# Chapter 8

# Biotechnology and its Applications

## Solutions

### SECTION - A

**Objective Type Questions**

**(Biotechnological Applications in Agriculture)**

1. Hirudin can be extracted from transgenic plant
   (1) *Brassica napus*
   (2) *Bacillus napus*
   (3) Bt brinjal
   (4) *Bt Brassica napus*

**Sol.** Answer (1)

Synthetic hirudin gene $\rightarrow$ Introduced into *Brassica napus* $\rightarrow$ seeds containing hirudin $\rightarrow$ Isolation and purification $\rightarrow$ Purified hirudin

2. Select **incorrect** statement w.r.t. RNAi
   (1) dsDNA binds target mRNA and initiate RNAi
   (2) *Agrobacterium* vector is used to introduce nematode specific gene into host plant
   (3) ssRNA binds target mRNA and initiate RNAi
   (4) Both (2) & (3)

**Sol.** Answer (1)

dsRNA binds target mRNA and initiates RNAi.

3. Nobel prize was given to Andrew Fire and Craig Mello for their work on RNAi on
   (1) *Meloidogyne incognita*
   (2) *Caenorhabditis elegans*
   (3) *Bacillus thuringiensis*
   (4) *Brassica napus*

**Sol.** Answer (2)

4. Infestation by tobacco budworm and armyworm is prevented by Bt toxin. These insects belong to order
   (1) Coleoptera (2) Lepidoptera (3) Diptera (4) Hymenoptera

**Sol.** Answer (2)

Beetles belong to coleoptera which is the largest order in class insecta.

5. Select the incorrect match

(1) *cry I Ab* - Corn borer

(2) Bt toxin - Beetles

(3) *cry I Ac* - Cotton Bollworm

(4) *cryIIAc* - Cotton Bollworm

**Sol.** Answer (4)

*Cry* I Ac and *Cry* II AB are used to control cotton bollworm.

6. Which of the following is **not** an application of genetic engineering in plants?

(1) Nitrogen fixation (2) DNA vaccines

(3) Resistance to glyphosate (4) Production of insecticidal proteins in plants

**Sol.** Answer (2)

DNA vaccines are genetic vaccines that use the genetic material of the pathogen itself to immunize the individual. DNA vaccines induce both humoral and cell-mediated immunity.

7. All the following statements are correct for Bt toxin but one is wrong. Which one is **wrong**?

(1) Bt toxin is produced by bacteria called *Bacillus thuringiensis*

(2) Bt toxin are protein toxins like thurioside and sporeine which are active against different group of insects

(3) Bt toxin is harmful for man

(4) Upon ingestion by susceptible insects the Bt protoxin is converted into active form and kills the insects

**Sol.** Answer (3)

Bt toxin is not harmful for man.

Bt toxins are insect group specific.

8. 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 in the field without the use of herbicides

(C) – Eliminate weeds from the field without the use of manual labour.

(D) – Soil pollution and biomagnification caused by herbicides.

Which of the following statements are correct?

(1) (A) only (2) (B) only (3) (A), (B), (C) & (D) (4) (C) only

**Sol.** Answer (4)

Herbicides show no effect on food articles for health safety.

Herbicides are required sometime.

Herbicides has no relation with/or no effect with biomagnification.

9. In “flavr savr” tomato, expression of a native tomato gene has been blocked to

(1) Prevent degradation of cellulose in cell wall

(2) Cause degradation of cellulose in cell wall

(3) Prevent degradation of pectin in cell wall

(4) Cause degradation of pectin in cell wall

**Sol.** Answer (3)

Expression of polygalacturonase delays ripening of tomato.

10. Transgenic *Brassica napus* has been used for synthesis of

(1) Hirudin (2) Heparin

(3) Polygalacturonase (4) Cry protein

**Sol.** Answer (1)

Hirudin is an anticoagulant.

**(Biotechnological Applications in Medicine)**

11. Which of the following is **correct** statement w.r.t. animal insulin?

(1) It is just as effective as human insulin over prolonged time

(2) It does not elicit immune response ever

(3) It can be orally administrated to diabetic people

(4) It was extracted from pancreas of slaughtered cattle and pigs

**Sol.** Answer (4)

The correct statements are:

(1) It is not as effective as human insulin.

(2) It can elicit immune response as it sometimes cause allergy.

(3) Insulin cannot be orally administered to diabetic patient because it degrades in alimentary canal.

12. Injecting functional adenosine deaminase into a patients (lacking ADA gene) blood cells may be considered as

(1) Gene therapy

(2) Enzyme replacement therapy

(3) Both (1) & (2)

(4) Genetic engineering

**Sol.** Answer (2)

In ERT, patient is given an intravenous injection of ADA or enzyme lacking in the content.

ADA deficient children are wide open to the attacks of viruses and bacteria.

