Grade 10 Science UP 2020

Time: 3 Hours 15 mins.   **Full Marks: 70**

Note: First 15 minutes are allotted for the candidates to read the question paper.

Instructions:

(i) This question paper is divided into three parts, A, B and C.

(ii) First question of each part is multiple choice type. Four alternative answers are given in each. Select the correct answer and write down in your answer-book.

(iii) Attempt all the questions of each part together at one place. Each part should be attempted on a new page.

(iv) All questions are compulsory.

(v) Marks of the questions are mentioned against them.

(vi) Illustrate your answers with neat and labelled diagrams and chemical equations wherever necessary.

PART-A

Q1. (a) The magnification of a virtual image of an object placed at distance 0.2 m from a lens is 0.5. The lens will be

(i) concave lens of focal length 0.1 m

(ii) concave lens of focal length 0.2 m

(iii) convex lens of focal length 0.1 m

(iv) convex lens of focal length 0.2 m.   1

Correct answer: (ii)

Solution:

The magnification (mmm) of a lens is given by:

$m=$ (image height)/(object height)$=v/u$

$0.5=v/(-0.2)$

$v=-0.1m$

The lens formula is as follows:

$1/f=1/v-1/u$

$1/f=1/(-0.1)-1/(-0.2)$

$1/f=-10+5=-5$

f=-0.2m

Since the (f) is negative, the lens is a concave lens with a focal length of 0.2 m.

(b) The refractive index of glass is maximum for

(i) red colour

(ii) yellow colour

(iii) violet colour

(iv) green colour   1

Correct answer: (iii)

Solution:

The refractive index of glass is highest for violet light because it has the shortest wavelength and bends the most when passing through glass.

(c) How many joules are there in 1 kilowatt-hour?

(i) 3600

(ii) 36×10^3

(iii) 3.6×10^5

(iv) 3.6×10^6 1

Correct answer: (iv)

Solution:

1 kilowatt-hour (kWh) is the amount of energy consumed when a 1 kW (1000 W) device operates for 1 hour (3600 seconds).

Energy = Power × Time= =1000 × 3600 =3.6×10^6 joules

(d) A moving electron produces

(i) electric field only

(ii) magnetic field only

(iii) electric and magnetic fields both

(iv) no field.   1

Correct answer: (iii)

Solution:

A moving electron is a charged particle in motion, which generates both electric and magnetic fields:

Electric field: Since an electron has charge, it always produces an electric field.

Magnetic field: A moving charge creates a magnetic field around it.

Q2. (a) What type of image is formed by a convex mirror? Write two practical uses of convex mirror. 2

(b) What is hypermetropia or long sightedness? How is it removed? 2

(c) Calculate the magnifying power of a lens of power +20 dioptre, when the image of an object is formed by the lens at least distance of distinct vision. 2

Solution:

(a) A convex mirror always forms a virtual, erect, and diminished image of the object. Uses of convex mirrors:

- Rear-view mirrors in vehicles – Provides a wider field of view.
- Security and surveillance mirrors – Used in shops and ATMs to monitor surroundings.

(b) Hypermetropia is a defect of vision where a person can see distant objects clearly but has difficulty seeing nearby objects. It occurs when the eyeball is too short, or the lens loses flexibility. It is corrected using a convex lens, which helps focus nearby objects properly on the retina.

(c) Given: Power (P) = +20 D,

Least Distance of Distinct Vision (D) = 25 cm

Focal length (f) = 1/P

F=1/20=0.05m=5cm

Magnifying Power (M) formula:

M=1+D/f

M=1+25/5=1+5=6

Q3. (a) A candle is placed 90 cm apart from a screen. Where should a convex lens of focal length 20 cm be placed in between candle and the screen so that a real and diminished image of the candle is formed distinctly on the screen? 4

OR

What is Myopia or short sightedness? What is the reason? Explain the method for its correction using labelled diagram. 4

(b) The potential difference between the ends of a wire is 1.5 volt. Energy of 15 joule is obtained when a current is flowing through the wire for 20 sec. Calculate the current flowing through the wire. 4

OR

How many bulbs of 25 watt each can glow in a circuit of 250 volt and 5 ampere fuse? 4

Solution:

(a) Distance between object and screen = 90 cm,

Focal length (f) = 20 cm

Using the lens formula:

1/f=1/v+1/u

Since u + v = 90 cm, solving gives u = 30 cm and v = 60 cm.

