BIOLOGY
PAPER & SOLUTION

Code : SS-42-1-BIO

Time : $3\frac{1}{4}$ Hours **M.M. 56**

General Instruction :

(1) Candidate must write first his/her Roll No. on the question paper compulsorily.

(2) All the questions are compulsory.

(3) Write the answer to each question in the given answer-book only.

(4) For questions having more than one part the answers to those parts are to be written together in continuity.

(5) If there is any error/ difference/ contradiction in Hindi and English versions of the question paper, the question of Hindi version should be treated valid.

(6)

Section	Q. Nos.	Marks per question
A	1-13	1
B	14-24	2
C	25-27	3
D	28-30	4

(7) Question Nos. 24, 27, 28, 29 and 30 have internal choices.

SECTION-A

Q.1 What is emasculation ? **[1]**

Sol. Removal of anther (Male sex organ) of bisexual flower is called emasculation.

Q.2 Write down the name of hormone secreted by ovary in the later phase of pregnancy. **[1]**

Sol. Hormone progesterone is produced by corpus luteum during later phase of pregnancy. It helps in maintaining pregnancy.

Q.3 Mention the application of in vitro fertilization. **[1]**

Sol. In vitro fertilization (IVF) is a method of ART (Assisted Reproductive Technology) to treat infertility.

Q.4 Write down the name of any one natural method of contraceptive. **[1]**

Sol. Following are the natural methods of contraception
(i) Periodic abstinence
(ii) Withdrawl method
(iii) Lactational amenorrhea.

Q.5 On which continent Homo sapiens arose ? **[1]**

Sol. Homo sapiens arose in African continent.

Q.6 Write down the name of typhoid causing pathogen. **[1]**

Sol. Typhoid is a infective disease caused by bacterium Salmonella typhi.

Q.7 How does opioids effect the body ? **[1]**

Sol. Opioids are the drugs which binds to specific opioid receptors present in our central nervous system and gastrointestinal tract and causes change in behaviour.

Q.8 What is Blue-Revolution ? **[1]**

Sol. Blue-Revolution is the culture of edible fishes and other aquatic animals like prawn for their increased yield.

Q.9 Write down the two beneficial roles of bacteria converting milk in to curd. **[1]**

Sol. Bacterium lactobacillus sporogens converts milk into curd. It enhances nutritional value of curd by increasing amount of vitamin B_{12} in it and checks growth of disease causing microbes in our gut.

Q.10 Define Antibiotics. **[1]**

Sol. Antibiotics are the chemical substances produced by microbes that suppress the growth of another microbe.

Q.11 Define gene therapy. **[1]**

Sol. Gene therapy is collection of methods which allow correction of a gene defect that has been diagnosed in individual.

Q.12 Which bacteria produces Bt toxin ? **[1]**

Sol. Bacillus thuringiensis

Q.13 Define population. **[1]**

Sol. Group of individuals present in given area which can interbreed and can produce fertile offspring is called population.

SECTION-B

Q.14 How bisexual and unisexual conditions in fungi and plants are denoted ? **[1+1=2]**

Sol.
Bisexual fungus → Homothallic
Unisexual fungus → Heterothallic
Bisexual plant → Monoecious
Unisexual plant → Dioecious

Q.15 Explain the process of spermatogenesis in detail. **[2]**

Sol. **Mechanism of production of sperms in testis is known as spermatogenesis.**

Spermatozoa are formed by the wall of the seminiferous tubules of the testes. The various cell-stages.in spermatogenesis are as follows (the number of chromosomes at each stage is given in brackets)

An adult male produces over 10^{12} to 10^{13} sperm cells each day. These gradually move into the epididymis and the first portion of the vas deferens, where they undergo further maturation and are stored

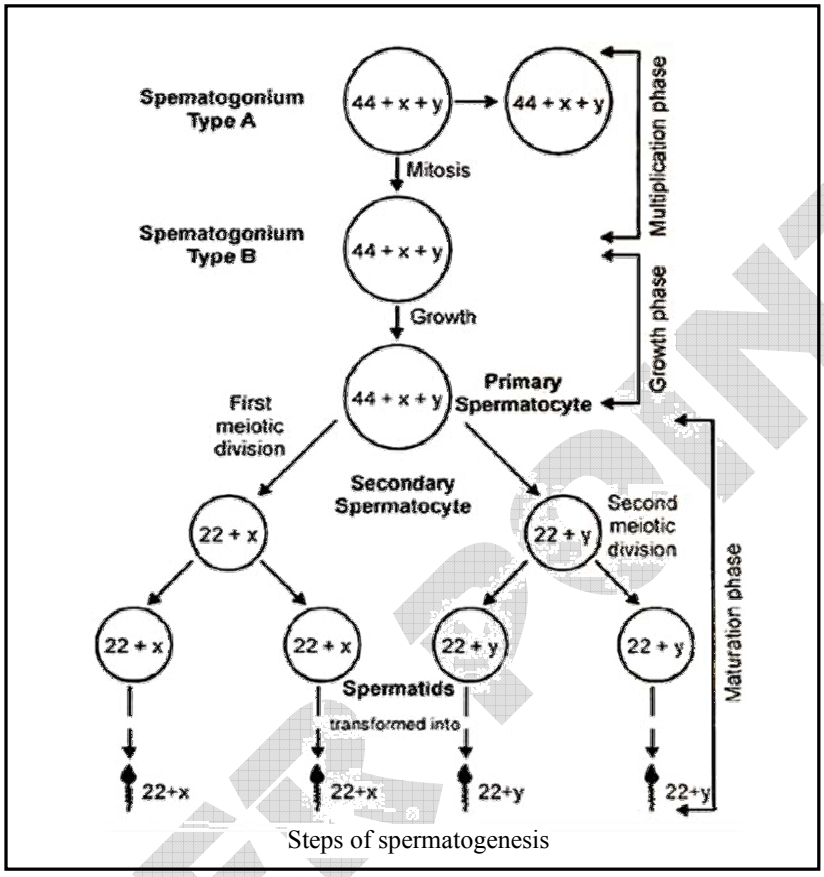
The process of spermatogenesis can be divided in 2 steps –

1. **Spermatocytogenesis :**

- The *spermatogonia (type A)* or *germ cells* (44 X + Y) divide mitotically, to give rise to more spermatogonia of type A (spermatogenic lineage) and also spermatogonia of type B.
- The *spermatogonia (type B)* (44 + X + Y) enlarge, to from primary spermatocytes (spermato cytogeneis)
- The *primary spermatocytes* (44 + X + Y) now divide so that each of them forms two secondary spermatocytes. This is the first meiotic division. it reduces the number of chromosomes to half.
- Each *secondary spermatocyte* has 22 + X or 22 + Y chromosomes. It divides to form two spermatids. This is the second meiotic division and this time there is no reduction in chromosome number.

