

Bihar Board Class 10 Science (SET - E) 2025 Question Paper with Solutions

Time Allowed :3 Hours 15 Minutes	Maximum Marks :80	Total Questions :110
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 1 hour duration.
2. Candidate must enter his/her Question Booklet Serial No. (10 Digits) in the OMR Answer Sheet.
3. Candidates are required to write their answers in their own words as far as practicable.
4. Figures in the top-hand margin indicate full marks.
5. An extra time of 15 minutes has been allotted for the candidates to read the questions carefully.
6. This question booklet is divided into two sections — Section-A and Section-B.
7. In Section-A, there are 100 objective type questions, out of which any 50 questions are to be answered. First 50 answers will be evaluated in case more than 50 questions are answered. Each question carries 1 mark. For answering these, darken the circle with blue/black ball pen against the correct option on the OMR Answer sheet provided to you. Do not use whitener/liquid/blade/nail etc. on the OMR sheet, otherwise the result will be treated as invalid.
8. In Section-B, there are 11 Descriptive Answer Type Questions, which are to be answered.
9. Use of any electronic appliances is strictly prohibited.

Section - A

1. Double circulation is not found in

- (A) Frog
- (B) Fish
- (C) Bird
- (D) Human

Correct Answer: (B) Fish

Solution:

Step 1: Understanding the Concept:

Circulatory systems can be single or double.

- **Single Circulation:** Blood passes through the heart only once in one complete circuit of the body.
- **Double Circulation:** Blood passes through the heart twice in one complete circuit. There are two pathways: pulmonary circulation (to the lungs) and systemic circulation (to the rest of the body).

Step 2: Detailed Explanation:

- **Fish:** Have a two-chambered heart (one atrium, one ventricle) and exhibit single circulation. The heart pumps deoxygenated blood to the gills for oxygenation, and this oxygenated blood then travels to the rest of the body before returning to the heart.
- **Frog (Amphibians):** Have a three-chambered heart (two atria, one ventricle) and show incomplete double circulation. Oxygenated and deoxygenated blood mix partially in the single ventricle.
- **Bird and Human (Mammals):** Have a four-chambered heart (two atria, two ventricles) and exhibit complete double circulation, which efficiently separates oxygenated and deoxygenated blood.

The question asks where double circulation is *not* found. This is true for fish.

Step 3: Final Answer:

Double circulation is not found in fish.

Quick Tip

Remember the progression of the heart: Fish (2 chambers, single loop), Amphibians/Reptiles (3 chambers, incomplete double loop), Birds/Mammals (4 chambers, complete double loop).

2. From where does urea enter the blood ?

- (A) Kidney
- (B) Lungs
- (C) Liver
- (D) None of these

Correct Answer: (C) Liver

Solution:

Step 1: Understanding the Concept:

Urea is the primary nitrogenous waste product in mammals. It is produced from the breakdown of proteins and amino acids. The body needs to convert the highly toxic ammonia, a byproduct of this breakdown, into a less toxic substance for transport and excretion.

Step 2: Detailed Explanation:

- The breakdown of amino acids produces ammonia (NH_3), which is very toxic to the body.
- The **liver** performs a crucial function called the **urea cycle**. In this cycle, the liver converts toxic ammonia into urea ($CO(NH_2)_2$), which is much less toxic.
- Once produced in the liver, this urea is released into the bloodstream.
- The blood then transports the urea to the **kidneys**.
- The kidneys filter the urea from the blood and excrete it as a component of urine.

So, urea enters the blood from the liver.

Step 3: Final Answer:

Urea enters the blood from the liver.

Quick Tip

Don't mix up the roles of the liver and kidney in urea handling. The Liver **Makes** urea, and the Kidney **Takes** urea (out of the blood).

3. Where does glucose reabsorption occur?

- (A) In PCT
- (B) In DCT
- (C) In Henle's loop
- (D) All of these

Correct Answer: (A) In PCT

Solution:

Step 1: Understanding the Concept:

The question is about the process of urine formation in the nephron, the functional unit of the kidney. After blood is filtered in the glomerulus, the resulting filtrate contains water, salts, glucose, amino acids, and urea. Essential substances like glucose need to be reabsorbed back into the blood.