13. The main challenge for production of insulin using rDNA techniques was getting insulin into mature form using _____ bond

(1) Hydrogen (2) Peptide

(3) Ionic (4) Disulphide

**Sol.** Answer (4)

Two interchain disulphide bonds exist between chain A and chain B in mature insulin.

14. Technique used to detect HIV in suspected AIDS patient in asymptomatic stage is

(1) PCR (2) Serum analysis

(3) Both (1) & (2) (4) Urine analysis

**Sol.** Answer (1)

**PCR:** It helps to detect very low conc. of bacteria or virus at the time when the symptoms of the disease are not visible, by amplification of their nucleic acid.

15. The vector used for delivery of ADA cDNA into cells of a patient receiving gene therapy is

(1) *Agrobacterium* (2) *Reovirus* (3) *E.coli* (4) Retrovirus

**Sol.** Answer (4)

Retrovirus insert the gene of interest into chromosomal DNA.

16. A doctor while operating on HIV positive patient accidently cuts himself with a scalpel. In order to confirm whether he has contracted the virus which of the following tests should be performed?

(1) Serum analysis (2) Urine analysis (3) Blood analysis (4) PCR

**Sol.** Answer (4)

**PCR:** It helps to detect very low concentration of bacteria or virus at the time when the symptoms of the disease are not visible by amplification of their nucleic acid.

17. Disadvantage of using porcine insulin in diabetic patients is

(1) That it may lead to hypercalcemia (2) It may cause allergic reactions

(3) It is expensive (4) It can lead to mutations in adult

**Sol.** Answer (2)

Porcine insulin is animal (pig) insulin.

18. Enzyme used in ELISA test is

(1) Endonuclease (2) Ligase (3) Peroxidase (4) Polymerase

**Sol.** Answer (3)

**Peroxidase:** It converts colourless substrate into coloured product which indicates the presence of antigens.

19. A probe is used in which stage of genetic engineering?

(1) Cleaving DNA (2) Recombining DNA (3) Cloning (4) Screening

**Sol.** Answer (4)

Molecular probes are labelled DNA segments, RNA segments or antibodies. They are used to detect the disorder through presence of complementary structure in defective gene, pathogen, their antigens or antibodies produced against them.

20. Which of the following genetically engineered microbe is used in scavening of oil spills by digesting hydrocarbons of crude oil?

(1) *Pseudomonas fluorescence* (2) *Rhizobium meliloti*

(3) *Pseudomonas putida* (4) *Trichoderma*

**Sol.** Answer (3)

*Pseudomonas putida* is called super bug.

21. An example of gene therapy is

(1) Production of antibodies and vaccines in transgenic plants like banana and tomato

(2) Delay in flower senescence and fruit ripening in Flavr Savr transgenic tomatoes which have longer shelf life

(3) Introduction of the gene for the synthesis of ADA (adenosine deaminase) into a person suffering with SCID

(4) Transfer of nitrogen fixing genes (‘nif’ genes) into plants that are unable to fix atmospheric nitrogen, example cereals

**Sol.** Answer (3)

Option (1) is an example of edible vaccines.

Option (2) Is an example of antisense RNA.

Option (3) Is an example of genetic engineering.

22. Eli Lilly an American company is famous for

(1) Producing GH (growth hormone) synthesised by recombinant DNA technology

(2) Preparing two DNA sequences corresponding to A and B chains of human insulin and introduced them in the plasmids of *E. coli* to produce insulin chains

(3) Producing pest resistant plants, by RNA interference

(4) Producing vitamin 'A' enriched rice

**Sol.** Answer (2)

23. What could be the possible harm of using antibiotic resistant gene as a selectable marker in plasmid, used for gene transfer in production of GM food?

(A) GM food contains the enzyme produced by the antibiotic resistance gene that was used during gene tranfer in genetic engineering. This could cause allergies since it is a foreign protein.

(B) The bacteria present in the alimentary canal of the humans could take up the antibiotic resistance gene present in GM food.

(C) The bacteria in the human alimentary canal would then become resistant to the concerned antibiotic.

(D) The transgene may be transferred through pollen to their wild relatives and make weeds more persistant and damaging.

(1) (A) only

(2) Both (B) & (C)

(3) (A), (B) & (C)

(4) (A), (B), (C) & (D)

**Sol.** Answer (3)

(**Transgenic Animals)**

24. What is the difference between the two mice as shown as in the figure?


(1) One is normal in size, the other is twice as big supermouse because of good diet

(2) The bigger 'Supermouse' is transgenic. It is larger because of expression of the gene for human growth hormone factor that has been introduced

(3) The smaller one is a dwarf

(4) Transgenic mice are an example of gene therapy

**Sol.** Answer (2)

**(Ethical Issues)**

25. The use of bioresources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment is called

(1) Bioethics (2) Biopiracy

(3) Bioterror (4) Bioweapon

**Sol.** Answer (2)

**Bioterror:** Terrorism involving the intentional release of biological agents (bacteria, viruses) may be in a naturally occurring or human modified form.