2. Spermiogenesis

- Each *spermatid* (22 + X or 22 + Y) gradually changes its shape to become a spermatozoon. This process of transformation of a circular spermatid to a spermatozoon is called **spermiogenesis**.



Steps of spermatogenesis

Q.16 What is co-dominance ? With the help of example explain co-dominance in human-being. **[2]**

Sol. Co-dominance is the condition in which f_1 generation resembles with both the parents.

ABO blood group system is good example of co-dominance.

Human blood group gene (I) has three alleles – I^A, I^B, i

Case for person having AB blood group :

	Allele from parent 1	Allele from parent 2	genotype of offspring	Blood group
(i)	I^A	I^B	$I^A I^B$	AB
(ii)	I^B	I^A	$I^A I^B$	AB

Q.17 Write down the four salient features of genetic code. **[4×½=2]**

Sol. **Characteristic of Genetic Code :**

(1) Triplet in Nature -

A codon is composed of **three adjacent nitrogen bases** which specifies the one amino acid in polypeptide chain.

(2) Universality -

The genetic code is applicable universally. The same genetic code is present in all kinds of living organism including viruses, bacteria, unicellular and multicellular organism.

(3) Non-Ambiguous -

Genetic code is non ambiguous i.e. **one codon specifies only one amino acid** and not any other.

(4) Non-Overlapping -
A nitrogen base is a constituent of only one codon.

(5) Comma less -
There is no punctuation (comma) between the adjacent codon i.e. each codon is immediately followed by the next codon.

(6) Degeneracy of Genetic code -
There are **64 codons for 20 types of amino acids**, so most of the amino acids (except two) can be coded by more than one codon. Single amino acid coded by more than one codon is called ***"Degeneracy of genetic code".*** This incident was discovered by **Baurnfield and Nirenberg.**

Q.18 Prove the organic evolution on the basis of comparative anatomy and morphology. **[2]**

Sol. **Morphological and Anatomical Evidences for evolution :**

Different animals and plants show dissimilarities in their structure but in some characters they show similarities. These similarities are of two types.

1. Homology, 2. Analogy

1. Homology – The similarity based on common origin, similar basic plan of organization and embryonic development is called **homology. Similarity in appearance and function is not necessary.** The organs which have common origin, embryonic development and same basic structure but perform different functions are called **Homolgous organ. Homologous term given by Richard Owen.**

Examples of Homologous organs –

(i) Forelimbs of Mammals – Horse, Bat, Whale, Seal, Man

(ii) Legs of Invertebrates – Cockroach, Honey bee

(iii) Mouth parts of Insects – Cockroach, Honey Bee, Mosquito

(iv) Homology is also seen in the skeleton, heart, blood vessels and excretory system of different vertebrates.

(v) Thorn of Bougainvillea and tendril of cucurbita (Modification of axillary bud).

Divergent evolution (adaptive divergence/adaption radiation)

Homology found in different animals indicate their evolution from common ancestors. Species which have diverged after origin from common ancestor giving rise to new species adapted to new habitats and ways of life is called **adaptive radiation,** exhibit large number of homologous organs. Homology shows **Divergent evolution.**

For Example Adaptive radiation gave rise to a variety of marsupials in Australia.

2. Analogy – It is similarity in organs based on similar function. Organs which have different origin and dissimilar fundamental structure but have similar function are called **Analogous organs.**

Examples of Analogous organs –

(i) Wings of bat & birds are analogous to wings of insects.

(ii) Pelvic fins of fish, flipper of seal

(iii) Sting of bee and scorpion.

(iv) Phylloclade of Ruscus and leaf

Convergent evolution (adaptive convergence/parallel evolution)

Development of similar adaptive functional structures in unrelated groups of organisms is called **convergent evolution.**

For Example : Some of the marsupials of Australia resemble equivalent placental mammals that live in similar habitats of other continents.

Q.19 What is innate immunity ? How many types of barriers are present in innate immunity. Write down their names. **[1 + 1 = 2]**

Sol. **Innate Immunity (Congenital Immunity) :**

It is **present by birth** and in most of animal. It is **first line of defense** of body. It is made up of following barriers.

(i) Anatomical Barrier :
Ex. Skin, Mucosal surface

(ii) Physiologocal Barriers : Many physiological functions of body make the unfavourable environment for the growth of microbes.
Ex. Fever, pH of body, Secretions, Interferon

(iii) Phagocytic Barrier :- In response to pathogenic infection, the total count of **WBC** in body **increases**. Phagocytosis is exhibited by some types of WBC's such WBC's are called **phagocytes**.

(iv) Inflammatory Barrier :
Inflammation of any tissue / organ prevents further infection.

Q.20 Write down the objectives of plant breeding. Mention the main steps in breeding any new genetic crop. **[1 + 1 = 2]**

Sol. **Objectives of plant breeding :**

(1) To create desired plant type that are better suited for cultivation
(2) To create plants which give better yield
(3) To create plants which are disease resistant

Steps in breeding any new genetic crop :

(1) Collection of variability
(2) Evaluation and selection of parents
(3) Cross hybridization among selected parents
(4) Selection and testing of superior recombinations
(5) Testing, release and commercialization of new cultivars.

Q.21 Write down the application of biofertilizers. Explain the role of cyanobacteria as a biofertilizer. **[1 + 1 = 2]**

Sol. Biofertilizers are organisms that enrich nutrient quality of soil. Biofertilizers do not contribute in pollution. By using biofertilizers we can avoid unwanted and harmfull effects of chemical fertilizers.

Role of cyanobacteria as Biofertilizer

→ Cyanobacteria can fix atmospheric nitrogen
→ Thus they increase fertility of soil
→ They also add organic matter to the soil and increase fertility of soil.

