental issues, like pollution control, development of renewable sources for energy, restoration of degraded lands and bio-diversity conservation.

(b) Sewage Water Treatment

Bacterial enzymes are used to treat sewage water to purify.

(c) Transgenic Microbes

Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic micro-organisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

Q.5 What is Fermentation and write down its types.

Ans. Cellular respiration;

In cellular respiration glucose molecule goes through oxidation reduction reactions to release energy in the form of ATP.

Fermentation

Fermentation is the process in which there is incomplete oxidation – reduction of glucose.

Fermentation has been in the knowledge of man since centuries but it was believed that it is purely a chemical process.

Louis Pasteur and Fermentation

In 1857, Pasteur convinced the scientific community that all fermentations are the results of microbial activity. He showed that fermentation is always accompanied by the development of micro-organisms. There are many kinds of fermentation and each kind is a characteristic of particular microbial group.

Types of Fermentation

(Board 2013)

Fermentations are classified in terms of the products formed. The initial steps of carbohydrate fermentation are identical to those of respiration. The process begins with glycolysis, in which the glucose molecule is broken into two molecules of pyruvic acid. Different micro-organisms proceed the further reactions in different ways. It results in the formation of various products from pyruvic acid.

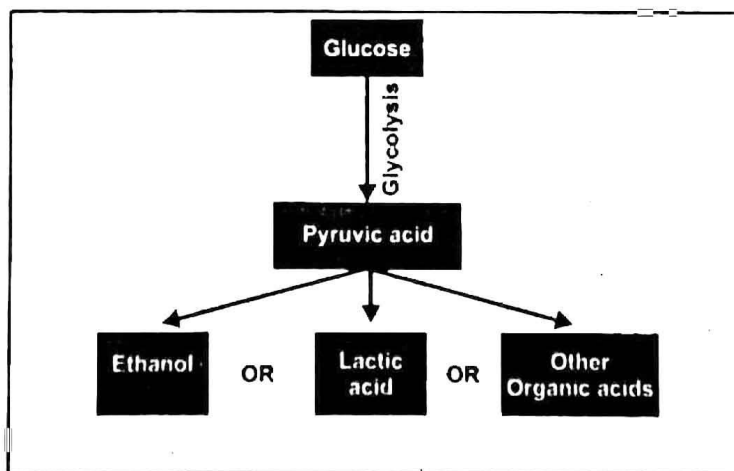


Figure 17.1: Carbohydrate Fermentation and its Products

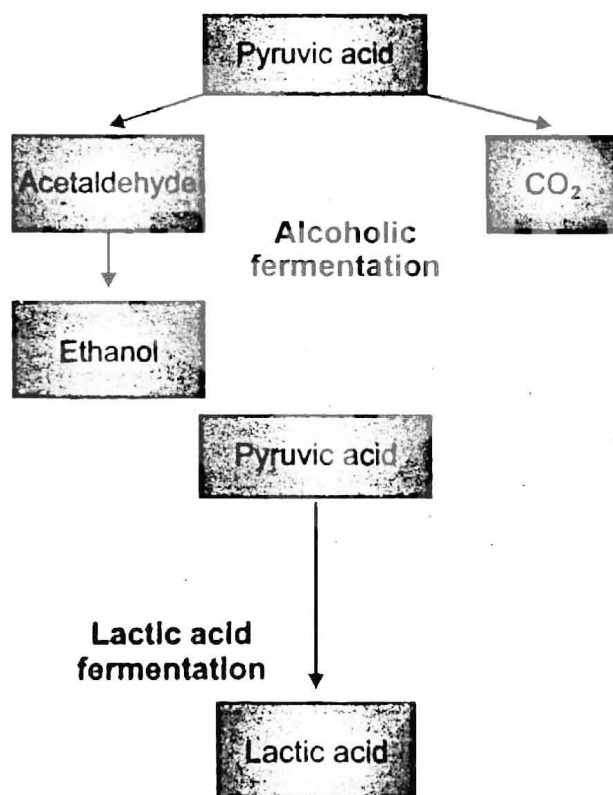
The two basic types of carbohydrate fermentation are:

1. Alcoholic Fermentation (by yeast)

This fermentation is carried out by many types of yeast such as *saccharomyces cerevisiae*. This process is quite important and is used to produce bread, beer, wine and distilled spirits. In this process, carbon dioxide is removed from pyruvic acid. The product i.e. acetaldehyde is then reduced to ethanol. The carbon dioxide produced during this fermentation causes the rise of the bread.

