

SAMPLE QUESTION PAPER

Biology (Theory) - Class XII (Code A)

Time : 3 Hours

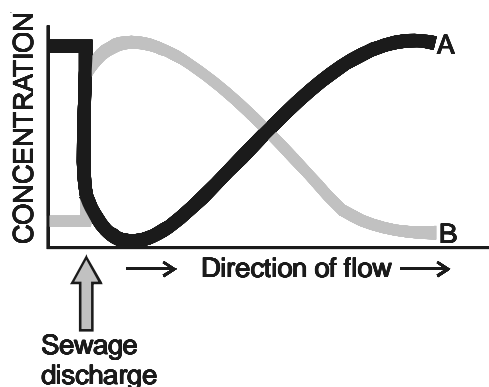
Max. Marks : 70

General Instructions :

- (i) All questions are compulsory.
- (ii) The question paper consists of four sections A, B, C and D.
- Section A** contains 8 questions of **1 mark** each.
- Section B** is of 10 questions of **2 marks** each.
- Section C** has 9 questions of **3 marks** each, whereas **Section D** is of 3 questions of **5 marks** each.
- (iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.
- (iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

SECTION - A

1. Write chromosome numbers in meiocytes of maize and rice plants. [1]
2. Which human chromosome has the most genes and how many genes are present on this chromosome? [1]
3. Name the recent extinctions from Africa and Russia respectively. [1]
4. Effect of sewage discharge into a river is shown below [1]



Out of curve A and B, which one is representing DO curve?

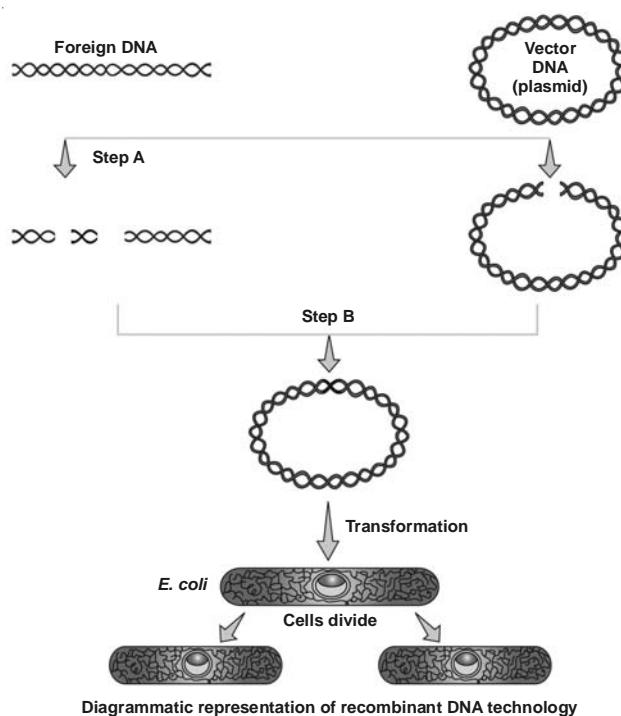
5. Write the numerical expression for a J-shape curve. [1]
6. What is meant by 'Golden Rice'? In what way it is different from the normal rice? [1]
7. Define 'dependence' w.r.t. drugs/alcohol. [1]
8. The *Agrobacterium* is considered as 'Natural Genetic Engineer of Plants'. Comment. [1]

SECTION - B

9. Mention the cellular stage of pollen grain at the time of pollination in majority of angiosperms. Write the correct developmental sequence of male gametes from sporogenous cell. [2]
10. What is apomixis? Give two examples. [2]
11. Name the blank spaces **a**, **b** and **c** given in the following table. [2]

Crop	Variety	Resistance to disease
<i>Brassica</i>	Karan rai	a
b	Pusa Komal	Bacterial blight
Chilli	c	Chilli mosaic virus, TMV and leaf curl

12. Why are predators prudent in nature? [2]
13. How is rate of decomposition affected by following factors? [2]
- Lignin and chitin rich detritus
 - Nitrogen and sugar rich detritus
 - Hot and moist environment
 - Low temperature and anaerobiosis.
14. List two criteria used for determining a hot spot. [2]
15. Define parturition and foetal ejection reflex. [2]
16. Following is a diagrammatic representation of recombinant DNA technology. Write down the missing steps A and B in proper sequence. [2]



17. State the principle underlying 'gel electrophoresis' and mention any one application/s of this technique in biotechnology. [2]
18. In case of Bt cotton, how does the toxic insecticide protein produced by the bacterium kill the insect pest. Also name the genes which encode for protein toxins used to control cotton bollworm? [2]

