

Biotechnology and Its Applications — NEET Biology PYQ (2005-2021)

Class 12 Biology · 49 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. Which of the following is not an application of PCR (Polymerase Chain Reaction) ?

- (A) Molecular diagnosis
- (B) Gene amplification
- (C) Purification of isolated protein
- (D) Detection of gene mutation

NEET 2021

2. When gene targetting 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

NEET 2021

3. With regard to insulin choose correct options.

(a) C-peptide is not present in mature insulin.

(b) The insulin produced by rDNA technology has C-peptide.

(c) The pro-insulin has C-peptide.

(d) A-peptide and B-peptide of insulin are interconnected by disulphide bridges.

Choose the correct answer from the options given below.

- (A) (b) and (d) only
- (B) (b) and (c) only
- (C) (a), (c) and (d) only
- (D) (a) and (d) only

NEET 2021

4. The Adenosine deaminase deficiency results into :

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

NEET 2020 · Q35

5. Which of the following statements is not correct?

- (A) In man insulin is synthesised as a proinsulin.
- (B) The proinsulin has an extra peptide called C-peptide.
- (C) The functional insulin has A and B chains linked together by hydrogen bonds.
- (D) Genetically engineered insulin is produced in E-Coli.

NEET 2020 · Q43

6. Bt cotton variety that was developed by the introduction of toxin gene of *Bacillus thuringiensis* (Bt) is resistant to:

- (A) Insect pests
- (B) Fungal diseases
- (C) Plant nematodes
- (D) Insect predators

NEET 2020 · Q55

7. Match the following columns and select the correct option.

Column - I | Column - II

(a) Bt cotton | (i) Gene therapy

(b) Adenosine deaminase deficiency | (ii) Cellular defence

(c) RNAi | (iii) Detection of HIV infection

(d) PCR | (iv) Bacillus thuringiensis

(A) (a)-iv, (b)-i, (c)-ii, (d)-iii

(B) (a)-iii, (b)-ii, (c)-i, (d)-iv

(C) (a)-ii, (b)-iii, (c)-iv, (d)-i

(D) (a)-i, (b)-ii, (c)-iii, (d)-iv

NEET 2019 · Q152

8. Which of the following is true for Golden rice ?

(A) It is Vitamin A enriched, with a gene from daffodil.

(B) It is pest resistant, with a gene from Bacillus thuringiensis.

(C) It is drought tolerant, developed using Agrobacterium vector.

(D) It has yellow grains, because of a gene introduced from a primitive variety of rice.

NEET 2019 · Q174

9. What triggers activation of protoxin to active Bt toxin of Bacillus thuringiensis in boll worm ?

(A) Body temperature

(B) Moist surface of midgut

(C) Alkaline pH of gut

(D) Acidic pH of stomach

NEET 2018 · Q98

10. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?

(A) λ phage

(B) Ti plasmid

(C) Retrovirus

(D) pBR 322

NEET 2018 · Q99

11. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called

(A) Biodegradation

(B) Biopiracy

(C) Bio-infringement

(D) Bioexploitation

NEET 2018 · Q100

12. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is

(A) Research Committee on Genetic Manipulation (RCGM)

(B) Council for Scientific and Industrial Research (CSIR)

(C) Indian Council of Medical Research (ICMR)

(D) Genetic Engineering Appraisal Committee (GEAC)

NEET 2018 · Q103

13. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to

(A) Lerma Rojo

(B) Sharbati Sonora

(C) Co-667

(D) Basmati

NEET 2017 (Gujarati paper) · Q51

14. Which of the following is not true for callus culture?

- (A) Somaclonal variation is generated
- (B) Parenchyma tissue increases by continuous mitotic divisions
- (C) Meiotic divisions are frequent
- (D) It can be used for micropropagation

NEET 2017 (Gujarati paper) · Q93

15. Which technique helps to identify a bacterial or viral pathogen in a human body even when its concentration is very low and clinical symptoms are not yet visible?