Step 2: Detailed Explanation:

The nephron consists of several parts where reabsorption and secretion occur:

- **Proximal Convoluted Tubule (PCT):** This is the first section after Bowman's capsule. It is the primary site for the reabsorption of most of the essential substances from the filtrate. Nearly 100% of glucose and amino acids, about 65% of water, and most of the salts are reabsorbed here via active transport and osmosis.
- **Henle's loop:** Primarily responsible for creating a salt concentration gradient in the medulla, which helps in reabsorbing water.
- **Distal Convoluted Tubule (DCT):** Involved in the conditional reabsorption of water and salts, often under hormonal control.

Since virtually all glucose is reabsorbed in the first part of the tubule, the PCT is the correct answer.

Step 3: Final Answer:

Glucose reabsorption primarily and almost completely occurs in the Proximal Convoluted Tubule (PCT).

Quick Tip

If glucose appears in the urine, it is a key indicator of diabetes mellitus. This happens when blood glucose levels are so high that the PCT's reabsorption capacity is overwhelmed.

4. The mechanism for removing harmful substances formed as a result of various activities from the body is called

- (A) Digestive system
- (B) Circulatory system
- (C) Excretory system
- (D) Nervous system

Correct Answer: (C) Excretory system

Solution:

Step 1: Understanding the Concept:

The question asks for the name of the organ system responsible for eliminating metabolic wastes and other non-useful materials from the body.

Step 2: Detailed Explanation:

- **Digestive system:** Breaks down food and absorbs nutrients. It eliminates undigested food as feces, but this is egestion, not excretion of metabolic waste.
- **Circulatory system:** Transports oxygen, nutrients, hormones, and wastes throughout the body. It carries waste to the excretory organs but doesn't remove it from the body.
- **Excretory system:** This system is specifically responsible for the removal of metabolic wastes (like urea, uric acid) and other harmful substances from the body fluids to maintain homeostasis. Key organs include the kidneys, lungs, skin, and liver. The process is called excretion.
- **Nervous system:** The body's command center, controlling actions and transmitting signals between different parts of the body.

Step 3: Final Answer:

The mechanism for removing harmful metabolic substances from the body is managed by the excretory system.

Quick Tip

Distinguish between egestion and excretion. Egestion is the removal of undigested food (feces) via the digestive system. Excretion is the removal of metabolic waste products (like urea in urine) via the excretory system.

5. What can happen due to spinal cord injury?

- (A) Goitre
- (B) Dwarfism
- (C) Diabetes
- (D) Paralysis

Correct Answer: (D) Paralysis

Solution:

Step 1: Understanding the Concept:

The spinal cord is a crucial part of the central nervous system, acting as a pathway for nerve signals between the brain and the rest of the body. The question asks about the consequences of damage to this pathway.

Step 2: Detailed Explanation:

- **Spinal Cord Function:** It transmits motor commands from the brain to the body, causing muscles to contract, and sensory information from the body to the brain, such as touch, pain, and temperature.
- **Spinal Cord Injury:** Damage to the spinal cord can interrupt or block these signals. If motor signals from the brain cannot reach the muscles, the person loses the ability to move parts of their body. This loss of muscle function is known as **paralysis**. The extent of paralysis depends on the location and severity of the injury.
- **Other options:** Goitre is caused by iodine deficiency or thyroid issues. Dwarfism is related to growth hormone deficiency. Diabetes is a metabolic disorder related to insulin. None of these are directly caused by spinal cord injury.

Step 3: Final Answer:

A spinal cord injury can lead to paralysis.

Quick Tip

Remember the spinal cord is the main information highway of the body. An injury is like a major roadblock on this highway, stopping the traffic of nerve signals, which can result in paralysis.

6. The largest gland in the human body is

- (A) Adrenal
- (B) Liver
- (C) Ovary
- (D) Pancreas

Correct Answer: (B) Liver

Solution:

Step 1: Understanding the Concept:

The question asks to identify the largest gland in the human body. A gland is an organ that produces and releases substances that perform a specific function in the body.

Step 2: Detailed Explanation:

- **Liver:** The liver is a large, reddish-brown organ located in the upper right quadrant of the abdomen. It weighs about 1.5 kg (3.3 lbs) in an average adult. It performs over 500 functions, including bile production (exocrine function) and synthesis of proteins and hormones (endocrine functions). It is the largest internal organ and the largest gland.
- **Pancreas:** Functions as both an endocrine (insulin, glucagon) and exocrine (digestive enzymes) gland, but is much smaller than the liver.
- **Adrenal glands:** Small glands located on top of the kidneys.
- **Ovary:** Female reproductive gland, relatively small.