OR

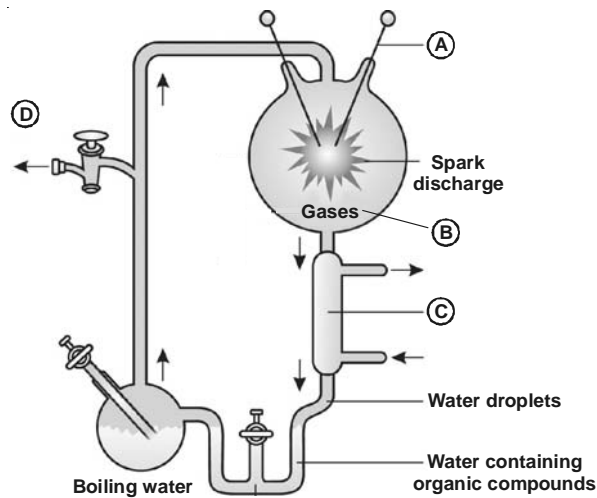
Define the following :

- (a) Periodic abstinence. [1]
- (b) Which type of contraceptive device is displayed in the figure and where it is implanted? [1]



SECTION - C

19. What are flocs? Give their importance in sewage treatment tank. [3]
20. A child has blood group O. If his father has blood group A and mother blood group B. Work out the possible genotypes of the parents and the possible genotypes of the other offsprings. [3]
21. Write down the chromosomal constitution and one important symptom of following syndromes.
- (a) Down's syndrome [1]
- (b) Klinefelter's syndrome [1]
- (c) Turner's syndrome [1]
22. (a) Which international treaty was signed to control emission of ODS. [1]
- (b) Write the names of major greenhouse gases. [1]
- (c) What is snow-blindness? [1]
23. What are biogeochemical cycles? Draw a simplified model of phosphorus cycling in a terrestrial ecosystem. [3]
24. (a) Differentiate between inbreeding and outbreeding. [1]
- (b) What is MOET? [1]
- (c) Differentiate between ZIFT and GIFT. [1]
25. (a) What is MALT? Explain. [1]
- (b) Differentiate between active and passive immunity. Also give examples. [1]
- (c) Following is the diagrammatic representation of Miller's experiment. Mention the correct labelling of A, B, C and D. [1]



26. How homozygosity develops in a population? How it is related to inbreeding depression? [3]
27. Differentiate between
- (a) Divergent and Convergent evolution [1½]
- (b) Stabilising and Directional selection [1½]

OR

Explain the factors which affect Hardy Weinberg equilibrium. Define Founder effect. [3]

SECTION - D

28. (a) Draw the mature embryo sac of a flowering plant and label [3]
- (i) Synergid
- (ii) Central cell
- (iii) Egg cell
- (b) Mention the role played by the polar nuclei and filiform apparatus. [2]
- OR
- (a) Define menarche and menstrual cycle. [2]
- (b) Make a well labelled suitable diagrammatic representation of various events during a menstrual cycle. [3]
29. Explain how biotechnology has been applied in each of the following :
- (a) In producing more nutritionally balanced milk. [2]
- (b) In curing diabetes mellitus. [2]
- (c) In vaccine safety. [1]

OR

What is gene therapy? Explain with an example.

30. What is an operon? Explain with diagram the functioning of *lac* operon in absence and presence of inducer. [5]

OR

What do you mean by semi-conservative mode of replication of DNA? Who proved it in *Escherichia coli* for the first time? Mention the role of DNA polymerase enzyme involved in the process of DNA replication.



Biology (Theory) - Class XII

SOLUTIONS

SECTION - A

1. Maize - 10
Rice - 12
2. Chromosome-1 has the maximum genes, it has 2968 genes.
3. Quagga - Africa
Steller's sea cow - Russia
4. Curve [A] is representing DO, because sewage water contains biodegradable organic matter, which is decomposed by micro-organisms, it decreases DO at the point of sewage discharge.
5. $\frac{dN}{dt} = rN$
6. Genetically engineered 'Golden Rice' is enriched in pro-vitamin A by introducing three genes involved in the biosynthetic pathway for carotenoid the precursor of vitamin A. The seeds of golden rice are yellow in colour because of provitamin A is produced in entire grain.
7. Dependence is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued.
8. *Agrobacterium tumefaciens*, attacks almost all dicotyledonous plants and produces crown galls. These bacteria contain large Ti plasmid which pass on a part of this plasmid called as T-DNA, containing tumor causing gene into the genome of host plant. This gene transfer is happening in nature without human interference, so this bacterium is called as 'natural genetic engineer'.