The convex lens should be placed 30 cm from the candle or 60 cm from the screen to form a real and diminished image.

OR

Myopia is a vision defect where a person can see nearby objects clearly but has difficulty seeing distant objects.

Reason:

- Elongation of the eyeball–The image is formed in front of the retina instead of on it.
- Increased curvature of the eye lens–The lens becomes too curved, increasing its converging power.

Correction of Myopia:

Myopia is corrected using a concave lens (diverging lens). The concave lens diverges the incoming light rays before they enter the eye, so the image is formed on the retina instead of in front of it.
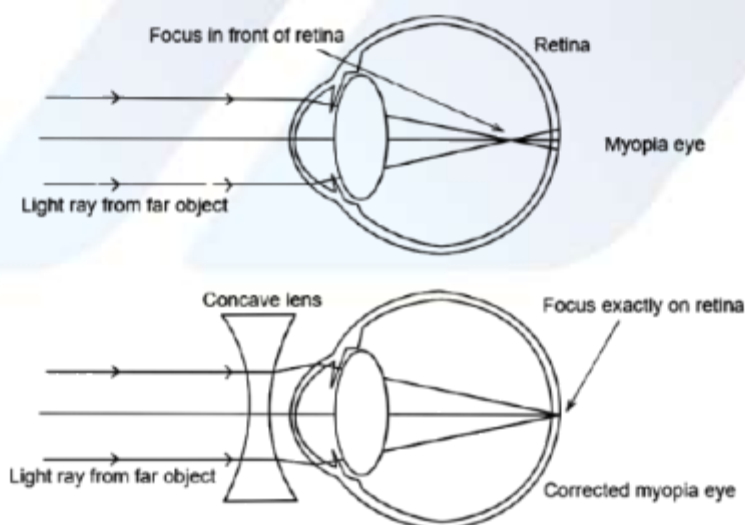
(b) The current flowing through the wire using the formula:

$$Power = \frac{Energy}{Time} = \frac{15}{20} = 0.75W$$

$$P = V \times I$$

$$I = \frac{P}{V} = \frac{0.75}{1.5} = 0.5\ A$$

The current flowing through the wire is 0.5 A (Ampere).

OR

The total power consumed by the bulbs in the circuit can be calculated using the formula:

Total Power = Voltage × Current

Total Power = 250 volts × 5 amperes Total Power = 1250 watts

Now, we need to determine how many bulbs each consuming 25 watts can be accommodated in the circuit.

Number of bulbs = Total Power / Power per bulb Number of bulbs = 1250 watts / 25 watts Number of bulbs = 50 bulbs

Therefore, you can have a maximum of 50 bulbs, each consuming 25 watts, glowing in the circuit with a 250-volt supply and a 5 ampere fuse.

Q4.   Explain the principle of Direct Current Dynamo and describe its working using a labelled diagram.   7

OR

Two bulbs, one with 100 watt and 220 volt, the other one with 60 watt and 220 volt rating are joined in parallel with 220 volt supply line. Calculate the current passing through the supply line.   7

Solution:

A DC dynamo (DC generator) works on the principle of electromagnetic induction, discovered by Michael Faraday.

Principle:

When a coil rotates in a magnetic field, an induced current is produced in the coil. The direction of this current is determined using Fleming's Right-Hand Rule.

A DC dynamo consists of the following parts:

- Armature Coil: A rectangular coil wound on a soft iron core that rotates between the poles of a magnet.
- Magnet: A strong permanent magnet or electromagnet provides a magnetic field.

- Split-ring Commutator: A device that converts AC into DC by reversing the direction of current every half rotation.
- Brushes: Two carbon brushes maintain contact with the rotating split-ring commutator and transfer current to the external circuit.
- Shaft and Handle: Used to rotate the coil mechanically.
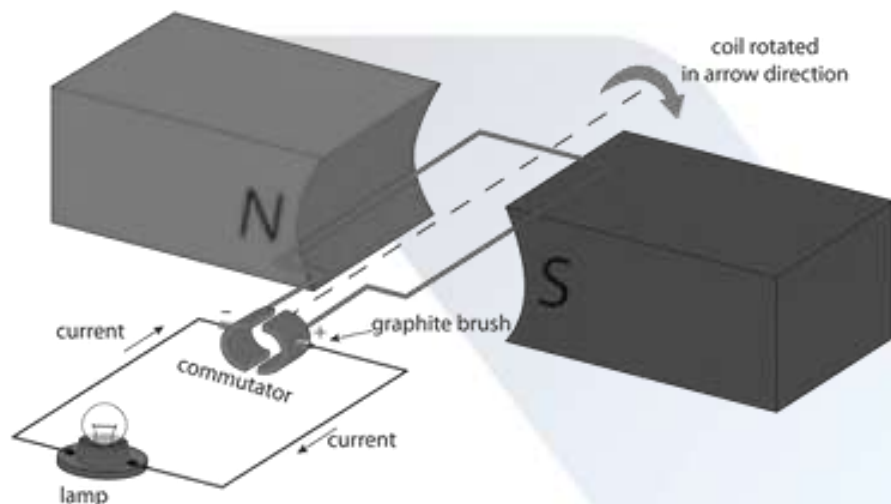
Working of a DC Dynamo:

- When the armature coil is rotated in the magnetic field, the magnetic flux linked with the coil changes.
- According to Faraday's Law of Electromagnetic Induction, a current is induced in the coil.
- As the coil rotates, the direction of induced current changes every half rotation.
- Split-ring commutator reverses the connection of the coil to the external circuit after every half rotation, ensuring that the current flows in one direction only.
- This results in the production of direct current (DC) in the external circuit.

OR

To calculate the current passing through the supply line when two bulbs are joined in parallel, we can use the formula:

Current (I) = Total Power / Voltage

Given:

Power of the first bulb = 100 watts

Power of the second bulb = 60 watts

Voltage supply = 220 volts

First, let's calculate the total power consumption of the bulbs in parallel:

Total Power = Power of first bulb + Power of second bulb Total Power

= 100 watts + 60 watts Total Power = 160 watts

Now, we can calculate the total current passing through the supply line:

Current (I)   = Total Power / Voltage Current (I)

= 160 watts / 220 volts Current (I) = 0.727 Amperes

Therefore, the current passing through the supply line when the two bulbs are joined in parallel with a 220-volt supply line is approximately 0.727 Amperes.

PART-B

Q5. (a) Which of the following is not strong electrolyte?

(i) Ammonium chloride

(ii) Sodium acetate

(iii) Hydrogen sulphide

(iv) Potassium nitrate   1

Correct answer: (iii)

Solution:

Hydrogen sulphide (H_2S) is not a strong electrolyte because it only partially ionizes in water, making it a weak electrolyte.

(b) Which of the following statements is incorrect for neutral solution?

(i) The value of H^+ ion concentration is 10^{-7} mol/lit

(ii) The value of OH^- ion concentration is 10^{-7} mol/lit

(iii) pH is zero

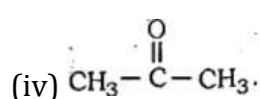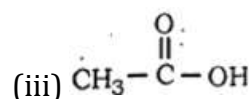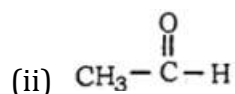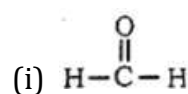(iv) pH is 7   1

Correct answer: (iii)

Solution:

The statement that pH is zero for a neutral solution is incorrect. In a neutral solution, the pH value is 7.

(c) Ketonic group > C = O is present in

(i) $$H-\overset{\overset{\textstyle O}{\|}}{C}-H$$ (ii) $$CH_3-\overset{\overset{\textstyle O}{\|}}{C}-H$$

(iii) $$CH_3-\overset{\overset{\textstyle O}{\|}}{C}-OH$$ (iv) $$CH_3-\overset{\overset{\textstyle O}{\|}}{C}-CH_3$$ 1

Correct answer: (iv)

Solution:

$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3$$
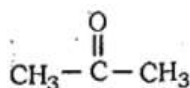
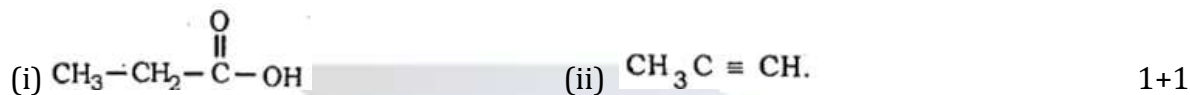Q6. (a) Write down the I.U.P.A.C. names of the following:

(i) $CH_3 - CH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - OH$ (ii) $CH_3 C \equiv CH.$ 1+1

(b) Write four uses of Mendeleef's Periodic Table. 0.5+0.5+0.5+0.5

(c) Differentiate between ethanol and ethanoic acid on the basis of physical and chemical properties. 2

Solution:

(a) (i) Propionic acid (ii) Propyne

(b) Uses of Mendeleef's Periodic Table

- Prediction of Elements: Mendeleev left gaps for undiscovered elements and successfully predicted their properties.
- Systematic Study of Elements: It helped in the classification of elements based on their atomic mass and properties.
- Correction of Atomic Masses: Mendeleev corrected the atomic masses of some elements based on their properties.
- Grouping of Similar Elements: Elements with similar chemical properties were placed in the same group, making study easier.

