Biotechnology and Its Applications

Question1

Following are the steps involved in action of toxin in Bt. Cotton
A. The inactive toxin converted into active form due to alkaline pH of gut of insect.
B. Bacillus thuringiensis produce crystals with toxic insecticidal proteins.
C. The alkaline pH solubilises the crystals.
D. The activated toxin binds to the surface of midgut cells, creates pores and causes death of the insect.
E. The toxin proteins exist as inactive protoxins in bacteria.

Choose the correct sequence of steps from the options given below:

[NEET 2024 Re]

Options:

A.

E ⟶ C ⟶ B ⟶ A ⟶ D

B.

B ⟶ C ⟶ A ⟶ E ⟶ D

C.

A ⟶ E ⟶ B ⟶ D ⟶ C

D.

B ⟶ E ⟶ C ⟶ A ⟶ D

Answer: D

Solution:

Option (4) is the correct answer because the correct sequence of action of toxin in Bt. cotton is

B. Bacillus thuringiensis produces crystals with toxic insecticidal proteins.

E. The toxin proteins exist as inactive protoxins in bacteria.

C. The alkaline pH solubilises the crystals.

A. The inactive toxin converted into active form due to alkaline pH of gut of insect.

D. The activated toxin binds to the surface of midgut cells, creates pores and causes death of the insect.

Hence, B ⟶ E ⟶ C ⟶ A ⟶ D is the correct order.

Question2

What is the fate of a piece of DNA carrying only gene of interest which is transferred into an alien organism?
A. The piece of DNA would be able to multiply itself independently in the progeny cells of the organism.
B. It may get integrated into the genome of the recipient.
C. It may multiply and be inherited along with the host DNA.
D. The alien piece of DNA is not an integral part of chromosome.
E. It shows ability to replicate.

Choose the correct answer from the options given below:

[NEET 2024]

Options:

A.

A and B only

B.

D and E only

C.

B and C only

D.

A and E only

Answer: C

Solution:

Correct answer is option (3) because

The fate of a piece of DNA carrying only gene of interest which is transferred into an alien organism are:

(B) It may get integrated into the genome of the recipient

(C) It may multiply and be inherited along with the host DNA

⇒ This piece of DNA would not be able to multiply itself in the progeny cells of the organism but when gets integrated into the genome of the recipient, it may multiply and be inherited along with the host DNA.

Question3

Which of the following are fused in somatic hybridization involving two varieties of plants?

[NEET 2024]

Options:

A.

Callus

B.

Somatic embryos

C.

Protoplasts

D.

Pollens

Answer: C

Solution:

Protoplast of two varieties of plants are fused in somatic hybridization.

Question4

Match List I with List II :

	List-I		List-II
A.	α –I antitrypsin	I.	Cotton bollworm
B.	Cry IAb	II.	ADA deficiency
C.	Cry IAc	III.	Emphysema
D.	Enzyme replacement therapy	IV.	Corn borer

Choose the correct answer form the options given below:

[NEET 2024]

Options:

A.

A-II, B-I, C-IV, D-III

B.

A-III, B-I, C-II, D-IV

C.

A-III, B-IV, C-I, D-II

D.

A-II, B-IV, C-I, D-III

Answer: C

Solution:

Sol. The correct answer is option (3) as

α– I antitrypsin → Is used for treatment of Emphysema

Cry I Ab gene → Controls corn borer

Cry I Ac gene → Controls cotton bollworms

Question5

Which of the following statements is incorrect?

[NEET 2024]

Options:

A.

A bio-reactor provides optimal growth conditions for achieving the desired product

B.

Most commonly used bio-reactors are of stirring type

C.

Bio-reactors are used to produce small scale bacterial cultures

D.

Bio-reactors have an agitator system, an oxygen delivery system and foam control system

Answer: C

Solution:

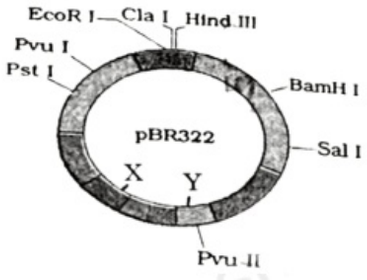
Correct answer is option (3)

The statement (3) is incorrect because bioreactors are used for processing of large volumes (100 – 1000 litres) of culture.

Small volume cultures cannot yield appreciable quantities of products. To produce in large quantities the development of bioreactors is required.

Question6

The following diagram showing restriction sites in E. coli cloning vector pBR322. Find the role of ‘X’ and ‘Y’ genes :



[NEET 2024]

Options:

A.

The gene ‘X’ is responsible for resistance to antibiotics and ‘Y’ for protein involved in the replication of Plasmid.

B.

The gene ‘X’ is responsible for controlling the copy number of the linked DNA and ‘Y’ for protein involved in the replication of Plasmid.

C.

The gene ‘X’ is for protein involved in replication of Plasmid and ‘Y’ for resistance to antibiotics.

D.

Gene ’X’ is responsible for recognitions sites and ‘Y’ is responsible for antibiotic resistance.

Answer: B

Solution:

Correct answer is option (2), because

‘X’ in the given diagram is ori while ‘Y’ is rop.

‘X’ which is ori is responsible for controlling the copy number of the linked DNA and ‘Y’ which is rop codes for protein involved in the replication of plasmid.

Options (1), (3) and (4) are incorrect as ‘X’ and ‘Y’ are not related to these functions.

Question7

Which of the following statement is incorrect about Agrobacterium tumifaciens?
[NEET 2023 mpr]

Options:

A.

It is used to deliver gene of interest in both prokaryotic as well as eukaryotic host cells.

B.

'Ti' plasmid from Agrobacterium tumifaciens used for gene transfer is not pathogenic to plant cell.