- (A) ELISA
- (B) Total leucocyte count
- (C) PCR
- (D) Differential leucocyte count

NEET 2017 (Gujarati paper) · Q108

16. In gene therapy to treat adenosine deaminase deficiency disorder, which of the patients blood cells are used?

- (A) Erythrocytes
- (B) Lymphocytes
- (C) Both Erythrocytes and Lymphocytes
- (D) Thrombocytes

NEET 2017 (Gujarati paper) · Q131

17. What is the meaning of Bt in Bt cotton?

- (A) Baculovirus treated cotton seeds against pink boll-worm.
- (B) Bigger thread of disease resistant cotton with better tensile strength.
- (C) Cotton produced by Biotechnology using restriction Enzyme and Ligases to resist microbial infection.
- (D) Cotton seeds carrying an endotoxin gene from *Bacillus thuringiensis* against pink boll-worm

NEET 2016 Phase 2 · Q129

18. Which kind of therapy was given in 1990 to a four-year-old girl with adenosine deaminase (ADA) deficiency?

- (A) Gene therapy
- (B) Chemotherapy
- (C) Immunotherapy
- (D) Radiation therapy

NEET 2016 Phase 1 · Q134

19. Which part of the tobacco plant is infected by *Meloidogyne incognita*?

- (A) Flower
- (B) Leaf
- (C) Stem
- (D) Root

AIPMT 2015

20. The crops engineered for glyphosate are resistant/tolerant to:

- (A) Herbicides
- (B) Fungi
- (C) Bacteria
- (D) Insects

AIPMT 2015

21. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to:

- (A) presence of conversion factors in insect gut
- (B) alkaline pH of the insect gut
- (C) acidic pH of the insect gut
- (D) action of gut micro-organisms

AIPMT 2015

22. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services?

- (A) Research Committee on Genetic Manipulation
- (B) Bio - safety committee
- (C) Indian Council of Agricultural Research
- (D) Genetic Engineering Approval Committee

AIPMT 2014

23. The first human hormone produced by recombinant DNA technology is:

- (A) Estrogen
- (B) Thyroxin
- (C) Progesterone
- (D) Insulin

NEET 2013

24. Which of the following Bt crops is being grown in India by the farmers?

- (A) Maize
- (B) Cotton
- (C) Brinjal
- (D) Soybean

AIPMT 2012 Mains

25. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produced (in the host cells)

- (A) both sense and anti-sense RNA
- (B) a particular hormone
- (C) an antifeedant
- (D) a toxic protein

AIPMT 2012 Mains

26. The first clinical gene therapy was given for treating

- (A) Diabetes mellitus
- (B) Chicken pox
- (C) Rheumatoid arthritis
- (D) Adenosine deaminase deficiency

AIPMT 2012 Prelims

27. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin 'A' deficiency?

- (A) Bt-Brinjal
- (B) 'Flavr Savr' tomato
- (C) Canola
- (D) Golden rice

AIPMT 2011 Mains

28. Read the following four statements (A-D) about certain mistakes in two of them:

(A) The first transgenic buffalo Rosie produced milk which was human alpha-lactalbumin enriched

(B) Restriction enzymes are used in isolation of DNA from other macro-molecules

(C) Downstream processing is one of the steps of R-DNA technology

(D) Disarmed pathogen vectors are also used in transfer of R-DNA into the host

Which are the two statements having mistakes?

- (A) Statements (A) and (C)
- (B) Statements (A) and (B)
- (C) Statements (B) and (C)
- (D) Statements (C) and (D)

AIPMT 2011 Mains

29. Silencing of mRNA has been used in producing transgenic plants resistant to

- (A) White rusts
- (B) Bacterial blights
- (C) Bollworms
- (D) Nematodes

AIPMT 2011 Mains

30. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein.

This protein:

- (A) Is activated by acid pH of the foregut of the insect pest
- (B) Does not kill the carrier bacterium which is itself resistant to this toxin
- (C) Binds with epithelial cells of midgut of the insect pest ultimately killing it
- (D) Is coded by several genes including the gene cry

AIPMT 2011 Prelims

31. Maximum number of existing transgenic animals is of

- (A) Pig
- (B) Fish
- (C) Mice
- (D) Cow

AIPMT 2011 Prelims

32. The process of RNA interference has been used in the development of plants resistant to

- (A) Insects
- (B) Nematodes
- (C) Fungi
- (D) Viruses

AIPMT 2010 Mains · Q16

33. Which one of the following is now being commercially produced by biotechnological procedures?

- (A) Nicotine
- (B) Morphine
- (C) Quinine
- (D) Insulin

AIPMT 2010 Prelims · Q193

34. DNA or RNA segment tagged with a radioactive molecule is called

- (A) Plasmid
- (B) Vector
- (C) Probe
- (D) Clone

AIPMT 2010 Prelims · Q195

35. The genetically-modified (GM) brinjal in India has been developed for

- (A) Drought-resistance
- (B) Insect-resistance
- (C) Enhancing shelf life
- (D) Enhancing mineral content