By mass and volume, the liver is by far the largest gland in the human body.

Step 3: Final Answer:

The liver is the largest gland in the human body.

Quick Tip

While the skin is the largest organ overall, the liver is the largest *internal* organ and the largest *gland*. Always read the question carefully to distinguish between "organ" and "gland".

7. Plant hormone is called

- (A) Pheromone
- (B) Phytohormone
- (C) Enzyme
- (D) None of these

Correct Answer: (B) Phytohormone

Solution:

Step 1: Understanding the Concept:

The question asks for the specific term used for hormones found in plants. Hormones are signaling molecules that regulate physiology and behavior.

Step 2: Detailed Explanation:

- **Phytohormone:** This is the correct scientific term for plant hormones. The prefix "phyto-" comes from the Greek word for plant. Phytohormones are signal molecules produced within plants that occur in extremely low concentrations. They regulate all aspects of plant growth and development, including germination, root growth, flowering, and fruit ripening. Examples include auxins, gibberellins, and cytokinins.
- **Pheromone:** A chemical substance produced and released into the environment by an animal, affecting the behavior or physiology of others of its species.
- **Enzyme:** A biological catalyst, usually a protein, that speeds up biochemical reactions. It is not a signaling molecule in the same way a hormone is.

Step 3: Final Answer:

A plant hormone is called a phytohormone.

Quick Tip

Remember prefixes from Greek or Latin. "Phyto-" means plant, so "phytohormone" literally means "plant hormone". This can help you decipher many scientific terms.

8. An example of vegetative propagation through leaves is

- (A) Onion
- (B) Potato
- (C) Rose
- (D) Bryophyllum

Correct Answer: (D) Bryophyllum

Solution:

Step 1: Understanding the Concept:

Vegetative propagation is a type of asexual reproduction in plants where new plants grow from parts of the parent plant, such as the stem, root, or leaf. The question asks for an example where this happens via leaves.

Step 2: Detailed Explanation:

- **Bryophyllum:** This plant is famous for its ability to reproduce through its leaves. Adventitious buds develop along the notches of the leaf margins. When these tiny plantlets detach from the leaf and fall on moist soil, they grow into new, independent plants.
- **Onion:** Propagates through its modified underground stem, which is a bulb.
- **Potato:** Propagates through its modified underground stem, which is a tuber. The "eyes" of the potato are buds that can sprout into new plants.
- **Rose:** Is commonly propagated by stem cuttings. A piece of the stem is cut and planted, which then develops roots and grows into a new plant.

Step 3: Final Answer:

Bryophyllum is an example of a plant that undergoes vegetative propagation through its leaves.

Quick Tip

Associate specific plants with their method of vegetative propagation: Potato → Tuber (stem), Onion → Bulb (stem), Rose → Cutting (stem), Bryophyllum → Leaf. These are classic examples often used in exams.

9. How many isomers of butane are possible ?

- (A) 2
- (B) 3
- (C) 4
- (D) 5

Correct Answer: (A) 2

Solution:

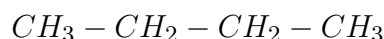
Step 1: Understanding the Concept:

Isomers are molecules that have the same molecular formula but a different arrangement of atoms in space. The question asks for the number of structural isomers for butane (C_4H_{10}).

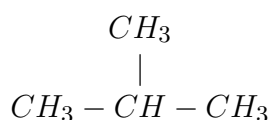
Step 2: Detailed Explanation:

The molecular formula for butane is C_4H_{10} . We can arrange the four carbon atoms in two different ways to form a stable structure:

1. **A straight chain:** The carbon atoms are linked one after another in a continuous chain. This isomer is called **n-butane**.



2. **A branched chain:** Three carbon atoms form a chain, and the fourth carbon atom is attached as a branch to the central carbon atom. This isomer is called **isobutane** (IUPAC name: 2-methylpropane).



There are no other ways to connect four carbon atoms and ten hydrogen atoms to form a different structure.

Step 3: Final Answer:

There are two possible structural isomers for butane: n-butane and isobutane.

Quick Tip

To find isomers, always start by drawing the longest possible straight chain. Then, shorten the main chain by one carbon and try to place it as a branch at different valid positions.

10. The shape of methane molecule is

- (A) Linear
- (B) Annular
- (C) Tetrahedral
- (D) Octahedral

Correct Answer: (C) Tetrahedral

Solution:

Step 1: Understanding the Concept:

The shape of a molecule is determined by the arrangement of its atoms in three-dimensional space, which in turn is governed by the repulsion between the electron pairs in the valence shell of the central atom (VSEPR Theory).