SECTION - B

9. Pollination in majority of angiosperms occurs at 2-celled stage *i.e.* vegetative cell (tube cell) and generative cell. Sporogenous cell → Microspore mother cell → Microspore tetrad → Pollen grain → Male gametes.
10. Apomixis a special mechanism to produce seeds without fertilization. It is a form of asexual reproduction that mimics sexual reproduction. Example : Species of Asteraceae and grasses.
11. a. White rust
b. Cow pea
c. Pusa Sadabahar
12. Predators are prudent in nature because if it is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct due to lack of food.
13. (a) Slow decomposition
(b) Quick decomposition
(c) Decreases decomposition
(d) Decreases decomposition

14. Any two
- Species richness (number of species present within a unit area).
 - Degree of endemism (species confined to that region and not found anywhere else).
 - Degree of threat due to habitat loss.
15. The process of delivery of foetus is called **parturition**. It is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.
16. **Step A** : Same restriction enzyme is used for cutting both foreign DNA and vector DNA at specific point.
Step B : Ligases join the foreign DNA to the plasmid.
17. The cutting of DNA by restriction endonucleases results in fragments of DNA which can be separated by gel electrophoresis. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode under electric field through a medium/matrix. The most commonly used matrix is agarose gel. The DNA fragments separate according to their size through the sieving effect provided by the agarose gel. Smaller fragments move farther away from starting point.
- Application** : The DNA fragments purified in this way are used in constructing recombinant DNA by joining them with cloning vectors.
18. In the bacterium Bt toxin protein exists as inactive protoxins but once the insect ingests the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilises the crystals. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis and this eventually causes the death of insect.
- The proteins encoded by the genes cry I Ac and cry II Ab control cotton boll worms.

OR

- Periodic abstinence is one of the natural methods of contraception in which the couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle when ovulation could be expected.
- Implants; It contains progesterone only or in combination with estrogen and can be used by females as implants under the skin. e.g. Norplant.

SECTION - C

19. Masses of aerobic bacteria associated with fungal filaments to form mesh like structures are called flocs. While growing, these flocs (microbes) consume the major part of the organic matter in the effluent. This significantly reduces the BOD of the effluent. The sewage water is treated with flocs till the BOD is reduced.
20. A child of blood group O is only possible to a couple of A (father) and B (mother) blood groups, when these parents are heterozygous for blood groups i.e., father has $I^A I^O$ and mother $I^B I^O$ genotypes.

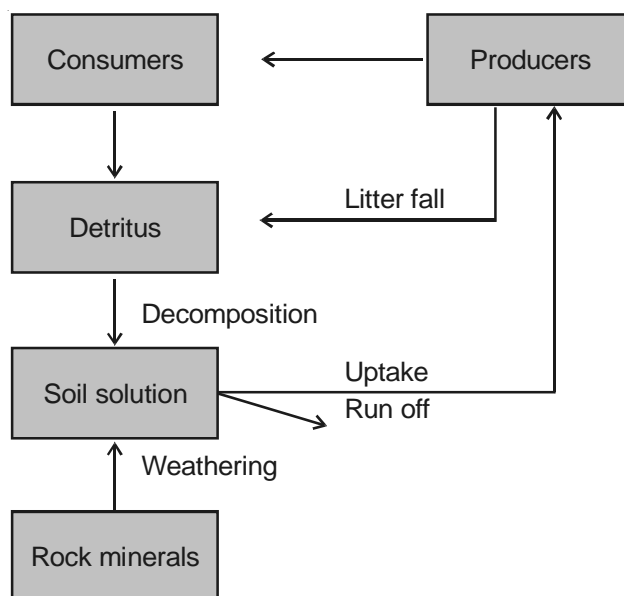
Genotype of parents

$$\begin{array}{c}
 I^A I^O \times I^B I^O \\
 \text{(Father)} \quad \downarrow \quad \text{(Mother)} \\
 \begin{array}{c}
 \text{♀ gametes } I^B \quad I^O \\
 \begin{array}{c}
 \text{♂ gametes } I^A \\
 I^O
 \end{array}
 \end{array}
 \end{array}$$

$I^A I^B$ (AB)	$I^A I^O$ (A)
$I^B I^O$ (B)	$I^O I^O$ (O)