C.

It transforms normal plant cells into tumor cells.

D.

It delivers 'T-DNA' into plant cell.

Answer: A

Solution:

Solution:

Option A is incorrect. Agrobacterium tumefaciens is primarily used to deliver genes of interest into eukaryotic host cells, specifically plant cells, and not typically into prokaryotic cells. It is known for its ability to naturally genetically engineer plants by inserting a portion of its 'Ti' (tumor-inducing) plasmid, the 'T-DNA', into the plant cell DNA. This makes it a useful tool for plant genetic engineering. However, its utility in transferring genes to prokaryotic host cells is quite limited.

Question8

Which of the following can act as molecular scissors? [NEET 2023 mpr]

Options:

A.

Restriction enzymes

B.

DNA ligase

C.

RNA polymerase

D.

DNA polymerase

Answer: A

Solution:

Solution:

Restriction enzymes, also known as restriction endonucleases, act as molecular scissors in molecular biology. They recognize specific DNA sequences in a molecule and then cut the DNA at these recognition sites. Different restriction enzymes recognize and cut at different DNA sequences.

Question9

	List - I		List - II
(A)	Gene therapy	(I)	Separation of DNA fragments
(B)	RNA interference	(II)	Diagnostic test for AIDS
(C)	ELISA	(III)	Cellular defence

(D)	Gel Electrophoresis	(IV)	Allows correction of a gene defect.

Choose the correct answer from the options given below : [NEET 2023 mpr]

Options:

A.

(A)-(IV), (B)-(I), (C)-(II), (D)-(III)

B.

(A)-(IV), (B)-(II), (C)-(III), (D)-(I)

C.

(A)-(IV), (B)-(III), (C)-(II), (D)-(I)

D.

(A)-(IV), (B)-(III), (C)-(I), (D)-(II)

Answer: C

Solution:

Solution:

The correct matching between List - I and List - II is as follows :

(A) Gene therapy - (IV) Allows correction of a gene defect.
Gene therapy is a technique that uses genes to treat or prevent disease by either replacing damaged genes with healthy ones, turning off harmful genes or introducing new genes to fight disease.

(B) RNA interference - (III) Cellular defence
RNA interference (RNAi) is a biological process in which RNA molecules inhibit gene expression or translation, by neutralizing targeted mRNA molecules. This is a form of cellular defense.

(C) ELISA - (II) Diagnostic test for AIDS
ELISA, or enzyme-linked immunosorbent assay, is a commonly used laboratory test that measures the amounts of antibodies in the blood and can be used as a diagnostic test for AIDS.

(D) Gel Electrophoresis - (I) Separation of DNA fragments
Gel electrophoresis is a laboratory method used to separate mixtures of DNA, RNA, or proteins according to molecular size and charge.

Question10

Which one of the following techniques does not serve the purpose of early diagnosis of a disease for its early treatment? [NEET 2023]

Options:

A. Serum and Urine analysis

B. Polymerase Chain Reaction (PCR) technique

C. Enzyme Linked Immuno-Sorbent Assay (ELISA) technique

D. Recombinant DNA Technology

Answer: A

Solution:

Solution:

The correct answer is option (1) because using conventional methods of diagnosis like serum and urine analysis, etc, do not help in early diagnosis. Recombinant DNA technology, Polymerase Chain Reaction [PCR] and Enzyme Linked Immuno-Sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis.

Question11

Milk of transgenic 'Cow Rosie' was nutritionally more balanced product for human babies than natural cow milk because it contained : [NEET Re-2022]

Options:

A. Human enzyme Adenosine Deaminase (ADA)

B. Human protein α-1-antitrypsin

C. Human alpha-lactalbumin

D. Human insulin-like growth factor

Answer: C

Solution:

Solution:

Alpha-lactalbumin is the human milk protein produced by the transgenic cow 'Rosie'.

Question12

Transposons can be used during which one of the following ? [NEET-2022]

Options:

A. Polymerase Chain Reaction

B. Gene Silencing

C. Autoradiography

D. Gene sequencing

Answer: B

Solution:

Option (2) is the correct answer as the source of the complementary RNA for RNAi could be mobile genetic elements (transposons) that replicate via an RNA intermediate.

Option (3) is incorrect as autoradiography usally follows hybridisation.

Option (1) is incorrect because polymerase chain reaction is used to make copies of the DNA sample and does not need transposons.

Option (4) is incorrect because transposons are not required during gene sequencing.

Question13

In gene therapy of Adenosine Deaminase (ADA) deficiency, the patient requires periodic infusion of genetically engineered lymphocytes because : [NEET-2022]

Options:

A. Retroviral vector is introduced into these lymphocytes.

B. Gene isolated from marrow cells producing ADA is introduced into cells at embryonic stages

C. Lymphocytes from patient's blood are grown in culture, outside the body.

D. Genetically engineered lymphocytes are not immortal cells.

Answer: D

Solution:

Solution:

Option (4) is the correct answer as genetically engineered lymphocyctes are not immortal cells and die after some time.

Option (3) is not the correct answer as the lymphocytes from patient’s blood are grown in culture,outside the body but it is not the correct reason.

In option (2), if the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

Question14

Statements related to human Insulin are given below.
Which statement(s) is/are correct about genetically engineered Insulin?
(a) Pro-hormone insulin contain extra stretch of C-peptide
(b) A-peptide and B-peptide chains of insulin were produced separately in E.coli, extracted and combined by creating disulphide bond between them.
(c) Insulin used for treating Diabetes was extracted from Cattles and Pigs.
(d) Pro-hormone Insulin needs to be processed for converting into a mature and functional hormone.
(e) Some patients develop allergic reactions to the foreign insulin.

