CBSE Class 12 Biology
Important Questions
Chapter 12
Biotechnology and its Applications

1 Marks Questions

1. Name the technique based on the principle of antigen-antibody interaction used in detection of a virus (HIV).

Ans.ELISA (Enzyme linked immuno - sorbent Assay)

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2. Development of a transgenic food crop may help in solving the problem of night blindness in the developing countries, name this crop plant.

Ans. Golden Rice

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3. Which nematode infects the roots of tobacco plant and causes a great reduction in yield?

Ans. Meloidegyneincognitia.

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4. The first transgenic cow, produced human protein - enriched milk. Name the cow and the protein found in milk.

Ans. Rosie, alpha-lactalbumin

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5. The insulin produced using recombinant DNA technology is more advantageous than the insulin extracted from pancreas of slaughtered cattle and pigs. How?

Ans. Insulin obtained from animal source causes allergy.

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6. Name two pest resistant plants produced by using recombinant DNA technology.

Ans. Bt Cotton, Bt Corn, BtBrinjal.

7.Name the genetically engineered human Insulin?

Ans. Humulin

8.Write the Scientific name of nematode that attacks the root of tobacco plant?

Ans. Meloidogyneincognitia.

9.Define a patent?

Ans. Patent is the government protection to the inventor of biological material, Securing to him for a specific time the exclusive right of manufacturing, exploiting, using & selling an invention.

10.Expand GEAC.

Ans. Genetic Engineering Approval Committee.

11.Name the first transgenic cow?

Ans. Dolly.

12.Which vaccine was being tested on mice?

Ans. Polio vaccine.

13.Name the bacterium which is used to produce insect-resistant plants by genetic engineering.

Ans. Bacillus thuringiensis.

14.Name any disease against which vaccine is developed lay Recombinant DNA technology.

Ans. Hepatitis B vaccine.

15.Name the technique which is used to detect HIV in Suspected AIDS patient?

Ans.PCR (polymerase chain reaction)

16.Name any two diseases for which transgenic mice are used as model organisms.

Ans. Rheumatoid Arthiritis& cystic fibrosis.

17.What is the difference between 'Cry' & 'CRY'.

Ans. Cry is the gene which codes for Bt-toxin which is an insecticidal protein while CRY is the protein coded by cry genes.

18.Name any one disease for which gene therapy has been proved effective?

Ans. Adenosine deaminase deficiency (ADA).

2 Marks Questions

1. What are the two methods for correcting ADA deficiency in a child?

Ans. Bone marrow transplantation having functional ADA enzyme and Enzyme replacement therapy.

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2. Some crop plants are modified genetically by manipulating their genes. How are they made beneficial?

Ans. More tolerant to abiotic stresses; pest resistant; reduction in post harvest losses; increased nutritional value of food.

3. GEAC is one of the organisation set up by Indian Government. Write its full form. Give its two objectives.

Ans.GEAC - Genetic Engineering approval committee. Objectives of GEAC as below:

(i) To make decisions regarding validity of GM research.

(ii) Safety of introducing GMO for public use.

4. "Industrialised nations are exploiting the bioresources of under industrialised nations. Justify the statement with a suitable example.

Ans. Industrialised nations are collecting and patenting the genetic resources of under industrialised country like India. An American Company got patent rights on Basmati rice.

Valuable biomolecules obtained from bioresources are patented and used for commercial purposes.

5.What is Golden rice? What is its advantage?

Ans. Golden rice is a transgenic variety of rice which contains a gene which codes for Vitamin A precursor. This variety have green yellow coloured grains and is rich in Vitamin A & thus nutritionally very advantageous.

6.What are the three critical research areas in the field of Biotechnology?

Ans. i) providing best catalyst in the form of improved organism usually in the form of microbe or pure enzyme.

ii) Creating optimal conditions through engineering for a catalyst to function.

iii) downstream processing to purify the protein / organic compound.

7.What are the advantages of molecular diagnostics over conventional methods?

Ans. In conventional methods, presence of pathogen is normally suspected only when pathogen has produced a disease symptom. By this time the concentration of pathogen is already very high in Body which could be harmful but with molecular diagnostics, Small amount of pathogen could be detected by amplification by PCR.