**Bioethics:** Ethics of medical and biological research.

26. Even through the highest number of varieties of this rice are found in India. Which variety of rice was patented by U.S. company?

(1) Sharbati sonara (2) Co-667

(3) Basmati (4) Lerma Roja

**Sol.** Answer (3)

27 documented varieties of Basmati are grown in India.

27. Which ingredient was present in higher concentrations in GM rice as compared to the usual rice?

(1) Protein (2) Carbohydrate (starch) (3) β-carotene (4) $Na^+$

**Sol.** Answer (3)

β-Carotene makes golden rice a source of vitamin A.

## SECTION - B

**Previous Years Questions**

1. In RNAi, the genes are silenced using **[NEET-2019 (Odisha)]**

(1) ds - DNA (2) ds - RNA

(3) ss - DNA (4) ss - RNA

**Sol.** Answer (2)

RNAi involves silencing of a specific mRNA and therefore the expression of a gene by formation of a dsRNA molecule. The dsRNA which is formed by binding of a complementary RNA (anti-sense RNA) molecule to original mRNA thereby preventing translation of the original mRNA.

2. Exploitation of bioresources of a nation by multinational companies without authorization from the concerned country is referred to as **[NEET-2019 (Odisha)]**

(1) Biowar (2) Bioweapon

(3) Biopiracy (4) Bioethics

**Sol.** Answer (3)

Biopiracy is the term used to refer to the use of bio-resources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment.

Biowar/warfare in which disease-producing microorganism, toxins, or organic biocides *e.g.* Bacillus anthracis or *Yersinia pestis* used to destroy, injure or immobilize livestock, vegetation, or human life.

Biological warfare/Germ warfare/Bioweapon → use of biological toxins or infectious agents such as bacteria, viruses and fungi with the intent to kill human, animal or plant.

Bioethics is the study of the ethical issues emerging from advances in biology and medicine.

3. Which of the following is **true** for Golden rice? **[NEET-2019]**

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

(2) It is pest resistant, with a gene from *Bacillus thuringiensis*

(3) It is drought tolerant, developed using *Agrobacterium* vector

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

**Sol.** Answer (1)

Golden rice is vitamin A enriched rice, with a gene from daffodil and is rich in carotene.

4. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology? **[NEET-2019]**

(1) Genetic code is not ambiguous (2) Genetic code is redundant

(3) Genetic code is nearly universal (4) Genetic code is specific

**Sol.** Answer (3)

In recombinant DNA technology bacteria is able to produce human insulin because genetic code is nearly universal.

5. What triggers activation of protoxin to active Bt toxin of *Bacillus thuringiensis* in boll worm? **[NEET-2019]**

(1) Body temperature (2) Moist surface of midgut (3) Alkaline pH of gut (4) Acidic pH of stomach

**Sol.** Answer (3)

*Bacillus thuringiensis* forms protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein. These protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to alkaline pH of the gut which solubilize the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of insect.

6. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes? **[NEET-2018]**

(1) Retrovirus (2) Ti plasmid (3) pBR 322 (4) $\lambda$ phage

**Sol.** Answer (1)

Retrovirus is commonly used as vector for introducing a DNA fragment in human lymphocyte.

**Gene therapy :** Lymphocyte from blood of patient are grown in culture outside the body, a functional gene is introduced by using a retroviral vector, into these lymphocyte.

7. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called **[NEET-2018]**

(1) Bio-infringement (2) Biopiracy (3) Bioexploitation (4) Biodegradation

**Sol.** Answer (2)

Biopiracy is term used for or refer to the use of bioresources by multinational companies and other organisation without proper authorisation from the countries and people concerned with compensatory payment (definition of biopiracy given in NCERT).

8. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is **[NEET-2018]**

(1) Indian Council of Medical Research (ICMR)

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

(3) Genetic Engineering Appraisal Committee (GEAC)

(4) Research Committee on Genetic Manipulation (RCGM)

**Sol.** Answer (3)

Indian Government has setup organisation such as GEAC (Genetic Engineering Appraisal Committee) which will make decisions regarding the validity of GM research and safety of introducing GM-organism for public services. (Direct from NCERT).

9. 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 **[NEET-2018]**

(1) Co-667 (2) Sharbati Sonora (3) Basmati (4) Lerma Rojo

**Sol.** Answer (3)

In 1997, an American company got patent rights on Basmati rice through the US patent and trademark office that was actually been derived from Indian farmer's varieties.

The diversity of rice in India is one of the richest in the world, 27 documented varieties of Basmati are grown in India.

Indian basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty.