Choose the most appropriate answer from the options given below

[NEET-2022]

Options:

A. (a), (b) and (d) only

B. (b) only

C. (c) and (d) only

D. (c), (d) and (e) only

Answer: A

Solution:

Solution:

Option (2) is the correct answer as genetically engineered insulin has A-peptide and B-peptide chains of insulin which are produced separately in E.coli, then they are extracted and combined by creating disulphide bond between them.

Statement (a) is incorrect as genetically engineered insulin does not have an extra stretch of C-peptide.

Statement (c) is incorrect as insulin obtained from cattles and pigs is not genetically engineered insulin.

Statement (d) is incorrect because conversion of pro-insulin to insulin is not required during production of insulin by genetic engineering as A-peptide and B-peptide chains are produced separately.

Statement (e) is incorrect as allergic reactions to insulin are mostly seen when the insulin is obtained from animals.

Question15

When gene targetting involving gene amplification is attempted in an individual's tissue to treat disease, it is known as :
[NEET 2021]

Options:

A. Biopiracy

B. Gene therapy

C. Molecular diagnosis

D. Safety testing

Answer: B

Solution:

Solution:
The correct option is (2)
• Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.
• 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.
• Molecular diagnosis refers to the act or process of determining the nature and cause of a disease.

Question16

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
[NEET 2021]

Options:

A. (b) and (d) only

B. (b) and (c) only

C. (a), (c) and (d) only

D. (a) and (d) only

Answer: C

Solution:

Solution:
• Insulin is synthesized as a pro-hormone which contains A-chain, B-chain and an extra stretch called the C-peptide.
• C-peptide is not present in mature insulin called humulin.
• Chains A and B are connected by interchain disulphide bridges.

Question17

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)	(B)	(C)	(D)
(a)	(iii)	(ii)	(i)	(iv)
(b)	(ii)	(iii)	(iv)	(i)
(c)	(i)	(ii)	(iii)	(iv)
(d)	(iv)	(i)	(ii)	(iii)

(2020)

Options:

A. (a)

B. (b)

C. (c)

D. (d)

Answer: D

Solution:

(d) The correct option is (d) because in Bt cotton the specific Bt toxin gene was isolated from Bacillus thuringiensis. The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. PCR is now routinely used to detect HIV in suspected AIDS patients.

Question18

Which of the following statements is not correct? [2020]

Options:

A. The proinsulin has an extra peptide called C-peptide.

B. The functional insulin has A and B chains linked together by hydrogen bonds.

C. Genetically engineered insulin is produced in E.Coli.

D. In man insulin is synthesised as a proinsulin

Answer: B

Solution:

Solution:
(b) The correct option is (b) because functional insulin has A and B chains linked together by disulphide bridges.

Question19

In RNAi, the genes are silenced using : [2019, OD]

Options:

A. ds - DNA

B. ds - RNA

C. ss - DNA

D. ss - RNA

Answer: B

Solution:

Solution:
(b) RNAi (RNA interference) is triggered by double stranded RNA in a wide variety of organisms including animals, plants and fungi. It involves silencing of a specific mRNA and therefore the expression of a gene by formation of a dsRNA molecule. The dsRNA is formed by binding of a complementary RNA (anti-sense RNA) molecule to original mRNA thereby preventing translation of the original mRNA.

Question20

Which of the following is true for Golden rice? [2019]

Options:

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.

Answer: A

Solution:

Solution:
(a) Golden rice is a form of rice with biosynthesis of beta-carotene (a form of vitamin A) which gives its golden or yellow colouring. It is considered a type of genetically modified rice (GMO) and a fortified food that is produced to combat a vitamin A deficiency in areas where this vitamin is scarce.

Question21

What triggers activation of protoxin to active Bt toxin of Bacillus thuringiensis in boll worm?
[2019]

Options:

A. Body temperature

B. Moist surface of midgut

C. Alkaline pH of gut

D. Acidic pH of stomach

Answer: C

Solution:

Solution:
(c) Bacillus thuringiensis (Bt) is a Gram positive, spore-forming bacterium that synthesises parasporal crystalline inclusions containing CryIA and CryIIAb proteins, some of which are toxic against a wide range of insect orders (for example, moth larva that attacks the fruiting bodies of certain crop), nematodes and human-cancer cells.
These toxins are produced in inactive protoxins form but become activated when dissolve in the high alkaline pH of insect gut. Once ingested by insects, these crystals are solubilised in the midgut, the toxins are then proteolytically activated by midgut proteases and bind to specific receptors located in the insect cell membrane, leading to cell disruption and insect death.

Question22

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

Options:

A. Genetic code is not ambiguous

B. Genetic code is redundant

C. Genetic code is nearly universal

D. Genetic code is specific

Answer: C

Solution:

Solution:
(c) In recombinant DNA technology bacteria are able to produce human insulin, used to treat diabetes because genetic code is nearly universal.

Question23

Which kind of therapy was given in 1990 to a four-year-old girl with adenosine deaminase (ADA) deficiency?
(NEET II 2016)

Options:

A. Gene therapy

B. Chemotherapy

C. Immunotherapy

D. Radiation therapy

Answer: A

Solution:

Solution:
(a) : Gene therapy is a technique of genetic engineering which involves replacement of a faulty/ disease causing gene by a normal healthy functional gene. The first clinical gene therapy was given in 1990 to a 4 -year old girl with adenosine deaminase (ADA) deficiency. This enzyme is very important for the immune system to function. The deficiency of this enzyme can lead to severe combined immune deficiency (SCID).