2. Lactic acid Fermentation (by bacteria)

In this process, pyruvic acid is reduced to lactic acid. It is carried out by many bacteria e.g. *Streptococcus* and many *Lactobacillus* species. It is quite important in dairy industry where it is used for souring milk and also for production of various types of cheese.



Q.6 What are applications of fermentation in biotechnology?

Ans. In beginning, the meaning of fermentation process was the use of microorganisms for the production of foods (cheese, yogurt, fermented pickles and sausages, soy sauce), beverages (beers, wines) and spirits. However, in biotechnology the term “fermentation” means the production of any product by the mass culture of microorganisms.

Applications of fermentation

In fermentation, maximum growth of an organism is obtained for the production of desired products of commercial value. Traditionally, only food and beverage products were produced by using fermentation. Now many other products e.g. industrial chemicals are also being produced.

a) Fermented foods

Fermentation often makes the food more nutritious, more digestible and tastier. It also tends to preserve the food, lowering the need for refrigeration. The following groups are included in the fermented foods.

1) Cereal products

Bread is the commonest type of fermented cereal product. Wheat dough is fermented by *S.cerevisiae* along with some lactic acid bacteria.

2) Dairy products

Cheese and yogurt are important fermentation products. Cheese is formed when a milk protein is coagulated. This happens when the acid produced by lactic acid bacteria reacts with milk protein. Yogurt is made from milk by different lactic acid bacteria.

3) Fruit and vegetable products

Fermentation is usually used, along with salt and acid, to preserve pickle, fruits and vegetables.

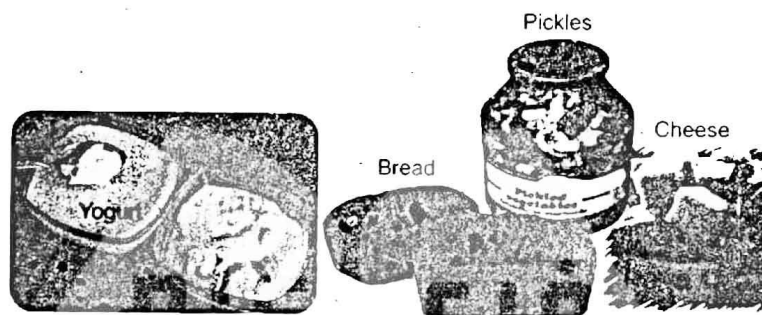


Figure 17.2: Fermented Foods

4) Beverage products.

Beer is produced from cereal grains which have been malted, dried and ground into fine powder. Fermentation of the powder is done by yeast. This process breaks the glucose present in powder into pyruvic acid and then into ethanol. Grapes can be directly fermented by yeast to wine.

b) Industrial products

The following are important industrial products produced through the process of fermentation.

Products	Microorganisms used	Some uses
Formic acid	<i>Aspergillus</i>	Used in textile dyeing, leather treatment, electroplating, rubber manufacture
Ethanol	<i>Saccharomyces</i>	Used as solvent, used in the production of vinegar and beverages
Glycerol	<i>Saccharomyces</i>	Used as solvent, used in the production of plastics, cosmetics and soaps, used in printing, used as sweetner.
Acrylic acid	<i>Bacillus</i>	Used in printing; used as sweetener. Used in the production of plastics.

Q.7. What is fermenter and write down its types. (Board 2014)

Ans. Fermenter

Fermenter is a device that provides optimum environment to micro-organisms to grow into a biomass, so that they can interact with a substrate, forming the product.

Types

Fermentation is carried out in fermenters, in the following two ways:-

1) Batch Fermentation

In this process, the tank of fermenter is filled with the raw materials to be fermented. The temperature and pH of microbial fermentation is properly adjusted and nutritive supplements are added. All the material is steam sterilized. The pure culture of micro-organisms is added to fermenter from a separate vessel.

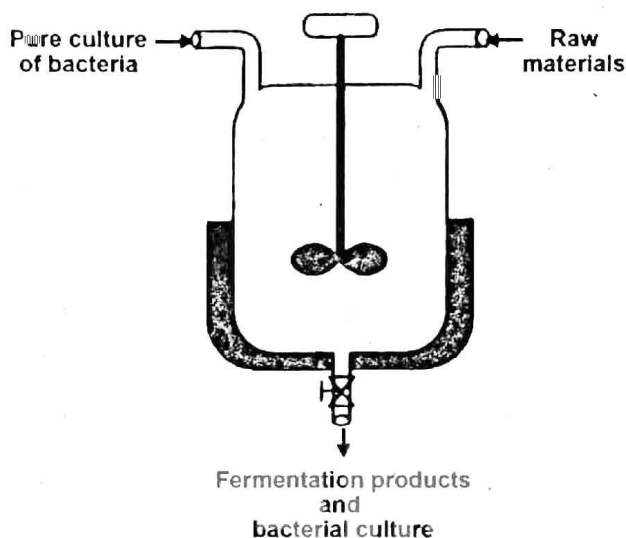


Figure 17.3 A batch Fermenter

Fermentation proceeds and after the proper time the contents of fermenter are taken out. Fermenter is cleaned and the process is repeated. Thus, fermentation is a dis-continuous process divided into batches.