Sharbati Sonora and Lerma Rojo are varieties of wheat.

10. The process of separation and purification of expressed protein before marketing is called **[NEET-2017]**

(1) Upstream processing (2) Downstream processing

(3) Bioprocessing (4) Postproduction processing

**Sol.** Answer (2)

Biosynthetic stage for synthesis of product in recombinant DNA technology is called upstreaming process while after completion of biosynthetic stage, the product has to be subjected through a series of processes which include separation and purification are collectively referred to as downstreaming processing.

11. Which kind of therapy was given in 1990 to a four- year-old girl with adenosine deaminase (ADA) deficiency? **[NEET(Phase-2)-2016]**

(1) Gene therapy (2) Chemotherapy

(3) Immunotherapy (4) Radiation therapy

**Sol.** Answer (1)

Gene therapy was given in 1990 to a four year old girl child with ADA deficiency.

12. Which part of the tobacco plant is infected by *Meloidogyne incognita?* **[NEET-2016]**

(1) Root (2) Flower (3) Leaf (4) Stem

**Sol.** Answer (1)

*Meloidogyne incognita* cause root knot disease in tobacco plant.

13. The two polypeptides of human insulin are linked together by **[NEET-2016]**

(1) Disulphide bridges (2) Hydrogen bonds

(3) Phosphodiester bond (4) Covalent bond

**Sol.** Answer (1)

Mature insulin has two polypeptide chains (A and B) which are linked together by disulphide linkages (bridges).

14. Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of **[ReAIPMT2015]**

(1) Vitamin A (2) Vitamin B (3) Vitamin C (4) Omega 3

**Sol.** Answer (1)

Golden rice is nutritionally enriched rich and is meant for biosynthesis of vitamin A.

15. The introduction of t-DNA into plant involves **[Re-AIPMT-2015]**

(1) Allowing the plant roots to stand in water

(2) Infection of the plant by *Agrobacterium tumefaciens*

(3) Altering the pH of the soil, then heat-shocking the plants

(4) Exposing the plants to cold for a brief period

**Sol.** Answer (2)

When *Agrobacterium tumifaciens* infects the host plant, it will transfer a part of DNA called t-DNA without any human interference so called natural genetic engineer.

16. The crops engineered for glyphosate are resistant/tolerant to **[AIPMT-2015]**

(1) Herbicides (2) Fungi (3) Bacteria (4) Insects

**Sol.** Answer (1)

Today the broad leaves plants are made resistant to a powerful biodegradable herbicide glyphosate. It is an active ingredient of Round Up ready plant. It inhibits the working of EPSP synthetase enzyme, a chloroplast enzyme for the synthesis of aromatic amino acid. If taken up by crop plants they will die.

So, our bioengineers have transferred gene for synthesis EPSP synthetase enzyme to our crop plants. They synthesis 20 times more enzyme than normal crop plant and remain protected in environment.

17. In Bt cotton, the Bt toxin present in plant tissue as pro-toxin is converted into active toxin due to **[AIPMT-2015]**

(1) Presence of conversion factors in insect gut (2) Alkaline pH of the insect gut

(3) Acidic pH of the insect gut (4) Action of gut micro-organisms

**Sol.** Answer (2)

Bt toxin crystals are solubilised in alkaline pH of the insect gut.

18. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services? **[AIPMT-2015]**

(1) Research Committee on Genetic Manipulation (2) Bio-safety committee

(3) Indian Council of Agricultural Research (4) Genetic Engineering Approval Committee

**Sol.** Answer (4)

ICAR is located in Delhi.

19. In vitro clonal propagation in plants is characterized by **[AIPMT-2014]**

(1) PCR and RAPD (2) Northern blotting

(3) Electrophoresis and HPLC (4) Microscopy

**Sol.** Answer (1)

Now a days PCR & RAPD technique are used for the characterisation of *in vitro* clonal propagation in plants.

20. Commonly used vectors for human genome sequencing are **[AIPMT-2014]**

(1) T-DNA (2) BAC and YAC (3) Expression vectors (4) T / A cloning vectors

**Sol.** Answer (2)

Commonly used vectors for human genome sequencing are BAC (Bacterial artificial chromosome) and YAC (Yeast Artificial chromosome)

21. The first human hormone produced by recombinant DNA technology is **[AIPMT-2014]**

(1) Insulin (2) Estrogen (3) Thyroxin (4) Progesterone

**Sol.** Answer (1)

The first hormone produced by recombinant DNA technology is insulin.

22. An analysis of chromosomal DNA using the Southern hybridization techinque does **not** use: **[AIPMT-2014]**

(1) Electrophoresis (2) Blotting (3) Autoradiography (4) PCR

**Sol.** Answer (4)

PCR is only for amplification of DNA.