- Genotype of other offsprings is (i) $I^A I^B$ (blood group AB)
 (ii) $I^A I^O$ (blood group A)
 (iii) $I^B I^O$ (blood group B)

21. (a) Chromosome constitution : $AA + 1 + XX$ or $AA + 1 + XY$
 Important symptoms : It is due to trisomy of 21st chromosome, may be male or female, palm crease, mental retardedness, short statured, small round head, furrowed tongue and partially opened mouth. (Any one)
- (b) Chromosome composition : $AA + XXY$
 Important symptom : Sterile males with gynaecomastia.
- (c) Chromosome composition : $AA + XO$
 Important symptoms : Sterile females with rudimentary ovaries and lack secondary sexual characters. (Any one)
22. (a) Montreal protocol
 (b) CO_2 , CFC, CH_4 , N_2O
 (c) High dose of UV-B causes inflammation of cornea which is called snow blindness.
23. The movement of nutrient elements through the various components of an ecosystem is called biogeochemical cycling. It is also called nutrient cycling. A simplified model of phosphorus cycling in a terrestrial ecosystem is given below :



24. (a) When breeding is between the closely related animals of the same breed for 4-6 generations, it is called **inbreeding**. **Outbreeding** is the breeding of the unrelated animals which may be between the individuals of same breed but have no common ancestors. It also includes cross breeding and interspecific hybridisation.
- (b) MOET is a programme for herd improvement. In MOET a cow is administered FSH like hormone to induce more ova formation (superovulation). The animal is either mated with an elite bull or artificially inseminated. The fertilised eggs at 8-32 cell stages, are recovered non-surgically and transferred to surrogate mothers.
- (c) ZIFT is zygote intra fallopian transfer. In this the zygote or early embryos upto 8 blastomeres produced by *In vitro* fertilisation are transferred into the fallopian tubes for further development. Whereas, GIFT – gamete intra fallopian transfer, involves transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development.

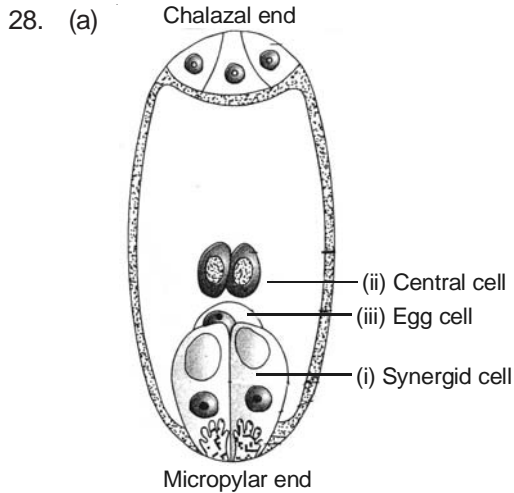
25. (a) **MALT (Mucosal Associated Lymphoid Tissue)** : The lymphoid tissue is located within the lining or mucosal surface of the major tracts like respiratory, digestive and urogenital tracts, called MALT. It constitutes about 50 percent of the lymphoid tissue in human body.
- (b) Active immunity is slow, long lived and takes time to give its full expression. When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the body. Example - injecting microbes deliberately during immunisation or infectious organisms gaining access into the body during natural infection induce active immunity. When readymade antibodies are directly given to protect the body against foreign agents, it is called passive immunisation. The foetus receives some antibodies from their mother through placenta during pregnancy is an example of passive immunity. The yellowish fluid colostrum secreted by mother during initial days of lactation is rich in IgA, antibodies, providing the foetus with passive immunity.
- (c) A - Electrodes, B - Gases, $\text{CH}_4 + \text{NH}_3 + \text{H}_2 + \text{water vapour}$
C - Condensor, D - Vacuum pump
26. Inbreeding increases homozygosity, thus inbreeding is necessary if we want to evolve a pureline in any animal. Inbreeding exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes. However, continued inbreeding, especially close inbreeding, usually reduces fertility and even productivity. This is called inbreeding depression.
27. (a) Divergent evolution is the development of dissimilar functional structures in closely related group of animals. For example, whales, bats, cheetah and humans, all are mammals share similarities in the pattern of bones of forelimbs. Though these forelimbs perform different functions in these animals, they have similar anatomical structure - all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs. In these animals, the same structure has developed along different directions due to the adaptive needs of the organisms. Homology is based on divergent evolution.
- In convergent evolution there is development of similar functional structures in unrelated group of animals. Analogous structures result in convergent evolution, Examples are eye of octopus and eye of mammal. Sweet potato and potato; both have a common function of storage of food. Wings of insect and birds.
- (b) **Stabilizing selection** : When selection acts to eliminate both extremes from an array of phenotypes, the frequency of intermediates type which is already most common is increased. Natural selection can lead to stabilisation in which more individuals acquire mean character value.
- Directional selection** : When selection acts to eliminate one extreme from an array of phenotypes, the genes determining this extreme becomes less frequent in the population. So, here more individuals acquire value other than the mean character value.