Question24

The two polypeptides of human insulin are linked together by
(NEET II 2016)

Options:

A. covalent bond

B. disulphide bridges

C. hydrogen bonds

D. phosphodiester bond

Answer: B

Solution:

Solution:
(b) : Human insulin is made up of 51 amino acids arranged in two polypeptide chains. Chain A has 21 amino acids and chain B has 30 amino acids. The two polypeptide chains are interconnected by disulphide bridges or S-S-linkages.

Question25

Which part of the tobacco plant is infected by Meloidogyne incognita? (NEET I 2016)

Options:

A. Stem

B. Root

C. Flower

D. Leaf

Answer: B

Solution:

Solution:
(b) : Meloidogyne incognita is a nematode which infects the roots of the tobacco plants and causes a great reduction in the yield.

Question26

Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of (2015)

Options:

A. omega 3

B. vitamin A

C. vitamin B

D. vitamin C

Answer: B

Solution:

Solution:
(b) Golden rice (Oryza sativa) is a genetically modified crop. It biosynthesizes β -carotene which is the precursor of vitamin-A.

(Golden Rice was engineered from normal rice by Ingo Potrykus and Peter Beyer in the 1990s to help improve human health. Golden Rice has an engineered multi-gene biochemical pathway in its genome. This pathway produces betacarotene, a molecule that becomes vitamin A when metabolized by humans.)

Question27

The introduction of T-DNA into plants involves (2015)

Options:

A. exposing the plants to cold for a brief period

B. allowing the plant roots to stand in water

C. infection of the plant by Agrobacterium tumefaciens

D. altering the pH of the soil, then heat shocking the plants

Answer: C

Solution:

Solution:
(c) : Ti plasmid (tumor inducing) from the soil bacterium Agrobacterium tumefaciens is effectively used as vector for gene transfer to plant cells. The part of Ti plasmid transferred into plant cell DNA, is called the T-DNA. This T-DNA with desired DNA spliced into it, is inserted into the chromosomes of the host plant where it produces copies of itself, by migrating from one chromosomal position to another at random. Such plant cells are then cultured, induced to multiply and differentiate to form plantlets. Transferred into soil, the plantlets grow into mature plants, carrying the foreign gene, expressed throughout the new plant.

Question28

In Bt cotton, the Bt toxin present in plant tissue as protoxin is converted into active toxin due to (2015 Cancelled)

Options:

A. action of gut microorganisms

B. presence of conversion factors in insect gut

C. alkaline pH of the insect gut

D. acidic pH of the insect gut

Answer: C

Solution:

Solution:
(a) : Soil bacterium Bacillus thuringiensis produces proteins that kill certain insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). B. thuringiensis forms some protein crystals. These crystals contain a toxic insecticidal protein. This toxin does not kill the Bacillus (bacterium) because it exists as inactive protoxins in them. But, once an insect ingests it, it is converted into an active form of toxin due to the alkaline pH of the alimentary canal. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause swelling and lysis and finally cause death of the insect.

Question29

Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services? (2015 Cancelled)

Options:

A. Genetic Engineering Approval Committee

B. Research Committee on Genetic Manipulation

C. Bio-safety committee

D. Indian Council of Agricultural Research

Answer: A

Solution:

Solution:
(a): Genetic modification of organisms can have unpredictable results, when such organisms are introduced into the ecosystem. Therefore, the Indian Government has set up organizations such as GEAC (Genetic Engineering Approval Committee), which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

Question30

The crops engineered for glyphosate are resistant/tolerant to (2015 Cancelled)

Options:

A. insects

B. herbicides

C. fungi

D. bacteria

Answer: B

Solution:

Solution:
(b) : Glyphosate is a broad spectrum herbicide which especially kills broad leaved herbs. Crop plants may also get affected by the herbicide, thus now crop plants are genetically engineered for glyphosate resistance. So, when glyphosate herbicide is applied, only weeds and no crop plants get harmed.

Question31

The first human hormone produced by recombinant DNA technology is (2014)

Options:

A. insulin

B. estrogen

C. thyroxin

D. progesterone

Answer: A

Solution:

Solution:
(a): The recombinant DNA technological processes have made great impact in the area of health care by mass production of safe and more effective therapeutic drugs. In 1983, Eli Lily, an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of Escherichia coli to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin (humulin).

Question32

Which of the following Bt crops is being grown in India by the farmers? (NEET 2013)

Options:

A. Brinjal

B. Soybean

C. Maize

D. Cotton

Answer: D

Solution:

Solution:
(d) : Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene named cry. These are numerous genes. Two cry genes cry I Ac and cry II Ab have been incorporated in cotton. The genetically modified crop is called Bt cotton as it contains Bt toxin genes against cotton bollworms.

Question33

RNA interference involves
(KN NEET 2013)

Options:

A. synthesis of cDNA and RNA using reverse transcriptase

B. silencing of specific m RNA due to complementary RNA

C. interference of RNA in synthesis of DNA

D. synthesis of m RNA from DNA

Answer: B

Solution:

Solution:
(b) : RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene through production of both sense and antisense RNA. RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves a specific m RNA silencing. It is due to a complementary dsRNA molecule which binds to and prevents translation of the m RNA causing its silencing.

Question34

Which one of the following vectors is used to replace the defective gene in gene therapy?
(KN NEET 2013)

Options:

A. Adenovirus

B. cosmid

C. Ri plasmid

D. Ti plasmid

Answer: A

Solution:

Solution:
Adenovirus vectors can be replication defective; certain essential viral genes are deleted and replaced by a cassette that expresses a foreign therapeutic gene. Such a vector are used for gene therapy, as vaccines and for cancer therapy.