AIPMT 2010 Prelims · Q196

36. Genetic engineering has been successfully used for producing

- (A) Animals like bulls for farm work as they have super power
- (B) Transgenic mice for testing safety of polio vaccine before use in humans
- (C) Transgenic models for studying new treatments for certain cardiac diseases
- (D) Transgenic Cow-Rosie which produces high fat milk for making ghee

AIPMT 2010 Prelims · Q198

37. Some of the characteristics of Bt cotton are

- (A) High yield and resistance to bollworms
- (B) Long fibre and resistance to aphids
- (C) Medium yield, long fibre and resistance to beetle pests
- (D) High yield and production of toxic protein crystals which kill dipteran pests

AIPMT 2010 Prelims · Q199

38. An improved variety of transgenic basmati rice

- (A) Give high yield but has no characteristic aroma
- (B) Does not require chemical fertilizers and growth hormones
- (C) Gives high yield and is rich in vitamin A
- (D) Is completely resistant to all insect pests and diseases of paddy

AIPMT 2009 Prelims · Q62

39. What is true about Bt toxin?

- (A) Bt protein exists as active toxin in the Bacillus.
- (B) The activated toxin enters the ovaries of the pest to sterilise it and thus prevent its multiplication.
- (C) The concerned Bacillus has antitoxins.
- (D) The inactive protoxin gets converted into active form in the insect gut.

AIPMT 2009 Prelims · Q75

40. The genetic defect - adenosine deaminase (ADA) deficiency may be cured permanently by:

- (A) administering adenosine deaminase activators.
- (B) introducing bone marrow cells producing ADA into cells at early embryonic stages.
- (C) enzyme replacement therapy.
- (D) periodic infusion of genetically engineered lymphocytes having functional ADA cDNA.

AIPMT 2009 Prelims · Q136

41. Transgenic plants are the ones:

- (A) generated by introducing foreign DNA into a cell and regenerating a plant from that cell.
- (B) produced after protoplast fusion in artificial medium.
- (C) grown in artificial medium after hybridization in the field.
- (D) produced by a somatic embryo in artificial medium.

AIPMT 2008 Prelims · Q180

42. A transgenic food crop which may help in solving the problem of night blindness in developing countries is

- (A) Golden rice
- (B) Flavr Savr tomatoes
- (C) Starlink maize
- (D) Bt Soybean

AIPMT 2008 Prelims · Q191

43. Cry 1 endotoxins obtained from Bacillus thuringiensis are effective against

- (A) Boll worms
- (B) Mosquitoes
- (C) Flies
- (D) Nematodes

AIPMT 2008 Prelims · Q195

44. Main objective of production/use of herbicide resistant GM crops is to

- (A) Reduce herbicide accumulation in food articles for health safety
- (B) Eliminate weeds from the field without the use of manual labour
- (C) Eliminate weeds from the field without the use of herbicides
- (D) Encourage eco-friendly herbicides

45. Human insulin is being commercially produced from a transgenic species of

- (A) Saccharomyces
- (B) Escherichia
- (C) Mycobacterium
- (D) Rhizobium

46. What is antisense technology?

- (A) RNA polymerase producing DNA
- (B) A cell displaying a foreign antigen used for synthesis of antigens
- (C) Production of somaclonal variants in tissue cultures
- (D) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene

47. Golden rice is a promising transgenic crop. When released for cultivation, it will help in :

- (A) alleviation of vitamin-A deficiency
- (B) pest resistance
- (C) herbicide tolerance
- (D) producing a petrol-like fuel from rice

48. Bacillus thuringiensis (Bt) strains have been used for designing novel :

- (A) bio-metallurgical technique
- (B) bio-mineralization processes
- (C) bio-insecticidal plants
- (D) bio-fertilizers

49. Golden rice is a transgenic crop of the future with the following improved trait :

- (A) high lysine (essential amino acid) content
- (B) insect resistance
- (C) high protein content
- (D) high vitamin A content

Answer key and explanations

1. Answer: (C) Purification of isolated protein

PCR amplifies nucleic acid sequences, which is used in molecular diagnosis, gene amplification and detecting gene mutations. It does not act on proteins, so it cannot purify an isolated protein.

2. Answer: (B) Gene therapy

Introducing or targeting genes in a person's cells or tissues to correct a genetic defect and treat disease is gene therapy. Molecular diagnosis only detects a disease, and biopiracy is the unauthorised use of bio-resources.

