

NEET Important Questions with Solutions from Biotechnology and its Applications

Q.1. The transgenic animals are those which have:

- A) Foreign RNA in all its cells
- B) Foreign DNA in some of its cells
- C) Foreign DNA in all its cells
- D) Both (A) and (C)

Answer: Foreign DNA in all its cells

Solution: Transgenic animals are animals that have a foreign gene intentionally embedded into their genome. Such animals are most generally made by the microinjection of DNA into the pronuclei of a fertilised egg which is then embedded into the oviduct of a pseudo-pregnant surrogate mother. Transgenic animals have foreign DNA in all its cells. The foreign genes are embedded into the genome of animals using recombinant DNA technology or gene manipulation.

Q.2. Crystals of Bt toxin produced by some bacteria do not kill the bacteria themselves because

- A) Bacteria are resistant to the toxin
- B) Toxin is immature
- C) Toxin is inactive
- D) Bacteria enclose the toxin in special sac.

Answer: Toxin is inactive

Solution: *Bacillus thuringiensis* which, during sporulation, produces an intracellular crystalline insecticidal protein called the endotoxins, an inactive precursor. After ingestion by the insect, this protoxin is cleaved by proteases (alkaline conditions in the gut), resulting in a display of the toxic activity, by binding to the insects midgut and damaging the surface epithelium by creating pores that cause swelling and lysis. Hence, the insect is unable to feed and consequently starves to death. This toxin called Bt toxin has been cloned in bacteria and been expressed in plants to provide resistance to insects without the need for insecticides. Examples are Bt cotton, corn, rice, tomato, potato, and soyabean etc.

Q.3. Which of the following is an incorrect statement?

- A) Golden rice is a variety rich in β - carotene.
- B) Bt brinjal was the first genetically modified plant commercially released in India.
- C) Flavr Savr is an example of transgenic tomato.
- D) In RNAi, genes are silenced using dsRNA.

Answer: Bt brinjal was the first genetically modified plant commercially released in India.

Solution: Bt cotton was the first genetically modified plant in India, which produces an insecticide to combat bollworms. The transgenic brinjal is created by inserting a crystalline protein gene (Cry1Ac) from the soil bacterium *Bacillus thuringiensis* into the genome of brinjal. The Government of India has asked the research organisations to stop all field trials and sought to ban Bt brinjal. Many studies revealed that the toxin might cause inflammatory and reproductive disorders with liver damage.

Q.4. Read the following statements regarding ELISA and select the incorrect one.

- A) It is used for the early diagnosis of diseases.



- B) It is based on the principle of antigen-antibody interaction.
- C) Infection by pathogen can be detected by the presence of antigens like proteins and glycoproteins.
- D) None of these

Answer: None of these

Solution: A widely used diagnostic test for AIDS is enzyme-linked immunosorbent assay (ELISA). It is used for the early diagnosis of AIDS and is based on the principle of antigen-antibody interaction. ELISA detects the infection by screening antigens like proteins and glycoproteins present in the RNA genome of retroviruses.

It helps in the recognition of antibodies in our body, antibodies help in the detection of pathogens and also produce antibodies against these pathogens. It is a method of target antigen (or antibody) capture in samples using a specific antibody (or antigen), and of target molecule detection/quantitation using an enzyme reaction with its substrate.

This test can be used to determine if you have antibodies related to certain infectious conditions. An ELISA test may be used to diagnose: HIV, which causes AIDS.

- Q.5. Genetic engineering has been successfully used for producing
- A) Transgenic mice for testing safety of polio vaccine before use in humans.
 - B) Transgenic cow - Rosie which produces high fat milk for making ghee.
 - C) Animals like bulls for farm work as they have super power.
 - D) All of these.

Answer: Transgenic mice for testing safety of polio vaccine before use in humans.