8.What are genetically modified organisms? Name two factors on which their behaviour depends?

Ans. Those organisms whose genes have been altered by manipulation, are called genetically modified organism or transgenic organisms. The two factors on which their behaviourdepends:-

i) proper insertion of gene of interest.

ii) Proper harvesting of Genetically modified organisms to produce desired product.

9.What do you mean by "Biopiracy" Give an example?

Ans. Biopiracy refers to the use of bio-resources lay multinational companies & other

organizations without proper authorizations from the countries & people concerned eg. Basmati rice grown in India is distinct for its unique flavor & aroma but an American company got patent rights on Basmati through US patent.

10.What are transgenic Bacteria? Illustrate using any one example?

Ans. The bacteria in which genes of interest (i-e. foreign DNA fragment) have been introduced are calls transgenic bacteria eg. Ecol when two DNA sequences A & B chains of insulin are introduced into plasmid of this bacteria, then it is called transgenic bacteria & Start to produce insulin chain.

11.Give any two examples of products, how transgenic animals can be used to produce biological compounds?

Ans. i) Alpha-1-antitrypsin – a protein that is used to treat emphysema.

ii) Alpha – lactalbumin – protein – rich milk that is more nutritionally balanced product for humanbabies?

12.How is autoradiography used to detect a mutated gene?

Ans.A single stranded DNA or RNA tagged with radioactive molecule is allowed to hybridise to its complements DNA in a clone of cells followed by detection using autoradiography. The clone having the mutated gene will hence not appear on photographic film because probe will not have complementarily with mutated gene.

13.Whydid Bacterial toxin does not kill the bacteria but only the insects?

Ans. Bacterial toxin does not kill the Bacillus because. But toxic protein exist as inactive protoxin but once an insect ingest the inactive protoxin it is converted into active form of toxin due to alkaline pH of gut which solublises the crystal. The activated toxin binds to surface of midgut epithelial cells & create pores that cause cell swelling &lysis.

14.Mention any four applications of Biotechnology in the field of Agriculture?

Ans.i) to made crops tolerant to abiotic stresses eg. cold, drought, salt, heat.

ii) to reduce reliance on chemical pesticide by producing pest-resistant crops.

iii) increased efficiency of mineral usage by plants.

iv) enhanced nutritional value of food eg. Vit – A rich golden rice.

15.Why is recombinant Insulin produced by genetic engineering need to be processed?

Ans. Recombinant Insulin produced by Genetic engineering need to be processed because insulinwhich is produced as proinsulin contains an additional C-peptide apart from $\alpha - \&\beta$-chain ofinsulin so, to make an active insulin vaccine; a peptidase enzyme is added to proinsulin to cleave C peptide& rejoining of $\alpha - \&\beta$- chain to form active Insulin.

3 Marks Questions

1. Some multinational companies and other organisations are using bioresources for commercial benefits, without proper authentication and compensation to concerned authorities.

(a) Give the term for this unauthorised act.

(b) Suggest any two ways to get rid of this.

Ans. (a) Biopiracy

(b) (i) Benefits of bioresources should be shared between developed and developing nations

(ii) Laws should be developed to prevent unauthorsied exploitation of them bioresources.

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2. A bacterium Bacillusthuringiensis produces a toxic protein named 'cry protein' that is lethal to certain insects but not to bacterium

(a) Why this toxin does not kill the bacteria?

(b) What type of changes occur in the gut of insects on consuming this protein?

(c) How man has exploited this protein for his benefit?

Ans. (a) Produced in inactive form as Prototoxins.

