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ICAR-IARI

Exam Guide

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INDIAN AGRICULTURAL RESEARCH INSTITUTE

RECRUITMENT FOR

TECHNICIAN (T-1) POSTS

by

V.V.K. Subburaj

SURA COLLEGE OF COMPETITION

Chennai

B660

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RECRUITMENT TO TECHNICIAN (T-1) POSTS AT ICAR HEADQUARTERS & ITS RESEARCH INSTITUTES - 2021

SCHEME AND SYLLABUS OF EXAMINATION

ELIGIBILITY

Essential Qualification:

Matriculation pass from a recognized Board.

Scheme of Examination:

(a) Examination will be of 100 marks consisting of Objective Type – Multiple Choice Questions and the duration will be of one and half hours. There will be four subjects carrying 25 marks for each of the following subjects as per the following scheme: -

Paper/Sections	Subject	Max. Marks/ Questions	Total Duration/Timing for candidates
1.	General Knowledge	25	1 and 1/2 Hours
2.	Mathematics	25	
3.	Science	25	
4.	Social Science	25	

(b) The question papers will be prepared bilingually, in English & Hindi for Sections 1, 2, 3 & 4.

(c) The question paper will be common for all the functional groups in which the recruitment is proposed to be made.

(d) There will be no interview for the posts of Technician (T-1).

(e) The Answer key will be placed on the IARI website after the written examination. Any representation regarding answer key received within 05 days of uploading of the answer key will be scrutinized and the decision of the IARI/Council in this regard will be final.

SCIENCE

Physics

- ★ Motion
- ★ Force
- ★ Work and Energy
- ★ Sound and Wave Motion
- ★ Heat
- ★ Light
- ★ Electricity
- ★ Magnetic Effects of Electric Current
- ★ Sources of Energy
- ★ The Universe
- ★ Important Facts

Chemistry

- ★ Is matter Around us Pure
- ★ Matter in our Surroundings
- ★ Atomic Structure
- ★ Atoms and Molecules
- ★ Chemical Reactions and Equations
- ★ Acids, Bases and Salts
- ★ Metals and Non- Metals
- ★ Carbon and its Compounds
- ★ Periodic classification of elements
- ★ Important Facts

Biology

- ★ Introduction of Biology
- ★ Excretion
- ★ Control and Co-Ordination
- ★ Heredity and Evolution
- ★ Transportation
- ★ Respiration
- ★ Soil
- ★ Agriculture & Economic importance of Plants & Animals
- ★ Microbiology
- ★ Cells and Tissues
- ★ Human Health and Diseases
- ★ Reproduction
- ★ Important Facts

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PHYSICS

1. MOTION

Origin : It is a fixed point with respect to which the position of any object changes.

Distance : The path covered by a body during the whole journey without taking consideration of its direction. It is a scalar quantity. It is always positive.

Displacement : Distance in a particular direction. It is a vector quantity. It may be positive, negative or zero.

Difference between distance and displacement : Distance is always greater than or equal to the displacement.

Speed : Rate of change of distance.

Average speed : Ratio of the total distance travelled to the total time taken.

$$\text{Ave. Speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

Initial Speed : Speed with which a body starts its motion in the begining. It is denoted by 'u'. It is zero whenever a body starts from rest.

Final Speed : Speed which is acquired by the body after its start. It is denoted by 'v'. When a body finally comes to rest its final speed is zero.

Scalar Quantities : The physical quantities which have only magnitude. e.g., time, mass, speed, etc.,

Vector Quantities : The physical quantities which have both magnitude and direction. e.g., displacement, acceleration, force etc.,

Variable Velocity : A body which covers unequal distances in equal intervals of time or its direction changes or both change.

Uniform Velocity : A body travels equal distances in equal intervals of time.

Angular Velocity : The rate of change of angular displacement.

Acceleration : Rate of change of velocity. It is a vector quantity.

Angular Acceleration : The rate of change of angular velocity.

Retardation : The final speed of a body is less than its initial speed. This is negative of the acceleration.

Centripetal Acceleration : If a body is moving along the circumference of a circle then the acceleration produced is directed towards the centre of the circle.

Force due to centripetal acceleration, acting towards the centre is called centripetal force.

Slope of the graphs :

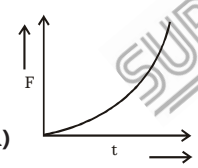
i) The slope of the distance-time graph gives to speed of the moving body.

ii) The distance travelled by a body can be obtained by determining the area under the speed-time graph.

iii) The slope of the velocity-time graph gives the acceleration of the moving body.

High Skill

1. **A heavy object is lifted by a helicopter to a higher place. The helicopter is moving vertically upwards. The graph below shows the resultant force on the object as a function of time. The acceleration of the helicopter moving upwards.**



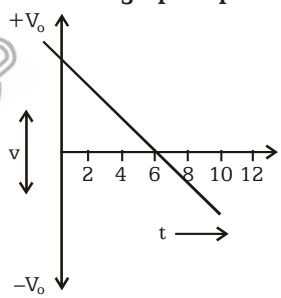
A) increases
B) decreases
C) stays constant
D) zero

Ans. (A)

2. **A motorcycle accelerates uniformly from rest along a straight road, reaching a speed of 200 km/h after 10s. At what stage during the motion does the bike's speedometer needle pass the 100 km/h mark?**

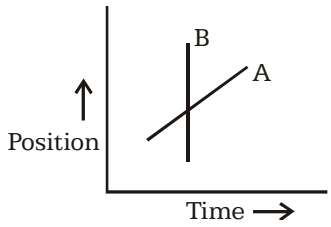
A) halfway along the road
B) 5 seconds after starting
C) some time before 5 sec.
D) some distance after the halfway mark **Ans. (B)**

3. **The v – t graph represents the motion of**



A) a projectile projected vertically upward
B) an electron in the H_2 atom
C) a bullet fired horizontally from the top of a tower
D) a car with constant acceleration along a straight road. **Ans. (A)**

4. **The position-time graph for two objects A and B is shown in the figure. If V_A and V_B are the velocities of the objects A & B respectively. Then the correct option is**



A) $V_A = V_B$ **B)** $V_A < V_B$
C) $V_A > V_B$
D) $V_A > V_B$ upto certain time and after that $V_A < V_B$
Ans. (B)

5. **A toy cyclist completes one round of a square track of side 2 m in 40 seconds. What will be the displacement at the end of 3 minutes?**
A) zero **B)** 52 m
C) $2\sqrt{2}$ m **D)** 16 m **Ans. (C)**

6. **If a ball is thrown vertically upwards with speed u, the distance covered during the last t seconds of its ascent is**
A) $\frac{1}{2}gt^2$ **B)** ut
C) $ut - \frac{1}{2}gt^2$ **D)** $(u + gt)t$ **Ans. (A)**

7. **A car covers $\frac{1}{3}$ distance with speed 20 km/hr and $\frac{2}{3}$ with 60 km/hr. Average speed is**
A) 16 km / hr **B)** 10 km / hr
C) 8 km / hr **D)** 12 km / hr **Ans. (D)**

8. **When a ball is thrown up vertically with velocity V_o, it reaches a maximum height of h. If one wishes to triple the maximum height then the ball should be thrown with velocity**
A) $\frac{3}{2}V_o$ **B)** $\sqrt{3}V_o$
C) $3V_o$ **D)** $9V_o$ **Ans. (B)**

9. **A ball is thrown from height h and another from 2 h. The ratio of time taken by the two balls to reach ground is**
A) $\sqrt{2}:1$ **B)** $1:\sqrt{2}$
C) 2 : 1 **D)** 1 : 2 **Ans. (B)**

10. **A ball is released freely from the top of a building of height h. How long will it take for the ball to come down if h = 80 m, g = 10 m/s²**
A) 6 s **B)** 8 s
C) 4 s **D)** 2 s **Ans. (C)**

11. **A particle is moving eastward with a velocity of 5 ms^{-1}. In 10 s the velocity changes to 5 ms^{-1} northwards. The average acceleration is**
A) zero
B) $\frac{1}{2}ms^{-1}$
C) $\frac{1}{2}ms^{-2}$ towards west
D) $\frac{1}{\sqrt{2}}ms^{-2}$ towards north-east **Ans. (D)**

Elementary Level

1. **The actual length of the path covered by a body irrespective of its direction is**
A) distance **B)** velocity
C) speed **D)** displacement **Ans. (A)**

2. **Which of the following is not a vector quantity?**
A) velocity **B)** displacement
C) acceleration **D)** speed **Ans. (D)**

3. **Odometer of automobiles records**
A) average speed
B) distance travelled
C) instantaneous speed
D) average acceleration **Ans. (B)**

4. **Which of the following physical quantity is constant for a uniform circular motion?**
A) velocity **B)** acceleration
C) speed **D)** distance **Ans. (C)**

5. **Acceleration is given by the relation**
A) velocity / time **B)** force / velocity
C) mass / distance **D)** mass × velocity
Ans. (A)

6. **A scooterist covers a distance of 6 km in 5 min. calculate the speed in m/s.**
A) 20 m/s **B)** 40 m/s
C) 15 m/s **D)** 30 m/s **Ans. (A)**

7. **m/s^2 is SI unit of**
A) speed **B)** acceleration
C) retardation **D)** both B & C **Ans. (D)**

8. **A body is said to have non-uniform motion if it**
A) Travel equal distance in equal intervals of time
B) Travel unequal distance in equal intervals of time
C) Travel unequal distance in unequal intervals of time
D) Travel equal distance in unequal intervals of time
Ans. (B)

9. **The velocity of stone thrown vertically upwards at its maximum height is**
A) maximum **B)** minimum
C) zero **D)** unity **Ans. (C)**

10. Under what conditions can a body travel a certain distance get its resultant displacement is zero?
A) If body travels along a straight line
B) If body travels around circular ring
C) If body travels in zigzag path
D) If body travels along a slope **Ans. (B)**

11. The motion of second hand of clock represents
A) uniform speed
B) uniform velocity
C) uniform acceleration
D) both A & B **Ans. (A)**

12. The slope of velocity - time graph gives
A) speed
B) displacement
C) acceleration
D) distance **Ans. (C)**

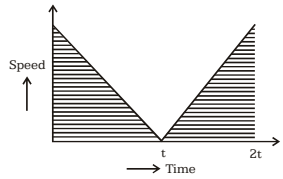
13. Area under a velocity - time graph gives
A) The time taken by a moving object
B) The displacement covered by an object
C) The acceleration of a moving object
D) The retardation of a moving object
Ans. (B)