OR

This principle says that allele frequency in a population are stable and is constant from generation to generation.

Five factors are known to affect Hardy Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection. When migration of a section of population to another place and population occurs, gene frequencies change in the original as well as in the new population. New genes/alleles are added to the new population and these are lost from the old population. There would be a gene flow if this gene migration, happens multiple times. If the same change occurs by chance it is called **genetic drift**. Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the affect is called **founder effect**.

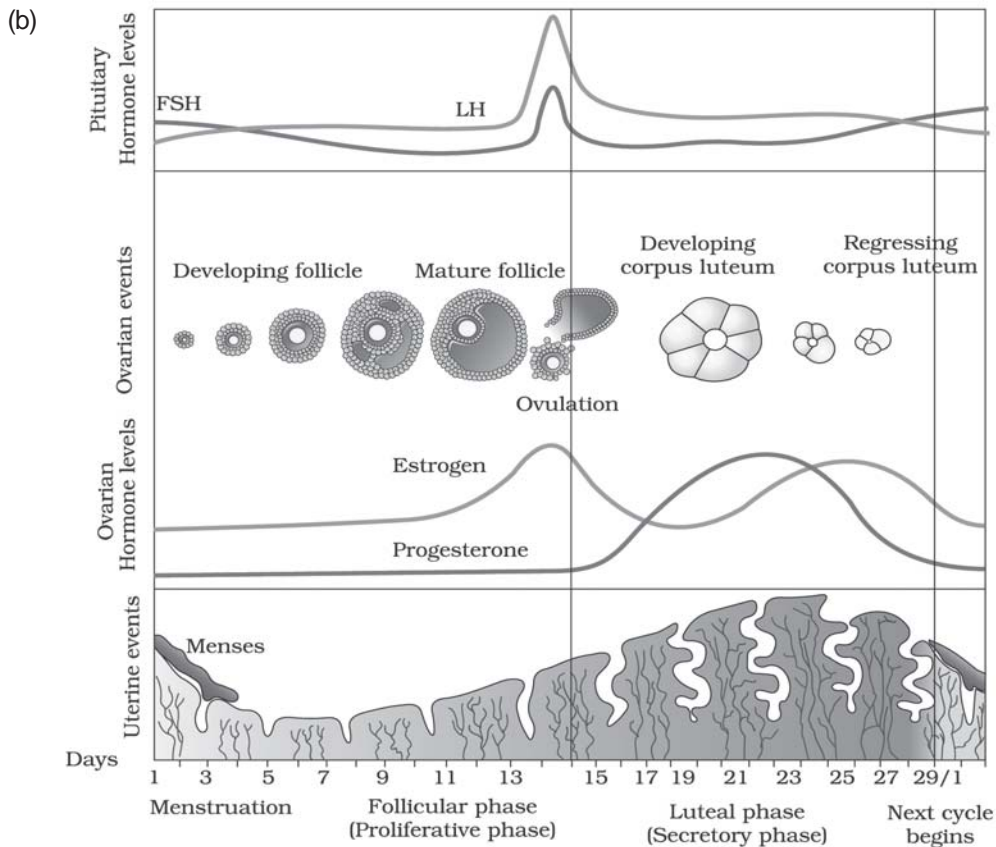
SECTION - D



- (b) Two polar nuclei fuses with one male gamete to produce a triploid primary endosperm nucleus (PEN). As it involves the fusion of three haploid nuclei thus known as triple fusion.
- The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which play an important role in guiding the pollen tubes into the synergid.

OR

- (a) The first menstruation begins at puberty and is called **Menarche**. In human females, menstruation is repeated at an average interval of about 28/29 days, and the cycle of events starting from one menstruation till the next one is called **menstrual cycle**.



29. (a) In 1997, the first transgenic cow, Rosie, produced human protein enriched milk (2.4 grams per litre). The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow milk.
- (b) In 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. The two DNA sequences were prepared by converting the m-RNA of A and B polypeptide chains into DNA with the help of the enzyme reverse transcriptase.

The chains A and B were produced separately, extracted and combined by creating disulphide bonds to form human insulin called as humulin.