(c) Ethanol vs. Ethanoic Acid

Property	Ethanol	Ethanoic Acid
Physical State	Colorless liquid with a pleasant smell	Colorless liquid with a strong vinegar-like smell
Acidity	Neutral (does not turn litmus red)	Acidic (turns blue litmus red)

Q7. (a) Write chemical equation for obtaining zinc metal from zinc sulphide. 1+1
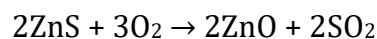
(b) Write short notes on the following: 1+1

(i) Combustion reaction

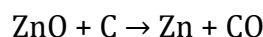(ii) Substitution reaction.

Solution:

(a) The extraction of zinc metal from zinc sulphide (ZnS) involves two main steps: roasting and reduction.

- Roasting: Zinc sulphide is heated in the presence of oxygen to form zinc oxide.
  $$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$$

- Reduction: Zinc oxide is then reduced with carbon (coke) to obtain zinc metal.
  $$ZnO + C \rightarrow Zn + CO$$

(b) i) Combustion Reaction: A combustion reaction is a chemical reaction in which a substance reacts with oxygen to produce heat and light. It usually involves burning a fuel.

(ii) Substitution Reaction: A substitution reaction is a chemical reaction in which one atom or a group of atoms in a molecule is replaced by another atom or group.

Q8. (a) Differentiate between metals and non-metals.   2

(b) Explain rusting of metals.   2

(c) Explain tetrahedral nature of carbon atom by taking the example of saturated and unsaturated hydrocarbons.   3

OR

Write short notes on the following:

(i) Homologous series.   2

(ii) Oxidation reaction.   2

(iii) Addition reaction.   2

(iv) Neutralisation reaction.   1

Solution:

(a) Metals and Non-metals

Property	Metals	Non-Metals
Appearance	Shiny (lustrous)	Dull (except iodine)
Conductivity	Good conductors of heat and electricity	Poor conductors (except graphite)
Malleability & Ductility	Can be hammered into sheets and drawn into wires	Brittle, break when hammered
Reaction with Acids	React with acids to produce hydrogen gas	Generally do not react with acids
Example	Iron (Fe), Copper (Cu)	Oxygen (O_2), Sulphur (S)

(b) Rusting is a slow chemical process in which iron reacts with oxygen and water to form hydrated iron oxide (rust). This weakens the metal and causes damage.

$$4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$$
$$4Fe(OH)_3 \rightarrow 2Fe_2O_3 \cdot xH_2O$$
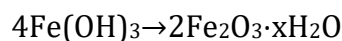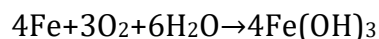
(c) The tetrahedral nature of carbon arises due to sp^3 hybridization, where one s-orbital and three p-orbitals mix to form four equivalent sp^3 hybrid orbitals. These orbitals arrange themselves at an angle of 109.5° to minimize repulsion, forming a tetrahedral geometry.

1) Saturated Hydrocarbons (Alkanes - sp^3 Hybridization)
- In saturated hydrocarbons (alkanes), each carbon forms four single covalent bonds with other atoms (carbon or hydrogen).
- Example: Methane (CH_4)
  - The carbon atom in methane undergoes sp^3 hybridization, forming four strong sigma (σ) bonds.
  - The tetrahedral structure ensures equal bond angles of 109.5°.
  - **H−C−H** (109.5°)

2) Unsaturated Hydrocarbons (Alkenes and Alkynes - sp^2 and sp Hybridization)
- In unsaturated hydrocarbons, the carbon-carbon bonding differs:
- Alkenes (sp^2 Hybridization, Planar Structure):
  - Example: Ethene (C_2H_4)
  - Each carbon forms three sigma (σ) bonds and one pi (π) bond.
  - The structure is trigonal planar, with a bond angle of 120°.
- Alkynes (sp Hybridization, Linear Structure):
  - Example: Ethyne (C_2H_2)
  - Each carbon forms two sigma (σ) bonds and two pi (π) bonds.
  - The structure is linear, with a bond angle of 180°.