23. Which of the following Bt crops is being grown in India by the farmers? **[NEET-2013]**

(1) Cotton (2) Brinjal (3) Soybean (4) Maize

**Sol.** Answer (1)

Cultivation of Bf brinjal was banned in India in 2010.

24. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin 'A' deficiency? **[AIPMT (Prelims)-2012]**

(1) Golden rice (2) Bt-Brinjal (3) 'Flaver Savr' tomato (4) Canolla

**Sol.** Answer (1)

Golden rise is rich in provitamin A, hence can help counter vitamin A deficiency.

25. The first clinical gene therapy was given for treating **[AIPMT (Mains)-2012]**

(1) Adenosine deaminase deficiency (2) Diabetes mellitus

(3) Chicken pox (4) Rheumatoid arthritis

**Sol.** Answer (1)

Adenosine deaminae is essential for purine metabolism.

26. A single strand of nucleic acid tagged with a radioactive molecule is called **[AIPMT (Prelims)-2012]**

(1) Plasmid (2) Probe (3) Vector (4) Selectable marker

**Sol.** Answer (2)

A probe can be radio labelled SS RNA or SC DNA.

27. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produced (in the host cells) **[AIPMT (Mains)-2012]**

(1) Both sense and anti-sense RNA (2) A particular hormone

(3) An antifeedant (4) A toxic protein

**Sol.** Answer (1)

Tobacco plant resistant to a nematode to prevent infestation is based on the process of RNA interference, which involves silencing of a specific mRNA by binding of dsRNA molecule.

28. Maximum number of existing transgenic animals is of **[AIPMT (Prelims)-2011]**

(1) Pig (2) Fish (3) Mice (4) Cow

**Sol.** Answer (3)

Mine have shorter reproductive spasms and are mammals.

29. 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 of the two statements having mistakes? **[AIPMT (Mains)-2011]**

(1) (A) and (C) (2) (A) and (B)

(3) (B) and (C) (4) (C) and (D)

**Sol.** Answer (2)

Rosic was a transgenic cow. RE are used in cutting DNA into fragments.

30. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein. This protein : **[AIPMT (Mains)-2011]**

(1) Is activated by acid pH of the foregut of the insect pest

(2) Does not kill the carrier bacterium which is itself resistant to this toxin

(3) Binds with epithelial cells of midgut of the insect pest ultimately killing it

(4) Is coded by several genes including the gene *cry*

**Sol.** Answer (3)

Activation of cry protein requires alkaline conditions.

31. Silencing of mRNA has been used in producing transgenic plants resistant to **[AIPMT (Mains)-2011]**

(1) White rusts (2) Bacterial blights

(3) Bollwroms (4) Nematodes

**Sol.** Answer (4)

RNAi has benn used to prevent Meloidogyne incognita from infecting tabacco plants.

32. The process of RNA interference has been used in the development of plants resistant to **[AIPMT (Prelims)-2011]**

(1) Insects (2) Nematodes (3) Fungi (4) Viruses

**Sol.** Answer (2)

Meloidogyne incognita is a parasitic helminth (Nematode).

33. The genetically-modified (GM) brinjal in India has been developed for **[AIPMT (Prelims)-2010]**

(1) Drought-resistance (2) Insect-resistance

(3) Enhancing shelf life (4) Enhancing mineral content

**Sol.** Answer (2)

Bt brinjal developed by mahyco was resistant to insects.

34. Genetic engineering has been successfully used for producing **[AIPMT (Prelims)-2010]**

(1) Animals like bulls for farm work as they have super power

(2) Transgenic mice for testing safety of polio vaccine before use in humans

(3) Transgenic models for studying new treatments for certain cardiac diseases

(4) Transgenic Cow-Rosie which produces high fat milk for making ghee

**Sol.** Answer (2)

35. Some of the characteristics of Bt cotton are **[AIPMT (Prelims)-2010]**

(1) High yield and resistance to bollworms

(2) Long fibre and resistance to aphids

(3) Medium yield, long fibre and resistance to beetle pests

(4) High yield and production of toxic protein crystals which kill dipteran pests

**Sol.** Answer (1)

Bt cotton is a biopesticide resistant to bollworm.

36. DNA or RNA segment tagged with a radioactive molecule is called **[AIPMT (Prelims)-2010]**

(1) Plasmid (2) Vector (3) Probe (4) Clone

**Sol.** Answer (3)

**Plasmid:** A genetic structure in a cell that can replicated independently of the chromosomes.

**Vector:** An organism, typically a biting insect, that transmits a disease or parasite from one animal or plant to another.

**Clone:** An organism or cell produced asexually from one to which they are genetically identical.

37. An improved variety of transgenic basmati rice **[AIPMT (Prelims)-2010]**

(1) Does not require chemical fertilizers and growth hormones

(2) Gives high yield and is rich in vitamin A

(3) Is completely resistant to all insect pests and diseases of paddy

(4) Gives high yield but has no characteristic aroma

**Sol.** Answer (3)

Improved quality is golden rice with genes for synthesis of $\beta$-carotene is a principal source of vitamin A.