14. The ratio of SI units to CGS units of velocity is
A) 10^{-2} **B)** 10^{2}
C) 10 **D)** 10^{-1} **Ans. (B)**

15. If the velocity of a body does not change with time, its acceleration is
A) zero **B)** infinity
C) unity **D)** non uniform **Ans. (A)**

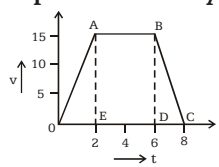
16. A player completes a circular path of radius r in 40 s. At the end of 2 min 20 sec. displacement will be
A) 2r **B)** $2\pi r$
C) $7\pi r$ **D)** zero **Ans. (A)**

17. In the following speed-time graph the shaded portion gives



A) distance travelled **B)** average speed
C) average velocity **D)** displacement travelled
Ans. (A)

18. In the following displacement time graph, BC represents a body moving



A) backward with uniform velocity
B) backward with non uniform velocity
C) forward with uniform velocity
D) forward with non-uniform velocity
Ans. (A)

19. The velocity of a particle increases from u to v in a time t during which it covers a distance s. If the particle has uniform acceleration, which one of the following equations does not apply to the motion?
A) $2s = (v+u)t$ **B)** $a = \frac{v-u}{t}$
C) $v^2 = u^2 - 2as$ **D)** $s = (u + \frac{1}{2}at)t$
Ans. (C)

20. In the v – t graph of a car, what is the distance covered by the car when it is moving with a uniform speed of 15 m/s.
A) 60 m **B)** 50 m
C) 120 m **D)** 160 m **Ans. (A)**

2. FORCE

Force : Pull or push which changes or tends to change the state of rest or of uniform motion of a body in a straight line. Unit is Newton or kg ms^{-2}.

Balanced force : It cannot change the shape and speed of the object. i.e., the resultant of the forces acting on a body is zero.

Unbalanced force : It cause the change in speed or direction of motion of the body. i.e., the resultant is not zero.

Resultant force : When two or more forces act on a body simultaneously, then the single force which produces the same effect as produced by all the forces acting together is known as resultant force.

Newton's laws of motion
First Law : Every body remains in its state of rest or of uniform motion unless it is compelled to change its state by unbalanced force.

Second Law : The rate of change of momention of a body is directly proportional to the unbalanced force applied and takes place in the direction of the force.
Third Law : To every action there is an equal and opposite reaction.
Momentum : The product of mass of a body and its velocity is called momentum.
Impulse : The product of force and time for which it is applied.

Friction : If two bodies are in contact with each other, the property by virtue of which a force is exerted by them at the point of contact to prevent one body from slipping over the other.

Static friction : The self-adjusting force of friction exactly balances the applied force so that the body on which force is applied does not move at all is static friction.

IMPORTANT FACTS

- A light year is a measure of distance and not of time. Light travels at a speed of 300,000 km/second. This equals to 9.461×10^{12} km. The mean distance between the sun and the earth is 149,898,000 km. In terms of light years, it is 8.311 minutes.
- **The Sun**

  Radius : 432,168.6 miles / 695,508 kilometres

  Star Type : Yellow dwarf

  Distance from Earth : 92.92 million miles / 149.60 million Kilometres / 1 astronomical unit
- The Sun travelling at a speed of 250 km per second (9 lakh km/h) takes about 225 million years to complete one revolution around the Milky Way. This period is called a cosmic year.
- Microgravity is the condition in which people or objects appear to be weightless.
- Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV) rockets are India's popular rockets.
- Rakesh Sharma, an Indian pilot from Punjab was selected as a 'Cosmonaut' in a joint space program between India and Soviet Russia and become the first Indian to enter into the space on 2nd April, 1984.
- India became the first Asian country to reach Mars and the first nation in the world to achieve this in the first attempt. Soviet Space Program, NASA, and European Space Agency are the three other agencies that reached Mars before ISRO.
- The Moon is the only natural satellite of the Earth. It is at a mean distance of about 3,84,400 km from the Earth. Its diameter is 3,474 km.
- The members present in the crew during the Moon Landing Mission were Neil Armstrong, Buzz Aldrin and Michael Collins.
- Kalpana Chawla travelled over 10.4 million miles in 252 orbits of t
- Light travels 3×10^8 m in one second or 3 lakhs kilometre in one second. The total number of seconds in one year is equal to $365 \times 24 \times 60 \times 60 = 3.153 \times 10^7$second.
- 1 light year = $(3.153 \times 10^7) \times (3 \times 10^8) = 9.46 \times 10^{15}$m.
- The nearest star alpha centauri is about 1.34 parsec from the sun. Most of the stars visible to the unaided eye in the night sky are within 500 parsec distance from the sun. he earth, logging more than 372 hours in space.
- The shell of an egg is 12% of its mass. A blue whale can weigh as much as 30 elephants and it is as long as 3 large tour buses.
- An Odometer is a device used for indicating distance travelled by an automobile.
- Until 1995, plane angle and solid angle were classified under supplementary quantities. However, they were shifted to derived quantities after 1995.
- The principle of a quartz clock is the Piezo - electric property of a crystal.
- **Greenwich Mean Time (GMT)** is the mean solar time at the Royal Observatory, located at Greenwich in London. It is measured at the longitude of zero degree.
- The Earth is divided into 24 zones, each of a width of 15 degree longitude. These regions are called as 'Time Zones'. Time difference between two adjacent time zones is 1 hour.
- **Indian Standard Time (IST) :** The location of Mirzapur in Uttar Pradesh is taken as the reference longitude of the Indian Standard Time. It is located at 82.5 degree longitude. IST = GMT + 5:30 hours
- The first atomic clock was developed in 1949 at the US National Bureau of Standards. But, it was less accurate than the quartz clock.
- The first accurate atomic clock (based on Caesium - 133) was built by Lauis Essan and Jack Penny in 1955, at the National Physics Laboratory in the United Kingdom.
- The Speedometer of an automobile measures the instantaneous speed of the automobile.
- **Separation of cream from milk :** A separator is a high speed spinner. It acts on the same principle of centrifuge machines.
- **Nautical mile :** Nautical mile is the unit for measuring the distance in the field of aviation and sea transportation. One nautical mile is 1.852 km.
- If a single nail pricks our body it is very painful. However it is possible for people to lie down on a bed of nails and still remains unhurt, because of the large contact area.
- Cutting edges of knife and axes are sharpened, because as the area decreases the pressure increases. Hence, small force is enough to cut a large object.
- Heavy trucks are fitted with six to eight wheels. As area increases pressure decreases. So weight of the truck exerts less pressure on the road.
- Animals' jaws can exert a pressure of more than 750 pounds per square inch as they are very sharp.
- Human lung is well adapted to breathe at a pressure of sea level (101.3 k Pa).
- Pascal per inch (P_{si}), an old system of unit is used in the petrol bunks to measure the tyre pressure of vehicles.
- Salt water provides more buoyant force than fresh water, because, buoyant force depends as much on the density of fluids as on the volume displaced.

- Copper does not react with water at any temperature. That is why it is used for making pipes and boilers.
- Tap water, river water and well water contain dissolved solids but rainwater and distilled water do not contain dissolved solids. Hence concentric rings are not formed in the rain water and distilled water after evaporation.
- The salinity of water is more in the Dead sea. It is actually a salt lake as it has a single source of water and is not connected to the ocean.
- Distilled water and boiled water have no taste. The pleasant taste of drinking water is due to the presence of dissolved substances which include air, carbon dioxide and minerals.
- Electrostatic forces between two point charges obey Newton's third law. The force on one charge is the action and on the other is reaction and vice versa.
- Extremely weak electric current is produced in the human body by the movement of charged particles. These are called synaptic signals. These signals are produced by electro-chemical process. They travel between brain and the organs through nervous system.
- Voltage and frequency of AC used in India for domestic purpose is 220V and 50 Hz respectively. In United States of America it is 110V and 60 Hz respectively.
- Nichrome is a conductor with highest resistivity equal to $1.5 \times 10^{-6}\ \Omega$ m. Hence, it is used in making heating elements.
- **Horse Power :** The horse power (hp) is a unit in the foot-pound-second (fps) or English system, sometimes used to express the electric power. It is equal to 746 watt.
- In India, domestic circuits are supplied with an alternating current of potential 220/230V and frequency 50 Hz. In countries like USA and UK, domestic circuits are supplied with an alternating current of potential 110/120 V and frequency 60 Hz.
- A step up transformer increases the voltage but it decreases the current and vice versa. Basically there will be loss of energy in a transformer in the form of heat, sound etc.
- There are three types of iron ores. They are Hematite (69% of Iron), Magnetite (72.4% of Iron) and Siderite (48.2% of Iron). Magnetite is an oxide ore of iron with the formula Fe_3O_4. Among these ores, Magnetite has more magnetic property.
- William Gilbert laid the foundation for the study of magnetism and suggested that the Earth has a giant bar magnet.
- Alnico cow magnet is used to attract sharp iron wire and other iron objects that may be ingested by animals while grazing thereby to avoid causing damage to their digestive tract.
- The temperature, at which the ferromagnetic material becomes paramagnetic is called the curie temperature.
- The most powerful magnet in the universe is actually a neutron star called magnetar (magnetic neutron star) located in the Milky Way Galaxy.
- Earth's magnet is 20 times more powerful than a fridge magnet.
- The strip on the back of a credit card/debit card is called as magnetic strip, often called a magstripe. The magstripe is made up of tiny iron-based magnetic particles in a thin plastic film. Each particle is really a very tiny bar magnet about 20 millionth of an inch long.
- The formation of rainbow is an example of dispersion of white light.
- The most common usage of mirror writing can be found on the front of ambulances, where the word "AMBULANCE" is often written in very large mirrored text.
- The sun gives us 3.8×10^{26} joule of heat energy per second. This energy is produced by nuclear fusion.
- Kavalur observatory located in Javadu Hills (Vellore Dist) in Tamil Nadu has one of the largest reflector telescopes in Asia.
- Mirrors are used in light houses. They reflect light a long way to help ships at sea.
- Optical fibre is a device that works on the principle of **total internal reflection** by which light signals (huge data) can be transmitted from one place to another place with a negligible loss of energy in a very short time.
- Colloid is a microscopically small substance that is equally dispersed throughout another material. Example: Milk, Ice cream, muddy water, smoke.
- Sound travels faster in solids and liquids because the molecules are closer to one another than in the gases. Sound travels about 5 times faster in water than in air.
- Animals, such as bats, dolphins, rats, whales and oil birds, use echolation, an ultrasound technique that uses echoes to identify and locate objects.
- When a dog keeps out its tongue and breathes hard, the moisture on the tongue turns into water and it evaporates. Since, heat energy is needed to turn a liquid into gas, heat is removed from dog's tongue. This helps to cool the body of the dog.
- Water in its various form, has different specific heat capacities.
  - Water (liquid state) = 4200 J Kg^{-1} K^{-1}
  - Ice (solid state) = 2100 J Kg^{-1} K^{-1}
  - Steam (gaseous state) = 460 J Kg^{-1} K^{-1}
- The nuclear bomb that was dropped in Hiroshima during World War II was called as **'Little boy'.** It was a gun-type bomb which used a uranium core. The bomb, which was subsequently dropped over Nagasaki was called as **'Fat man'.** It was an explosion type bomb, which used a plutonium core.