Solution: Transgenic mice are being formed for use in testing the safety of vaccine before they are used on human beings. They are being used to test the security of the polio vaccine. The first transgenic cow, Rosie produced human protein enriched milk (2.4 gms per litre). The milk contained the human alpha- lactalbumin. It is a more adjusted item for human children than natural cow-milk or bovine milk. Bulls with more power are delivered by creature reproducing not by genetic engineering.

- Q.6. The organization which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services is
- A) Genetic Engineering Approval Committee
 - B) Genome Environment Action Committee
 - C) Genetic Environment Approval Committee
 - D) Genetics and Ethical Issue Action Committee.

Answer: Genetic Engineering Approval Committee

Solution: Genetic modification of living beings can have unpredictable results when such organisms are brought into the biological system. Therefore, the Indian Government has set up associations such as GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the legitimacy of GM research and the safety of introducing GM-organisms for public services. India was one of the earliest nation to build up a biosafety system for the regulation of GMOs. It established the Genetic Engineering Approval Committee (GEAC) inside the Ministry of Environment and Forests (MOEF) in 1986. GEAC authorization is required for field trials, cultivation and commercial release of all GM crops.

- Q.7. A technique is used to detect the DNA by _____, after the separation of DNA by Gel electrophoresis.
- A) Polymerase chain reaction
 - B) Gel electrophoresis
 - C) Chromatography



D) Autoradiography

Answer: Autoradiography

Solution: Polymerase chain reaction (PCR) tests are used to detect HIV's genetic material, called RNA. These tests can be used to screen the donated blood flexibly and to recognise early diseases before antibodies have been created.

Chromatography is used in industrial processes to purify chemicals, test for trace amounts of substances, separate chiral compounds and test products for quality control.

Gel electrophoresis is utilised in modern procedures to separate nucleic acid molecules and proteins are also separated by this technique. It could be used for isolation and purification of DNA, RNA and proteins. DNA can be separated from a mixture like any other bio molecule, whereas Autoradiography is the technique through which we can detect the presence of radioactive test by locating the spot formed on the photographic plate. The photographic emulsion plate has silver halides which are reduced to silver due to radiation causing the development of a spot.

Q.8. Which of the following is an incorrect statement?

- A) GM crops are more tolerant to abiotic stresses such as heat, cold, salinity, and drought.
- B) By using herbicide-resistant GM crops, weeds can be eliminated from the field without the use of manual labour.
- C) RNAi has been used to make tobacco plant resistant to *Bacillus thuringiensis*.
- D) A nematode *Meloidogyne incognita* infects the roots of tobacco plants and causes a great reduction in yield.

Answer: RNAi has been used to make tobacco plant resistant to *Bacillus thuringiensis*.

Solution: RNAi is a gene-silencing method which is used to make tobacco plant resistant to *Meloidogyne incognita* that causes root knot disease in tobacco plants. RNAi is a naturally occurring mechanism that leads to the "silencing" of genes. Consequently, the respective protein is no longer synthesized. In nature, this mechanism is used for the regulation of specific genes and is also applied as a defence against viruses.

Q.9. The Adenosine deaminase deficiency results into:

- A) Dysfunction of Immune system
- B) Parkinson's disease
- C) Digestive disorder
- D) Addison's disease

Answer: Dysfunction of Immune system

Solution: Adenosine deaminase enzyme deficiency causes SCID (Severe Combined Immunodeficiency). ADA enzyme is required for the survival of T-lymphocytes. Thus, deficiency of Adenosine deaminase enzyme causes dysfunction of immune system, due to loss of cell-mediated immunity.

The main symptoms of ADA deficiency are pneumonia, chronic diarrhea, and widespread skin rashes. Affected children also grow much more slowly than healthy children and some have developmental delay.