Q.22 Define Genetically Modified Organism. How GM Plants are useful for us ? **[1 + 1 = 2]**

Sol. Organisms whose genes have been altered by manipulation are called genetically modified organisms. Gene manipulations is done by genetic engineering.

GM plants are usefull for us in following aspects

→ GM crops are more tolerant to abiotic stresses like cold, heat, drought. It makes cultivation of these crops easy.
→ GM crops are pest resistant. Thus yield increases
→ Minimal or No chemical pesticides are required for GM crops. So these crops do not contribute in pollution.
→ GM crops are more efficient in mineral usage.
→ GM crops have enhanced nutritional value of food.
Ex. Vitamin 'A' enriched rice.

Q.23 What is bio-diversity ? Mention the causes of loss of biodiversity. (Any three) **[½ + 1½ = 2]**

Sol. Presence of variety of living organism in the world or in a particular habitat is called Biodiversity.

Diversity at different levels can be mentioned as : -

(1) Genetic diversity
(2) Species diversity
(3) Ecological diversity
→ Biodiversity

Causes of loss of Biodiversity

(1) Habitat loss and fragmentation of large habitat
(2) Over exploitation of natural resources
(3) Alien species invasion

Q.24 What is air pollution ? Describe the efforts made for controlling vehicular air pollutions. **[½ + 1½ = 2]**

Sol. **Air pollution** → Any undesirable change in physical, chemical or biological characters of air is called air pollution.

Efforts made for controlling vehicular air pollution :

(1) All the public transport vehicles of Delhi are switched from diesel to CNG.
(2) CNG burns more efficiently and less unburnt hydrocarbons are released in air.
(3) Old vehicles causing more air pollution are phased out gradually.
(4) Unleaded petrol is being used.
(5) Stringent pollution level norms are applicable on vehicles.
(6) Now a days catalytic converters are used in vehicles.

OR

What is pollution ? Describe the study and efforts made for the remedy of plastic waste. **[½ + 1½ = 2]**

Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil.

Efforts made for remedy of plastic waste :

(1) Ahmed Khan, a plastic sac producers of Bangalore has developed polyblend. It is mixture of recycled modified plastic
(2) Mixture of polyblend with bitumen is used to lay roads.
(3) These roads are more water repelleant hence more durable.
(4) Lying these roads is economical also.

SECTION-C

Q.25 Write down the names of post fertilization events in flowering plants. Describe the process of embryo development. **[1 + 2 = 3]**

Sol. Name of post fertilization events

(i) Endosperm development
(ii) Embryo development
(iii) Seed development

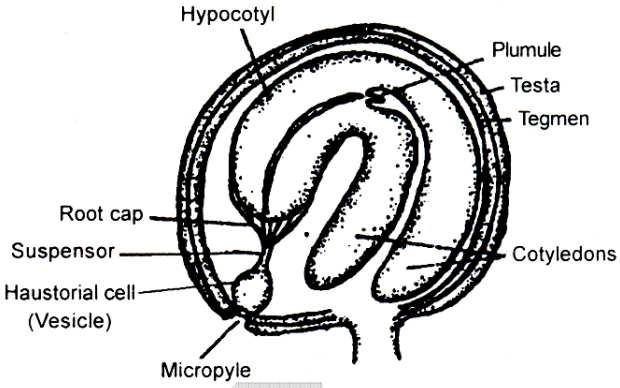
Development of dicot embryo :

In Angiosperm, Zygote undergoes in resting phase. When the endosperm is formed, development of zygote starts. In the beginning it absorb food from the endosrperm and increase in size then after a layer sectreted by itself. Now it is called **Oospore.** The **first division** of Oospore is **transverse**, results two cells are formed

The basal cell divides transversly and apical cell divides vertically resulting, two suspensor cells and two embryonal cell are formed. The **two suspensor** cells divided by the transverse divisions forming a **6-10 celled** long filament like structure called **suspensor**. The **cell of suspensor** lies near the embryonal cells is called **hypophysis**. This cell combined with radicle to form the **apex of root** [Root cap]

This four cell quadrent embryo further divide transversely to produce eight cells. The eight celled stage of embryo is called **octant stage.** All cells of octant divide fast & heart shape embryo is formed Due to the fast growth in **two lobes** of heart shaped embryo, they develop into **two cotyledons**. The tissues are present below the joining place of both the cotyledons are responsible to form **plumule** and behind it **epicotyl** is formed

The tissues present opposite to the plumule near the hypophysis give rise to **radicle**. The apex **root** [root cap] is formed by hypophysis. When embryo is formed, **suspensor** dries and **degenerates** so it is known as **meroblastic development**. **Ovule** modified into **seed** in which **testa** is formed by **outer integument** and **tegmen** is formed by **inner integument**. Only **micropyle of ovule** remains **unchanged** and also present in **seed**. Ovary modifies into fruit.



Development of Embryo in Monocotyledon :

The **Lilium type** of embryonic development is found in **monocotyledons**. The first division is transverse division in oospore. Results two cells are formed the upper cell chalazal is called **embryonal cell** and lower micropylar cell is termed as **basal cell**. The basal cell does not divide further and later on it increases in size and form single celled **vesicular suspensor**. Only embryonal cell divides transversly in which terminal cell is called **cotyledon cell** and lower (middle) cell is known as **embryonal axis cell**.

A transverse division takes place in embryonal axis cell to gives rise two cells. The one cell out of two, gives rise to **plumule initial** and another gives rise to **radicle initial**. The plumule initial divides to form the plumule of the embryo. Radicle initial divide to form the radicle. In this both the initials are responsible to form embryo in lateral position. **An apical cotyledon** is formed by the continuous division of **cotyledon cell**.