CHEMISTRY

1. IS MATTER AROUND US PURE

Matter

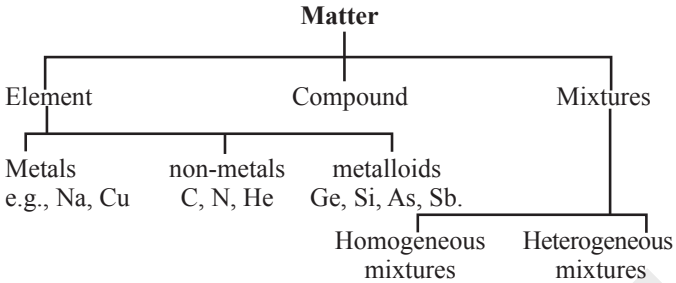
Anything that occupies mass and space is called matter. The smallest particles of matter which have all the properties of matter and independent existence is called molecules.

The space between the molecules of matter is called intermolecular space.

The force of attraction between the molecules is called intermolecular force of attraction.

Classification of Matter

Based on the chemical composition matter can be classified into element, compound and mixtures.



Element : Elements are the building block of matter and made up of only one kind of atoms. It cannot be further divided into simpler substances. At present 114 elements are known.

Atomicity : The number of atoms present in one molecule of an element is known as atomicity.

Monoatomic elements : Ar, He, Cu, Na

Diatomic elements : H_2, O_2, Cl_2

Polyatomic elements : O_3 (ozone), S_8 (sulphur), P_4 (phosphorus)

Compound :

- It is a pure substance made up of two or more elements combined chemically in a fixed ratio by weight.
- It is always homogeneous.
- A compound can be separated into its constituents only by chemical methods.
- The properties of a compound are different from its constituent elements.

e.g., CO_2 is a compound in which carbon and oxygen combined chemically in the ratio of 12 : 32 i.e., 3 : 8. The properties of CO_2 is entirely different from that of carbon and oxygen.

Mixture :

- Mixture consists of two or more elements/compounds combine physically at any proportion.
- Mixture has the properties of constituent of elements or compounds. Mixtures may be homogeneous or heterogeneous.

Homogeneous Mixture : Mixtures having uniform composition throughout the mass is known as homogeneous mixture. eg. sugar in water.

Heterogeneous Mixture : Mixtures which does not have uniform composition is known as heterogeneous mixture. eg. A mixture of oil in water.

Solution

Homogeneous mixture of two or more sustances is known as solution. A binary solution has two compounds. Solvent (the component which is in excess) and solute (the component which is in less amount).

Types of Solutions

Solute	Solvent	Example
Gas	Gas	Air
Gas	Liquid	Oxygen dissolved in water, soda water
Gas	Solid	H_2 /Pd
Liquid	Gas	Moisture in air
Liquid	Liquid	Ethanol dissolved in water
Liquid	Solid	Amalgam of Hg with Na, Hydrated salts.
Solid	Gas	Camphor in nitrogen gas
Solid	Liquid	Glucose dissolved in water
Solid	Solid	Alloys

Depending on the amount of solute that can be dissolved in a given amount of solvent at a particular temperature and pressure, solutions are classified into saturated, unsaturated and supersaturated solutions.

Saturated Solution : A solution in which no more solute can be dissolved at the same temperature is known as saturated solution.

The amount of solute dissolved in 100g of the solvent is the solubility.

$$\text{Solubility (S)} = \frac{\text{mass of solute}}{\text{mass of solvent}} \times 100$$

Unsaturated Solution : A solution in which more amount of solute can be dissolved at the same temperature is known as unsaturated solution. When a saturated solution is heated it becomes unsaturated.

Supersaturated Solution : If a saturated solution is cooled, the solubility of the solute decreases and will be precipitated. Such a solution is known as supersaturated solution.

Based on the particle size of the constituents solutions are classified into true solutions, colloidal solutions and suspensions.

Comparative Study of Suspension, Colloidal Solution and True Solution

Property	Suspension	Colloidal Solution	True Solution
Particle size	$> 10^{-7}$ m	10^{-7} to 10^{-9} m	$< 10^{-9}$ m
Filtration on through ordinary filter paper	Possible	Not possible	Not possible
Settling of particles	Settle under gravity	Settle only on centrifugation	Does not settle
Tyndall effect	Shows	Shows	Does not show
Nature	Heterogeneous	Heterogeneous	Homogeneous
Example	Muddy water	Milk, fog, smoke, cream etc	Glucose solution, ethanol dissolved in water.

Separation of Mixtures

1. **Recrystallisation :** This method is used for the purification of organic solids. This method is makes the use of differences in the solubility of the solid and the impurities.
2. **Sublimation :** Certain solids directly changes from solid to vapour state on heating. This process is called sublimation. This method is used to separate sublimable solids from non sublimable impurities. Example, substances such as Iodine, ammonium chloride, naphthalene, camphor, benzoic acid etc. can be purified by sublimation.
3. **Filtration :** This method is used to separate insoluble solid component from liquid by passing through filter paper. Example, separation of charcoal from water.
4. **Evaporation :** To separate volatile liquid component from solid-liquid mixture. Example, dye from ink, sodium chloride from sodium chloride and water.
5. **Distillation :** Simple Distillation is used to purify liquids which boil without decomposition and contain non-volatile impurities. In this method, the liquid is boiled and the vapours are condensed back to get pure liquid.
6. **Fractional Distillation :** This process is used to separate a mixture of two or more miscible liquids which have boiling points close to each other. Example, Refining of petroleum.
7. **Separating Funnel :** In this method two immiscible liquids are separated into two layers depending on their densities.

Physical and Chemical Changes

Physical Change	Chemical Change
Change in physical properties like colour, state, refractive index, conductivity etc. No change in composition of the substance.	Molecular composition of the substance is changed.
Reversible (Temporary) changes.	Irreversible (Permanent) changes.
No new substances are formed e.g., melting, boiling, sublimation, dissolution of salt in water etc.	New substances are formed, e.g., combustion, rusting, cooking of food, curdling of milk etc.

High Skill

1. Which of the following processes is considered as only physical change?

A) Combustion of petrol in automobile engine
B) Photosynthesis
C) Condensation of water vapour
D) Tarnishing of silver

Ans. (C)

2. Cut an apple and keep the slices exposed to air for sometime. Identify the true statement about the process.

A) The colour of the cut surface becomes brown.
B) The colour of the cut surface changes due to chemical change.
C) The colour change is irreversible
D) All the above

Ans. (D)

3. Match the following :

List-I	List-II
a. CO_2	**1.** mixture
b. Graphite	**2.** Retains the properties of the constituents
c. Air	**3.** contains only one type of atoms
d. Soil	**4.** heterogeneous

Codes :

	a)	b)	c)	d)
A)	2	4	1	3
B)	2	3	1	4
C)	4	3	1	2
D)	2	1	3	4

Ans. (B)

High Skill

1. **Identify the substance which has highest boiling point**
   A) Rain water **B)** Sea water
   C) Distilled water **D)** Ethanol
   Ans. (B)

2. **Two beakers A and B contain distilled water. 0.2 g NaCl is added to the beaker A and both the samples allowed to freeze at the same experimental conditions. It is observed that**
   A) Freezing points of A and B are same
   B) A freezes at a higher temperature than B
   C) A freezes at a lower temperature than B
   D) None of the above
   Explanation : **Ans. (C)**
   Addition of impurity decreases the freezing point.

3. **Boiling point of four liquids A, B, C and D are given. Arrange them in the decreasing order of the intermolecular force of attraction.**
   1. 33^0C **2.** 175^0C
   3. 100^0C **4.** 72^0C
   Select the correct answer :
   A) $2 > 3 > 4 > 1$ **B)** $1 > 4 > 3 > 2$
   C) $2 < 3 < 4 < 1$ **D)** $2 < 3 < 1 < 4$
   Ans. (A)

4. **Boiling point generally as the molecular weight increases. But boiling point of water (Mol. mass = 18) is 100^0C where as H_2S (Mol. mass 34) is a gas. Based on the given data identify the correct statements.**
   A) Intermolecular force of attraction between the molecules of water is higher than that of H_2S
   B) Molecules of water are associated by strong hydrogen bonding
   C) Both A and B
   D) Neither A nor B **Ans. (C)**

5. **Which of the following is true about the two statements?**
   Statement I : Use of pressure cooker reduces the cooking time.
   Statement II : Pressure is low inside the cooker, hence cooking temperature is higher.
   Select the correct answer :
   A) I and II are correct and II is the correct explanation of I
   B) I and II are correct but II is not the correct explanation of I
   C) I is correct but II is wrong
   D) I is wrong but II is correct
   Explanation : **Ans. (C)**
   Temperature increases with pressure and inside the cooker pressure is higher when compared to open vessel.

6. **Cooling sensation produced by alcohol is more than that of water. Which of the following statement is correct about this?**
   A) Alcohol is less volatile than water
   B) Intermolecular force is less in alcohol than in water
   C) Intermolecular force is less in water than in alcohol
   D) All of the above
   Ans. (B)

7. **Freezing mixture used for the preservation of fish and meat is made by mixing of ice and common salt in the ratio 3 : 1. The purpose of adding salt to ice is**
   A) to increase the melting point of ice
   B) to decrease the melting point of ice
   C) to absorb the water formed during the melting of ice
   D) to increase the density of ice
   Ans. (B)

8. **During the process of boiling, temperature of the liquid**
   A) decreases
   B) increases
   C) remains constant
   D) first decreases then increase
   Explanation : **Ans. (C)**
   During the change of state of matter viz. melting, boiling temp. remains constant. The given heat is used to overcome the intermolecular force of attraction.