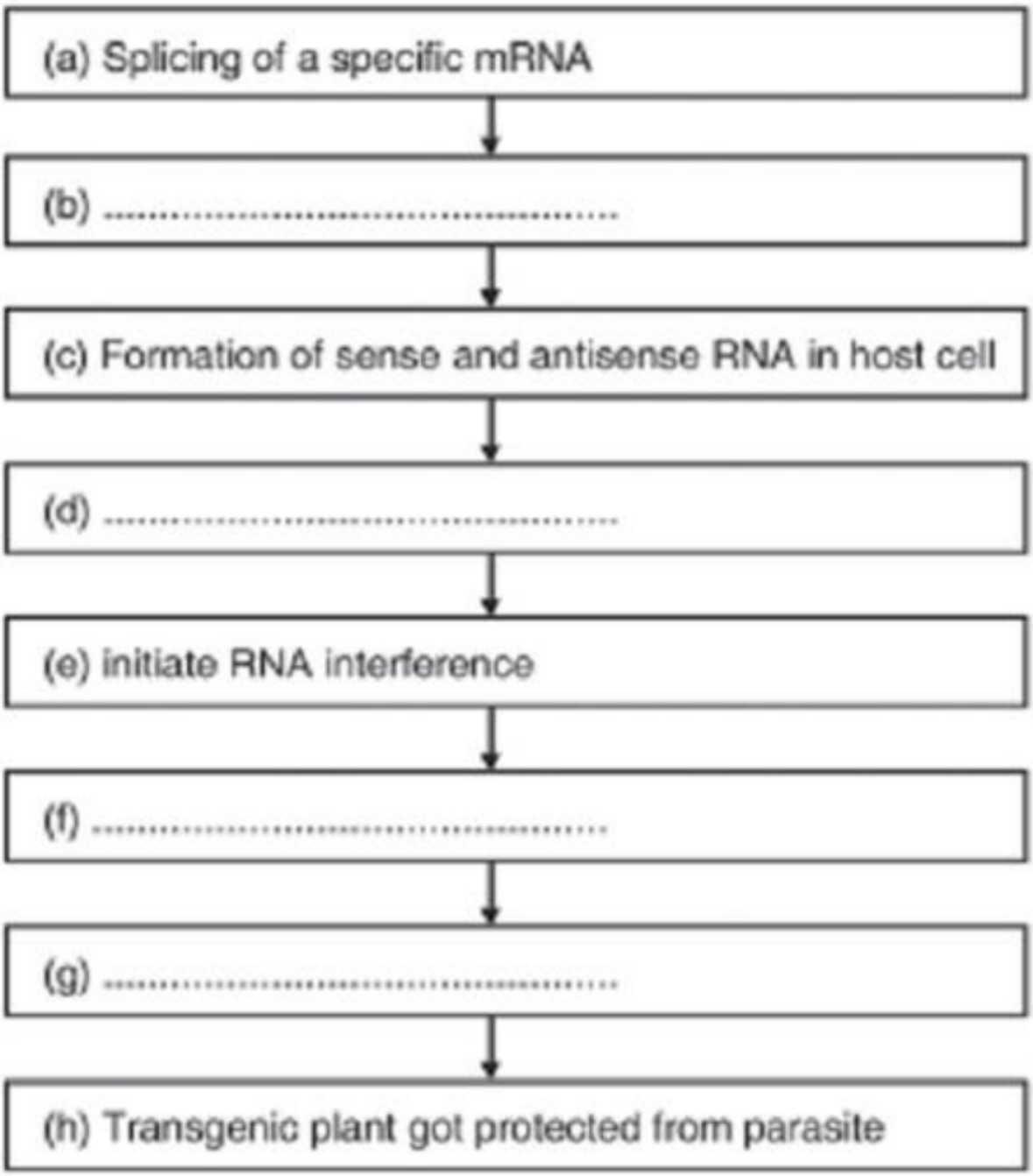
(b) Prototoxin becomes active toxin in alkaline pH of gut of insects. Toxins bind to surface of midgut and cause perforation, swelling, lysis of cells ultimately leading to death.

(c) Specific Bt toxin genes isolated from Bacillusthuringiensis and incorporated into several crop plants such as cotton and corn which become pest resistant against certain insects.

3. Given below is an incomplete flow chart showing the process of production of nematode resistant tobacco plants based on RNAitechnique.

(i) Write the missing steps in proper sequence

(ii) At which level RNAi silences the gene?



Ans. (i) (b) Using Agrobacterium as a vector, introduced into tobacco

(d) dsRNA (double stranded RNA)

(f) Silenced specific mRNA of the nematode

(g) Parasite could not survive.

(ii) RNAi silences the gene at translation level

4.Describe with example, Why transgenic animals are produced?