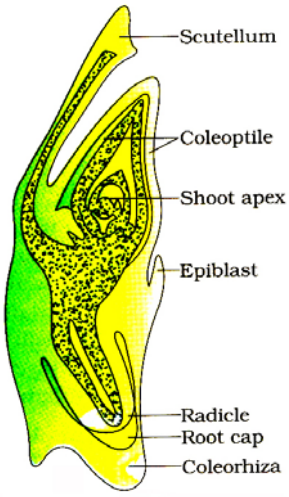


Fig. L.S. of an embryo of grass

Q.26 Describe the dihybrid cross experiment performed by Mendal. Explain the law postulated by this experiment **[2 + 1 = 3]**

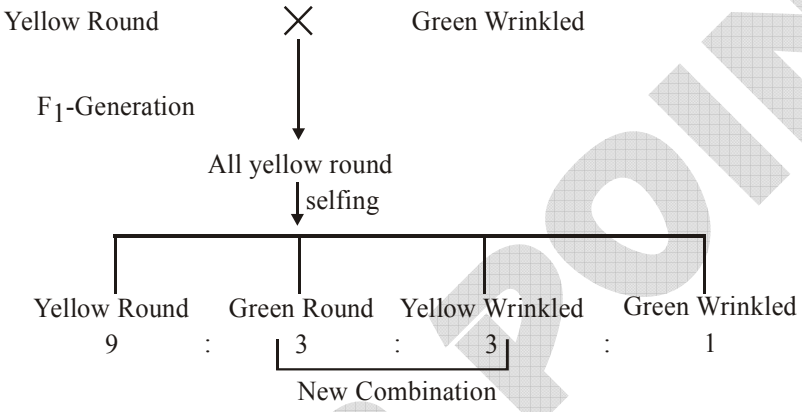
Sol. **Dihybrid Cross :**

A cross in which study of inheritance of two pairs of contrasting traits or two characters

Colour of cotyledons → Yellow (Y) & Green (y)

Seed form → Round (R) and Wrinkled (r)

Yellow and round characters are dominant and green and wrinkled are recesive characters. Mendel crossed yellow and round seeded plants with green and wrinkled seeded plants. All the plants in F_1-generation had yellow and round seeds. All the plants in F_1-generation had yellow and round seeds. When F_1 plants were self pollinated to produce four kinds of plants in F_2 generation such as yellow round, yellow-wrinkled, green round and green wrinkled, there were in the ratio of 9 : 3 : 3 : 1. This ratio is known as Dihybrid ratio.



Conclusion :

This observation leads to the Mendel's conclusion that different type of characters present in plants assorted independently during inheritace.

This is known as **Conclusion of Independent Assortment**. It is based on F_2 - generation of dihybrid cross. The nonhomologous chromosome show random distribution during anaphasei-I of meiosis.

The F_2 generation plant produce two new phenotypes, so inheritance of seed coat colour is independent from the inheritance of shape of seed. Otherwise It can not possible to obtain yellow wrinkled and green round type of seeds.

Explaination :

A pure yellow and round seeded plant crossed with green and wrinkled seeded plant which are having genotype YYRR and yyrr to produced F_1 generation having YyRr genotype.

Demonstration by checker board method :

Q.27 Describe the responses found in organisms against the environmental abiotic factors (Any three) **[3 × 1 = 3]**

Sol. Organisms show four means to regulates their internal body environment with changing external environment.

(1) Regulators / Regulates (2) Conformers/Conforms (3) Migration (4) Suspend

(1) Regulators / Regulates :

- Organims which can maintains homeostatasis by **physiological** (Sometime behavioral/physical also) **means** and maintains constant body temperature.
- All **birds** and **mammals**, some **lower invertebrates** and **vertebrates.**
- For example, human beings or mammals maintains their constant body temperature 37ºC in summer by sweat results in cooling and in winter by shivering. Which produce heat and raise body temperature.
- Plants can not show homeostasis so in different climatic zones different plants species are successfully survive.

(2) Conforms :

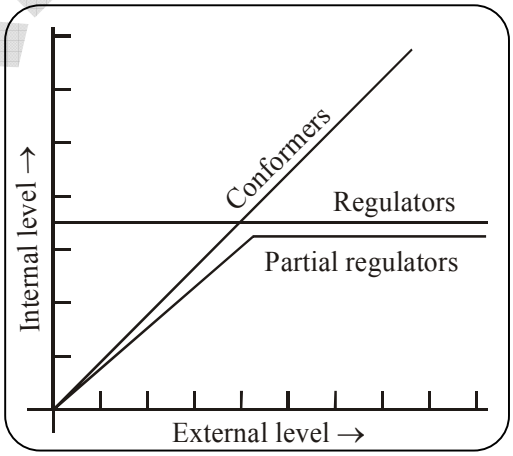
- Organisms which not able to maintains their internal environment (**Temperature**, osmotic concentration) means their body temperature change with change in temperature.
- About 99% of animals and plants are conforms.
- These organism do so, as the thermoregulation is energetically expensive for many organisms.
- For example in small animals like shrews and humming birds, the heat loss or heat gain is function of surface area. Since small animals have larger surface area relative to their volume, they loss body heat very fast when it is cold outside. So they have to expand much energy to generate body heat through metabolism. Thats why small animals are rarely found in polar region or animals are large in size, in polar region.
- Some species have evolved the ability to regulate, but over a limited range at environmental conditions, beyond which they are conform called **partial regulaters.**
- If stressfull external conditions are localized or remain only for a short duration then some organisms show migration and suspension.

(3) Migration :

- The organisms can move away temporarily from stressful habitat to more suitable area and returns when stressful period is over.
- For example, birds migration. **Keoladev National Park** of Bharatpur Rajasthan hosts thousands of migratory birds coming from **Siberia** and other extremely cold northern regions.

(4) Suspend ;

- In bacteria, fungi, lower plants, various kind of thick walled spores are formed which helps them to survive unfavorable condition and germinate on return of favorable condition.
- In higher plants seeds show suspended stage of plant life.
- In animals **hibernation** (winter sleep) shown by bears, frogs, during winter. While **aestivation** (summer sleep) shown by some fishes & snails in summer which is mode of time escape or suspension.
- In unfavorable conditions many zooplanktons species in lakes and ponds enter in stage of suspended development called **diapause**



OR

Write down the adaptations found in organism to face the extremes conditions of environmental factors (Any three) **[3 × 1 = 3]**

Adaptation of animals to face extreme condition :

(i) In the polar sea aquatic mammals like **seals** have a **thick layer** of fat (blubber) below their skin that acts as an **insulator** and **reduces loss of body heat**

(ii) The **kangaroo rat** conserves water by excreting solid urin, and can live from birth to death without even drinking water (By oxidation of fat)

(iii) **Adaptation of animals against High pressure.**

- No excess body cavities (swim bladder) → provide boyancy.
- Flesh and bones are Flubby
- T.M.O-Tri methylineoxide. Binds with pressure sensitive protiens and protects their pressure inhibition.
- Serine phosphaethanol amine - protects protiens from pressure effect.