OR

i) A homologous series is a group of organic compounds that have the same functional group and general formula but differ by a CH_2 unit in their molecular structure.

ii) An oxidation reaction involves the addition of oxygen or the removal of hydrogen from a substance. It is a key reaction in combustion, respiration, and rusting.

iii) An addition reaction occurs when two or more molecules combine to form a single product, typically seen in unsaturated hydrocarbons (alkenes and alkynes).

iv) A neutralization reaction is a reaction between an acid and a base to form salt and water

PART-C

Q9. (a) According to Mendel, genotype of a dwarf pea plant is   1

(i) TT   (ii) Tt

(iii) tt   (iv) tT

Correct answer: (iii)

Solution:

According to Mendel's Laws of Inheritance, a dwarf pea plant has a homozygous recessive genotype (tt). The t allele represents the recessive trait for dwarfism, and only plants with both recessive alleles (tt) will be dwarf.

(b) The branch of science which deals with the study of fossils is called   1

(i) Ecology   (ii) Ethology

(iii) Palaeontology   (iv) Biology

Correct answer: (iii)

Solution:

Palaeontology is the branch of science that studies fossils and ancient life forms.

(c) Regulation of Goitre is carried out by   1

(i) thyroxine   (ii) adrenaline

(iii) insulin   (iv) oxytoxin

Correct answer: (i)

Solution:

Goitre is caused by iodine deficiency, which leads to reduced thyroxine hormone production by the thyroid gland.

d) Which one of the following mechanisms occurs only in animals?   1

(i) Hormonal control   ii) Respiration

iii) Growth   (iv) Nervous control.

Correct answer: (iv)

Solution:

Nervous control occurs only in animals, as they have a nervous system for responding to stimuli, whereas plants regulate responses through hormones.

Q10. (a) What products are obtained during oxidation of glucose molecule by yeast in the absence of oxygen?   2

(b) What are the roles of acid in our digestion? Discuss.   2

(c) Explain the conduction of water and minerals in plants.   2

Solution:

(a) During the oxidation of glucose molecule by yeast in the absence of oxygen (anaerobic conditions), the products obtained are ethanol and carbon dioxide. This process is known as fermentation.

(b) What are the roles of acid in our digestion? Discuss.

In our digestion, acids play crucial roles in the following ways:

- Activation of Enzymes: Stomach acid, mainly hydrochloric acid, activates enzymes like pepsin that are responsible for breaking down proteins into smaller components for easier digestion.
- Killing Pathogens: The acidic environment in the stomach helps in killing harmful pathogens that might enter the body through food, thus protecting us from infections.
- Optimal pH for Enzymatic Action: Acids help in maintaining the optimal pH levels in different parts of the digestive system, facilitating the action of specific enzymes that work best under acidic conditions.

(c) The conduction of water and minerals in plants occurs through specialized tissues:

- Xylem: Water and minerals are transported from roots to the rest of the plant through xylem vessels. This process, known as transpiration, involves water movement due to evaporation and creates a negative pressure that pulls water and nutrients upwards.
- Root System: The root system absorbs water and minerals from the soil through osmosis. This uptake is assisted by root hairs and mycorrhizal fungi, which increase the surface area for absorption.
- Capillary Action: Water moves from the roots to the leaves through capillary action, driven by the cohesive and adhesive properties of water molecules. Cohesion helps water molecules stick together and move in a continuous stream, while adhesion allows water to adhere to the walls of xylem vessels.

Q11. (a) Despite the difference in shape, size and colour, all human beings are placed in the same single species. Explain the reason.   4

OR

Write notes on the following: 2+2

(i) Natural selection.

(ii) Reflex action.

b) Differentiate between unisexual and bisexual flowers and give one example of each.

     2+2

OR

Define pollination. Name the various types of pollination and describe
 any one of them.   1+1+2

Solution:

(a) Despite differences in shape, size, and color, all human beings belong to the same species, Homo sapiens, because they share fundamental biological and genetic characteristics that define a species. A species is a group of organisms that can interbreed and produce fertile offspring.