Question35

Consumption of which one of the following foods can prevent the kind of

blindness associated with vitamin 'A' deficiency?
(2012)

Options:

A. 'Flavr Savr' tomato

B. Canolla

C. Golden rice

D. Bt-Brinjal

Answer: C

Solution:

Solution:
Golden rice is a transgenic variety of rice (Oryza sativa) which contains good quantities of (3-carotene (provitamin A - inactive state of vitamin A). P-carotene is a principal source of vitamin A. Deficiency of vitamin A causes night blindness and skin disorders.

Question36

Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produces (in the host cells)
(Mains 2012)

Options:

A. both sense and anti-sense RNA

B. a particular hormone

C. an antifeedant

D. a toxic protein

Answer: A

Solution:

Solution:
(a): Many nematodes live in plants and animals including human beings. A nematode Meloidogyne incognita infests the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infection that was based on the process of RNA interference (RNAi). RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene by synthesis of RNA molecules complementary to the $\mathrm{mRN\,A}$. The normal (in vivo synthesized) $\mathrm{mRN\,A}$ of a gene is said to be "sense" because it carries the codons that are "read" during translation. Normally, the complement to the $\mathrm{mRN\,A}$ "sense" strand will not contain a sequence of codons that can be translated to produce a functional protein; thus, this complementary strand is called "anti-sense RNA". The anti-sense RNA and m RNA molecules will anneal to form duplex RNA molecules (or double stranded RNA) and the duplex RNA molecules can not be translated. Thus, the presence of anti-sense RNA will block translation of the $\mathrm{mRN\,A}$ of the affected gene. In fact, recent evidence indicates that these RNA duplexes are often rapidly degraded in vivo.

Question37

What is it that forms the basis of DNA fingerprinting? (Mains 2012)

Options:

A. The relative proportions of purines and pyrimidines in DNA.

B. The relative difference in the DNA occurrence in blood, skin and saliva.

C. The relative amount of DNA in the ridges and grooves of the fingerprints.

D. Satellite DNA occurring as highly repeated short DNA segments

Answer: D

Solution:

Solution:
(d) : DNA fingerprinting is a technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. The difference of about 0.1% or 3×10^6 base pairs (out of 3×10^9bp) provides individuality to each human being. Human genome possesses numerous small noncoding but inheritable sequences of bases which are repeated many times. These sequences occur near telomere, centromeres, Y chromosome and heterochromatic area. The area with same sequence of bases repeated several times is called repetitive DNA. It is separated as satellite from the bulk DNA during density gradient centrifugation and hence called satellite DNA where, repetition of bases is in tandem. Satellite DNAs show polymorphism (the occurrence of mutations in a population at high frequency), which is the basis of genetic mapping of human genome as well as DNA fingerprinting. While mutations in genes produce alleles with different expressions, mutations in noncoding repetitive DNA have no immediate impact. These mutations which have piled up with time form the basis of polymorphism.

Question38

The first clinical gene therapy was given for treating (Mains 2012)

Options:

A. diabetes mellitus

B. chicken pox

C. rheumatoid arthritis

D. adenosine deaminase deficiency

Answer: D

Solution:

(d) : Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here genes are inserted into a person's cells and tissues to treat a disease. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene. The first clinical gene therapy was given in 1990 to a 4 - year old girl with adenosine deaminase (ADA) deficiency. This enzyme is very important for the immune system to function. SCID is caused due to defect in the gene for the enzyme adenosine deaminase. In some children ADA deficiency can be cured by bone marrow transplantation. Here, the isolated gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages; it can be a permanent cure.

Question39

Maximum number of existing transgenic animals is of (2011)

Options:

A. fish

B. mice

C. cow

D. pig.

Answer: B

Solution:

Solution:
Cover 95% of all existing trangenic animals are mice. Animals that have their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals, e.g. rats, rabbits, pig, sheep, cows, fish, etc.

Question40

The process of RNA interference (RNAi) has been used in the development of plants resistant to (2011)

Options:

A. nematodes

B. fungi

C. viruses

D. insects

Answer: A

Solution:

(a) : Many nematodes live in plants and animals including human beings. A nematode Meloidogyne incognita infests the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infection that was based on the process of RNA interference (RNAi). RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene by synthesis of RNA molecules complementary to the mRNA. The normal (in vivo synthesized) mRNA of a gene is said to be "sense" because it carries the codons that are "read" during translation. Normally, the complement to the mRNA "sense" strand will not contain a sequence of codons that can be translated to produce a functional protein; thus, this complementary strand is called "anti-sense RNA". The anti-sense RNA and m RNA molecules will anneal to form duplex RNA molecules (or double stranded RNA) and the duplex RNA molecules can not be translated. Thus, the presence of anti-sense RNA will block translation of the mRNA of the affected gene. In fact, recent evidence indicates that these RNA duplexes are often rapidly degraded in vivo.

Question41

Bacillus thuringiensis forms protein crystals which contain insectidical protein. This protein
(Mains 2011)

Options:

A. binds with epithelial cells of midgut of the insect pest ultimately killing it.

B. is coded by several genes including the gene cry

C. is activated by acid pH of the foregut of the insect pest.

D. does not kill the carrier bacterium which is itself resistant to this toxin

Answer: A

Solution:

Solution:
Soil bacterium Bacillus thuringiensis produces proteins that kill certain insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). B. thuringiensis forms some protein crystals. These crystals contain a toxic insecticidal protein. This toxin does not kill the Bacillus (bacterium) because it exists as inactive protoxins in them. But, once an insect ingests it, it is converted into an active form of toxin due to the alkaline pH of the alimentary canal. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause swelling and lysis and finally cause death of the insect.