38. Which one of the following is now being commercially produced by biotechnological procedures? **[AIPMT (Mains)-2010]**

(1) Nicotine (2) Morphine (3) Quinine (4) Insulin

**Sol.** Answer (4)

Humulin is human insulin being synthesized on commercial scales by Eli lilly.

39. Polyethylene glycol method is used for **[AIPMT (Prelims)-2009]**

(1) Biodiesel production (2) Seedless fruit production

(3) Energy production from sewage (4) Gene transfer without a vector

**Sol.** Answer (4)

PEG is useful for protoplast fusion.

40. What is **true** about Bt toxin? **[AIPMT (Prelims)-2009]**

(1) Bt protein exists as active toxin in the *Bacillus*.

(2) The activated toxin enters the ovaries of the pest to sterilise it and thus prevent its multiplication.

(3) The concerned *Bacillus* has antitoxins.

(4) The inactive protoxin gets converted into active form in the insect gut

**Sol.** Answer (4)

The concerned *Bacillus* has inactive toxins as protoxin.

*Bt* protein exists as inactive toxin in the *Bacillus.*

The activated toxin enters the gut of the pest to damage the mid-gut epithelium.

41. Transgenic plants are the ones **[AIPMT (Prelims)-2009]**

(1) Generated by introducing foreign DNA into a cell and regenerating a plant from that cell.

(2) Produced after protoplast fusion in artificial medium.

(3) Grown in artificial medium after hybridization in the field.

(4) Produced by a somatic embryo in artificial medium.

**Sol.** Answer (1)

DNA from more than one source is present in transgenic/recombinant plants.

42. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as **[AIPMT (Prelims)-2009]**

(1) Insecticide (2) Agent for production of dairy products

(3) Source of industrial enzyme (4) Indicator of water pollution

**Sol.** Answer (1)

Toxin for *Bascillus thurinjiensis* helps provide resistance against many insects.

43. Which one of the following is commonly used in transfer of foreign DNA into crop plants? **[AIPMT (Prelims)-2009]**

(1) *Meloidogyne incognita* (2) *Agrobacterium tumefaciens*

(3) *Penicillium expansum* (4) *Trichoderma harzianum*

**Sol.** Answer (2)

A. tumefaciend has Ti plasmid which can infect driol plants.

44. The genetic defect – adenosine deaminase (ADA) deficiency may be cured **permanently** by **[AIPMT (Prelims)-2009]**

(1) Administering adenosine deaminase activators.

(2) Introducing bone marrow cells producing ADA into cells at early embryonic stages.

(3) Enzyme replacement therapy.

(4) Periodic infusion of genetically engineered lymphocytes having functional ADA cDNA

**Sol.** Answer (2)

Options (1), (3) & (4) cannot cure the disease permanently.

45. A transgenic food crop which may help in solving the problem of night blindness in developing countries is **[AIPMT (Prelims)-2008]**

(1) Golden rice (2) Flavr Savr tomatoes

(3) Starlink maize (4) Bt Soyabean

**Sol.** Answer (1)

Golden rice is rich in provitamin A needed for synthesis of rhodopsin.

46. Cry I endotoxins obtained from *Bacillus thuringiensis* are effective against **[AIPMT (Prelims)-2008]**

(1) Boll worms (2) Mosquitoes (3) Flies (4) Nematodes

**Sol.** Answer (1)

Cry I endotoxins are effective against hepidoterans.

47. What is antisense technology? **[AIPMT (Prelims)-2008]**

(1) RNA polymerase producing DNA

(2) A cell displaying a foreign antigen used for synthesis of antigens

(3) Production of somaclonal variants in tissue cultures

(4) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene

**Sol.** Answer (4)

48. Main objective of production/use of herbicide resistant GM crops is to **[AIPMT (Prelims)-2008]**

(1) Reduce herbicide accumulation in food articles for health safety

(2) Eliminate weeds from the field without the use of manual labour

(3) Eliminate weeds from the field without the use of herbicides

(4) Encourage eco-friendly herbicides

**Sol.** Answer (2)

Agriculture is labour extensive technique in most developed countries.

49. A genetically engineered micro-organism used successfully in bioremediation of oil spills is a species of **[AIPMT (Prelims)-2007]**

(1) *Bacillus* (2) *Pseudomonas* (3) *Trichoderma* (4) *Xanthomonas*

**Sol.** Answer (2)

*P. putida* is effective in controlling damage against oil spills.