9. **Which of the following statements is not true?**
   A) The rate of evaporation is more in coastal area than in non-coastal area.
   B) Rate of evaporation is more in hot sunny days than in rainy days.
   C) Water kept in earthern pot gets cooled due to the evaporation of water from inside the pot.
   D) Pure solvent freezes at a higher temperature than solution.
   Ans. (A)

10. **The kinetic energy of the gas molecules decrease with**
    A) increase in temperature
    B) decrease in temperature
    C) temperature independent
    D) None of the above **Ans. (B)**

Elementary Level

1. Maximum intermolecular force is present in
A) Glycerol **B)** Honey
C) Oxygen **D)** Solid CO_2
Explanation : **Ans. (D)**
Solid CO_2 is in solid state.

2. Which of the following substances undergoes maximum expansion on heating?
A) Bromine **B)** Iodine
C) Chlorine **D)** Mercury
Explanation : **Ans. (C)**
Gases have maximum thermal expansion.

3. Which of the following statements are not correct about the liquids?
i. They have fixed volume but no fixed shape
ii. They are rigid
iii. Thermal expansion is very high
iv. They are fluids
Select the correct answer :
A) i, iv **B)** i, ii
C) ii, iii **D)** i, ii and iii **Ans. (A)**

4. Arrange the following substances A, B and C in the increasing order of their kinetic energy.
1. Sulphur dioxide **2.** Carbon disulphide
3. Quartz
Select the correct answer :
A) 1 > 2 > 3 **B)** 1 < 2 < 3
C) 3 < 1 < 2 **D)** 3 < 2 < 1 **Ans. (C)**

5. The physical state of water at 1 atm pressure and 25°C is
A) Solid **B)** Semi solid
C) Liquid **D)** Gas **Ans. (C)**

6. Rate of evaporation
A) increases with humidity and temperature
B) decreases with temperature, but increases with humidity
C) decreases with wind speed, but increases with humidity
D) increases with temperature, but decreases with humidity **Ans. (B)**

7. Identify the pair of substances which undergo diffusion
A) Benzene and hexane
B) Water and ethanoic acid
C) Nitrogen and oxygen
D) All the above **Ans. (B)**

8. The boiling point of a sample of water is 373 K at the sea level. If the sample of water is taken to Darjeeling, what would be the boiling point?
A) 373 K **B)** Greater than 373 K
C) Less than 373 K **D)** None of these
Ans. (C)

9. Which of the following statement is not true?
A) Boiling is a bulk process and is very slow
B) Evaporation is a rapid process and is a surface phenomena
C) At 1 atmospheric pressure boiling point of all the liquids are same.
D) All of the above **Ans. (A)**

10. 25^0C is represented in Kelvin scale as ..... K
A) 25 K **B)** 0 K
C) 298 K **D)** 248 K
Explanation : **Ans. (B)**
Temperature at Kelvin Scale = $(273 + t^0C)$ K

3. ATOMIC STRUCTURE

Atomic Structure :

The fundamental constituent of matter is atoms and molecules. In ancient times atoms were considered to be indivisible. John Dalton in his atomic theory proposed that atoms are indivisible, which takes part in chemical reaction.

According to modern concept atoms consist of three fundamental particles : Electrons, protons and neutrons.

- Protons and neutrons are present inside the nucleus at the centre of the atom
- Electrons are outside the nucleus

Electrons :

Electrons were discovered by J.J. Thomson by using a discharge tube. When high voltage is applied at low pressure between the electrodes of the discharge tube some rays were found to be emitted by the cathode. These are cathode rays which consists of small, negatively charged particles called electrons.

- Charge of an electron = -1.6×10^{-19} C.
- Mass of an electron = 9.1×10^{-31} Kg

Protons :

Protons were discovered by Goldstein when cathode ray experiment was conducted by using a perforated cathode.

- Mass of proton = 1.66×10^{-27} Kg
- Charge of proton = 1.6×10^{-19} C.

Neutrons :

As mass of the electron was negligible when compared to that of proton, mass of an atom should be equal to mass of the total number of protons. But for all atoms except hydrogen this was not true. Chadwick (1932) discovered another neutral particle in the nucleus. They are called neutrons.

- Mass of neutron = 1.66×10^{-27} Kg
- Charge of neutron = Zero

Comparison between Proton, Neutron and Electron

S. No.	Fundamental Particle	Charge	Relative Charge	Mass	Approx. Mass/u
1.	Proton	$+1.6 \times 10^{-19}$ C	+1	1.67×10^{-27} Kg	1
2.	Neutron	0	0	1.67×10^{-27} Kg	1
3.	Electron	-1.6×10^{-19} C	–1	9.1×10^{-31} Kg	0

Thomson's Atomic Model

J.J. Thomson proposed that an atom possesses a spherical shape in which positive charge is uniformly distributed and electrons are embedded into it.

- Mass of the atom is uniformly distributed over the atom.
- Atom is electrically neutral as the number of protons and electrons are same.
- Although Thomson's model could explain the electrical neutrality it could not explain the results of the later experiments.

Rutherford's Nuclear Model of Atom

Rutherford's α -Particle Scattering Experiment

Rutherford bombarded thin gold foil with α-particles. (α-particles are He^{2+} ions i.e., having two units positive charge and 4 unit mass). It was observed that,

- Most of the α-particles passed through the gold foil undeflected indicates the presence of large empty space in the atom.
- A small fraction of the α-particles was deflected by small angles – indicates the presence of positively charged centre i.e., nucleus.
- Very few α-particles (1 in 20,000) were deflected by 180^0 – can be concluded that volume occupied by nucleus is negligibly small as compared to the total volume of the atom.

Based on the above observation and conclusion Rutherford proposed the nuclear model of atom.

- The entire positive charge and mass of the atom is concentrated in nucleus.
- The electrons are moving around the nucleus with very high speed in circular path called orbits. It is also known as planetary model as it resembles with solar system.
- Electrons and nucleus are held together by electrostatic forces of attraction.

A major drawback of this model is that it cannot explain the stability of the atom.

When negatively charged electrons move around nucleus in an orbit will emit radiation and the orbit will continue to shrink and finally electrons drop into the nucleus.

Atomic Number and Mass Number

Atomic number (Z) = Number of protons in the nucleus of an atom
= Number of electrons in a neutral atom.

(As an atom is electrically neutral and charge of the proton is equal but opposite to that of the electron, number of the proton is equal to number of the electron).

Mass Number

Protons and neutrons are collectively known as nucleons

Mass number (A) = number of protons + number of neutrons (n)
= Atomic number + number of neutrons.

therefore, number of neutrons (n) = Mass number (A) – Atomic number (Z) i.e., n = A – Z

Bohr's Atomic Model

Postulates of Bohr's Model

- Electrons revolve round the nucleus in fixed circular paths called orbits or shells.
- These orbits are also called energy levels as each orbit is associated with definite amount of energy.
- These energy levels are designated as K, L, M, N etc.
- The energy of an electron in an orbit does not change with time. But when an electron moves from higher energy level (outer orbit) to lower energy level (inner orbit) energy is emitted or released.

When an electron moves from inner to outer orbit energy is observed.

Electronic configuration of atoms

✦ The distribution of electrons in different shells is called **electronic configuration.** This distribution of electrons is governed by three basic rules or principles, known as **Bohr and Bury** rules of electronic configuration.

✦ **Rule 1 :** The maximum number of electrons that can be accommodated in a shell is equal to 2n2, where 'n' is the serial number of the shell from the nucleus. Thus, the maximum number of electrons that can be accommodated in different shells are as follows :

Shell	Value of (n)	Maximum number of electrons ($2n^2$)
K	1	$2 \times 1^2 = 2$
L	2	$2 \times 2^2 = 8$
M	3	$2 \times 3^2 = 18$
N	4	$2 \times 4^2 = 32$

✦ **Rule 2 :** The shells are occupied in the increasing order of their energies.

✦ **Rule 3 :** The outermost shell of an atom cannot have more than 8 electrons, even if it has capacity to accommodate more electrons. For example, electronic configuration of calcium having 20 electrons can be written as,

K	L	M	N
2	8	8	2

Electronic Configuration of Elements of Atomic No. 1 to 20

S.No.	Element	Symbol	Atomic No. (z)	Electronic Configuration			
				K	L	M	N
1.	Hydrogen	H	1	1			
2.	Helium	He	2	2			
3.	Lithium	Li	3	2	1		
4.	Beryllium	Be	4	2	2		
5.	Boron	B	5	2	2		
6.	Carbon	C	6	2	2		
7.	Nitrogen	N	7	2	5		
8.	Oxygen	O	8	2	6		
9.	Fluorine	F	9	2	7		
10.	Neon	Ne	10	2	8		
11.	Sodium	Na	11	2	8	1	
12.	Magnesium	Mg	12	2	8	2	
13.	Aluminium	Al	13	2	8	3	
14.	Silicon	Si	14	2	8	4	
15.	Phosphorus	P	15	2	8	5	
16.	Sulphur	S	16	2	8	6	
17.	Chlorine	Cl	17	2	8	7	
18.	Argon	Ar	18	2	8	8	
19.	Potassium	K	19	2	8	8	1
20.	Calcium	Ca	20	2	8	8	2

Points to Remember

- Radioactivity is the spontaneous emission of radiations by certain elements like Ra, Rn, U etc.
- Radio active radiations are of 3 types

α -rays : Doubly charged He nucleus (He^{2+})
β -rays : These are similar to electrons ($_{o}e^{-1}$)
γ -rays : High energy electro magnetic radiations having no charge

- Isotopes : Atoms of same element with same atomic no. but different mass no.

e.g., $_{1}H^{1}$ $_{1}H^{2}$ $_{1}H^{3}$

Protium Deuterium Tritium

- Isotopes have same number of neutrons.
- Isobars : Atoms of different element with same mass no. e.g., $_{18}Ar^{20}$, $_{20}Ca^{20}$
- Isotones : Atoms of different element with same no. of neutrons e.g., $_{7}N^{15}$ $_{8}O^{16}$
- Isotopes are the atoms of same element where as isobars and isotones are atoms of different elements.