Reasons:

- Genetic Similarity – Humans have over 99% identical DNA, meaning their genetic makeup is highly similar despite physical variations.
- Interbreeding Ability – All humans can naturally reproduce with each other and produce fertile offspring, which is a key criterion for belonging to the same species.
- Same Number of Chromosomes – All humans have 46 chromosomes (23 pairs), which ensures genetic continuity within the species.
- Common Evolutionary Origin – Modern humans evolved from a common ancestor and share evolutionary traits.
- Similar Biological and Physiological Functions – Despite variations, all humans have the same organ systems, metabolic processes, and life cycle.

OR

(i) Natural Selection

Natural selection is the process by which organisms with favorable traits survive, reproduce, and pass on their genes to the next generation. It was proposed by Charles Darwin. Individuals with adaptations suited to their environment have a higher

chance of survival, while those with less favorable traits may not survive or reproduce. Over time, this leads to the evolution of species.

(ii) Reflex Action

A reflex action is an automatic, quick, and involuntary response of the body to a stimulus without conscious thought. It is controlled by the spinal cord and helps in immediate protection from harm. Examples include pulling away the hand from a hot object and

(b) Unisexual vs bisexual flowers

Feature	Unisexual Flower	Bisexual Flower
Definition	A flower that has either stamens (male) or carpels (female) but not both.	A flower that has both stamens (male) and carpels (female).
Reproductive Organs	Contains only one reproductive organ (either male or female).	Contains both male and female reproductive organs.
Pollination	Requires cross-pollination for reproduction.	Can undergo self-pollination or cross-pollination.
Example	Papaya	Hibiscus

OR

Pollination is the process of transfer of pollen grains from the anther (male part) to the stigma (female part) of a flower for fertilization.

Types of Pollination

    1. Self-Pollination (Autogamy) – Pollen is transferred within the same flower or between flowers of the same plant.

    2. Cross-Pollination (Allogamy) – Pollen is transferred from the anther of one flower to the stigma of another flower on a different plant of the same species.

Self-pollination occurs when pollen from the anther of a flower is deposited on the stigma of the same flower or another flower of the same plant. It ensures purity of the species but reduces genetic variation. Example: Pea (Pisum sativum).

Q12. What do you mean by Family Planning? Describe its various methods to control population.   2+5

OR

Write notes on the following:

(a) Plant hormones.   3

(b) Ecosystem.   4

Solution:

Family planning refers to the practice of controlling the number and spacing of children in a family through various methods. It helps in maintaining the health of both mother and child and controlling population growth.

Methods to Control Population:

- Natural Methods: Based on avoiding sexual intercourse during the fertile period of the menstrual cycle. Example: Rhythm Method (avoiding intercourse during ovulation).

- Barrier Methods: Prevent the entry of sperm into the female reproductive tract. Examples: Condoms, diaphragms, cervical caps.

- Hormonal Methods: Use of hormones to prevent ovulation or implantation. Examples: Oral contraceptive pills, contraceptive injections, implants.

- Intrauterine Devices (IUDs): Devices inserted into the uterus to prevent fertilization or implantation. Example: Copper-T, Mirena.

- Surgical Methods: Permanent methods of contraception. Examples: Vasectomy (in males), Tubectomy (in females).

- Emergency Contraception: Pills taken after unprotected intercourse to prevent pregnancy. Example: Morning-after pill.

OR

(a) Plant hormones, also known as phytohormones, are chemical substances that regulate growth, development, and various physiological processes in plants. They are produced in small amounts and transported to different parts of the plant.

Types of Plant Hormones:

1) Auxins – Promote cell elongation, root growth, and fruit development (e.g., Indole Acetic Acid - IAA).

2) Gibberellins – Stimulate stem elongation, seed germination, and flowering.

3) Cytokinins – Promote cell division and delay leaf aging.

4) Abscisic Acid (ABA) – Inhibits growth, promotes dormancy, and helps plants survive drought conditions.

5) Ethylene – Regulates fruit ripening and leaf shedding.

(b) An ecosystem is a self-sustaining unit of the environment where living organisms (plants, animals, and microorganisms) interact with each other and their non-living surroundings (air, water, soil, sunlight).

Components of an Ecosystem:

1) Biotic Components – Living organisms such as producers (plants), consumers (animals), and decomposers (bacteria and fungi).

2) Abiotic Components – Non-living factors like sunlight, air, water, temperature, and minerals.

Types of Ecosystems:

1) Natural Ecosystem – Exists naturally (e.g., forests, ponds, oceans).

2) Artificial Ecosystem – Created by humans (e.g., gardens, aquariums, agricultural fields).

Ecosystems help maintain ecological balance and sustain life on Earth.