Adaptation in plants to face extreme condition :

(i) In succulent xerophyts **Scotoactive stomata** are found. Such type of stomata remains close during the days and opens at night. The possibility of transpiration is more during the day. They mainly exchange gases during the night

(ii) In succulent serophyts The root system is very long and penetrate the soil to great depth and is well developed. The shoot is less developed **(High root-shoot ratio)** as compared to the root, so that it reduces the transpiration.

(iii) In mangrove vegetation **Pneumatophores are found.** Oxygen is not available to the roots of the plant in swampy soil so that some special type of **respiratory roots** are found in Magrove the **pneumatophore**, they are **negative geotropic**. Pores are present at the apex of the pneumatophore, they exchange gases through the pores from the atmosphere as O_2 is not available in soil.

SECTION-D

Q.28 What is nucleosome ? Explain the packaging of DNA helix. Draw the labelled diagram of nucleosome **[1 + 2 + 1 = 4]**

Sol. **Nucleosome :** The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called **nucleosome**

Packaging of DNA helix : Nucleic acids are polymer of **nucleotides** = **Nitrogen base + pentose + phosphate** On the basis of structure nitrogen bases are broadly of two types :

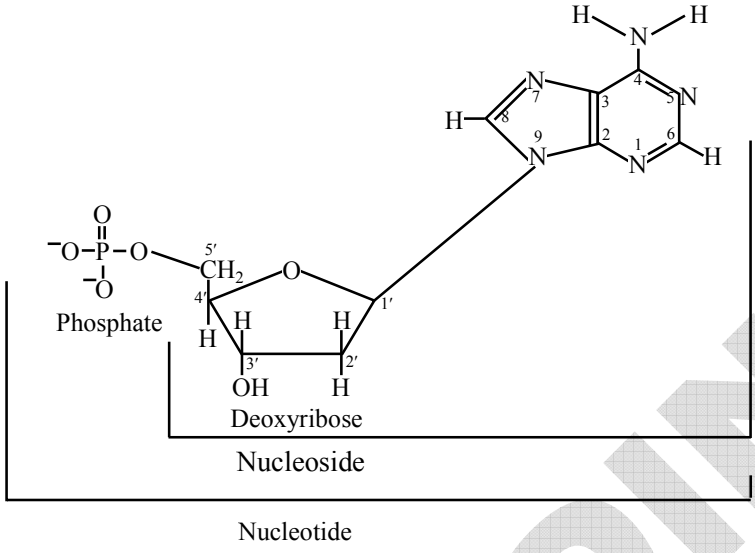
1. **Pyrimidines –** Consist of one pyrimidine ring. Skeleton of ring composed of two nitrogen and four Carbon atoms e.g. **Cytosine and Thymine.**
2. **Purines –** Consist of two rings i.e. one pyrimidine ring (2N + 4C) and one imidazole ring (2N + 3C) e.g. Adenine and Guanine.

Pentose Sugar

Deoxyribose sugar and **phosphoric acid**

Nitrogen base forms bond with first carbon of pentose sugar to form a nucleoside. Nitrogen of first place (N_1) forms bond with sugar in case of Pyrimidines while in purines nitrogen of ninth place (N_9) forms bond with sugar.

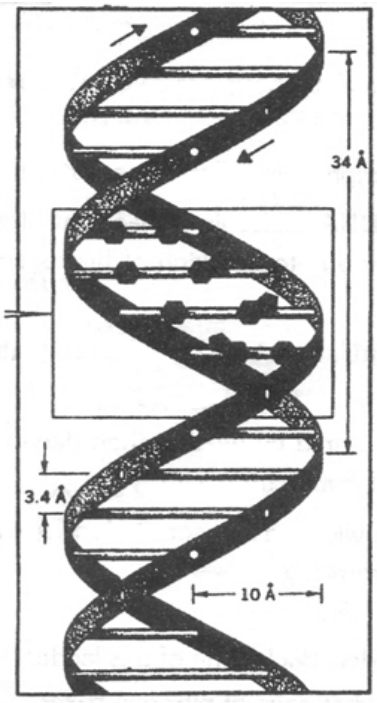
Phosphate forms **ester bond (covalent bond)** with fifth carbon of sugar to form a complete nucleotide.

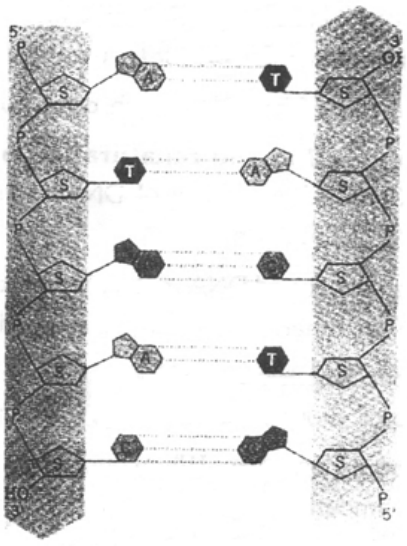


DNA : Discovered by – **Meischer**

In DNA pentose sugar is **deoxyribose sugar** and four types of nitrogen bases **A, T, G, C**

Wilkins and **Franklin** studied DNA molecule with the help of X-Ray crystallography.





With the help of this study, **Watson** and **Crick** (1953) proposed a double helix molel for DNA. According to this model, DNA is composed of two polynucleotide chains. Both polynucleotide chains are **complementary** and **antiparallel** to each other. In both strand of DNA **direction of phosphodiester bond is opposite.** i.e. If direction of phosphodiester bond in one strand is 5'-3' then it is 3'-5' in another strand.

Both strand of DNA held together by **Hydrogen bonds.** These hydrogen bond are present between Nitrogen bases of both strand. Adenine binds to Thymine by two hydrogen bonds and cytosine binds to Guanine by three hydrogen bonds.