Ans..Transgenic animals are produced for following purposes:-

1. To allow the study of how genes are regulated & how they affect normal function of body & its development eg. information obtained about biological role of insulin like growth factor.
2. To increase our understanding on how genes contribute to development of diseases.
3. To produce useful biological compounds by introducing a portion of DNA that codes for that product from other organisms, eg. α-1 antitrypsin, a protein used to treat emphysema.
4. For testing the safety of vaccine eg. polio vaccine in transgenic mice.
5. To test the toxicity of drugs.

5.Describe how nematode – resistant transgenic plants have been obtained?

Ans.A nematode Meloidogyne incognita infects tobacco plant &reduces its yield. The specific genes fromparasite are introduced into plant using Agrobacterium. The genes are introduced in such a way that bothsense& Antisense RNA are produced. Since these two RNAs are complementary, they form a doublestranded RNA (ds RNA). This neutralizes the specific RNA of nematode by a process called RNAinterference as a result, the parasite cannot live in transgenic host & plant is protected from the pest.

6.What are Cry proteins? Name an organism that produces it. How has man exploited this protein to his benefit?

Ans. The soil bacterium Bacillus thuringiensis produces crystal proteins called cry proteins that are toxicto larvae of insects like tobacco budworm, beetles & mosquitoes. The cry proteins exist as inactiveprotoxin& gets converted into active toxin when ingested lay the

insect, as the alkaline pH of gutSolublises the crystal. The activated toxia binds to surface of epithelial cells ofmidgut& create pores thiscauseslysis of cells leading to death of insects.The genes encoding this protein are isolated from bacterium & incorporated into crop-plant to make them insect – resistant.

7.Write an account on the production of human insulin in transgenic organisms.

Ans. Human insulin consists of two short polypeptide chains: chain A & B linked by disulfide bonds.Insulin is secreted as prohormone which has to be processed before it becomes a mature & functionalhormone. The prohormone contains another polypeptides called C-peptide which is removed during

maturation.Using genetic engineering, the two DNA sequences coding for chains A & B of human insulin areintroduced into plasmid of E – coli – to produce insulin. The two chains produced are extracted &combinedby creating disulfide bridges.

8.Compare & contrast the advantages & disadvantage of production of Genetically modified organisms?

Ans. ADVANTAGES OF PRODUCING GMOS.

1. GM crops produce desired phenotypic traits in crop plants.
2. The genes responsible for production of specific proteins are inserted into GM crops. These crops then produce that specific protein.
3. Transgenic crops synthesizes new end product of specific biochemical pathway.
4. These crops also help in preventing expression of existing native Gene.

DISADVANTAGES OF PRODUCING GMOS:

1. Transgenic crops may endanger wild & native species.
2. GM crops may cause health problems by supplying allergens.
3. GM crops may damage to the natural environment.

9.What is RNA Silencing? How is this strategy used to create pest – resistant plants?

Ans.RNA silencing is a technique which involves silencing or disabling of specific mRNA due

tocomplementary ds RNA molecule that binds to & prevent translation of mRNA. This strategy is used toprevent infection of roots of tobacco plants lay nematode Meloidegyne incognita. In this strategy, complementary ds RNA is produced against specific mRNA. The source of this complementary RNA couldbe from an infection by viruses having RNA genomes. Using Agrobacterium vector nematode specificgenes were introduced into host plant. The introduction of DNA was such that it produced both sense &anti-dense RNA in the host cell. These two RNA's being complementary to each other formed a doublestrand RNA that initiated RNAi& thus silenced specific mRNA of the nematode. The consequence wasthat parasite could not survive in transgenic host.