50. Golden rice is a promising transgenic crop. When released for cultivation, it will help in **[AIPMT (Prelims)-2006]**

(1) Alleviation of vitamin-A deficiency (2) Pest resistance

(3) Herbicide tolerance (4) Producing a petrol-like fuel from rice

**Sol.** Answer (1)

51. The protein products of the following Bt toxin genes *Cry I* Ac and *Cry* II Ab are responsible for controlling

(1) Bollworm (2) Roundworm (3) Moth (4) Fruit fly

**Sol.** Answer (1)

Bollworm is a lepidopteran.

52. *Bacillus thuringiensis* (Bt) strains have been used for designing novel

(1) Biofertilizers

(2) Bio-metallurgical techniques

(3) Bio-mineralization processes

(4) Bioinsecticidal plants

**Sol.** Answer (4)

*Bacillus thuringiensis* produce Bt toxin which is insect group specific. This toxin is encoded by a gene named *cry*. These genes are effective against various types of insects. This Bt toxin gene has been cloned and expressed in plants to provide resistance to insects thus creating bioinsecticidal plants.

53. How is Bt toxin known to kill the target insects in protection of cotton plants?

(1) Midgut cell lysis and swelling
(2) Paralysis and loss of coordination
(3) Formation of abnormal proteins
(4) Brain death

**Sol.** Answer (1)

Bt toxin binds to mid gut epithelial cells and create pores that cause swelling and lysis. So that, insect is unable to feed and consequently starves to death.

54. Which gene isolated from *Bacillus thuringiensis* has been known to control the insect population of corn borer?

(1) HLA-gene (2) *cry* I Ab-gene (3) *cry* I Ac-gene (4) *cry* II Ab-gene

**Sol.** Answer (2)

This gene codes for a cry stallized protein..

55. Which of the following statements about *Bacillus thuringiensis* are correct?

A. One of the toxins produced by the bacteria is thurioside, which is active against different groups of insect larvae
B. The toxin accumulates inside the bacteria during sporulation
C. Upon ingestion by susceptible insects they are converted into active form and kill them by inhibition of ion transport in the midgut
D. The proteins encoded by the gene *cry* II Ab controls corn borer

(1) B only
(2) A and B
(3) A, B and C
(4) A, B, C and D

**Sol.** Answer (3)

The proteins encoded by the gene *cry I Ab* controls corn borer.

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

(1) Bacteria are resistant to the toxin
(2) Toxin is immature
(3) Toxin is inactive
(4) Bacteria encloses toxin in a special sac

**Sol.** Answer (3)

*B. thuringiensis* during sporulation, forms intracellular crystalline bodies that contain an insecticidal protein called the endotoxin. This endotoxin that accumulates in the bacterium is an inactive precursor.

57. Which of the following is used as a bioweapon?

(1) *Bacillus subtilis*
(2) *Bacillus licheniformis*
(3) *Bacillus thuringiensis*
(4) *Bacillus anthracis*

**Sol.** Answer (4)

*Bacillus anthracis* spores are extraordinarily well-suited to use as biological weapons as spores are highly resilient, surviving extremes of temperature, low nutrient environments, and harsh chemical treatment.

*Bacillus subtilis* : Found in soil and GI tract of human. Used in biotechnology.

*Bacillus licheniformis* : It is cultured in order to obtain protease for use in biological laundry industry.

58. Which enzyme deficiency will lead to a disease called SCID?

(1) Adenosine deaminase (2) Alcohol dehydrogenase

(3) Creatine kinase (4) Myosin ATPase

**Sol.** Answer (1)

**Adenosine deaminase:** This enzyme is crucial for the immune system to function because in its absence lymphocyte proliferation is inhibited and person is wide open to the attacks of viruses and bacteria.

59. ANDi is a transgenic

(1) Plant (2) Goat (3) Monkey (4) Dog

**Sol.** Answer (3)

ANDi was the first genetically modified monkey. The GFP gene was inserted into the monkey's chromosome.

60. A regulatory body working under MoEF for the release of transgenic crops is

(1) NBPGR (2) GEAC (3) NSC (4) NIPGR

**Sol.** Answer (2)

**GEAC:** Genetic Engineering Approval Committee.

**NBPGR:** National Bureau of Plant Genetic Resources.

**NIPGR:** National Institute of Plant Genome Research.

61. A nematode *Meloidogyne* infects the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infestation which was based on the process of

(1) RNA interference (2) DNA interference (3) Protein inhibitor (4) Both (1) & (2)

**Sol.** Answer (1)

**RNA interference:** This process involves silencing of a specific mRNA responsible for parasitism.

62. Why is usually insulin not administered orally to a diabetic patient?

(1) Insulin is bitter in taste

(2) Insulin is a peptide

(3) Insulin will lead to a sudden decrease in blood sugar if given orally

(4) Insulin leads to peptic ulcer if taken orally

**Sol.** Answer (2)

Insulin cannot be administered orally to diabetic patients because it is a peptide and gets digested in alimentary canal.