Q.10. The cry gene is obtained from

- A) *Haemophilus influenzae*
- B) *Agrobacterium tumefaciens*
- C) *Bacillus thuringiensis*
- D) *Rhizobium phaseoli*

Answer: *Bacillus thuringiensis*



Solution: Bt toxin gene called the cry gene has been isolated from the bacterium, *Bacillus thuringiensis* and introduced into the cotton and corn plants, where it encodes for a toxin, that protects the crop from insects such as bollworms and corn borers. There are a number of such genes for instance, the proteins encoded by gene cryIAC and cryIIAb controls cotton bollworm and that of cryIAb controls corn borer.

Q.11. What does “Bt” stand for in the popular Bt cotton?

- A) Biotechnology
- B) Best type
- C) *Bacillus thuringiensis*
- D) *Bacillus thermophilus*

Answer: *Bacillus thuringiensis*

Solution: Bt stands for *Bacillus thuringiensis*, a soil bacterium from which the toxin-producing genes cryIAC and cryIIAb are incorporated in cotton plants to control bollworms. The toxin proteins are toxic to some insects when digested, but not to others. The proteins are not toxic to humans because, like all mammals, we cannot activate them.

Q.12. Select incorrect statement w.r.t. RNAi

- A) dsDNA binds target mRNA and initiate RNAi
- B) *Agrobacterium* vector is used to introduce nematode specific gene into host plant
- C) ssRNA binds target mRNA and initiate RNAi
- D) Both (2) & (3)

Answer: dsDNA binds target mRNA and initiate RNAi

Solution: RNA interference is an evolutionarily conserved mechanism of gene regulation that can be induced by double-stranded RNA molecules having the same nucleotide sequence as the sequence of target mRNA. This mechanism is initiated with the degradation and denaturation of dsRNA molecules by a series of steps involving different proteins. Further, the single-stranded RNA molecules bind to the target mRNA and induce its degradation.

For example, a transgenic tobacco plant variety was produced, using RNA interference, to prevent the infection of a nematode. The introduction of the nematode DNA was done in such a way that it resulted in the formation of sense and antisense RNA both of which initiated the naturally occurring phenomenon i.e., RNA interference. It leads to the degradation of the nematode genome.

The nematode specific genes were introduced into the host plant using *Agrobacterium tumefaciens* whose Ti plasmid is disarmed by deleting the genes coding for phytohormones.

Q.13. During the processing of the prohormone proinsulin into the mature insulin,

- A) B-peptide is removed from proinsulin.
- B) C-peptide is added to proinsulin.
- C) C-peptide is removed from proinsulin.
- D) A-peptide is removed.

Answer: C-peptide is removed from proinsulin.

Solution: Human Insulin is a peptide hormone produced by the β -cells of islets of Langerhans of pancreas. This is known for the glucose homeostasis in our body.

Mature insulin consists of two polypeptide chains (51 amino acids): A and B consisting of 21 and 30 amino acids, respectively, which are linked by disulphide bonds. In mammals, insulin is synthesised from **proinsulin, a prohormone**. This pro-hormone needs maturation before insulin is completely active. The inactive form has 110 amino acids with the signal peptide and C peptide. This C-peptide is not present in the mature insulin and is removed during maturation into insulin.



Q.14. Which of the following is a permanent cure for ADA deficiency?

- A) Bone marrow transplantation.
- B) Injecting functional ADA into patients.
- C) Introducing ADA gene isolated from marrow cells into cells at early embryonic stages.
- D) Introducing ADA gene into lymphocytes, which are subsequently returned to the patient.

Answer: Introducing ADA gene isolated from marrow cells into cells at early embryonic stages.

Solution: Adenosine deaminase (ADA) deficiency can lead to severe combined immunodeficiency (SCID). In gene therapy, the cells are extracted from the bone marrow of the patient and cultured. A functional ADA cDNA (using a retroviral vector) is then introduced into these lymphocytes, which are subsequently injected into the patient's bone marrow. The process is repeated as these cells do not remain alive. If the functional gene from bone marrow cells producing ADA is introduced into cells at an early embryonic stage, the cure can be permanent.