2) Continuous fermentation

In this process, the substrate is added to fermenter continuously at a fixed rate. This maintains the micro-organisms in growth phase. Fermentation products are taken out continuously. The design and arrangements for continuous fermentation are more complex.

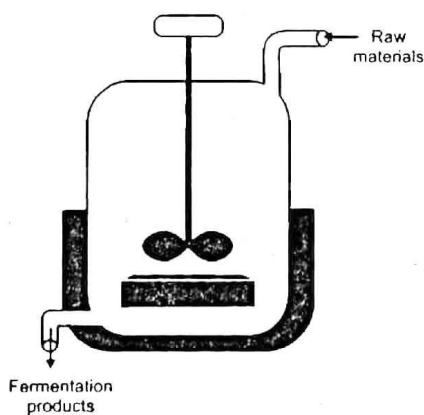


Figure 17.4 A Continuous Fermenter

Q.8 Write two advantages of using fermenters. (Board 2014)

Ans. Advantages of using fermenters

(1) Controlled Environment

For each biotechnological process, the environment provided to the organisms must be monitored and controlled. Such a controlled environment is provided by fermenters. A fermenter optimizes the growth of the organisms by controlling many factors, like nutrients, oxygen, growth inhibitors, pH and temperature.

(2) Production of materials in bulk quantities

A fermenter may hold several thousand litres of the growth medium. So fermenters allow the production of materials in bulk quantities. Massive amounts of medicines, insulin, human growth hormone and other proteins are being produced in fermenters and this production proves much inexpensive.

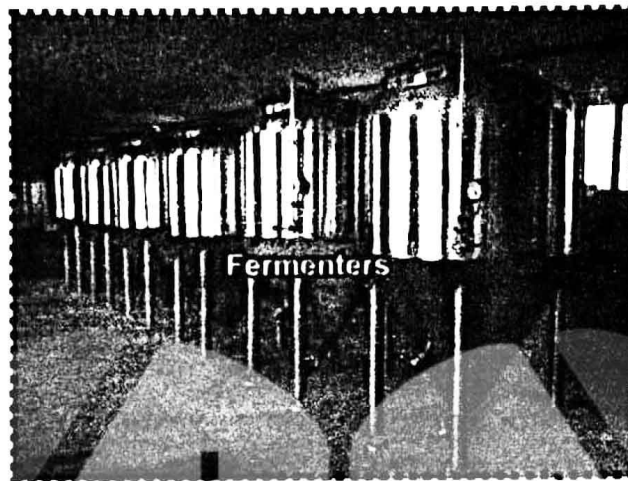


Figure 17.5: Fermenters used in food and Pharmaceutical industry

Q.9 What is genetic engineering and write down its objectives.

Ans. Definition

Genetic engineering or recombinant DNA technology involves the artificial synthesis, modification, removal, addition and repair of the genetic material (DNA).

Development of Genetic Engineering

Genetic engineering developed in the mid – 1970s when it became possible to cut DNA and to transfer particular pieces of DNA from one type of organism into another.

As a result, the characteristics of the host organism could be changed. If host organism is a microorganism, such as a bacterium, the transferred DNA is multiplied many times as the microorganism multiplies. Consequently, it is possible to obtain millions of copies of a specific DNA inside a bacterial cell.

Objectives of genetic engineering

The important objectives of genetic engineering are as follows:

1) Isolation of gene

Isolation of a particular gene or part of gene for various purposes such as gene therapy.

2) Production of RNA and protein

Production of particular RNA and protein molecules.

3) Production of enzymes, drugs and organic chemicals

Improvement in the production of enzymes, drugs, and commercially important organic chemicals.

4) Production of desirable plants

Production of varieties of plants having particular desirable characteristics.

5) Treatment of genetic defects

Treatment of genetic defects in higher organisms.

Q.10 Write down basic steps in genetic engineering.