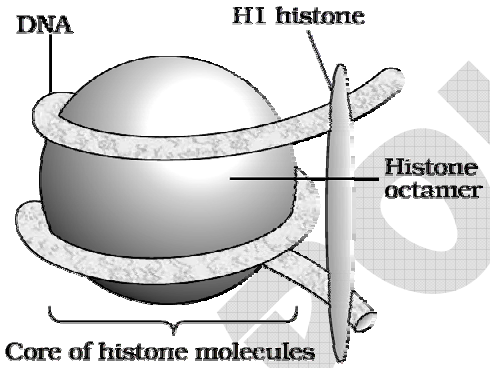
Configuration of DNA Molecule –

Two strands of DNA are helically coiled like a revolving ladder. **Back bone** of this ladder (Reiling) is composed of **phosphates** and **sugars** while **steps (bars)** composed of pairs of **nitrogen bases.** Distance between two successive steps is **3.4Å.** In one complete turn of DNA molecule there are such **10 steps** (10 pairs of nitrogen bases.) So the length of one complete turn is **34Å.** This is called **helix length. Diameter of DNA** molecule i.e. distance between phosphates of two strands is **20Å.** Distance between sugar of two strands is **11.1 Å.**

In nucleus of eukaryotes the DNA is associated with **histone protein** to form nucleoprotein. Histone occupies major groove of DNA at **30° angle.** Bond between DNA and Histone is **salt linkage** (Mg^{+2}).

DNA in chromosomes is linear while in prokaryotes, mitochondria and chloroplast is **circular.**

Structure of nucleosome



OR

What is transcription ? Explain the process of transcription in bacteria by labelled diagram **[1 + 2 + 1 = 4]**

TRANSCRIPTION :

Formation of RNA over DNA templet is called transcription. Out of two strand of DNA only one strand participates in transcription and called "Template strand" The segment of DNA involved in transcription is ***"Cistron".*** RNA polymerase enzyme involved in transcription. In eukaryotes there are three types of RNA polymerases.

- **RNA polymerase-I for 28s rRNA, 18s RNA, 5.8s rRNA**
- **RNA polymerase-II for m-RNA.**
- **RNA polymerase enzyme-III for t-RNA, 5s RNA, SnRNA**

In eukaryotes RNA polymerase enzyme composed of **10-15 polypeptide chains**. Prokaryotes have one type of RNA polymerase which synthesizes all types of RNAs. RNA polymerase of E. Coli has six polypeptide chains **β, β′, α, α, ω** and **σ.**

σ polypeptide chain is also known as σ **factor (sigma factor).**

Core enzyme + Sigma factor ⇒ RNA Polymerase

(β, β′, α, α, ω) + (σ)

Following steps are present in transcription –

(1) INITIATION –

DNA has a ***"Promoter site or initiation site"*** where transcription begins and a ***"Terminator site"*** where transcription stops. **Sigma factor (σ)** recognizes the **promoter site** of DNA. With the help of sigma factor RNA polymerase attached to a specific site of DNA called ***"Promoter site"*.**

In prokaryotes before the 10 N_2 base from ***"Structural site"*** a sequence of 6 base pairs (**TATAAT**) is present on DNA, Which is called **"Pribnow box".**

In eukaryotes before the 20 N_2 base from ***"Structural site"*** a sequence of 7 base pairs (**TATAAA**) or (**TATATAT**) is present on DNA which is called **"TATA box** or **Hogness box"** At promoter site RNA polymerase enzyme breaks H-bonds between two DNA strands and separates them One of them strand takes part in Transcription. Transcription proceeds in **5′ → 3″ direction.** Ribonucleotide triphosphate come to lie opposite complementary nitrogen bases of **anti sense strand.**

These Ribonucleotides present in the form of triphosphate ATP, GTP, UTP and CTP in nucleoplasm. When they used in transcription, pyrophosphates hydrolyse two phosphates from each activated nucleotide. This releases energy. This energy used in process of transcription.

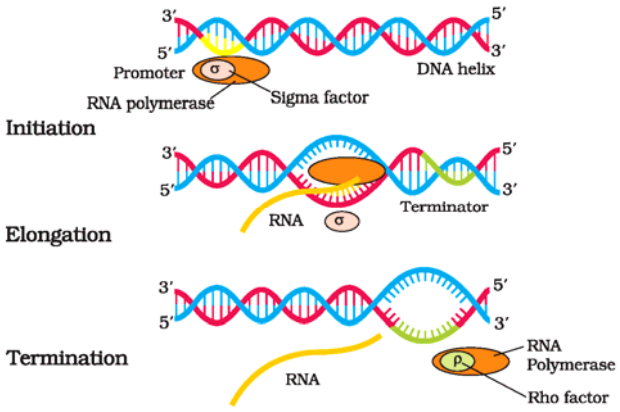
(2) ELONGATION –

RNA polymerase enzyme establishes **phosphodiester bond** between adjacent ribonucleotides.

Sigma factor separates and core enzyme moves along the anti sense strand till it reaches terminator site.

(3) TERMINATION –

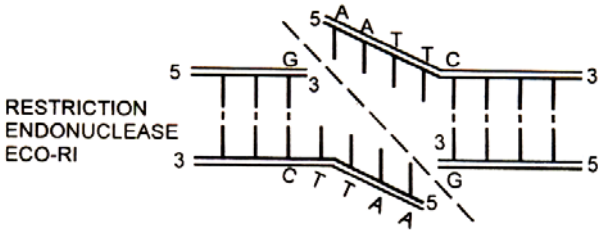
When RNA polymerase enzyme reaches at terminator site, it separates from DNA templet. In **terminator site** on DNA, N_2 bases are present in **palindromic sequence.** In most cases RNA polymerase enzyme can recognize the ***"Terminator site"*** and stop the synthesis of RNA chain, but in prokaryotes, it recognizes the **terminator site** with the help of **Rho factor (ρ factor).** Rho (ρ) factor is a specific protein which helps RNA polymerase enzyme to recognize the terminator site.



Process of transcription in prokaryotes

Q.29 Explain in details the role of restriction endonuclease in formation of recombinant DNA. Draw a labelled diagram of E.Coli cloning vector pBR 322. **[3 + 1 = 4]**

Sol. **Endonucleases** break DNA duplex at any point except the end.



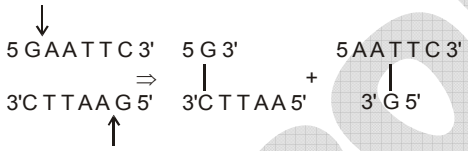
Restriction endonucleases cleave DNA duplex at specific points in such a way that they come to posses short single stranded free ends. For example, a restriction endonuclease ECOR-I (from Escherichia coli) recoginzes the base sequence GAATTC / CTTAAG in DNA duplex and cleaves it's strands between G and A.