Step 2: Detailed Explanation:

The methane molecule has the formula CH_4 . The central atom is carbon.

Carbon has 4 valence electrons. It forms four single covalent bonds with four hydrogen atoms. These four bonding pairs of electrons are regions of negative charge, and they repel each other. To maximize the distance between them and minimize repulsion, they arrange themselves in a three-dimensional shape.

This arrangement results in a **tetrahedral** geometry, where the carbon atom is at the center and the four hydrogen atoms are at the vertices of a regular tetrahedron. The angle between any two C-H bonds is approximately 109.5° .

Step 3: Final Answer:

The shape of the methane (CH_4) molecule is tetrahedral.

Quick Tip

Memorize the shapes of basic molecules: Methane (CH_4) is tetrahedral, Ammonia (NH_3) is trigonal pyramidal, and Water (H_2O) is bent. These are common examples based on VSEPR theory.

11. The valency of carbon in organic compounds is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Correct Answer: (D) 4

Solution:**Step 1: Understanding the Concept:**

Valency is the combining capacity of an element. It is the number of electrons an atom needs to gain, lose, or share to achieve a stable electron configuration (usually a full outer shell).

Step 2: Detailed Explanation:

The atomic number of carbon is 6. Its electronic configuration is (2, 4).

Carbon has 4 electrons in its outermost (valence) shell. To achieve the stable configuration of the nearest noble gas (Neon, 2, 8), it needs to gain 4 more electrons.

Instead of gaining or losing electrons (which would require a large amount of energy), carbon shares its 4 valence electrons with other atoms to form four covalent bonds.

This ability to form four covalent bonds is known as tetravalency. Therefore, the valency of carbon is 4.

Step 3: Final Answer:

In all its organic compounds, carbon is tetravalent, meaning its valency is 4.

Quick Tip

Carbon's tetravalency is the foundation of organic chemistry. It allows carbon to form a vast number of compounds by bonding with itself and other elements in various arrangements.

12. Which of the following is saturated hydrocarbon ?

- (A) Alkane
- (B) Alkene
- (C) Alkyne
- (D) None of these

Correct Answer: (A) Alkane

Solution:**Step 1: Understanding the Concept:**

Hydrocarbons are organic compounds composed entirely of hydrogen and carbon atoms. They are classified as saturated or unsaturated based on the types of bonds between the carbon atoms.

Step 2: Detailed Explanation:

- **Saturated Hydrocarbons:** These are hydrocarbons in which all the carbon-carbon bonds are single bonds. Each carbon atom is bonded to the maximum possible number of

hydrogen atoms. This class of hydrocarbons is known as **alkanes**. Their general formula is C_nH_{2n+2} .

- **Unsaturated Hydrocarbons:** These are hydrocarbons that contain at least one carbon-carbon double bond or triple bond. They have fewer hydrogen atoms than the corresponding alkane.
 - **Alkenes** contain at least one $C=C$ double bond.
 - **Alkynes** contain at least one $C\equiv C$ triple bond.

Step 3: Final Answer:

Alkanes are saturated hydrocarbons because they only contain carbon-carbon single bonds.

Quick Tip

Think of "saturated" as being "full" of hydrogen atoms. Since single bonds allow for the maximum number of hydrogens to be attached to the carbon skeleton, alkanes are saturated.

13. IUPAC name of ethylene is

- (A) Ethane
- (B) Ethyne
- (C) Ethene
- (D) None of these

Correct Answer: (C) Ethene

Solution:

Step 1: Understanding the Concept:

IUPAC (International Union of Pure and Applied Chemistry) nomenclature provides a systematic way of naming organic compounds. Ethylene is a common name. The question asks for its systematic IUPAC name.

Step 2: Detailed Explanation:

The molecular formula for ethylene is C_2H_4 , and its structure is $CH_2 = CH_2$. To determine the IUPAC name, we follow these steps:

1. **Identify the parent chain:** The longest carbon chain has 2 carbon atoms. The root word for 2 carbons is "**eth**".

2. **Identify the principal functional group/bond type:** The molecule contains a carbon-carbon double bond ($C=C$). The suffix for a double bond is "**ene**".

Combining the root word and the suffix gives the name **Ethene**.