Q.15. An example of gene therapy is

- A) production of injectable hepatitis B vaccine
- B) production of vaccines in food crops like potatoes which can be eaten
- C) introduction of gene for adenosine deaminase in persons suffering from Severe Combined Immuno Deficiency (SCID)
- D) production of test tube babies by artifitilized eggs

Answer: introduction of gene for adenosine deaminase in persons suffering from Severe Combined Immuno Deficiency (SCID)

Solution: Gene therapy is a collection of techniques used for correcting defective genes responsible for disease development. It aims to supplement a defective mutant allele with a functional one. The first case of gene therapy was reported in 1990 at NIH. In that case, the patient was suffering from the deficiency of the enzyme adenosine deaminase caused by deletion of the gene for the respective enzyme. Deficiency of enzyme ADA can lead to the disorder called as severe combined immuno deficiency. ADA enzyme is crucial for immune system to function properly. As the patients do not have functional T-lymphocytes, so initially the lymphocytes are extracted from the bone marrow of the patient and are grown in a culture. Then, functional ADA cDNA was introduced into the cultured lymphocytes, using retroviral vector, which are reinfused into the patient's bone marrow. This is not a permanent cure because such genetically engineered lymphocytes are not immortal and a periodic infusion the such lymphocytes is required.

Q.16. Insulin consists of two short polypeptide chains: chain A and chain B, which are linked together by:

- A) Hydrogen bonds
- B) Disulphide bridges
- C) Glycosidic bonds
- D) Both (A) and (B)

Answer: Disulphide bridges

Solution: Insulin is a protein hormone, that contains two polypeptide chains A and B, consisting of 21 and 30 amino acids respectively. These A and B chains are linked together by two disulphide bonds. Chain A has intra disulphide bond and hence the hormone has three disulphide bonds.

Q.17. Select the incorrect statement w.r.t. ELISA.

- A) It is based on the principle of antigen-antibody interactions
- B) Peroxidase is used in ELISA
- C) ELISA detects presence of antibodies synthesized against the pathogen



D) It is used to detect mutations in genes of only suspected cancer patients

Answer: It is used to detect mutations in genes of only suspected cancer patients

Solution: ELISA stands for enzyme-linked immunosorbent assay. It exploits an enzymatic reaction for detecting the immune reaction. It is the technique used for quantitative or qualitative analysis of specific proteins in a sample. In this technique, the enzyme conjugated antibodies are used as the probe molecules to detect the presence of specific proteins (antigens). The enzyme linked with the antibodies reacts with a colourless substrate to generate a coloured reaction product. Such substrates are called as chromogenic substrates. A number of enzymes have been used for ELISA such as alkaline phosphatase, horseradish peroxidase, urease, etc.

Q.18. The vector used for the delivery of cDNA of adenosine deaminase (ADA) into a patient's lymphocyte is

A) *Thermus aquaticus*.

B) Arbovirus.

C) Retrovirus.

D) *Agrobacterium tumefaciens*.

Answer: Retrovirus.

Solution: Replacement of a faulty gene by a normal healthy functional gene is called gene therapy and is of two types: somatic and germline. Adenosine deaminase (ADA) deficiency can lead to severe combined immunodeficiency disease (SCID). Retroviruses are used for delivering cDNA of adenosine deaminase into lymphocytes (somatic cells) of patients.

SCID is a rare genetic condition, an autosomal recessive disorder. The basic characteristic of this disease is that the infants lack the two primary lymphocytes B and T lymphocytes, which form an integral part of the adaptive immune response. Hence, the affected individual will be immunologically compromised, becoming prime targets for numerous life-threatening infections.

Q.19. Which of the following is a disadvantage of using insulin from slaughtered animals such as cattle and pigs in diabetic patients?

A) It may cause allergic reaction.

B) It is expensive.

C) It lowers the immunity against infections.

D) It may cause mutations.

Answer: It may cause allergic reaction.