(Board 2013)

Ans. All the objectives of genetic engineering can be obtained by some basic methodologies such as:

1) Isolation of gene of interest

In the 1st step, the genetic engineer identifies the gene of interest in a donor organism. Special enzymes called restriction endonucleases, are used to cut the identified gene from the total DNA of donor organism.

2) Insertion of the gene into a vector

Vector is selected for the transfer of the isolated gene of interest to the host cell. The vector may be a plasmid (the extra chromosomal DNA present in many bacteria) or a bacteriophage.

The gene of interest is attached with the vector DNA by using endonuclease (breaking enzymes) and ligase (joining enzymes). The vector DNA and the attached gene of interest are collectively called recombinant DNA.

3) Transfer of recombinant DNA into Host Organism

Recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

4) Growth of the GMO

The GMO are provided suitable culture medium for growth to give as much copies of the gene of interest as needed.

5) Expression of the gene

The GMO contains the gene of interest and manufactures the desired product which is isolated from culture medium.

Q.11 What are different achievements of genetic engineering?

Ans. Various achievements of genetic engineering are as follows:

1) Formation of human insulin

Human insulin gene was transferred into bacteria. The genetically modified bacteria became able to synthesize insulin. Diabetics are now receiving this insulin.

2) Formation of human growth hormone

In 1977, an *E.coli* bacterium was created that was capable of synthesizing the human growth hormone.

3) Formation of thymosin hormone

The hormone thymosin which may prove effective against brain and lung cancer has been produced by genetically modified micro-organisms.

4) Formation of beta-endorphin

Beta-endorphin, a pain killer produced by the brain, has also been produced by genetic engineering techniques.

5) Formation of vaccines

Genetic engineers produced a safe vaccine against the foot and mouth disease (a viral disease in cattle, goats and deer). Similarly many vaccines have been produced against human disease such as hepatitis-B.

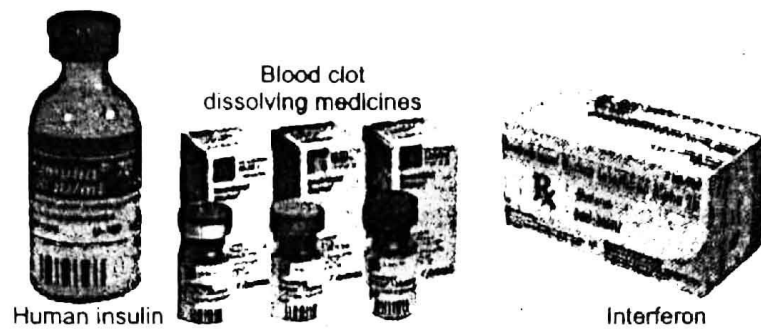


Figure 17.6 Some medicines produced by genetic engineers.

6) Formation of interferons

Interferons are anti-viral proteins produced by cells infected with viruses. In 1980, interferon was produced in the genetically modified micro-organisms for the 1st time.

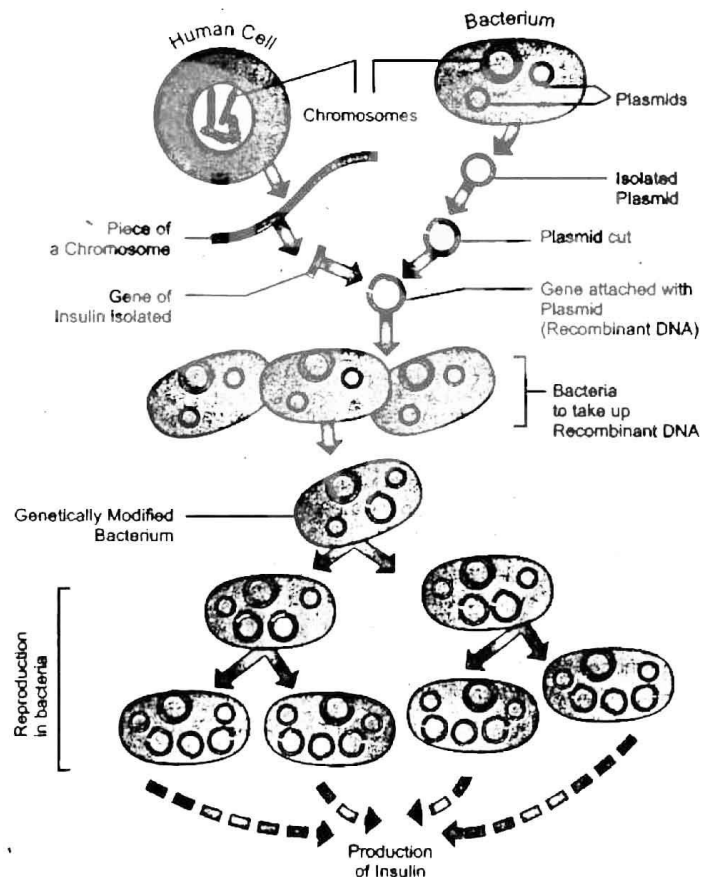


Figure 17.7 Production of insulin through genetic engineering

7) Formation of urokinase enzyme

The enzyme urokinase which is used to dissolve blood clots, has been produced by genetically modified micro-organisms.