Restriction enzymes are obtained from bacteria. They are useful to bacteria because the enzyme bring about fragmentation of viral DNA without affecting the bacterial genome. This is an protective adaptation against baceriophages. Restriction enzyme (Eco R - I) was discovered by Arber, Smith & Nathans (1978 Nobel prize).

These enzymes exist in many bacteria beside cleavage some restriction endonuclease, also have capability of modification. Modification in the form of methylation, by methylation the bacterial DNA modifies own DNA and therofore protects its own chromosomal DNA. Restriction enzymes are used in recombinant DNA technology because they can be used in vitro to recoginze and cleave within specific DNA sequence typically consisting of 4 to 8 nucleotides. The specific 4 to 8 nucleotide sequence is called restriction site and is usually **palindromic**, this means that the DNA sequence is the same when read in a 5'-3' direction on both DNA strand

AND MADAM DNA

As a results the DNA fregments produced by cleavage with these enzymes have short single stranded overhang at each these kinds of ends are called sticky or cohesive ends because base pairing between them can stick the DNA molecule back together again.



Therefore by cutting two different DNA samples with the same restriction enzyme and mixing the fragments together a recombinant DNA molecule can be generated.

Exceptionally, some enzymes cleave both strand of DNA at exactly the same nucleotide position, typically in the center of the recognition sequence resulting in blunt end or flush end.

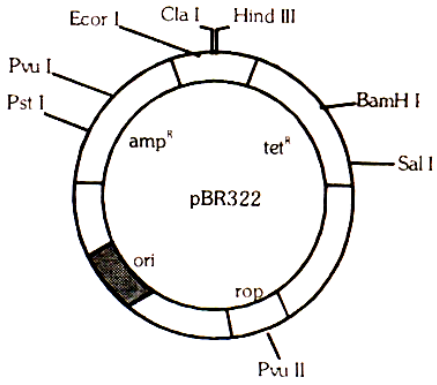
Sma I (Serratia marcescens)

Nomenclature of enzyme : The first letter used for the enzyme is the first letter of the bacterium genus name (in Italics) then comes the first two letter of it's species (In Italics), next is the strain of the bacteria, last is Roman numerical signifing the order of discovery of Bacteria.

EXAMPLES OF RESTRICTION ENZYME

Recognition sequences of some restriction endonucleases

Name	Recognition sequence	End after cleavage		Source
Eco RI	↓ – G A A T T C – – C T T A A G – ↑	– G – C T T A A	A A T T C – G –	Escherichia coli - containing drug resistant plasmid RI
Hind III	↓ – A A G C T T – – T T C G A A – ↑	– A – T T C G A	A G C T T – A –	Haemophilus influenzae
Bam I	↓ – G G A T C C – – C C T A G G – ↑	– G – C C T A G	G A T C C – G –	Bacillus amyloliquefaciens
Hae III	↓ – G G C C – – C C G G – ↑	– G G – C C	C C – G G –	Haemophilus aegyptius



E.Coli cloning vector pBR322 showing restriction sites

OR

Define biotechnology. Mentioning all steps and explain only first two steps of recombinant DNA technology in detail. Give diagrammatic representation of recombinant DNA technology. **[3 + 1 = 4]**

Biotechnology (Genetic Enginerring) :

Gentic engineering also referred as '**recombinant DNA technology**' or '**gene splicing**' is one kind of biotechnology involving manipulation of DNA

Biotechnology deals with techniques of using line organisms or enzymes for organisms to produce products & process usefull for mankind.

PROCESSES OF RECOMBINANT DNA TECHNOLOGY

Recombinant DNA technology involves several steps in specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of a desired DNA fragment, ligation of the DNA fragment into a vector, transferring the recombinant DNA into the host, culturing the host cells in a medium at large scale and extraction of the desired product. Let us examine each of these steps in some details.

Steps of process of recombinant DNA technology :

1. Isolation of the Genetic Material (DNA)
2 Cutting of DNA at Specific Locations
3 Amplification of Gene of Interest using PCR
4 Insertion of Recombinant DNA into the Host Cell/Organism
5 Obtaining the Foreign Gene Product

Description of first two steps

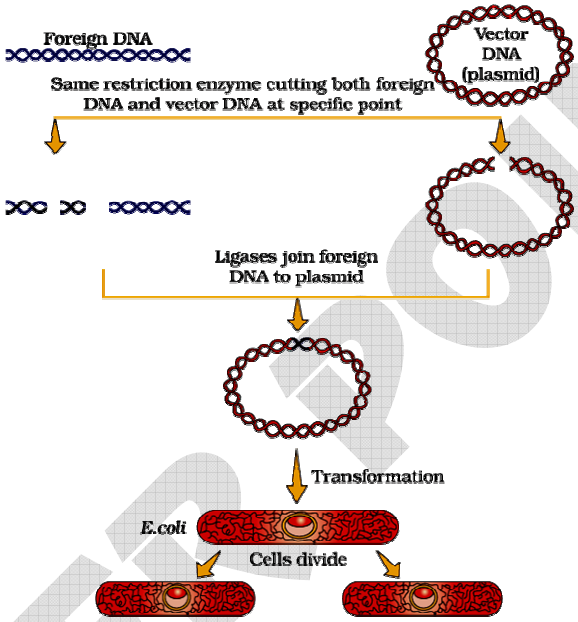
1 Isolation of the Genetic Material (DNA) :

Recall that nucleic acid is the genetic material of all organisms without exception. In majority of organisms this is deoxyribonucleic acid or DNA. In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other macro-molecules. Since the DNA is enclosed within the membranes, we have to break the cell open to release DNA along with other macromolecules such as RNA, proteins, polysaccharides and also lipids. This can be achieved by treating the bacterial cells/plant or animal tissue with enzymes such as **lysozyme** (bacteria), **cellulase** (plant cells), **chitinase** (fungus). You know that genes are located on long molecules of DNA interwined with proteins such as histones. The RNA can be removed by treatment with ribonuclease whereas proteins can be removed by treatment with protease. Other molecules can be removed by appropriate treatments and purified DNA ultimately precipitates out after the addition of chilled ethanol. This can be seen as collection of fine threads in the suspension

2 Cutting of DNA at Specific Locations

Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzyme, at the optimal conditions for that specific enzyme. Agarose gel electrophoresis is employed to check the progression of a restriction enzyme digestion. DNA is a negatively charged molecule, hence it moves towards the positive electrode (anode). The process is repeated with the vector DNA also. The joining of DNA involves several processes. After having cut the source DNA as well as the vector DNA with a specific restriction enzyme, the cut out 'gene of interest' from the source DNA and the cut vector with space are mixed and ligase is added. This results in the preparation of recombinant DNA.