High Skill

1. The number of electrons in the outermost shell and the number of neutrons in the nucleus of $_{19}X^{39}$ are respectively

A) 9, 20 **B)** 1, 20
C) 1, 19 **D)** 9, 19

Explanation : **Ans. (A)**

Z=19 (2, 8, 8, 1) ; n = A – Z = 39 – 19 = 20

2. The total mass of the protons in an atom of an element is 16 u. Atomic number of the element is

A) less than 16 **B)** greater than 16
C) equal to 16 **D)** cannot be predicted

Ans. (C)

3. Identify the correct statement/s.

A) α-particles when combine with two electrons yield Helium gas.
B) β -rays are negatively charged particles.
C) γ -rays are high energy radiations like X-rays
D) All of the above **Ans. (D)**

4. The number of protons, neutrons and electrons in $_{35}Br^{80}$ are respectively

A) 35, 45, 35 **B)** 35, 35, 45
C) 35, 35, 80 **D)** 35, 80, 35

Explanation : **Ans. (A)**

A=80; Z=35;
no. of protons = 35 ; no. of electrons = 35
no. of neutrons = A – Z = 80 – 35 = 45

5. The radio active isotope of hydrogen contains ..... no. of neutrons

A) 0 **B)** 1
C) 2 **D)** 3

Explanation : **Ans. (C)**

Tritium ($_1T^3$) is the radio active isotope of hydrogen

6. The electronic configuration of an ion X^{-2} is 2, 8, 8. If its mass number is 32, the number of protons, neutrons and electrons are respectively

A) 18, 14, 18 **B)** 16, 16, 16
C) 14, 18, 14 **D)** None of these

Explanation : **Ans. (B)**

X^{-2} = 2, 8, 8 $\quad X \rightarrow 8, 6 \quad (Z=16)$;
no. of protons = 16
no. of electrons = 16
no. of neutrons = A–Z
= 32 – 16 = 16

7. Structures of nuclei of three atoms X, Y and Z are given below.

X has 18 electrons and 22 neutrons
Y has 20 protons and 20 neutrons
Z has 19 protons and 20 neutrons

Based on the above data, which of the following statement is correct?

A) X and Y are isotopes, Y and Z are isobars
B) X and Y are isobars, Y and Z are isotopes
C) X and Y are isobars, Y and Z are isotones
D) None of the above

Explanation : **Ans. (C)**

X has 18 electrons (Z=18) and 22 neutrons ; A=40
Y has 20 protons (Z=20) and 20 neutrons A=40
So X and Y are isobars.
Z has 19 protons (Z=19) and 20 neutrons
Y and Z have same number of neutrons, hence isotones.

8. Which of the following will have equal number of electrons?

i) O^{-2} and F^- **ii)** Na^+ and Mg^{2+}
iii) Ar and K^+ **iv)** Cl^- and Ar
Choose the correct answer :
A) i and ii **B)** ii and iii
C) i, ii and iii **D)** i, ii, iii and iv

Ans. (D)

9. Which of the following statement is incorrect about the model of atoms?

A) According to Rutherford's model electrons are moving around the nucleus with high velocity
B) Plum pudding model was proposed by J.J. Thomson
C) According to Bohr's model when an electron revolves in a particular orbit its energy does not change with time
D) Rutherford's model could explain the stability of the atom

Ans. (D)

10. Identify the wrong statement about cathode rays.

A) These consist of a stream of electrons
B) They are charged particles
C) Can be deflected by electric field
D) They have same velocity as that of light

Ans. (D)

11. An electron of an atom of sodium moves from its valence shell to K shell. It will

A) absorb energy
B) release energy
C) neither absorb nor release energy
D) none of the above

Explanation : **Ans. (B)**

$_{11}Na$=2, 8, 1 ; Valence electron is in M shell; So electronic transition is from n=3 to n=1 (K shell). Hence energy will be released.

12. The number of protons in Ca^{2+} ion are

A) 18 **B)** 20
C) 22 **D)** 21 **Ans. (B)**

13. Which pair shows isobars?
A) $_1H^1$ and $_1H^3$ **B)** $_6C^{14}$ and $_7N^{14}$
C) $_{18}Ar^{40}$ and $_{19}K^{40}$ **D)** both B and C
Ans. (D)

14. Match the following :

List-I	List-II
a. Nucleus	1. J.J. Thomson
b. X-rays	2. Chadwick
c. Electrons	3. Roentgen
d. Neutrons	4. Rutherford

Codes :

	a)	b)	c)	d)
A)	3	**4**	1	2
B)	4	**3**	1	2
C)	4	**2**	3	1
D)	3	**1**	4	2

Ans. (B)

15. The neutral atom isoelectronic with Ca^{2+} is
A) Cl^- **B)** K^+
C) Ar **D)** Kr **Ans. (C)**

Elementary Level

1. Number of neutrons in an atom of hydrogen is
A) 1 **B)** 2
C) 3 **D)** 0 **Ans. (D)**

2. Number of neutrons are different in
A) Isotopes **B)** Isobars
C) Isotones **D)** None of these
Ans. (B)

3. Charge and mass of α - particles are respectively
A) +2 and 0 **B)** 0 and +2
C) +2 and 4u **D)** +4 and 2u
Ans. (C)

4. Number of electrons in α - particles are
A) 4 **B)** 1
C) 2 **D)** 0 **Ans. (D)**

5. Radioactive isotope of carbon is
A) $_6C^{12}$ **B)** $_6C^{13}$
C) $_6C^{14}$ **D)** All of these **Ans. (C)**

6. An atom of an element has a mass number of 40. If it has 18 electrons, what is the number of neutrons in the nucleus ?
A) 40 **B)** 18
C) 22 **D)** cannot be calculated
Explanation : **Ans. (C)**
A=40 ; Z = 18; n = A – Z = 22

7. The unipositive ion of an element contains 8 electrons in its M shell. If its nucleus contains 20 neutrons what is the mass number of the element?
A) 18 **B)** 19
C) 38 **D)** 39
Explanation : **Ans. (D)**
$M^+ \rightarrow 2, 8, 8$; $M \rightarrow 2, 8, 8, 1$;
Z = 19 ; n = 20 ; A = Z + n = 39

8. How many electrons are present in L shell of chlorine atom?
A) 2 **B)** 8
C) 7 **D)** none of these
Explanation : **Ans. (B)**
$_{17}Cl \rightarrow 2, 8, 7$

9. Charge and mass of β- particles are respectively
A) –1 and 0 **B)** 0 and –1
C) +2 and 4u **D)** 0 and 0 **Ans. (A)**

10. Number of valence electrons in an atom of phosphorus is
A) 7 **B)** 5
C) 3 **D)** 8
Explanation : **Ans. (B)**
$_{15}P \rightarrow 2, 8, 5$

11. Nucleus was discovered by
A) J.J. Thomson **B)** Neils Bohr
C) Chadwick **D)** Rutherford **Ans. (D)**

12. Which of the following represents the electronic configuration of an inert gas?
A) 2, 8, 8, 1 **B)** 2, 8, 18, 8
C) 2, 8, 2 **D)** 2, 1 **Ans. (B)**

13. Number of electrons present in protium and deuterium are respectively
A) 1 and 1 **B)** 0 and 1
C) 1 and 0 **D)** 1 and 2
Explanation : **Ans. (A)**
Isotopes have same atomic number, hence same number of electrons.

14. Which pair shows isotones?
A) $_1H^2$ and $_1H^3$ **B)** $_6C^{14}$ and $_7N^{14}$
C) $_{14}Si^{30}$ and $_{15}P^{31}$ **D)** $_{17}Cl^{35}$ and $_{17}Cl^{37}$
Ans. (C)

15. The electronic configuration of sodium is 2, 8, 1. The electron having maximum energy occupies in
A) K Shell **B)** L Shell
C) M Shell **D)** None of these
Ans. (C)

4. ATOMS AND MOLECULES

Atoms : Atoms are fundamental particles of matter which have no independent existence except in the case of noble gases.

Molecules : Molecules are smallest particles which have independent existence.

Symbols : Symbols are the shorthand notations of a single atom of an element. It is the 'first letter' of the English name or Latin/Greek name of the element. When two or more elements start with the same letter (e.g., boron and beryllium) then first letter and another letter from the name of the element is written.

Symbols Derived from English Names

Element	Symbol	Element	Symbol
Hydrogen	H	Sulphur	S
Helium	He	Chlorine	Cl
Lithium	Li	Argon	Ar
Beryllium	Be	Calcium	Ca
Boron	B	Chromium	Cr
Carbon	C	Manganese	Mn
Nitrogen	N	Cobalt	Co
Oxygen	O	Nickel	Ni
Fluorine	F	Zinc	Zn
Neon	Ne	Bromine	Br
Magnesium	Mg	Iodine	I
Aluminium	Al	Platinum	Pt
Silicon	Si	Caesium	Cs
Phosphorus	P	Germanium	Ge

Symbols Derived from Latin Names

Name of the Element	Symbol	Latin Name
Sodium	Na	Natrium
Potassium	K	Kalium
Iron	Fe	Ferrum
Copper	Cu	Cuprum
Silver	Ag	Argentum
Gold	Au	Aurum
Mercury	Hg	Hydragyrum
Lead	Pb	Plumbum
Tin	Sn	Stannum

Atomic Masses of some Elements

Elements	Atomic Mass (u)
Hydrogen	1
Carbon	12
Nitrogen	14
Oxygen	16
Sodium	23
Magnesium	24
Alluminium	27
Phosphorus	31
Sulphur	32
Chlorine	35.5
Calcium	20

Formula

Formula represents a molecule of an element or a compound.

e.g., Oxygen - O_2; i.e., 1 molecule of oxygen contains two oxygen atoms.

Carbon dioxide - CO_2; i.e., 1 molecule of carbon dioxide contains one atom of carbon and two atoms of oxygen.

Molecular Mass

Molecular mass is the sum of atomic masses of the elements present in a molecule.

e.g. : Molecular mass of methane.

CH_4 = 1 × Mass of C atom + 4 × Mass of H atom
= 12 + 4 = 16 u or 16 amu.

Molecular mass expressed in grams is called gram molecular mass. i.e., Gram molecular mass of CH_4 = 16 g.

Ion and Radical

An atom carrying a charge is known as an ion. Ions formed by the loss of electron(s) are positively charged ions (cations) and ions formed by the gain of electron(s) are negatively charged ions (anions)

e.g. $Na \text{ -------> } Na^+ + e^-$; $Ca \text{ -------> } Ca^{2+} + 2e^-$
mono positive ion di positive ion

A group of atoms with a charge is known as radical
eg. NH_4^+, SO_4^{2-}, Cl^-

Names and Symbols of some Ions

Name	Symbol	Name	Symbol
Hydrogen	H^+	Chloride	Cl^-
Sodium	Na^+	Oxide	O^{2-}
Potassium	K^+	Sulphide	S^{2-}
Ammonium	NH_4^+	Nitrate	NO_3^-
Lithium	Li^+	Bicarbonate	HCO_3^-
Magnesium	Mg^{2+}	Carbonate	CO_3^{2-}
Calcium	Ca^{2+}	Sulphite	SO_3^{2-}
Aluminium	Al^{3+}	Sulphate	SO_4^{2-}
Zinc	Zn^{2+}	Phophate	PO_4^{3-}

Iron (ii) Ferrous	Fe^{2+}	Phosphide	P^{3-}
Iron (iii) Ferric	Fe^{3+}	Nitride	N^{3-}
Copper (I) (Cuprous)	Cu^{+}	Hydroxide	OH^{-}
Copper (II) (Cupric)	Cu^{2+}		

Derivation of Formulae

Step 1 : Write the positive radical first followed by negative radical Mg^{2+} Cl^{-}

Step 2 : Write the valencies of each below the radical

Mg Cl
2 1

Step 3 : Cross the valencies to get the formula

Mg Cl
2 1

Step 4 : If a radical is present more than one time enclose it in brackets

Ca^{2+} NO_3^{-1}
2 1
$Ca(NO_3)_2$

Mole Concept

One mole is the amount of substance that contains as many as particles as in 12 g of carbon.