8) Elimination of inherited diseases

Now it has become possible to modify the genes in the human egg cell. This can lead to the elimination of inherited diseases like haemophilia.

9) Cure of blood diseases

Genetic engineering techniques can also be used to cure blood diseases like thalassemia and sickle cell anaemia which result from defects in single genes. Normal genes could be transferred into the bone marrow.

10) Formation of nitrogen fixing plants

Genetic engineers have developed plants that can fix nitrogen directly from the atmosphere. Such plants need less fertilizers.

Q.12 What is single cell protein? Give its role in the service of humanity.

Ans. Definition

Single-cell protein (SCP) refers to the protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria.

OR

It is known as single cell protein because the micro-organisms used as producers are unicellular or filamentous individuals.

Production of Single Cell Protein

For the production of single cell proteins, the microorganisms are grown in fermenters. These microorganisms utilize a variety of substrate like agricultural wastes, industrial wastes, natural gas like methane etc.

Production of novel protein

Microorganisms grow very vigorously and produce a high yield of protein. The protein content produced by microorganisms is also known as novel protein or minifood.

Better management of Food Shortage Problem

Due to overpopulation, the world is facing the problem of food shortage. In future, the conventional agricultural methods might not be able to provide a sufficient supply of food (especially proteins). For a better management of food shortage problems (in human and domestic animals), the use of microbes as the producers of single cell proteins has been successful on experimental basis.

Work of Prof. Scrimshaw

This technique was introduced by Prof. Scrimshaw of Massachusetts Institute of technology. Scientist and food technologists believe that single cell proteins will substitute the other protein rich foods in human and animal feeds.

Significance of single cell protein

(a) High yield of SCP

All scientists recognize the significance of the production of single-cell proteins. The micro-organisms grow very vigorously and produce a high yield. It has been calculated that 50 kilogram of yeast produces about 250 tons of proteins within 24 hours.

Algae grown in ponds produce 20 tons (dry weight) of protein per acre/year. This yield of protein is 10-15 times higher than soybeans and 20-50 times higher than corn.

When single cell proteins are produced by using yeasts, the products also contain high vitamin content.

(b) Raw Material in the Production of Single cell Proteins

In the production of single cell proteins, industrial wastes are used as raw materials for micro-organisms. It helps in controlling pollution.

(c) Use of SCP in Future

The use of single cell proteins has good prospects in future because they contain all essential amino acids. Moreover the production of single-cell proteins is independent of seasonal variations.

(d) Limited land Area Required

SCP is gaining popularity day by day because it requires limited land area for production.

Multiply Choices Questions

1. Find the correct match for the fermentation product and the organism involved;
 - (a) Formic acid – *Saccharomyces*
 - (b) Ethanol – *Saccharomyces*
 - (c) Ethanol – *Aspergillus*
 - (d) Glycerol – *Aspergillus*
 2. Which is not an objective of genetic engineering?
 - (a) Production of cheese and yogurt by lactic acid bacteria
 - (b) Isolation of a particular gene, or part of a gene
 - (c) Production of RNA and protein molecules.
 - (d) Correction of genetic defects in higher organisms
 3. Which of these is an anti-viral protein?
 - (a) Urokinase
 - (b) Thymosin
 - (c) Insulin
 - (d) Interferon
 4. The first step in genetic engineering is:
 - (a) Growth of the genetically modified organism
 - (b) Transfer of the recombinant DNA into the host organism
 - (c) Isolation of the gene of interest
 - (d) Insertion of gene into a vector
 5. The work on genetic engineering started in:
 - (a) 1944
 - (b) 1955
 - (c) 1945
 - (d) 1943
 6. Scientists are able to cut and paste the DNA of organism in:
 - (a) 1944
 - (b) 1970
 - (c) 1990
 - (d) 2002
 7. Scientists prepared human insulin by inserting the insulin gene in bacteria in:
 - (a) 1970
 - (b) 1978
 - (c) 1990
 - (d) 2002
 8. Human genome project was launched in:
 - (a) 1990
 - (b) 1970
 - (c) 1978
 - (d) 2002
 9. In alcoholic fermentation, which bacteria is used?
 - (a) *Saccharomyces*
 - (b) *Lactobacillus*
 - (c) *Streptococcus*
 - (d) Both B and C
 10. Which of these micro-organism is used in the production of formic acid?
 - (a) *Aspergillus*
 - (b) *Bacillus*
 - (c) *Saccharomyces*
 - (d) None
 11. Glycerol is produced by:
 - (a) *Aspergillus*
 - (b) *Bacillus*
 - (c) *Saccharomyces*
 - (d) *Streptococcus*
 12. Which one is used to dissolve blood clots?
 - (a) Urokinase
 - (b) Interferons
 - (c) Thymosin
 - (d) Vaccine
 13. The complete map of human genome was published in:
 - (a) 2002
 - (b) 1944
 - (c) 1978
 - (d) 1990
 14. 50 kilogram of yeast produces how many tons of proteins within 24 hours.
 - (a) 250
 - (b) 150
 - (c) 350
 - (d) 450