For comparison:

- **Ethane** (C_2H_6) is the alkane with two carbons (all single bonds).
- **Ethyne** (C_2H_2) is the alkyne with two carbons (a triple bond).

Step 3: Final Answer:

The IUPAC name for ethylene is Ethene.

Quick Tip

Memorize the suffixes for hydrocarbons: "-ane" for single bonds (alkanes), "-ene" for double bonds (alkenes), and "-yne" for triple bonds (alkynes).

14. Which was a defect of Mendeleev's periodic table ?

- (A) Not giving proper place to oxygen
- (B) Not giving proper place to Cl
- (C) Not giving proper place to hydrogen
- (D) None of these

Correct Answer: (C) Not giving proper place to hydrogen

Solution:

Step 1: Understanding the Concept:

Mendeleev's periodic table, while revolutionary for its time, had certain limitations or defects. These were later addressed by the modern periodic table.

Step 2: Detailed Explanation:

The main defects of Mendeleev's periodic table were:

1. **Position of Hydrogen:** Hydrogen shows properties similar to both alkali metals (Group 1) and halogens (Group 17). It forms a $+1$ ion like alkali metals and exists as a diatomic molecule (H_2) like halogens (F_2 , Cl_2). Due to this dual nature, Mendeleev could not assign a fixed, correct position for hydrogen in his table.
2. **Position of Isotopes:** Isotopes are atoms of the same element with the same atomic number but different mass numbers. Since Mendeleev's table was based on increasing

atomic mass, isotopes would have required different positions, which would disrupt the periodic arrangement.

3. **Anomalous Pairs:** In some cases, Mendeleev placed elements with a slightly higher atomic mass before elements with a lower atomic mass to maintain the order of properties (e.g., Cobalt before Nickel).

Among the given options, not giving a proper place to hydrogen is a well-known defect.

Step 3: Final Answer:

A major defect of Mendeleev's periodic table was its failure to assign a proper and fixed place to hydrogen.

Quick Tip

The three major limitations of Mendeleev's periodic table can be remembered as issues with **H**ydrogen, **I**sotopes, and **P**airs (anomalous pairs).

15. Who among the following propounded the laws of octave ?

- (A) Mendeleev
- (B) Newlands
- (C) Lothar Meyer
- (D) Dobereiner

Correct Answer: (B) Newlands

Solution:

Step 1: Understanding the Concept:

The question asks to identify the scientist responsible for the "Law of Octaves," an early attempt at classifying elements.

Step 2: Detailed Explanation:

- **John Newlands (1866):** He arranged the known elements in order of increasing atomic mass. He observed that the properties of every eighth element were similar to those of the first one, much like the eighth note in a musical octave. This was called **Newlands' Law of Octaves**.
- **Johann Dobereiner (1817):** He grouped elements into "triads," where the atomic mass of the middle element was the average of the other two.

- **Lothar Meyer** (1869): He plotted physical properties like atomic volume against atomic mass and found periodic patterns.
- **Dmitri Mendeleev** (1869): He created the first widely recognized periodic table, arranging elements by atomic mass and leaving gaps for undiscovered elements.

Step 3: Final Answer:

The Law of Octaves was propounded by John Newlands.

Quick Tip

Associate the scientist with their key contribution: Dobereiner → Triads; Newlands → Octaves; Mendeleev → Periodic Law/Table.

16. Which of the following compounds would be the most basic ?

- (A) SO_2
- (B) Na_2O
- (C) Al_2O_3
- (D) NO_2

Correct Answer: (B) Na_2O

Solution:

Step 1: Understanding the Concept:

The acidic or basic nature of an oxide depends on the element it is formed from. A general trend in the periodic table is:

- **Metallic oxides** are typically **basic** in nature (they react with acids to form salt and water).
- **Non-metallic oxides** are typically **acidic** in nature (they react with bases to form salt and water).
- **Amphoteric oxides** can react with both acids and bases (e.g., Al_2O_3 , ZnO).

The basic character of oxides increases down a group and decreases across a period.

Step 2: Detailed Explanation:

Let's analyze the given options:

- SO_2 (**Sulfur dioxide**): Sulfur (S) is a non-metal. Its oxide is acidic.
- Na_2O (**Sodium oxide**): Sodium (Na) is an alkali metal (Group 1). It is highly metallic, and its oxide is a strong base.
- Al_2O_3 (**Aluminum oxide**): Aluminum (Al) is a metal, but its oxide is amphoteric.
- NO_2 (**Nitrogen dioxide**): Nitrogen (N) is a non-metal. Its oxide is acidic.