3. Answer: (C) (a), (c) and (d) only

Pro-insulin carries an extra C-peptide that is removed to give mature insulin, whose A and B chains are joined by disulphide bridges. Eli Lilly's rDNA insulin was made by producing the A and B chains separately and joining them, so it has no C-peptide; hence (a), (c) and (d).

4. Answer: (A) Dysfunction of Immune system

Adenosine deaminase is needed for the immune system to work, and its deficiency causes severe combined immunodeficiency; it was the first disease treated by gene therapy. Parkinson's and Addison's diseases have no link with this enzyme.

5. Answer: (C) The functional insulin has A and B chains linked together by hydrogen bonds.

In mature insulin the A and B polypeptide chains are joined by disulphide bridges, not by hydrogen bonds. Insulin is indeed made as proinsulin with an extra C-peptide that is removed, and Eli Lilly made human insulin chains in E. coli in 1983.

6. Answer: (A) Insect pests

The cry genes of *Bacillus thuringiensis* code for crystal proteins that kill insect larvae such as cotton bollworms, so Bt cotton resists insect pests. It gives no protection against fungi, and nematode resistance is made by RNA interference, not by Bt toxin.

7. Answer: (A) (a)-iv, (b)-i, (c)-ii, (d)-iii

Bt cotton carries genes from *Bacillus thuringiensis*, ADA deficiency was the first disease treated by gene therapy, RNA interference is a natural cellular defence against viruses and is used against nematodes, and PCR detects HIV in suspected AIDS patients. Hence *Bacillus thuringiensis*, gene therapy, cellular defence, HIV detection is correct.

8. Answer: (A) It is Vitamin A enriched, with a gene from daffodil.

Golden rice is a transgenic rice enriched in β -carotene, the precursor of vitamin A; the original version carried a phytoene synthase gene from daffodil. Pest resistance with a Bt gene describes Bt crops, not golden rice.

9. Answer: (C) Alkaline pH of gut

The inactive Bt protoxin crystals are solubilised and activated by the alkaline pH of the insect gut, after which the toxin binds midgut cells and creates pores. An acidic pH does not activate it, which is why it is harmless in the acidic human stomach.

10. Answer: (C) Retrovirus

In gene therapy (for example ADA deficiency), a functional gene is put into a patient's lymphocytes using a disarmed retroviral vector, because retroviruses integrate their DNA into the host genome. λ phage and pBR322 are vectors for bacteria and the Ti plasmid is used for plants.

11. Answer: (B) Biopiracy

Biopiracy is the use of a country's bioresources and traditional knowledge by multinational companies without proper authorisation or compensation to the country and its people. Biodegradation is breakdown of matter by microbes, and the other two terms are not the standard name for this practice.

12. Answer: (D) Genetic Engineering Appraisal Committee (GEAC)

The Indian Government set up GEAC to decide on the validity of GM research and the safety of introducing GM organisms for public services. RCGM oversees research-level work, while CSIR and ICMR are general research councils.

13. Answer: (D) Basmati

In 1997 an American company obtained a patent on a Basmati-derived rice, although Basmati varieties have been grown in India for centuries; NCERT cites it as an example of biopiracy. Lerma Rojo and Sharbati Sonora are wheat varieties and Co-667 is a sugarcane variety.

14. Answer: (C) Meiotic divisions are frequent

Callus is an undifferentiated mass of parenchyma that grows only by repeated mitosis; meiosis does not occur in callus culture. Somaclonal variation does arise in callus and callus can be used to regenerate many plantlets, so those statements are true.

15. Answer: (C) PCR

PCR amplifies the pathogen's nucleic acid many times, so a bacterium or virus can be detected at very low concentration, before symptoms appear. ELISA detects antigens or antibodies and needs a larger pathogen load or an immune response, and leucocyte counts are not pathogen-specific.

16. Answer: (B) Lymphocytes

In the first gene therapy (1990) for ADA deficiency, lymphocytes from the patient's blood were grown in culture, given a functional ADA cDNA using a retroviral vector, and returned to the patient. Erythrocytes lack a nucleus, so they cannot carry and express the introduced gene.

17. Answer: (D) Cotton seeds carrying an endotoxin gene from *Bacillus thuringiensis* against pink boll-worm

Bt stands for *Bacillus thuringiensis*; Bt cotton carries its cry gene coding for an insecticidal protein toxin that kills bollworms. Baculoviruses are separate biocontrol agents, and Bt cotton gives insect resistance rather than resistance to microbial infection.