15. Interferon was produced by genetically modified microorganisms in;

- (a) 1980 (b) 1944
- (c) 1990 (d) 1970

16. 500,000 sheep brains were required to produce how much milligrams of human growth hormone?

- (a) 5 (b) 10
- (c) 15 (d) 20

17. Which one is effective against brain and lung cancer?

- (a) Beta – endorphin (b) Vaccine
- (c) Thymosin (d) Insulin

18. Which one is not used for the production of plastics?

- (a) *Bacillus* (b) *Aspergillus*
- (c) *Saccharomyces* (d) none of these

19. Alcoholic fermentation is carried out by; (Board 2013)

- (a) Yeast (b) Bacteria
- (c) Virus (d) Algae

20. Enzyme used to cut the identified gene from the total DNA of donor organism is; (Board 2013)

- (a) Endonuclease
- (b) Ligase
- (c) Restriction Endonuclease
- (d) Amylase

21. Vector transmits;

- (a) Bacterium (b) Parasite
- (c) Pathogen (d) Both B and C

22. Which is an important application of Biotechnology?

- (a) Respiration (b) Decomposition
- (c) Digestion (d) Fermentation

23. In glycolysis, glucose molecule is broken down into two molecules of:

- (a) Pyruvic acid (b) Lactic acid
- (c) Formic acid (d) Acrylic acid

24. Who produced the Dolly sheep?

- (a) Louis Pasteur
- (b) Walther Flemming
- (c) Ian Wilmut
- (d) Mendel

25. Who invented Pasteurization?

- (a) Louis pasteur
- (b) Walther Flemming
- (c) Carolus Linnaeus
- (d) Aristotle

26. Who introduced the term “single cell Protein”?

- (a) Mendel (b) Loius Pasteur
- (c) Scrimshaw (d) Ian Wilmut

27. The use of living organisms in processes for the manufactures of useful products for services is called:

- (a) Genetic Engineering
- (b) Biotechnology
- (c) Vaccination
- (d) Maltation

28. *Streptococcus* and *Lactobacillus* are:

- (a) Viruses (b) Fungi
- (c) Bacteria (d) Algae

29. When Pasteur convinced the scientific community that all fermentations are the results of microbial activity?

- (a) 1957 (b) 1857
- (c) 1900 (d) 2010

30. Which one is the commonest type of fermented cereal product?

- (a) Pickles (b) Bread
- (c) Jams (d) Powdered milk

31. In the synthesis of beer, fermentation of fine powder of cereal grains is done by?

- (a) Yeast (b) Bacteria
- (c) Viruses (d) All of the above

32. Which one is used in the production of Vinegar and Beverages?

- (a) *Aspergillus* (b) *Bacillus*
- (c) *Saccharomyces* (d) *Lactobacillus*

33. The vector DNA and the attached gene of interest are collectively called:
(a) GMO
(b) Recombinant DNA
(c) DNA
(d) Endonucleases
34. Wheat dough is fermented by:
(a) Yeast (b) *S. cerevisiae*
(c) *Lactobacillus* (d) *Streptococcus*
35. Organisms with modified genetic set up are called:
(a) Dolly
(b) Transgenic organisms
(c) Breed
(d) Vector
36. The process in which glucose molecule is broken into two molecules of pyruvic acid is called:
(a) Fermentation
(b) Genetic Engineering
(c) Glycolysis
(d) Biotechnology
37. Which one is used as a Sweetener?
(a) Formic acid (b) Ethanol
(c) Glycerol (d) All of these
38. DNA carries genetic information, it was proved in?
(a) 1970's (b) 1944
(c) 1978 (d) 2000
39. When was DNA prepared outside the cells?
(a) 1944 (b) 1953
(c) 1970's (d) 1990
40. Scientists were able to cut and paste the DNA of organisms in;
(a) 1953 (b) 1970's
(c) 1944 (d) 1990
41. Human Genome project was launched?
(a) 1970 (b) 1990
(c) 1991 (d) 2000
42. Complete human genome map was published in?
(a) 1976 (b) 2004
(c) 2002 (d) 2012
43. Malted food is / are;
(a) Powdered milk
(b) Mixture of barely
(c) Whole milk
(d) All of these
44. Fermented food is/are;
(a) Pickles (b) Yogurt
(c) Both A and B (d) Wheat flour
45. Which is used for souring milk and for production of various types of cheese?
(a) *Lactobacillus*
(b) *Streptococcus*
(c) Both *lactobacillus* and *streptococcus*
(d) *Saccharomyces*
46. Fermentation makes the food more?
(a) More Digestible
(b) Less Nutritious
(c) Tasteless
(d) Less digestible
47. Grapes can directly be fermented by yeasts to:
(a) Formic acid (b) Wine
(c) Pyruvic acid (d) Ethanol
48. Which product is used in electroplating?
(a) Formic acid
(b) Ethanol
(c) Glycerol
(d) Acrylic acid
49. Which maintains the microorganisms in growth phase?
(a) Fermenter
(b) Continuous fermenter
(c) Batch fermenter
(d) All of these

50. A joining enzyme is;

- (a) Thymosin
(b) Endonuclease
(c) Ligase
(d) Urokinase

51. A breaking enzyme is;

- Recombinant DNA
- Ligase
- Urokinase
- Endonuclease

52. SCP has good prospects for future because it contains all important;

- (a) Nutrients (b) Amino acids
(c) Lipids (d) Fats

53. It is a catabolic process:

- (a) Photosynthesis
(b) Fermentation
(c) Fragmentation
(d) None of these

54. To preserve fruits, vegetables and pickles we add; (Board 2014)

- (a) Water and yogurt
(b) Salt and acid
(c) Flour and salt
(d) Onion and garlic

55. An enzyme produced by genetically modified organisms used to break up blood clots is called;

- (a) Lipase (b) Amylase
(c) Urokinase (d) Peptidase

Answer Key

1	b	2	a	3	d	4	c	5	a	6	b
7	b	8	a	9	a	10	a	11	c	12	a
13	a	14	a	15	a	16	a	17	c	18	b
19	a	20	c	21	d	22	d	23	a	24	c
25	a	26	c	27	b	28	c	29	b	30	b
31	a	32	c	33	b	34	b	35	b	36	c
37	c	38	b	39	a	40	b	41	b	42	c
43	d	44	c	45	c	46	a	47	b	48	a
49	b	50	c	51	d	52	b	53	b	54	b
55	c										

Short Questions

Q.1 How would you define fermentation with reference to biotechnology?

Ans: Fermentation is the process in which there is incomplete oxidation reduction of glucose.

Q.2 Name any two industrial products made by fermentation? Also describe their uses in the industry.

Ans: Two industrial products are:

(i) Formic acid

It is used in textile dyeing, leather treatment, electroplating, rubber manufacture.

(ii) Ethanol

It is used as solvent and used in the production of vinegar and beverages.

Q.3 What are the products of the two types of carbohydrate fermentation?

Ans: In alcoholic fermentation, CO_2 and ethanol are the products. In lactic acid fermentation, lactic acid is the product.

Q.4 Give an example how biotechnology is helping for better environment?

Ans: Bacterial enzymes are used to treat sewage water to purify.

Q.5 In biotechnology, what is meant by genetically modified organism (GMO)? How is it made?

Ans: In biotechnology, recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

Q.6 What is Batch fermentation?

Ans: In this process, the tank of fermenter is filled with the raw materials to be fermented. The temperature and pH for microbial fermentation is properly adjusted and nutritive supplements are added. All the material is steam sterilized. The pure culture of microorganisms is added to fermenter from a separate vessel.

Q.7 Define Biotechnology. (Board 2014)

Ans: It is defined as the use of living organisms in processes for the manufacture of useful products or for services.

Q.8 What is continuous fermentation?