1 mole of atoms = 6.022×10^{23} atoms.

The mass of one mole of a substance in grams is called a molar mass.

Molar mass = atomic mass / molecular mass (in gram).

i.e., 1 mole H_2O = 18 g water = 6.022×10^{23} H_2O molecules

1 mole O_2 = 32 g oxygen = 6.022×10^{23} O_2 molecules

1 mole of hydrogen atom = 1g of H atoms = 6.022×10^{23} hydrogen atoms

$$\text{Number of moles} = \frac{\text{Amount of substance}}{\text{molecular mass}} \text{(for molecules)}$$

$$= \frac{\text{Amount of substance}}{\text{atomic mass}} \text{(for atoms)}$$

1. Mass of 3 moles of carbon is

A) 12 g **B)** 24 g

C) 36 g **D)** 18 g

Explanation : **Ans. (C)**

$$\text{No. of moles} = \frac{\text{Mass}}{\text{Atomic mass}}$$

$$3 = \frac{\text{Mass}}{12}$$

∴ Mass of 3 moles of C = 3×12 = 36 g

(or) 1 mole → 1 gram atomic mass of C = 12 g of C

∴ 3 moles of C → 3×12 = 36 g.

Law of Conversation of Mass

The law states that mass can neither be created nor destroyed in a chemical reaction. This means that the number of atoms of each element should be equal on both sides of the equation.

eg. $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

Element	No. of Atoms before the Reaction	No. of Atoms after the Reaction
Ca	1	1
C	1	1
O	3	3

Law of Definite Proportions

It states that a given compound always contains the same elements in the same proportion by mass.

Additional Points

Concentration of a solution is the amount of substance present in a given volume.

- $\text{Mass \%} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$
- $\text{Mole fraction} = \frac{\text{No. of moles of a component}}{\text{Total No. of moles}}$
- $\text{Molarity} = \frac{\text{No. of moles of a solute}}{\text{Volume of solution in litres}}$
- $\text{Molarity} = \frac{\text{No. of moles of a solute}}{\text{Mass of solvent in Kg.}}$
- $\text{Normality} = \frac{\text{No. of equivalents of solute}}{\text{Volume of solution in litres}}$
- Equivalent mass of an element $= \frac{\text{Atomic mass of the element}}{\text{Valency}}$
- Equivalent mass of acid $= \frac{\text{Molecular mass of the acid}}{\text{Basicity of acid}}$
- Equivalent mass of base $= \frac{\text{Molecular mass of base}}{\text{Acidity of base}}$

Acidity is the number of replaceable H^+ ions

Basicity is the number of replaceable OH^- ions

High Skill

15. The properties which generally increase as we move down a group is
A) Metallic character and ionisation enthalpy
B) Electro-negativity and electron gain enthalpy
C) Electro-positive character and atomic radius
D) Ionic radius and ionisation enthalpy
Ans. (C)

16. Elements of group 3 in modern periodic table are called
A) Transition elements
B) Alkali metals
C) Representative elements
D) Chalcogens **Ans. (A)**

17. An atom has electronic configuration 2, 8, 5. Its atomic size is greater than that of
A) fluorine **B)** potassium
C) magnesium **D)** sodium **Ans. (A)**

18. Which of the following elements forms bond by gaining electrons?
A) Li **B)** Mg
C) Br **D)** Ne.
Explanation : **Ans. (C)**
Bromine is a non-metal and is electro-negative.

19. Electron gain enthalpy is maximum for
A) transition metals **B)** metals
C) semi-metals **D)** non-metals **Ans. (D)**

IMPORTANT FACTS

- Oxygen is about two times more soluble in water than nitrogen.
- If oxygen has the capacity to burn itself, striking a match stick will be enough to burn all the oxygen in our planet's atmosphere.
- Now a days nitrogen is used as a substitute for compressed air in tyres.
- The process of conversion of solid into vapour without reaching liquid state is called sublimation.
- Venus' atmosphere consists of roughly 96-97% carbon dioxide. Because of the amount of carbon dioxide present, the surface of Venus continually retains heat as such, the surface temperature of Venus is roughly 462°C, making it the hottest planet in our solar system.
- Aerated water is nothing but carbon dioxide dissolved in water under pressure. This is also called 'soda water'.
- Acid rain has pH less than 4.4 whereas pH of pure rain water is around 5.6 due to dissolution of atmospheric CO_2 in it.
- The freshness of fish and meat can be maintained by placing them in contact with ice. With its larger latent heat, ice is able to absorb a large quantity of heat from the fish as it melts.
- Copper does not react with water at any temperature. That is why it is used for making pipes and boilers.
- Tap water, river water and well water contain dissolved solids but rainwater and distilled water do not contain dissolved solids. Hence concentric rings are not formed in the rain water and distilled water after evaporation.
- Every year 4.6 million children die due to diarrhea. Access to clean water improves hygiene and health.
- RO purifiers are the purifiers that can remove the dissolved impurities and germs. They also improve the taste of water. RO stands for the name of the technology, reverse osmosis, used in these purifiers. Some RO purifiers also have a UV (ultraviolet) unit that destroys the germs present in water.
- Distilled water and boiled water have no taste. The pleasant taste of drinking water is due to the presence of dissolved substances which include air, carbon dioxide and minerals.
- About 90% of the available surface water has already been tapped mainly for agriculture and irrigation.
- The largest source of water pollution in India is untreated sewage. On an average, a person uses 180 litres of water per day for washing clothes, cooking, bathing, etc.
- In the modern periodic table there are 118 elements. 92 of which are naturally occurring while the remaining 26 have been artificially created. But from these 118 elements, billions of compounds are formed.
- Compounds of phosphorous, nitrogen and potassium are used in fertilizers.
- Silicon compounds are of immense importance in the electrical and electronic industries.
- Compounds of fluorine are used in toothpastes as they strengthen our teeth.
- LPG, Liquefied through pressurisation, is used for heating, cooking, auto fuel etc. It is increasingly used as an aerosol propellant and a refrigerant, replacing chlorofluorocarbons in an effort to reduce damage to the ozone layer. When specifically used as a vehicle fuel it is often referred to as autogas.
- Blood is not a pure substance. It is a mixture of various components such as platelets, red and white blood cells and plasma.

BIOLOGY

INTRODUCTION OF BIOLOGY

Important Biologists

Biologists	Discovered
Aristotle	Father of Biology
David Baltimore	Reverse Transcriptase
George Beadle	One Gene / One Enzyme Hypothesis
Erwin Chargaff	Double Helix Structure of DNA
Charles Darwin	Theory of Evolution
Louis Pasteur	The Germ Theory of Disease
Francis Crick	Molecular Biology
William Harvey	Criculation of the Blood
Robert Koch	Bacteriology
James Watson	The Structure of DNA
Gregor Mendel	The Law of Inheritance
Max Delbruck	The Bacteriophage
Jean Baptiste Lamark	The Foundations of Biology
Frederick Sanger	The Genetic Code
Carl Linnaeus	The Binomial Nomenclature
Karl & Landsteiner	The Blood Group
Frederick Gowl and Hopkins	Vitamins
Jonas Salk	Vaccination
Dmitry Ivanowsky	Discoverer of Viruses
Edward Jenner	Small Pox Vaccination
Robert Brown	Identifies the Nucleus of the Cell
Pasteur	Anthrax
August Weismann	Theory of Germplasm
Sutton and Boveri	Chromosomal Theory of Inheritance
Thomas Hunt Morgan	Gene Theory of Inherritance
Alexander Flemming	Discovery of Pencillin
R.A. Fisher & S. Wright	Mathematical Foundations for Population Genetics
Kroll and Ruska	First Electron Microscope
Beadle and Tatum	One-Gene-One-Enzyme Hypothesis
Avery, Mcleod, Mccarty	DNA Controls Heredity Effects
Watson and Crick	Model for DNA
Alick Issacs	Discovers Interferon
Lederberg	Discovers Plasmids
Kornberg	Synthesize DNA Molecule
Mikhail Tsvet	Chromotography
Robert Hook	By Microscope, Observe Cells
Barbara Mcclintock	Jumping Genes (or) Transposable Elements
Linus Pauling	Sickle Cell Anemia and Molecular Disease
Hershey-Chase Experiment	Uses Bacteriophage to Prove DNA is the Genetic Material
Meselson and Stahl Experiment	DNA Replication is Semi-conservative

Fields of Biology

Field	Study of Science Dealt with
Agriculture	The cultivation of plants and animals for food
Biochemistry	The study of chemical process in living things
Botany	The study of plant life
Cell Biology	The study of cells
Ecology	How living things interact with non-living things
Entomology	The study of insects (a branch of zoology)
Environmental Biology	The study of the natural world as a whole
Herpetology	The study of reptiles (a branch of zoology)
Icthyology	The study of fish (a branch of zoology)
Genetics	The study of heredity and genetics
Marine Biology	The study of marine life
Microbiology	The study of micro ogranisms
Mycology	The study of fungi
Neurobiology	The study of the nervous system
Oncology	The study of cancer
Ornithology	The study of birds (a branch of zoology)
Paleontology	The study of fossils and pre-historic life
Pathology	The study of disease
Pharmacology	The study of effects of medication
Zoology	The study of animals

Cell as a fundamental unit of life

Structure of a cell represents the arrangement of parts or organelles in a cell. Human body has millions of cells which vary in shapes and sizes. The basic functional unit of an organism is called cell.