Diagramatic representation of rDNA technology



Steps of recombinant DNA technology

Q.30 What are ecological pyramids ? What precautions should be kept in mind in calculating its different aspects ? Draw the diagrams of pyramids of grassland ecosystem and energy flow ecosystem. **[1 + 1 + 1 + 1 = 4]**

Sol. **Pyramids of Ecosystem :**

Graphical representation of ecological parameters at different trophic levels and trophic structure in ecosystem is called pyramids. These parameters are **Number**, **Biomass** and **Energy**. First of all, pyramid was formed by **Charis Elton;** So we called it **Eltonian pyramids.**

These Pyramid are of three types

(1) Pyramids of number, (2) Pyramids of energy, (3) Pyramids of biomass.

Precuations to be kept in mind calculating its different aspect :

Any calculations of energy content, biomass, or numbers has to include all organisms at that trophic level. No generalisations we make will be true if we take only a few individuals at any trophic level into account. Also a given organism may occupy more than one trophic level simultaneously. One must remember that the trophic level represents a functional level, not a species as such. A given species may occupy more than one trophic level in the same ecosystem at the same time; for example, a sparrow is a primary consumer when it eats seeds, fruits, peas, and a secondary consumer when it eats insects and worms.

Pyramid of grassland ecosystem :

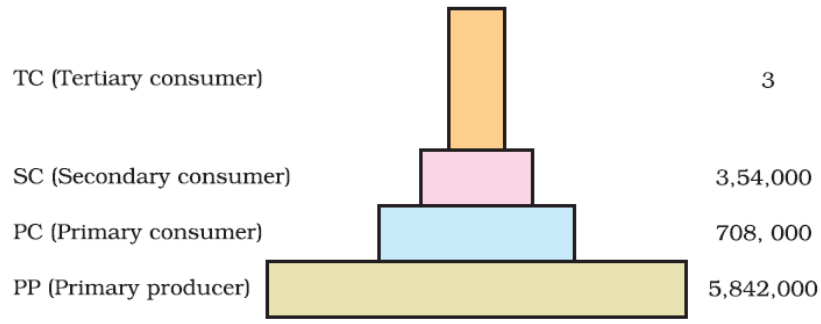


Figure : Pyramid of numbers in a grassland ecosystem. Only three top-carnivores are supported in an ecosystem basd on production of nearly 6 millions plants

Pyramid of energy :

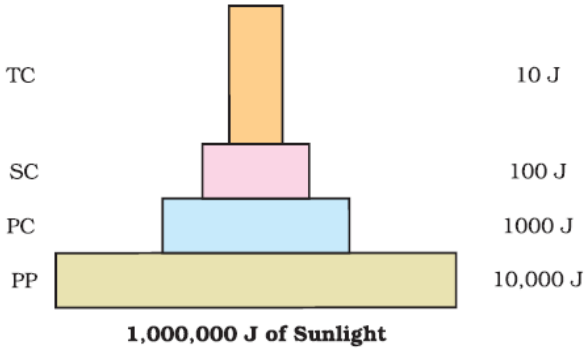


Figure : An ideal pyramid of energy. Observe that primary produces convert only 1% of the energy in the sunlight available to them into NPP

OR

What is ecological succession. Mention its different steps. Explain Hydrach and Xerarch succession with diagrammatic representation. **[1 + 1 + 1 + 1 = 4]**

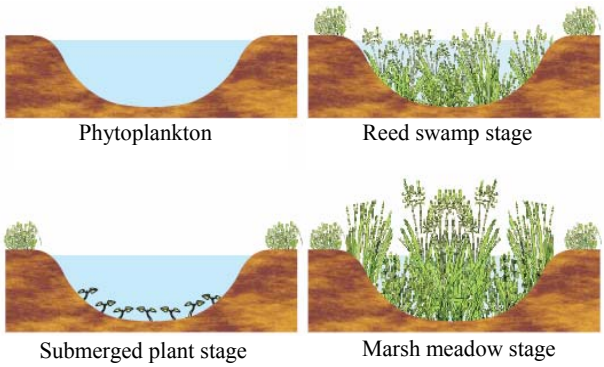
Succession :

The successive replacement of communities in an area over a period of time is known as succession. Both biotic and abiotic components are involved in successional changes. Succession is a community controlled phenomenon, which results due to action and co-action of living organisms.

Steps of Succesion

(i) Nudation
(ii) Migration
(iii) Ecesis
(iv) Aggregation
(v) Competition & coaction
(vi) Reaction
(vii) Stabilization

Hydrarch :



Forest

Xerarch :

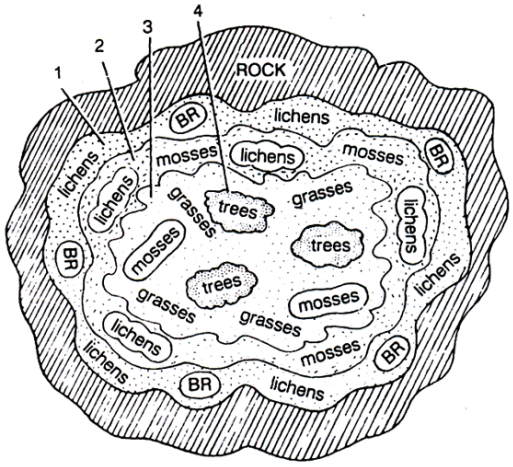


Fig.: Diagrammatic representation of different plant communities of a xerosere. Note the vegetational zonation showing the pioneer comunity of lichens around the outer edge and more advanced stages of trees located in the centre. The variou zones from outside towards the centre of rock are :(1) lichens (pioneers), (2) ring of mosses, (3) grasses (broad zone), and (4) trees (seedlings) scattered BR-bare rock.