Ans: In this process, the substrate is added to fermenter continuously at a fixed rate. This maintains the micro-organisms in growth phase. Fermentation products are taken continually.

Q.9 Define Fermentation. (Board 2013)

Ans: It is a process in which incomplete oxidation reduction of glucose takes place.

Q.10 What is Fermenter?

Ans: Fermenter is a device that provides optimum environment to microorganisms to grow into a biomass, so that they can interact with a substrate forming the product. Fermentation is carried out in fermenters.

Q.11 What is Genetically modified organism GMO?

Ans: GMO is genetically modified organism. Recombinant DNA is transferred to the target host. In this way the host organism is transformed into genetically modified organism (GMO).

Q.12 What is Recombinant DNA?

Ans: The vector DNA and the attached gene of interest are collectively called recombinant DNA.

Q.13 What is Restriction endonucleases?

Ans: Special enzymes, called restriction endonucleases are used to cut the identified gene from the total DNA of donor organism.

Q.14 What is Single cell protein?

(Board 2013)

Ans: Single cell protein (SCP) refers to the protein content extracted from pure or mixed culture of algae, yeasts, fungi or bacteria.

Q.15 What is Transgenic organism?

Ans: Organism with modified genetic set up is known as transgenic organism.

Q.16 Define vector?

Ans: A vector is a carrier or transmitter which is selected for transfer of the isolated gene of interest to the host cell. The vector may be a plasmid or a bacteriophage.

Q.17 What is Genetic donor?

Ans: The organism from which the gene of interest is taken during the process of genetic engineering is called genetic donor.

Q.18 Define Plasmid.

Ans: The extra chromosomal DNA present in many bacteria is called plasmid.

Q.19 What is Alcoholic fermentation?

Ans: This fermentation is carried out by many types of yeast such as *saccharomyces cerevisiae*. In this process, carbondioxide is removed from pyruvic acid. The product acetaldehyde is then reduced to ethanol. The CO₂ production causes the rise of the bread. It is used to produce bread, beer, wine and distilled spirits.

Q.20 What is Lactic acid fermentation?

Ans: In this process, pyruvic acid is reduced to lactic acid. It is carried out by many bacteria. e.g. *Streptococcus* and many *Lactobacillus* species. It is quite important in dairy industry where it is used for souring milk and also for production of various types of cheese.

Q.21 What is Beta-Endorphin?

Ans: It is a pain killer produced by the brain, has also been produced by genetic engineering techniques.

Q.22 What is thymosin?

Ans: It is a hormone which is effective against brain and lung cancer.

Q.23 What is ligase?

Ans: Ligase is an enzyme which is used to join the DNA.

Q.24 Write any two objectives of genetic engineering?

(Board 2013)

Ans. i. Production of particular RNA and Protein molecules.

ii. Treatment of genetic defects in higher organisms.

Q.25 Define genetic engineering

(Board 2013)

Ans: Genetic engineering or recombinant DNA technology involves the artificial synthesis, modification, removal, addition and repair of the genetic material DNA.

Q.26 Define Dolly

Ans: In Scotland in 1997, an embryologist Ian Wilmut produced a sheep named Dolly from the body cell of an adult sheep.

Q.27 What are interferons?

Ans: Interferons are anti-viral protein produced by cells infected with viruses.

Q.28 What is urokinase?

Ans: Urokinase is an enzyme which is used to dissolve blood clots, has been produced by genetically modified microorganisms.

Q.29 What is Human Genome Project?

Ans: Human Genome Project was launched to map all the genome in human cell. The complete map of human genome was published in 2002.

Q.30 What is meant by single cell protein? How are these produced? (Board 2014)

Ans: Definition:

Single-cell protein (SCP) refers to the protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria.

Production of single Cell Protein

For the production of single cell proteins, the microorganisms utilize a variety of substrates like agricultural wastes, industrial wastes, natural gas like methane etc.

Q.31 What is meant by Recombinant DNA Technology? Give its one benefit. (Board 2014)

Ans: A technology in which a vector is selected for the transfer of the isolated gene of interest to the host cell. The vector may be a plasmid or a bacteriophage. The gene of interest is attached with the vector DNA by using endonuclease and ligase. The vector DNA and the attached gene of interest are collectively called recombinant DNA. This recombinant DNA is transferred to target host and host organism is transformed into a genetically modified organisms (GMO).

Q.32 Name two basic types of Fermentation.

(Board 2014)

- Ans:** 1. Alcoholic fermentation (by yeast)
2. Lactic acid fermentation (by bacteria)