Cell Components	Main Functions	Special Name
Cell wall	Surrounds and protects the cell Make the cell stiff and strong	Supporter and protector
Cell membrane	Holds and protects the cell Controls the movement of materials in and out of the cell	Gate of the cell
Cytoplasm	A watery, gel-like material in which cell parts move	Area of movement
Mitochondria	Produce and supply most of the energy for the cell	Power house of the cell
Chloroplasts	Contain green pigment chlorophyll Capture the energy of sunlight and use it to produce food for the cell by photosynthesis.	Food producers for the cell (Plant cell)
Vacuoles	Store food, water and chemicals	Storage tanks
Nucleus	Acts as 'brain' of the cell Regulates and controls all the cell activities	Control centre
Nucleus membrane	Surrounds and protects the nucleus control the movement of materials in and out of the nucleus	Gate of the nucleus

1. EXCRETION

Excretion : The elimination of waste products from the body is known as excretion. Skin, liver, lungs & large intestine and kidneys are the excretory organs of the body. The excretory organs along with the elimination of waste products also help in performing the osmoregulatory function of the body. Whereas the main excretory products are formed due to the breakdown of protein, on the basis of the production of protein breakdown, the animals are classified into following three types:

Ammonotelic Animals : The elimination of excess of nitrogen in the form of ammonia is known as ammonotelism. (e.g.,) protozoans, freshwater fishes.

Ureotelic Animals : The main excretory product is urea then the phenomenon is ureotelism. (e.g.,) man, desert animals.

Uricotelic Animals : The main excretory product is uric acid. (e.g.,) reptiles, birds, insects.

Excretion in Human Beings

The process of eliminating waste materials from the human body of the human excretory system.

The human excretory system consists of the following systems :

i) Digestive system to eliminate water and undigested food via large intestine.

ii) Respiratory system to eliminate carbon dioxide and water through the combine efforts to circulatory system.

iii) Urinary system to eliminate excess water, metabolic wastes and salts.

Human Excretory System

In human, the excretory system consists of a pair of kidneys, one pair of ureters, a urinary bladder and a urethra.

Kidney

Shape & Size : Kidneys are reddish brown, bean shaped structures situated between the levels of last thoracic and third lumbar vertebra close to the dorsal inner wall of the abdominal cavity. Each kidney of an adult human measures 10–12 cm in length, 5–7 cm in width, 2–3 cm in thickness with an average weight of 120–170 g.

Structure : Towards the centre of the inner concave surface of the kidney is a notch called hilum through which ureter, blood vessels and nerves enter.

Inner Strucuture : Inner to the hilum is a broad funnel shaped space called the renal pelvis with projections called calyces. The outer layer of kidney is a tough capsule. Inside the kidney, there are two zones, an outer cortex and an inner medulla. The medulla is divided into a few conical masses (medullary pyramids) projecting into the calcyces (sing : calyx). The cortex extends in between the medullary pyramids as renal column called columns of Bertini.

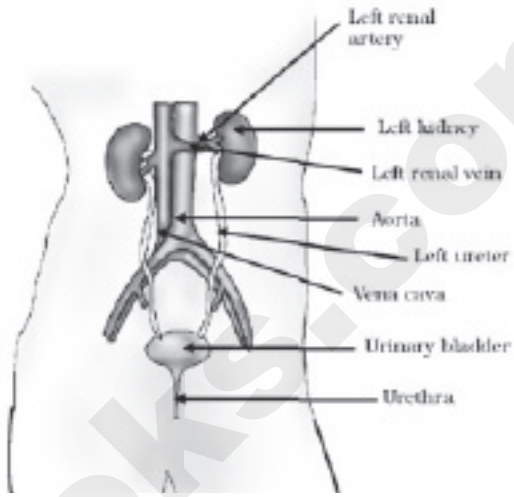


Fig. 1.1 - Excretory system in human beings

Nephrons : Each kidney has nearly one million complex tubular structures called nephrons, which are the functional units. Each nephron has two parts – the glomerulus and the renal tubule.

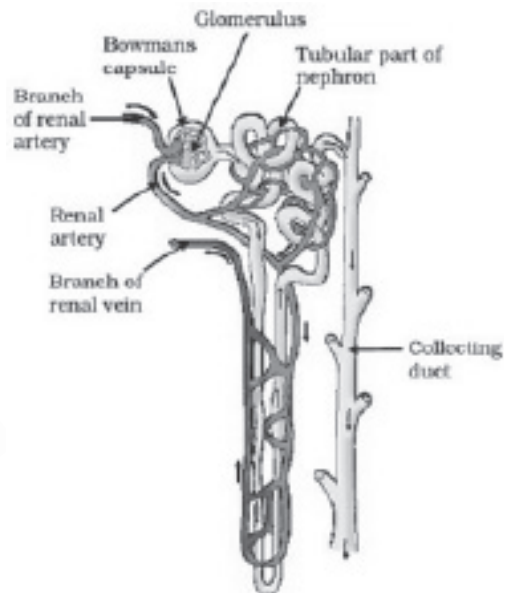


Fig. 1.2 - Structure of a nephron

Glomerulus : Glomerulus is a tuft of capillaries formed by the afferent arteriole, a fine branch of renal artery. Blood from the glomerulus is carried away by the efferent arteriole. The renal tubule begins with the double walled cup-like structure called Bowman's capsule, which encloses the glomerulus. Glomerulus along with Bowman's capsule is called the malphigian body or renal corpuscle.

7. AGRICULTURE & ECONOMIC IMPORTANCE OF PLANTS & ANIMALS

Food is essential for our survival, it provides energy and materials required for the growth and maintenance of our body. In order to provide sufficient food for a larger population, a regular production, proper management, storage and application of recent technology are to be implemented in agriculture. Activities which are involved in the cultivation of crops from sowing to harvesting are known as agricultural practices.

Basic Practices of Crop Production

- Preparation of soil and sowing
- Adding manure & fertilizer
- Types of irrigation
- Protection from weeds
- Harvesting
- Storage & Marketing

Preparation of Soil : Preparation of soil is the first step in cultivating a crop for food production. The soil is prepared for sowing the seeds of the crop, by ploughing, levelling and manuring.

Ploughing : The process of loosening and upturning the soil is called ploughing. Ploughing is done by using a plough, which is made of either wood or iron. Ploughed soil becomes soft and porous. Ploughing helps in the following ways.

- Ploughing breaks the large lumps of clay into smaller particles.
- Roots of plants can penetrate the loose soil easily.
- It leads to aeration of soil.
- Ploughing uproots the unwanted plants already growing in the field.
- Ploughing facilitates uniform mixing of fertilizers with soil.

Levelling : The ploughed soil is then levelled to ensure uniform irrigation. The levelling is done with the help of a soil leveller which is wooden plank or an iron plank. Levelling prevents loss of fertile top layer of soil with wind or washed away with water. Levelling prevents soil erosion

Manuring : Manure or chemical fertilizers are added to the soil so that it can supply all the nutrients to the plants required for their growth. Before adding the fertilizer, the soil must be analysed to find out which nutrient is lacking.

Sowing : The process of putting seeds into the soil is called sowing. Seeds used for sowing should be of good quality, healthy and free from infection. Sowing is done by Broadcasting and seed drill method.

Manure or Fertilizers : The substance which are added to the soil in the form of nutrients for the healthy growth of plants are called manure or fertilizers.

Irrigation : The supply of water to crops at different intervals is called irrigation. Sources of irrigation are wells, tube wells, ponds, lakes, rivers, dams and canals.

Traditional Methods of Irrigation :

i) Moat (Pulley-system) ii) Chain Pump
iii) Lever System

Modern Methods of Irrigation

- Furrow irrigation
- Basin irrigation
- Sprinkler irrigation
- Drip irrigation

Furrow irrigation : In this method water is allowed to enter the field through channels of furrows made between two rows of crop. (e.g.,) sugarcane, banana etc.

Basin irrigation : In this method the field is just filled with water (e.g.,) paddy field.

Sprinkler irrigation : This irrigation is used where the soil cannot retain water for a long time. Here the water is sprinkled by sprinklers (e.g.,) lawn.

Drip irrigation : In this irrigation the water falls drop by drop direct at the position of the roots. So if is called drip irrigation. It is the best method to save water (e.g.,) banana, brinjal.

Protection from Weeds : Weeds are undesirable plants growing naturally along with the crop. Removal of these weeds is called weeding.

The Common Types of Weeds are

- Grass
- Amaranthus
- Chenopodium

Methods of Weeding :

- Manual Weeding
- Chemical control

Harvesting :

The process of cutting and gathering a matured crop is known as harvesting.

Grains are separated from the stalks by the process of threshing. The chaff (pieces of straw and husk after threshing) is separated from the whole grain by winnowing.

Storage :

Grains are kept safe from moisture, insects and micro-organisms. Farmers store grains in jute bags and metallic bins. In large scale the grains are stored in godowns silos and granaries.

Fruits and vegetables are stores in cold storage.

Crop Rotation :

The practice of growing a cereal crop and the pulse crop alternately in the same field in successive season is called as crop rotation.

Bio-technology in Agriculture

Biotechnology has also revolutionised research activities in the area of agriculture. There are seven different techniques that are used in plant improvement.

- Selection
- Hybridisation
- Polyploid breeding
- Mutation breeding
- Protoplast fusion
- Tissue culture
- Genetic engineering

Genetic Engineering

The aim of agricultural biotechnology is to give transgenic plants carrying desirable traits like.

- Disease / insect / herbicide resistant
- Increased photosynthetic efficiency
- Nitrogen fixing ability
- Increased size of storage roots, seeds, fruits and vegetables.
- Oil seeds (soya) rich in PUFA (Poly Unsaturated Fatty Acid) recommended for heart patients.
- Potatoes with vaccines, improves starch and vitamin A is produced.
- Genetically modified (GM) seeds, biofertilizers, biofuels are also produced.

Bio-technology in Food Processing

- Gene modification and transfer
- Development of recombinant vaccines, vitamins and proteins
- Improving the quality, safety and consistency of fermented foods
- Improving of micro-organisms in order to improve process, control and yield of the processed products
- Genetically modified to reduce ripening rate

Animals that Yield Wool :

Wool is obtained from goat hair. The fur (hair) of Kashmiri goat is shof. It is woven into fine shawls called pashmina shawls. Angora wool is obtained from angora goats, found in hilly regions such as Jammu & Kashmir.

Some Indian Breeds of Sheep

	Name of Breed	Quality of Wool
1.	Lohi	Good quality wool
2.	Rampur bushair	Brown fleece
3.	Nali	Carpet wool
4.	Bakharwal	For woollen shawls
5.	Nearwari	Coarse wool
6.	Patanwadi	For hosiery

Animal Products

Meat : Animals such as goat, sheep, pig, poultry birds, prawn, crab etc., yield flesh as food.

Silk : Silk is obtained from silk worm and it is used for making silk clothes.

Leather : The skin of animals such as goat, sheep and cattle is used for manufacturing leather goods.