Solution: Earlier, insulin was used to cure diabetes was extracted from the pancreas of the slaughtered pigs and cattle. This insulin was comparatively slightly different from human insulin and caused some undesirable side effects such as allergy. Genetically engineered insulin is far more efficient.

Humulin is the genetically engineered insulin produced by inserting the human insulin gene into a host cell (*E. coli*), allowing it to grow and reproduce normally. The inserted human DNA leads them to produce a synthetic version of human insulin.

Q.20. The uses of transgenic animals are:

A) To test the safety of vaccines

B) To study human diseases such as cystic fibrosis, haemophilia and rheumatoid arthritis

C) To study the complex factors involved in growth such as insulin-like growth factor

D) All of these

Answer: All of these



Solution: Transgenic animals are organisms whose genetic material has been altered using genetic engineering techniques. These animals are used for testing the safety of vaccines, studying diseases like cystic fibrosis, haemophilia and study of complex factors in growth such as insulin-like growth factor, fibroblast growth factor etc. Transgenic animals are used for the production of therapeutic proteins, organ transplantation etc., and are used to study the process of gene regulation in cells.

Q.21. Select the correct statement among the following:

- A) The diversity of rice in America is one of the richest in the world.
- B) RNA interference involves interference of RNA in synthesis of DNA.
- C) Golden rice developed through transgenic approach has high lysine content than normal rice.
- D) Transgenic food may cause toxicity and allergy in human beings, and the bacteria present in alimentary canal may become resistant to antibiotics by taking up the antibiotic-resistant gene that is present in the GM food.

Answer: Transgenic food may cause toxicity and allergy in human beings, and the bacteria present in alimentary canal may become resistant to antibiotics by taking up the antibiotic-resistant gene that is present in the GM food.

Solution: The diversity of rice in India is one of the richest in the world.

RNA interference (RNAi) takes place in all the eukaryotic organisms as a method of cellular defence. RNAi is a gene-silencing method, where the m-RNA of the parasite is not able to express due to presence of complementary RNA. As a result, there is no protein formation.

Golden rice is a genetically modified crop, which synthesises beta-carotene, a precursor for vitamin A. A variety having high content of lysine is found in bio-fortified maize.

GM food may cause toxicity or produce allergies. The enzyme produced by the antibiotic resistant gene can cause allergies, as it is a foreign protein.

The antibiotic resistant gene present in the GM food can be taken up by the bacteria present in the alimentary canal and thus the bacteria can become resistant to the concerned antibiotic.

Q.22. Select the correct options to fill up the blanks.

- (i) _____ enzyme is crucial for the immune system to function and its absence is caused by the deletion of a gene.
- (ii) Insulin consists of _____ and _____ that are linked together by _____.
- (iii) Transgenic mice are being used to test the safety of the _____.
- (iv) _____ involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

- A) (i) Adenosine deaminase; (ii) A-chain, B-chain, disulphide bridges; (iii) polio vaccine; (iv) RNAi
- B) (i) RNAi; (ii) A-chain, B-chain, disulphide bridges; (iii) adenosine deaminase; (iv) polio vaccine
- C) (i) Adenosine deaminase; (ii) A-chain, B-chain, hydrogen bonds; (iii) polio vaccine; (iv) RNAi
- D) (i) RNAi; (ii) A-chain, B-chain, non-covalent bridges; (iii) polio vaccine; (iv) adenosine deaminase

Answer: (i) Adenosine deaminase; (ii) A-chain, B-chain, disulphide bridges; (iii) polio vaccine; (iv) RNAi

Solution: Adenosine deaminase enzymes are crucial for the immune system to function and their absence is caused by the deletion of a gene. It is cured by gene therapy.

Adenosine deaminase (ADA) deficiency can be treated by bone marrow transplantation, or by enzyme replacement therapy, in which functional ADA is given to the patient by injection.