63. Which of the following techniques serve the purpose of early diagnosis than most conventional methods of diagnosis?

A. Recombinant DNA technology

B. PCR

C. ELISA

(1) A only (2) A & C only (3) A & B only (4) A, B & C

**Sol.** Answer (4)

These are modern methods of diagnosis.

**PCR:** Helps to detect very low concentration of bacteria or virus even when symptoms of the disease are not visible by amplifying their nucleic acid.

**ELISA:** Based on antigen-antibody interaction.

64. Choose the **incorrect** statement w.r.t. Ethical issues in biotechnology

(1) Basmati rice is distinct for its unique aroma and flavour and 27 documented varieties of Basmati are grown in India

(2) In 1997, an American company got patent rights on Basmati rice through the US Patent and Trademark office.

(3) Biopiracy is the form used to refer to the use of bioresources by multinational companies without proper authorisation from the countries and people concerned without compensatory payment

(4) The current interest in the manipulation of microbes, plants and animals has raised no ethical questions.

**Sol.** Answer (4)

The manipulation of living organisms by human race cannot go on any further without regulation because genetically modified organisms can have unpredictable results when such organisms are introduced into the ecosystem.

65. During gene cloning, which is called 'gene taxi'?

(1) Vaccine (2) Plasmid (3) Bacterium (4) Protozoa

**Sol.** Answer (2)

Plasmid is called gene taxi as it acts as a vector for transmitting gene of interest.

66. Some of the steps involved in the production of humulin are given below. Choose the correct sequence

(i) Synthesis of gene (DNA) for human insulin artificially.

(ii) Culturing recombinant *E.coli* in bioreactors

(iii) Purification of humulin

(iv) Insertion of synthetic human insulin gene into plasmid

(v) Introduction of recombinant plasmid into *E.coli*

(vi) Extraction of recombinant gene product from *E.coli*

(1) ii, i, iv, iii, v, vi (2) i, iii, v, vi, ii, iv (3) i, iv, v, ii, vi, iii (4) iii, v, ii, i, vi, iv

**Sol.** Answer (3)

67. *Bt* brinjal is an example of transgenic crops. In this *Bt* refers to

(1) *Bacillus tuberculosis* (2) *Bacillus thuringiensis* (3) Biotechnology (4) β-carotene

**Sol.** Answer (2)

*Bacillus thuringiensis* is a bacterium.

## SECTION - C

### Assertion-Reason Type Questions

1. A : RNAi takes place in all eukaryotic organisms as a method of cellular defense.

R : Complementary dsRNA molecule binds to specific mRNA and prevents its translation (silencing).

**Sol.** Answer (2)

RNAi is a post transcriptional silencing technique.

2. A : Bt toxin are protein crystals containing insecticidal protein

R : *B. thuringiensis* forms these protein crystals during their growth period phase.

**Sol.** Answer (3)

*B. thuringiensis* forms these protein crystals throughout continuously during **sporulation**.

3. A : Recombinant DNA technologies process has been less effective in therapeutic drug production.

R : Recombinant therapeutics induce always unwanted immunological responses.

**Sol.** Answer (4)

Recombinant DNA technologies process has been proved effective in therapeutic drug production and recombinant therapeutics do not induce unwanted immunological responses.

4. A : Transgenic mice are being used to test the safety of the polio vaccine.

R : It could replace the use of monkeys to test the safety of batches of the vaccine.

**Sol.** Answer (2)

5. A : Indian Government has set up organisation such as GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the validity of GM research and safety of introducing GM organisms for public services.

R : Genetic modification of organisms can have unpredictable results when such organism are introduced into the ecosystem.

**Sol.** Answer (1)

6. A : Dolly was the first mammal to be cloned from an udder cell.

R : To create, Dolly the finn dorset ewe, Ian Wilmut and Keith Campbell used aid from three mothers.

**Sol.** Answer (2)

7. A : Some nations are developing laws to prevent unauthorised exploiation of their bioresources and traditional knowledge.

R : Brazzein, a protein obtained from West African plant, was isolated, sequenced and patented in U.S.A.

**Sol.** Answer (2)

8. A : ELISA can enable very easy detection of infection through antigen antibody interaction.

R : It is a nucleic acid based diagnostic tool that can confirm presence of infectious microbe at early stages.

**Sol.** Answer (3)

It is an antigen-antibody reaction based diagnostic tool that can confirm presence of infectious microbe at early stage.

9. A : Production of hirudin from transgenic *Brassica* required use of synthetic gene.

R : Eukaryotic genes have intron sequences that need to be spliced out.

**Sol.** Answer (1)

10. A : Biofortified crops such as golden rice are helpful in overcoming the problem of night blindness in developing nations.

R : It has enhanced nutritional content of pro vitamin A.

**Sol.** Answer (1)

Golden rice contains $\beta$-carotene gene.

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