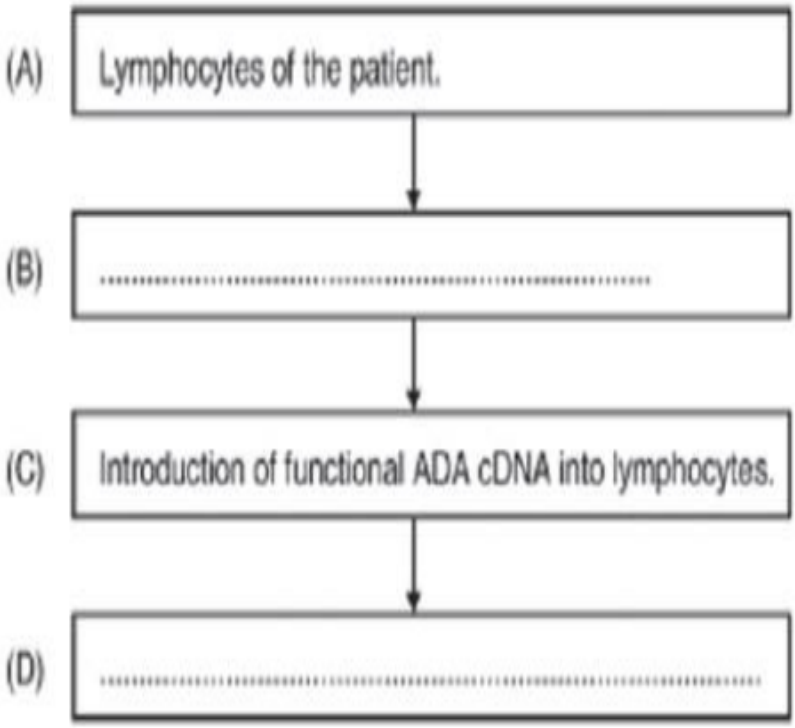
10.What are the steps involved in synthesis of genetically engineered insulin.

Ans. Steps involved in Insulin production are :-

1. for synthesis of Insulin, RNA is extracted from $\beta-$cells of islets of Langehans of pancreas.
2. With the help of enzyme Reverse transcriptase, single stranded DNA complementary to mRNA is synthesized second strand of DNA complementary to first is synthesized with enzyme DNA polymerase.
3. The two strands of copy DNA is joined to plasmid by using an enzyme called terminal transferase.
4. The two ends of DNA get annealed by enzyme called ligase thus ends of inserted DNA & plasmid are sealed & a new circular plasmid is formed. This is a molecule of recombinant DNA.
5. This recombinant DNA is then inoculated in a new bacterial cell of E-coli & inserted in a bacterial gene after having cut by restriction enzyme.
6. After proper expression of genes the bacterial cells of both cultures are lysed with appropriate chemicals. The fragments of insulin are then separated from enzyme by cyanogen bromide.

5 Marks Questions

1. The clinical gene therapy is given to a 4 years old patient for an enzyme which is crucial for the immune system to function.



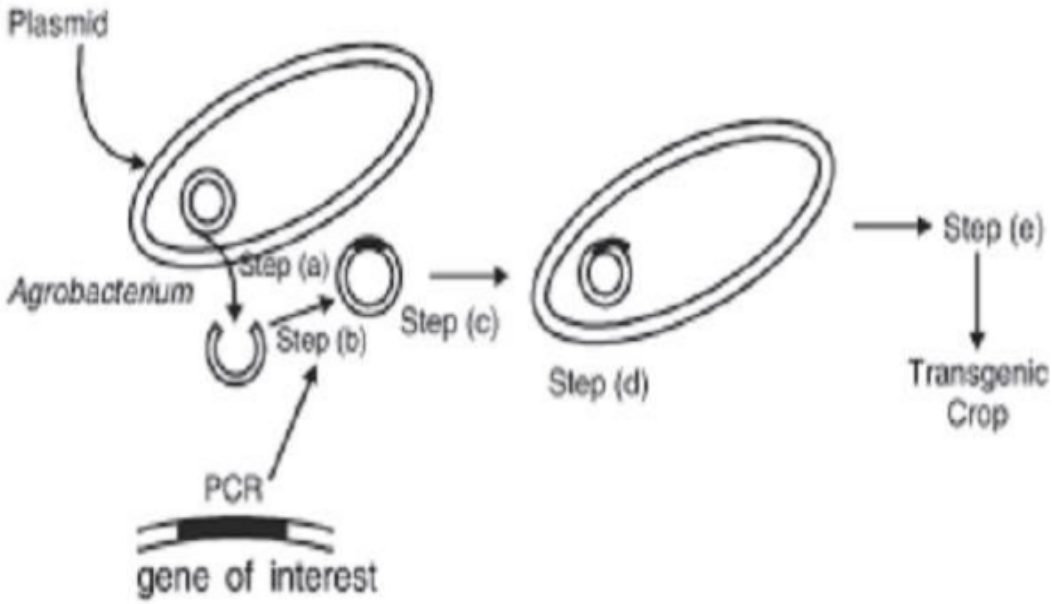
Observe the therapeutical flow chart and give the answer of the following:

(a) Complete the missing steps (B) and (D)
(b) Identify the disease to be cured.
(c) Why the above method is not a complete solution to the problem?
(d) Scientists have developed a method to cure this disease permanently. How?

Ans. (a) Step (B) : Lymphocytes are grown in culture medium. Step (D) : Infusion of genetically engineered lymphocytes into patients.
(b) Adenosine deaminase (ADA) deficiency.

(c) As genetically engineered lymphocytes are not immortal, the patient requires periodic infusion of cells.
(d) If the gene isolated from bone marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

2. In the given figure, Agrobacterium is utilized for the production of a transgenic crop. Explain the steps a, b, c, d and e shown in the figure.



Ans. Step (a) Plasmid is removed and cut open with restriction endonuclease.

Step (b) Gene of interest is isolated from another organism and amplified using PCR
Step (c) New gene is inserted into plasmid
Step (d) Plasmid is put back into Agrobacterium
Step (e) Agrobacterium based transformation.

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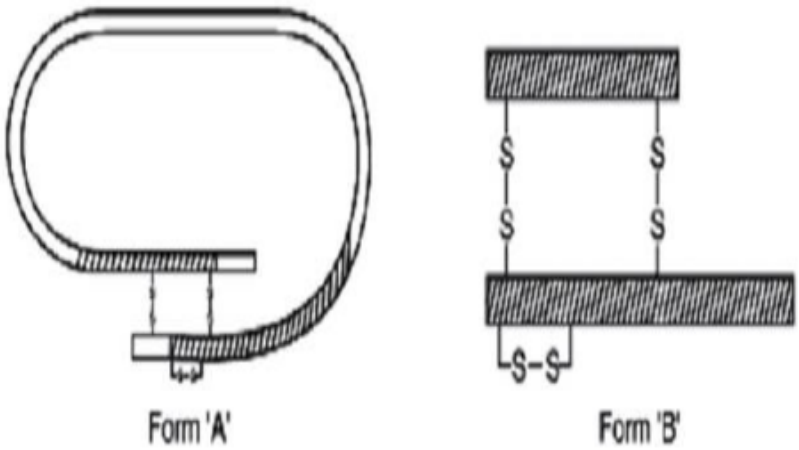
3. In the given figure, Form (A) and Form (B) represents different forms of a proteinaceous hormone secreted by pancreas in mammals.



(a) What type of bonding is present between chains of this hormone?
(b) What are these form (A) and form (B). How these forms differ from each other?
(c) Explain how was this hormone produced by Eli Lilly, an American company, using rDNA technology.

Ans. (a) Disulphide bonds
(b) Form (A) - Proinsulin

Form (B) - Mature insulin.Proinsulin contains an extra stretch called C peptide which is absent in mature insulin.

(c) Eli Lilly company prepared two DNA sequences corresponding to A and B peptide chains of human insulin and introduced them in plasmid E. coli to produce insulin chains. Chains A and B were producedseparately, extracted and combined by creating disulphide bonds to form insulin.

4.What is Gene therapy – Illustrate using example of Adenosine deaminase deficiency?

Ans. Gene therapy is a collection of methods that allows correction of a gene defect. In this method,genes are inserted into the cells & tissues of an individual to correct certain hereditary diseases. Itinvolves delivery of a normal gene into the individual or embryo to replace the defective mutant allele of the gene. Viruses which attack the host cell & introduce genetic material into host are usedas vectors.

For example Adenosine deaminase (ADA) deficiency can be cured by bone marrow transplantation in some children but is not curative for Gene therapy, lymphocytes are grown in a culture & functional ADA, cDNA is introduced into these lymphocytes. These lymphocytes are then transferred into body of patient the patient requires infusion of such genetically engineered lymphocytes.