Pearl : Pearl is a valuable gem obtained from pearl oysters and is used for making ornaments.

Lac : Some insects secrete a resin like substance called lac. It is used for making paints, varnish, printing inks and cosmetics.

Milk : Animals like cows, buffaloes and goats give milk as food.

Honey : Honey is obtained from honey bees. It is consumed along with food and used in the preparation of certain medicines.

Egg : Poultry brids such as hen, duck, goose and turkey give us eggs as food.

High Skill

1. **A water fern, which is used as a green manure in rice fields, is**
   A) Salvinia **B)** Mucor
   C) Aspergillus **D)** Azolla **Ans. (D)**

2. **Green manure plants used by farmers mainly belongs to?**
   A) Compositae **B)** Leguminosae
   C) Solanaceae **D)** Poaceae **Ans. (B)**

3. **Major food crops of the world belongs to**
   A) Leguminosae **B)** Granineae
   C) Solanaceae **D)** Cruciferae **Ans. (B)**

4. **The desired varieties of economically useful crops are raised by**
   A) Vernalisation **B)** Mutation
   C) Natural selection **D)** Hybridisation **Ans. (D)**

5. **An organism used as a biofertilizer for raising soyabean crop is**
   A) Nostoc **B)** Azobacter
   C) Azospirillum **D)** Rhizobium **Ans. (D)**

6. **Necrosis in crops is due to deficiency of**
   A) Ca, K, S and Mo
   B) N, K, S and Mo
   C) N, S, Fe and Zn
   D) Mg, S, Mn and Ca **Ans. (A)**

7. **Which one of the following is commonly used in transfer of foreign DNA into crop plants?**
   A) Penicillium
   B) Trichoderma
   C) Clostridium
   D) Agrobacterium tumefaciens **Ans. (D)**

8. **Breeding crops with higher levels of minerals, vitamins or higher protein and healthier fats is called?**
   A) Micropropagation **B)** Somatic hybridization
   C) Biofortification **D)** Biomagnification
   Ans. (C)

9. **Which one of the following is not a biofertilizer?**
   A) Mycorrhiza **B)** Agrobacterium
   C) Rhizobium **D)** Nostoc **Ans. (B)**

10. **A transgenic food crop which may help in solving the problem of night blindness in developing countries is**
    A) Golden rice **B)** Flavr savr tomatoes
    C) Bt soybean **D)** Stralink maize
    Ans. (A)

IMPORTANT FACTS

- **Living Fossils :** These are living organisms that are similar in appearance to their fossilized distant ancestors and usually have no extinct close features. e.g. Ginko biloba.
- Bacteria are micro-organisms that can be seen only under microscope. Salmonella species is a kind of bacteria that can cause food-borne infection.
- **Stem Cells :** Stem cells are quite amazing as they can divide and multiply while at the same time with their ability to develop into any other type of cell.
- Chloroplast is a type of plastid, which are present only in plant cells. Plastids are mainly of two types – chromoplasts (coloured) and leucoplasts (colourless).
- Various range of plastids impart different colours to various parts of plant. Chromoplast imparts colour to flower and fruits. As fruits ripen, chloroplasts change to chromoplasts.
- Red blood cells do not contain a nucleus. Without nucleus, these cells die quickly; about two million red blood cells die every second. However, the body produces new red blood cells every day.
- Fungi do not have chlorophyll and cannot prepare their own food.
- Some halophytes produce negatively geotropic roots **(e.g. Rhizophora).** These roots turn 180° upright for respiration.
- The Venus Flytrap ***(Dionaea muscipula)*** is a Carnivorous plant which presents a spectacular example of thigmonasty. It exhibits one of the fastest known nastic movement.
- Melvin Calvin, an American biochemist, discovered chemical pathway for photosynthesis. The cycle is named as Calvin cycle. He was awarded with Nobel Prize in the year 1961 for his discovery.
- Artificial photosynthesis is a method for producing renewable energy by the use of sunlight. Indian scientist C.N.R. Rao who was conferred the Bharat Ratna (2013) is also working on similar technology of artificial photosynthesis to produce -Hydrogen fuel (renewable energy).
- The smallest vertebrate, Philippine goby/dwarf pygmy goby is a tropical species fish found in brackish water and mangrove areas in south East Asia, measuring only 10 mm in length.
- The Chinese giant salamander Andrias davidians is the largest amphibian in the world. Its length is about five feet and eleven inches. It weighs about 65 kg, found in Central and South China.
- The gigantic Blue whale which is 35 meters long and 120 tons in weight is the biggest vertebrate animal.
- Antonie Van Leeuwenhoek, the first microbiologist designed his own microscope.
- Many bacteria like Rhizobium, Acetobacter and Clostridium can fix atmospheric nitrogen. This phenomenon is called biological nitrogen fixation.
- **Viroids :** The protein free pathogenic RNA of virus is viroids. They are found in plant cells and cause disease in plants.
- Alexander Fleming, a Scottish microbiologist discovered the 'wonder' Drug – penicillin in 1929.
- Robert Koch (Father of Bacteriology) is the first German physician to study how pathogens cause diseases.
- In 1902, he received the Nobel Prize for Physiology or Medicine for his work on the transmission of malaria.
- An extraction of tender leaves of papaya and herbal drink Nilavembu Kudineer is given to dengue patients. It is known to increase the blood platelet count.
- Swine flu first surfaced in April 2009 and affected millions of people. Then in June 2009 it was declared a pandemic by the World Health Organization (WHO). In 2015, India reportedly had over 31,000 people infected and 1,900 resulting deaths.
- The avian influenza virus A (H5N1) emerged in 1996. It was first identified in Southern China and Hong Kong. H5N1 was first discovered in humans in 1997 by World Health Organisation. First outbreak was in December 2003.
- The process of vaccination was introduced by Edward Jenner who is also known as "Father of modern immunobiology". According to WHO, Jennerian vaccination has eliminated small pox from the human population.
- Louis Pasteur is an 18th century French chemist and microbiologist. He coined the term vaccine. Pasteur developed vaccine against chicken pox, cholera, anthrax, etc.
- In potato, parenchyma vacuoles are filled with starch. In apple, parenchyma stores sugar.

Age of our body cells

- Cells of the eye lens, nerve cells of cerebral cortex and most muscle cells last a life time but once dead are not replaced.
- Epithelial cells lining the gut last only about 5 days.

Duration of cell replacement

- Skin cells- about every 2 weeks.
- Bone cells- about every 10 years.
- Liver cells- about every 300 – 500 days.
- Red blood cells last for about 120 days and are replaced.

- Nerve cells do not undergo cell division due to the absence of centrioles, but they are developed from glial cells by neurogenesis
- Blood letting is a technique of bleeding in a patient to remove toxic impurities from the body.
- **Medicinal value of Leech :** Leeches are effective in increasing blood circulation and breaking up blood clots. It is surprising that they can be used to treat cardiovascular diseases. Biochemical substances derived from leech saliva are used for preparation of pharmaceutical drugs that can treat hypertension.
- Sometimes ovaries releases two eggs and each is fertilised by a different sperm, resulting in Non-Identical Twins (Fraternal Twins). If single egg is fertilised and then divides into two foetus, Identical Twins develop.
- The milk produced from the breast during the first 2 to 3 days after child birth is called colostrum. It contains immune substances and provides immunity to the new born which is essential for the body.
- Every year May 28 is observed as Menstrual Hygiene day to make girls and women aware of maintaining menstrual hygiene and importance of menstrual hygiene for good health.
- **Rennin** is a proteolytic enzyme found in gastric juice of infants which helps in the digestion of milk proteins. Small amounts of lipases are also secreted by gastric glands.
- **Renin** also known as an angiotensinogenase secreted by the kidneys that converts angiotensinogen to angiotension and regulate the absorption of water and Na^+ from glomerular filtrate.
- The intestinal juice secreted by the small intestine contains the enzymes like sucrase, maltase, lactase and lipase.
- William Beaumont (1785-1853) was a surgeon in the U.S. Army who became known as the "father of Gastric physiology".
- The small intestine is about 5 m long and is the longest part of the digestive system. The large intestine is a thicker tube, but is about 1.5 m long.
- Two healthy kidneys contain a total of about 2 million nephrons, which filter about 1700-1800 litres of blood. The kidneys reabsorb and redistribute 99% of the blood volume and only 1% of the blood filtered becomes urine.
- The sperm is the smallest cell in the male body. A normal male produces more than 500 billion sperm cells in his life time. The process of formation of sperms is known as spermatogenesis.
- An ovum is the largest human cell. The process of formation of ova is known as **oogenesis.**
- **Anemia :** Decrease in number of erythrocytes.
- **Leucocytosis :** Increase in the number of leukocytes.
- **Leukopenia :** Decrease in number of leukocytes.
- **Thrombocytopenia :** Decrease in the number of thrombocytes.
- Closed circulatory system was discovered by William Harvey (1628) who is regarded the Father of Modern Physiology.
- Snakes doesnot have legs. Instead, they use their muscles and scales to move.
- Fishes have streamlined body structure which helps them to move smoothly with the flow of water. Muscles, fins and tail helps them to keep the balance.
- A Cheetah can run 76 kilometrer per hour.
- A Hippopotamus can run faster than a man.
- Cockroach is the fastest animal on 6 legs covering a metre per second.
- The fastest mammal, the Dolphin can swim up to 35 miles per hour.
- The femur or thighbone is the longest and strongest bone of the human skeleton.
- The stapes in the middle ear is the smallest and lightest bone of the human skeleton.
- There are muscles in the root of our hair that give us goose bumps.
- It takes 17 muscles to smile and 42 muscles to frown.
- The hardest working muscle is in eye.
- Meningitis is an inflammation of the meninges. It can occur when fluid surrounding the meninges becomes infected. The most common causes of meningitis are viral and bacterial infections.
- Each neuron can transmit 1,000 nerve impulses per second and make as many as ten thousands of synaptic contacts with other neurons.
- Electroencephalogram (EEG) is an instrument which records the electrical impulses of brain. An EEG can detect abnormalities in the brain waves and help in diagnoses of seizures, epilepsy, brain tumors, head injuries,etc.
- Melatonin is a hormone produced by the pineal gland. It is known as a 'time messenger'. It signals night time information throughout the body.
- Human insulin was first discovered by Fredrick Banting, Charles Best and Mac Leod in 1921. Insulin was first used in treatment of diabetes on 11th January 1922.
- The cortisol hormones of adrenal cortex serves to maintain the body in living condition and recover it from the severe effects of stress reactions. Thus an increased output of cortisol is "life saving" in "shock conditions". It is also known as life-saving hormone.