18. Answer: (A) Gene therapy

In 1990 the first clinical gene therapy was given to a four-year-old girl with ADA deficiency: her lymphocytes were given a working ADA gene with a retroviral vector and returned to her body. Chemotherapy, immunotherapy and radiation therapy do not replace a missing gene.

19. Answer: (D) Root

Meloidogyne incognita is a root-knot nematode that infects tobacco roots and reduces yield; RNA interference was used to make nematode-resistant tobacco. It does not attack flowers, leaves or stems.

20. Answer: (A) Herbicides

Glyphosate is a broad-spectrum herbicide, and glyphosate-tolerant (e.g. Roundup Ready) crops survive spraying that kills weeds. Insect resistance is a different trait, given by Bt genes.

21. Answer: (B) alkaline pH of the insect gut

Bt toxin is made as an inactive protoxin crystal. The alkaline pH of the insect gut dissolves the crystal and activates the toxin, which then binds the midgut cells and makes pores. An acidic gut would not activate it.

22. Answer: (D) Genetic Engineering Approval Committee

The Genetic Engineering Approval Committee (GEAC) is the Indian body that decides on the validity of GM research and the safety of releasing GM organisms for public use. The Review Committee on Genetic Manipulation and institutional bio-safety committees handle research-level oversight only.

23. Answer: (D) Insulin

Human insulin (Humulin, by Eli Lilly in 1983) was the first human hormone produced through recombinant DNA technology, by making the A and B chains separately in *E. coli*. Estrogen, progesterone and thyroxine are not proteins and were not made this way.

24. Answer: (B) Cotton

Bt cotton, carrying cry genes from *Bacillus thuringiensis*, is the Bt crop approved and grown by Indian farmers. Bt brinjal was developed but its commercial release was put under moratorium.

25. Answer: (A) both sense and anti-sense RNA

Nematode-resistant tobacco uses RNA interference. The introduced DNA makes both sense and antisense RNA, which pair into double-stranded RNA that silences the nematode's mRNA, so no toxin or hormone is involved.

26. Answer: (D) Adenosine deaminase deficiency

The first clinical gene therapy (1990) was given to a four-year-old girl with adenosine deaminase (ADA) deficiency, putting a functional ADA cDNA into her lymphocytes. Diabetes is treated with recombinant insulin, which is not gene therapy.

27. Answer: (D) Golden rice

Golden rice is genetically engineered to make β -carotene (provitamin A), so eating it helps prevent the night blindness caused by vitamin A deficiency. Bt-brinjal is pest resistant and Flavr Savr tomato has delayed ripening.

28. Answer: (B) Statements (A) and (B)

Rosie was a transgenic cow, not a buffalo, and restriction enzymes cut DNA at specific sites; isolation of DNA from other macromolecules uses enzymes such as lysozyme, cellulase, ribonuclease and protease. Downstream processing is a recognised step of recombinant DNA technology and disarmed pathogens are used as vectors, so those two statements are correct.

29. Answer: (D) Nematodes

RNA interference, in which double-stranded RNA silences the parasite's mRNA, was used to make tobacco plants resistant to the nematode *Meloidogyne incognita*. Bollworm resistance comes from cry genes (Bt toxin), not mRNA silencing.

30. Answer: (C) Binds with epithelial cells of midgut of the insect pest ultimately killing it

Bt protoxin is activated by the alkaline pH of the insect's gut; the active toxin binds to midgut epithelial cells, makes pores and kills the insect. The bacterium is not harmed because it keeps the toxin as an inactive protoxin, not because it is resistant, and acid pH does not activate it.

31. Answer: (C) Mice

Although transgenic rats, rabbits, pigs, sheep, cows and fish have been produced, more than 95 percent of all existing transgenic animals are mice.

32. Answer: (B) Nematodes

Using *Agrobacterium* vectors, nematode-specific genes were introduced into tobacco so that the plant makes dsRNA that silences a vital mRNA of the nematode *Meloidogyne incognita*. The parasite then cannot survive in the transgenic host, giving nematode-resistant plants.

33. Answer: (D) Insulin

Human insulin is now made by recombinant DNA technology: Eli Lilly produced the A and B chains separately in *E. coli* and then joined them. Nicotine, morphine and quinine are plant alkaloids still obtained mainly from plants.

34. Answer: (C) Probe

A probe is a single-stranded DNA or RNA labelled with a radioactive marker. It finds its complementary sequence by hybridisation, as in DNA fingerprinting and molecular diagnosis. A plasmid or vector carries genes but is not labelled.