Question42

Silencing of m RNA has been used in producing transgenic plants resistant to
(Mains 2011)

Options:

A. bollworms

B. nematodes

C. white rusts

D. bacterial blights

Answer: B

Solution:

(b) In this technique, nematode specific genes are introduced in the host plant in such a way that it produces both sense and antisense RNA. The two RNA's being complementary to each other from a double stranded RNA (dsRNA) which is also called interfering RNA responsible for initiating RNA interference (RNAi). This (dsRNA) bind to and prevent translation of specific mRNA of nematode (gene silencing). Thus, transgenic plants based on RNAi technology are resistant to nematode.

Question43

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 alphalactalbumin enriched.
(B) Restriction enzymes are used in isolation of DNA from other macromolecules.
(C) Downstream processing is one of the steps of rDNA technology.
(D) Disarmed pathogen vectors are also used in transfer of rDNA into the host. Which of the two statements have mistakes?
(Mains 2011)

Options:

A. B and C

B. C and D

C. A and C

D. A and B

Answer: D

Solution:

Solution:
(d) : In 1997, the first transgenic cow, Rosie, produced human protein enriched milk. The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk. Isolation of DNA from other macromolecule is achieved by treating the bacterial cells/plant or animal tissue with enzymes such as lysozyme (bacteria), cellulase (plant cells), chitinase (fungus).

Question44

The genetically-modified (GM) brinjal in India has been developed for (2010)

Options:

A. insect-resistance

B. enhancing shelf life

C. enhancing mineral content

D. drought-resistance

Answer: A

Solution:

Solution:
(a) : The genetically modified (GM) Bt brinjal in India has been developed mainly for insect resistance. Through genetic engineering Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton, brinjal.

Question45

Genetic engineering has been successfully used for producing (2010)

Options:

A. transgenic mice for testing safety of polio vaccine before use in humans

B. transgenic models for studying new treatments for certain cardiac diseases

C. transgenic cow-Rosie which produces high fat milk for making ghee

D. animals like bulls for farm work as they have super power.

Answer: A

Solution:

Solution:
(a) : Many transgenic animals are designed to increase our understanding of how genes contribute to the development of diseases. These are specially made to serve as models for human diseases so that investigation of new treatments for diseases is made possible. Today transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's. Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans. Transgenic mice are being used to test the safety of the polio vaccine.

Question46

Some of the characteristics of Bt cotton are (2010)

Options:

A. long fibre and resistance to aphids

B. medium yield, long fibre and resistance to beetle pests

C. high yield and production of toxic protein crystals which kill dipteran pests

D. high yield and resistance to bollworms

Answer: D

Solution:

Solution:
(d) : Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into cotton plant. The genetically modified crop is called Bt cotton. Bt cotton has the following useful characteristics: pest resistance, herbicide tolerance, high yield and resistance to bollworm infestation.

Question47

An improved variety of transgenic basmati rice (2010)

Options:

A. does not require chemical fertilizers and growth hormones

B. gives high yield and is rich in vitamin A

C. is completely resistant to all insect pests and diseases of paddy

D. gives high yield but has no characteristic aroma

Answer: B

Solution:

Solution:
Golden rice is an improved variety of transgenic basmati rice, which gives high yield and rich in vitamin A. It is produced by the genetic modification of biosynthesize beta-carotene (precursor of vitamin A).

Question48

Which one of the following is now being commercially produced by biotechnological procedures? (Mains 2010)

Options:

A. Nicotine

B. Morphine

C. Quinine

D. Insulin

Answer: D

Solution:

Solution:
(d) : Insulin is now being commercially produced by genetic engineering. Insulin consists of two short polypeptide chains: chain A and chain B, that are linked together by disulphide bonds. Insulin, in mammal is synthesised as a prohormone which contains an extra stretch called the C-peptide. During maturation this C-peptide is removed. The production of insulin could only have been commercially possible if somehow the maturation process of C-peptide been skipped. This problem was solved in 1988 by Eli Lilly, an American company which prepared functionable insulin from two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli to produce insulin chains. In this way, chains A and B were produced separately which was extracted, combined by creating disulfide bonds to get human insulin.

Question49

What is true about Bt toxin?
(2009)

Options:

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

Answer: D

Solution:

Solution:
(d) : About Bt toxin, it is true, that the inactive protoxin gets converted into active form in the insect gut. There are several advantages in expressing Bt toxins in transgenic Bt crops. The level of toxin expression can be very high, thus delivering sufficient dosage to the pest.
The toxin expression is contained within the plant system and hence only those insects that feed on the crop perish. The toxin expression can be modulated by using tissue-specific promoters and replaces the use of synthetic pesticides in the environment.

Question50

Transgenic plants are the ones
(2009)

Options:

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

Answer: A

Solution:

Solution:
(a) : The plants produced through genetic engineering contain gene or genes usually from an unrelated organism. Such genes are called transgenes and the plants having transgenes are called transgenic plants. Recombinant DNA techniques are being used to improve crop plants by increasing their productivity, by making them more nutritious, and by developing disease resistance. Transgenic plants have a natural resistance to herbicides and pests. In the future, plants may have an ability to fix atmospheric nitrogen and an increased ability to grow in arid and salty soils.

Question51

The bacterium Bacillus thuringiensis is widely used in contemporary biology as
(2009)

Options:

A. insecticide

B. agent for production of dairy products

C. source of industrial enzyme

D. indicator of water pollution

Answer: A

Solution:

(a) : Soil bacterium Bacillus thuringiensis produces proteins that kill certain insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). B. thuringiensis forms some protein crystals. These crystals contain a toxic insecticidal protein. This toxin does not kill the Bacillus (bacterium) because it exists as inactive protoxins in them. But, once an insect ingests it, it is converted into an active form of toxin due to the alkaline pH of the alimentary canal. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause swelling and lysis and finally cause death of the insect.