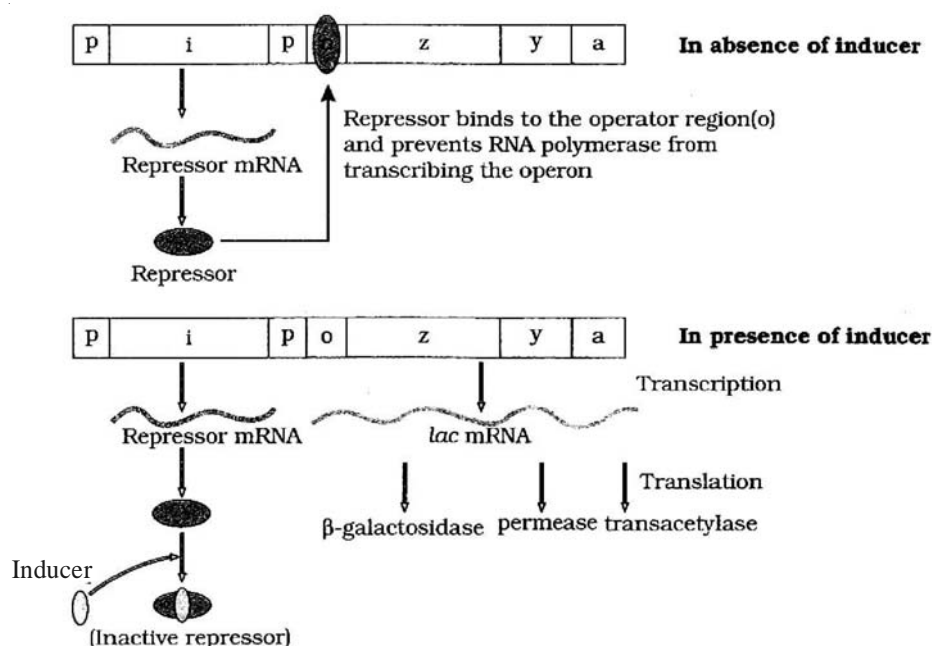
- (c) **Vaccine safety** : Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans. Transgenic milk are being used to test the safety of the polio vaccine. If successful and found to be reliable, they could replace the use of monkeys to test the safety of batches of the vaccine.

OR

Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child or embryo. In gene therapy, 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 years old girl with adenosine deaminase (ADA) deficiency. This enzyme is essential for the immune system to function. The disorder is caused due to the deletion of the gene for adenosine deaminase. In gene therapy, lymphocytes from the blood of the patient are grown in a culture outside the body. A functional ADA cDNA is introduced into these lymphocytes by the use of retroviral vector and that lymphocytes are now returned to the patient. However, as these cells are not immortal, the patient requires periodic infusion of such genetic engineered lymphocytes. If the gene isolate from marrow cells producing ADA is introduced into the cells in early embryonic stages could be a permanent cure.

30. A set of structural genes (polycistronic structural genes) which is regulated by a common promoter, operator and regulator gene is called operon. If such operon is connected with lactose metabolism, then called as *lac*-operon.



Lactose is the substrate for the enzyme β -galactosidase and it regulates switching on and off the operon. Hence, it is termed as **inducer**. In the absence of a preferred carbon source such as glucose, if lactose is provided in the growth medium of the bacteria, the lactose is transported into the cells through the action of permease (a very low level of expression of *lac* operon has to be present in the cell all the time, otherwise lactose cannot enter the cells).

The repressor of the operon is synthesised (all-the-time-constitutively) from the **i** gene. The repressor protein binds to the operator region of the operon and prevents RNA polymerase from transcribing the operon. In the presence of an inducer, such as lactose or allolactose, the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds. Essentially, regulation of *lac* operon can also be visualised as regulation of enzyme synthesis by its substrate.

OR

- During DNA replication, two strands would separate and act as a template for the synthesis of new complementary strands. After the completion of replication, each DNA molecule would have one parental and one newly synthesised strand.

This scheme is termed as semi-conservative mode of replication of DNA.

- It was proved by Matthew Meselson and Franklin Stahl in *Escherichia coli* in 1958.
- DNA polymerase is a DNA dependent enzyme and it uses a DNA template to catalyse the polymerisation of deoxyribonucleotides. These are highly efficient enzymes as they have to function at a faster rate. The average rate of polymerisation has to be 2000 bp per second, hence these have to be very accurate. They polymerise in $5' \rightarrow 3'$ direction only.