35. Answer: (B) Insect-resistance

Bt brinjal carries a *Bacillus thuringiensis* cry gene whose toxin protects the crop against the fruit and shoot borer, making it insect-resistant. Delayed ripening (longer shelf life) was the trait of the Flavr Savr tomato, not brinjal.

36. Answer: (B) Transgenic mice for testing safety of polio vaccine before use in humans

NCERT states that transgenic mice are used to test the safety of vaccines, specifically polio vaccine, before they are used in humans. Rosie's milk was enriched with human alpha-lactalbumin protein, not fat. The disease models NCERT lists are cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's, not cardiac disease.

37. Answer: (A) High yield and resistance to bollworms

Bt cotton expresses the cryI_{Ac} and cryII_{Ab} genes, whose toxins control cotton bollworms (lepidopteran larvae), cutting pest losses and raising yield. The cry genes in Bt cotton act on bollworms, not on dipterans such as flies and mosquitoes, aphids or beetles.

38. Answer: (C) Gives high yield and is rich in vitamin A

Transgenic rice has been engineered with genes for β -carotene (the vitamin A precursor), known as Golden Rice, so 'rich in vitamin A' is the intended answer. No crop is completely resistant to all pests, none can do without fertilisers, and losing the aroma would not count as an improvement.

39. Answer: (D) The inactive protoxin gets converted into active form in the insect gut.

Bacillus thuringiensis makes Bt toxin as an inactive protoxin crystal; the alkaline pH of the insect gut solubilises and activates it, and it binds the midgut epithelium, creating pores that kill the insect. It is not active inside the bacterium, which is why the bacterium is unharmed, and it does not act on the ovaries.

40. Answer: (B) introducing bone marrow cells producing ADA into cells at early embryonic stages.

NCERT notes that if the gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure. Infusing engineered lymphocytes is not permanent because lymphocytes are not immortal and the infusion must be repeated; enzyme replacement is also only a treatment.

41. Answer: (A) generated by introducing foreign DNA into a cell and regenerating a plant from that cell.

Transgenic (GM) plants carry a foreign gene that was introduced into a cell, from which a whole plant is regenerated. Protoplast fusion produces somatic hybrids, not transgenic plants.

42. Answer: (A) Golden rice

Golden rice is engineered to make β -carotene, the precursor of vitamin A, whose deficiency causes night blindness. Flavr Savr tomato was modified for delayed ripening and Bt crops for insect resistance, neither of which targets vitamin A.

43. Answer: (A) Boll worms

NCERT notes that the proteins coded by cryI_{Ac} and cryII_{Ab} control cotton bollworms, and cryI_{Ab} controls the corn borer. Nematodes are controlled by RNA interference in the NCERT example, not by Cry toxins.

44. Answer: (B) Eliminate weeds from the field without the use of manual labour

Herbicide-tolerant crops survive a broad-spectrum herbicide that kills the weeds around them, so fields can be weeded chemically instead of by manual labour. Herbicides are still sprayed, so 'without the use of herbicides' is wrong.

45. Answer: (B) Escherichia

Eli Lilly produced human insulin (1983) by inserting DNA for the A and B chains into plasmids of *E. coli* and then joining the chains. *Saccharomyces* has also been used, but the standard NCERT answer is *Escherichia coli*.

46. Answer: (D) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene

Antisense technology uses an RNA (or DNA) strand complementary to a target mRNA. It pairs with the mRNA and blocks its translation, silencing the gene, the same principle as RNA interference in NCERT. Making DNA from RNA is reverse transcription, not antisense technology.

47. Answer: (A) alleviation of vitamin-A deficiency

Golden rice is genetically engineered to make beta-carotene (provitamin A) in the grain, so it is meant to reduce vitamin A deficiency. Pest resistance is the trait of Bt crops, not golden rice.

48. Answer: (C) bio-insecticidal plants

Bt makes Cry protein toxins that kill specific insect larvae. Transferring cry genes into crops (Bt cotton, Bt brinjal) produces insect-resistant transgenic plants. Bt is not a biofertiliser and plays no part in metal extraction.

49. Answer: (D) high vitamin A content

Golden rice is engineered to make β -carotene (provitamin A) in its grain, which gives it a golden colour and helps fight vitamin A deficiency. Insect resistance is the trait of Bt crops, and high lysine is the trait of quality-protein maize.

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