Question52

What is antisense technology?
(2009)

Options:

A. When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene

B. RNA polymerase producing DNA

C. A cell displaying a foreign antigen used for synthesis of antigens

D. Production of somaclonal variants in tissue cultures

Answer: A

Solution:

Solution:
(a): Many nematodes live in plants and animals including human beings. A nematode Meloidogyne incognita infests the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infection that was based on the process of RNA interference (RNAi). RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene by synthesis of RNA molecules complementary to the mRNA. The normal (in vivo synthesized) mRNA of a gene is said to be "sense" because it carries the codons that are "read" during translation. Normally, the complement to the mRNA "sense" strand will not contain a sequence of codons that can be translated to produce a functional protein; thus, this complementary strand is called "anti-sense RNA". The anti-sense RNA and m RNA molecules will anneal to form duplex RNA molecules (or double stranded RNA) and the duplex RNA molecules can not be translated. Thus, the presence of anti-sense RNA will block translation of the mRNA of the affected gene. In fact, recent evidence indicates that these RNA duplexes are often rapidly degraded in vivo.

Question53

Cry I endotoxins obtained from Bacillus thuringiensis are effective against
(2008)

Options:

A. nematodes

B. boll worms

C. mosquitoes

D. flies

Answer: B

Solution:

(b) Cry endotoxin obtained from Bacillus thuringiensis are effective against bollworms. A bollworm is a common term for any larva of a moth that attacks the fruiting bodies of certain crops, especially cotton.

Question54

A transgenic food crop which may help in solving the problem of night blindness in developing countries is (2008)

Options:

A. Bt soybean

B. Golden rice

C. Flavr Savr tomatoes

D. Starlink maize

Answer: B

Solution:

Solution:
Transgenic plants are resistant to diseases, pests, pesticides etc, can tolerate adverse environmental condition, can produce pharmaceutically important compounds like antibodies, vaccines, etc. Golden rice, developed at Swiss Federal Institute of technology is a transgenic plant, rich in vitamin A (β carotene) may help in solving the problem of night blindness in developing countries.

Question55

Main objective of production/use of herbicide resistant GM crops is to (2008)

Options:

A. encourage eco-friendly herbicides

B. reduce herbicide accumulation in food articles for health safety

C. eliminate weeds from the field without the use of manual labour

D. eliminate weeds from the field without the use of herbicides

Answer: C

Solution:

(c) : Genetic engineering has helped to develop such transgenic crop plants which are resistant to herbicides so that they

are not damaged when farmers spray herbicides in the fields. Herbicide resistant plants have been developed in such a way that they continue to produce normal crop yield and at the same time remain unaffected by the activity of herbicides. These plants also reduces the use of weeding labour, farmer's cost and increases yield.

Question56

Human insulin is being commercially produced from a transgenic species of
(2008)

Options:

A. Rhizobium

B. Saccharomyces

C. Escherichia

D. Mycobacterium

Answer: C

Solution:

Solution:
(c) : Insulin is now being commercially produced by genetic engineering. Insulin consists of two short polypeptide chains: chain A and chain B, that are linked together by disulphide bonds. Insulin, in mammal is synthesised as a prohormone which contains an extra stretch called the C-peptide. During maturation this C-peptide is removed. The production of insulin could only have been commercially possible if somehow the maturation process of C-peptide been skipped. This problem was solved in 1988 by Eli Lilly, an American company which prepared functionable insulin from two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli to produce insulin chains. In this way, chains A and B were produced separately which was extracted, combined by creating disulfide bonds to get human insulin.

Question57

A genetically engineered micro-organism used successfully in bioremediation of oil spills is a species of
(2007)

Options:

A. Trichoderma

B. Xanthomonas

C. Bacillus

D. Pseudomonas

Answer: D

Solution:

(d) : Bioremediation is the process of using living micro-organisms to clean up a contaminated site. Micro-organisms do this by removing toxins from materials. They decompose these compounds by using enzymes, specific proteins that control reactions in living cells. Organisms that produce enzymes capable of degrading petroleum are useful in cleaning up oil spills. Some common ones that break down oil are genetically engineered species of Pseudomonas and Azotobacter. Bioremediation accounts for 5 to 10 percent of all pollution treatment and has been used successfully in cleaning up leaking underground gasoline storage tanks. Bioremediation has many applications, from the ordinary garden compost to the removal of selenium and other toxic metals from waste. The best agents for bioremediation are the ones that can break down contaminants without becoming contaminated or harmful themselves.

Question58

Golden rice is a promising transgenic crop. When released for cultivation, it will help in (2007)

Options:

A. producing a petrol-like fuel from rice

B. alleviation of vitamin A deficiency

C. pest resistance

D. herbicide tolerance

Answer: B

Solution:

Solution:
(b) : Rice produces carotene in the leaves but the biosynthetic pathway is turned off during plant development in grains. Transgenic rice, Golden Rice, was engineered by inserting two genes that restart the carotenoid biosynthetic pathway leading to the production and accumulation of carotene in the grains. These are the naturally occurring down-regulated genes. But the transgenic variety does not show down regulation and grains are rich in vitamin A.

Question59

Bacillus thuringiensis (Bt) strains have been used for designing novel (2005)

Options:

A. biofertilizers

B. bio-metallurgical techniques

C. bio-mineralization processes

D. bioinsecticidal plants

Answer: D

Solution:

Solution:
(d) : Bacillus thuringiensis strains have been used for designing bioinsecticidal plants. A gene from this bacteria have insecticidal property which is transferred to cotton plants to produce Bt cotton which is resistant to bollworm insect which is a major pest of cotton. Similarly insects affecting maize; cabbage, sunflower etc., are also controlled by mutant strains of Bacillus thuringiensis bacteria.