Insulin is a hormone that regulates the amount of glucose in the blood and is required for the body to function normally. Insulin is a hypoglycemic hormone release from beta- cells of islet of Langerhans and insulin is a peptide in nature it is made of 2-alpha chains and 2-Beta chains.

It consists of chain A and chain B that are linked together by disulfide bridges. Transgenic mice are being used to test the safety of the polio vaccine.

RNAi involves the silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

Q.23. When gene targeting involving gene amplification is attempted in an individual's tissue to treat disease, it is known as:

- A) Biopiracy



- B) Gene therapy
- C) Molecular diagnosis
- D) Safety testing

Answer: Gene therapy

Solution: Recombinant DNA technology, Polymerase Chain Reaction (PCR) or gene amplification, and Enzyme-Linked Immuno-sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis. This is the use of recombinant DNA technology in gene therapy.

Gene therapy is a collection of methods that allows the correction of a gene defect that has been diagnosed in a child/embryo.

Q.24. Read the following statements:

- (i) *Agrobacterium tumefaciens* infects the roots of the tobacco plant.
- (ii) Enzymes present in the saliva of insects convert the inactive form of Bt toxin into an active form.
- (iii) Bt corn has been made resistant to corn borer by introducing the cryIAc gene.
- (iv) Foods derived from transgenic crops are called GM foods.

Which of these statements are correct?

- A) (iv) and (ii)
- B) (iii) and (iv)
- C) (iv) only
- D) (i) only

Answer: (iv) only

Solution: *Meloidogyne incognita* a soil nematode infects the roots of tobacco plants and causes the root-knot disease. This lessens the yield of the plant. These are examples of applied biological techniques.

The toxin produced by *B. thuringiensis* is an inactive form called the protoxin. After the protoxin is ingested by the insect, the inactive toxin gets converted to the active form of toxin due to the alkaline pH of the alimentary canal. Bt corn has been made resistant to corn borer by introducing the cryIAb gene from *Bacillus thuringiensis*.

Plants in which foreign genes have been introduced through genetic engineering techniques are called genetically modified crops.

Q.25. Match Column I with Column II and select the correct option.

	Column I		Column II
A.	<i>Agrobacterium</i>	i)	Humulin
B.	<i>Bacillus thuringiensis</i>	ii)	Biopesticide
C.	<i>Escherichia coli</i>	iii)	Gene therapy
D.	Retroviruses	iv)	RNAi

- A) A–(iii), B– (ii), C– (i), D–(iv)
- B) A–(ii), B–(i), C–(iv), D–(iii)
- C) A–(iv), B–(ii), C–(i), D–(iii)
- D) A–(iv), B–(i), C– (ii), D–(iii)

Answer: A–(iv), B–(ii), C–(i), D–(iii)



Solution: *Agrobacterium*-based vectors are used in the RNA interference technique. To get rid of nematode infection in tobacco plants anti-sense RNA technology is used.

Bacillus thuringiensis (Bt) is a kind of bacteria that produces proteins, which act as toxic to insects. They secrete toxins extracellularly, and it's a crystalline protein that can block the gut of insects on digestion. Therefore, it is widely used as a biological pesticide, and Bt is the most commonly used biological pesticide globally. The application of Bt can happen, either way. It can be sprayed on crops or added to the DNA of genetically modified crops.

Humulin is a genetically engineered insulin that is usually obtained by using recombinant DNA technology. The DNA sequence for A and B chains of human insulin is isolated from the pancreatic cells of humans. It gets inserted in the plasmids of *E. coli*, and subsequent chains were produced as the bacteria multiply. Both A and B chains were grown separately in different units. These chains were extracted by lysing the *E. coli*. They were then combined by introducing the disulphide bonds between them to make human insulin, also called humulin. Hence large and unlimited quantities of insulin were obtained.

The retroviral vectors are used in gene therapy techniques. The ADA gene is transferred from the viral vector to the host through the transfection technique.

[Practice more on Biotechnology and its Applications](#)