Question60

Production of a human protein in bacteria by genetic engineering is possible because
(2005)

Options:

A. the human chromosome can replicate in bacterial cell

B. the mechanism of gene regulation is identical in humans and bacteria

C. bacterial cell can carry out the RNA splicing reactions

D. the genetic code is universal

Answer: D

Solution:

Solution:
(d) : Genetic code may be defined as the sequence of nucleotides in polynucleotide chain which determines the sequence of amino acids in a polypeptide chain. Thus the genetic code is universal. These is no ambiguity regarding genetic code. It means that each codon codes for the same amino acid in all organisms including bacteria, plants and animals.

Question61

Golden rice is a transgenic crop of the future with the following improved trait
(2005)

Options:

A. insect resistance

B. high lysine (essential amino acid) content

C. high protein content

D. high vitamin-A content

Answer: D

Solution:

Solution:
(d) : Golden rice is a transgenic crop rice with high vitamin A content. It has been developed by transferring beta carotene synthesizing gene into the transgenic rice. Beta carotene is the precursor of vitamin A. This transgenic rice has been crossed with the already adapted varieties of rice to make them grow well in a particular area. It is very useful for the people suffering from vision impairment due to vitamin A deficiency.

Question62

DNA fingerprinting refer to
(2004)

Options:

A. molecular analysis of profiles of DNA samples

B. analysis of DNA samples using imprinting devices

C. techniques used for molecular analysis of different specimens of DNA

D. techniques used for identification of fingerprints of individuals

Answer: A

Solution:

Solution:
(a) : DNA fingerprinting is a technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. The difference of about 0.1% or 3×10^6 base pairs (out of $3 \times 10^9 \mathrm{bp}$) provides individuality to each human being. Human genome possesses numerous small noncoding but inheritable sequences of bases which are repeated many times. These sequences occur near telomere, centromeres, Y chromosome and heterochromatic area. The area with same sequence of bases repeated several times is called repetitive DNA. It is separated as satellite from the bulk DNA during density gradient centrifugation and hence called satellite DNA where, repetition of bases is in tandem. Satellite DNAs show polymorphism (the occurrence of mutations in a population at high frequency), which is the basis of genetic mapping of human genome as well as DNA fingerprinting. While mutations in genes produce alleles with different expressions, mutations in noncoding repetitive DNA have no immediate impact. These mutations which have piled up with time form the basis of polymorphism.

Question63

The T i plasmid, is often used for making transgenic plants. The plasmid is found in
(2004)

Options:

A. Azotobacter

B. Rhizobium of the roots of leguminous plants

C. Agrobacterium

D. Yeast as a 2mm plasmid

Answer: C

Solution:

Solution:
(c) : Ti plasmid (tumor inducing) from the soil bacterium Agrobacterium tumefaciens is effectively used as vector for gene transfer to plant cells. The part of Ti plasmid transferred into plant cell DNA, is called the T-DNA. This T-DNA with desired DNA spliced into it, is inserted into the chromosomes of the host plant where it produces copies of itself, by migrating from one chromosomal position to another at random. Such plant cells are then cultured, induced to multiply and differentiate to form plantlets. Transferred into soil, the plantlets grow into mature plants, carrying the foreign gene, expressed throughout the new plant.

Question64

ELISA is used to detect viruses where the key reagent is (2004, 2003)

Options:

A. alkaline phosphatase

B. catalase

C. DNA probe

D. RNase.

Answer: A

Solution:

Solution:
(a) : ELISA (enzyme linked immunosorbent assay) screening test is the initial test to diagnose AIDS. The test works by detecting anitibodies/ substances or protein which are produced in the blood when virus is present. Alkaline phosphatase and peroxidases are commonly used enzymes as key reagent to perform the ELISA test. These enzymes are used to provide antibody-antigen complex in a specialised ELISA plate or tray. In ELISA test for detecting a particular antigen, its antibody is buffered and a drop of serum (supernatant of centrifuged blood) poured over it If the latter contains antigen, it will produce antigen antibody complex. A second enzyme labelled antibody is added. It forms enzyme-antigenantibody complex, if the antigen is present. Substrate is now added. It produces a stain if the antigen is present.

Question65

The term 'humulin' is used for (1999)

Options:

A. hydrolytic enzyme

B. powerful antibiotic

C. human insulin

D. isoenzyme.

Answer: C

Solution:

Solution:
(c) : Human insulin (humulin) is the first therapeutic product produced by means of recombinant technology by Eli lilly and Co. on July 5,1983

Question66

The first transgenic crop was (1999)

Options:

A. tobacco

B. cotton

C. pea

D. flax.

Answer: A

Solution:

Solution:
(a) : Transgenic plants are those plants in which a foreign gene has been introduced and stably integrated into host DNA. The first transgenic plants were produced in tobacco (Nicotiana tabacum). A gene resistant to PPT (L-phosphinothricin), an active ingredient of herbicide 'Basta', was isolated from Medicago sativa. It inhibits the enzyme GS (glutamine synthase) which is involved in ammonia assimilation. This gene resistant to PPT was incorporated into tobacco, as a result of which transgenic tobacco was produced which was resistant to PRT.

Question67

The transgenic animals are those which have (1995)

Options:

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 (b)

Answer: C

Solution:

(c) : Transgenic organism is one that has become transformed following the introduction of novel genes into its genome. It is most frequently achieved by integration of cloned DNA sequences following their injection into the fertilized egg. This fertilized egg divides mitotically to form the whole organism so that all the cells of the organism will carry the transferred gene. The transferred genes are known as transgenes. Transgenesis can be done by pronuclear microinjection and somatic cell nuclear transfer or cloning. Transgenic animals produced by this technology include mice, Drosophila, Xenopus and some of the fish species.