Comparing the options, Na_2O is the only strong basic oxide. The others are either acidic or amphoteric. Therefore, Na_2O is the most basic compound.

Step 3: Final Answer:

Sodium oxide (Na_2O) is the most basic compound among the choices.

Quick Tip

To determine the most basic oxide, look for the oxide of the most metallic element. In the periodic table, metallic character increases from right to left and from top to bottom.

17. A group of rays is called

- (A) Light beam
- (B) Ray beam
- (C) Both (A) and (B)
- (D) None of these

Correct Answer: (A) Light beam

Solution:

Step 1: Understanding the Concept:

In optics, specific terms are used to describe the path and collection of light.

- **Ray of light:** The path along which light energy travels in a given direction. It is represented by a straight line with an arrow.
- **Beam of light:** A bundle or collection of a large number of light rays.

Step 2: Detailed Explanation:

A group of light rays is called a beam of light. The term "Light beam" is the standard and widely accepted terminology in physics. While "Ray beam" might seem descriptive, it is not the conventional term. A beam is inherently made of rays, so "Ray beam" is redundant. The correct technical term is "Light beam" or "beam of light". Given the options, "Light beam" is the most accurate and standard choice.

Step 3: Final Answer:

The standard term for a group of rays is a light beam.

Quick Tip

Remember that a beam of light can be of three types: parallel (rays are parallel), convergent (rays meet at a point), or divergent (rays spread out from a point).

18. The light rays travel in

- (A) any direction
- (B) oblique line
- (C) a straight line
- (D) none of these

Correct Answer: (C) a straight line

Solution:

Step 1: Understanding the Concept:

This question refers to a fundamental property of light propagation. The principle is known as the rectilinear propagation of light.

Step 2: Detailed Explanation:

The principle of rectilinear propagation of light states that in a homogeneous and transparent medium, light travels along a straight-line path. This is why we cannot see around corners and why opaque objects cast sharp shadows. While light can travel in any direction from its source, the path it takes in a uniform medium is always a straight line.

Step 3: Final Answer:

Light rays travel in a straight line in a uniform medium.

Quick Tip

The operation of a pinhole camera is a simple and effective demonstration of the rectilinear propagation of light.

19. Which type of mirror is a concave mirror ?

- (A) Divergent
- (B) Convergent
- (C) Both convergent and divergent
- (D) None of these

Correct Answer: (B) Convergent

Solution:

Step 1: Understanding the Concept:

Mirrors are classified as convergent or divergent based on their effect on a parallel beam of light after reflection.

Step 2: Detailed Explanation:

A **concave mirror** has a reflecting surface that is curved inwards (like the inside of a spoon). When a parallel beam of light rays strikes a concave mirror, the rays are reflected and meet, or **converge**, at a single point called the principal focus (F). Because it brings light rays together, a concave mirror is known as a **convergent mirror**.

In contrast, a convex mirror has a reflecting surface that bulges outwards. It reflects a parallel beam of light so that the rays appear to spread out, or **diverge**, from a point behind the mirror. Thus, a convex mirror is a divergent mirror.

Step 3: Final Answer:

A concave mirror is a convergent mirror.

Quick Tip

A simple mnemonic: Concave mirrors have a "cave" and they make light rays come together (converge) into that cave.

20. Which of the following types of mirror is used in the headlight of a car ?

- (A) Convex mirror
- (B) Concave mirror
- (C) Plane mirror

(D) None of these

Correct Answer: (B) Concave mirror

Solution:

Step 1: Understanding the Concept:

The purpose of a car headlight is to project a strong, parallel beam of light to illuminate the road over a long distance. The choice of mirror depends on its ability to produce such a beam.

Step 2: Detailed Explanation:

A **concave mirror** has the property that if a light source is placed at its principal focus (F), the rays of light, after reflection from the mirror's surface, travel out as a parallel beam.

This is exactly the requirement for a car headlight. The bulb of the headlight is positioned at the focus of a concave reflector. This ensures that the light produced is directed forward as a powerful, parallel beam, providing maximum illumination of the path ahead.

A convex mirror would scatter the light, and a plane mirror would simply reflect it without focusing it into a beam.

Step 3: Final Answer:

A concave mirror is used as a reflector in the headlight of a car.

Quick Tip

Remember the key applications: Concave mirrors are used where light needs to be concentrated (headlights, solar cookers, shaving mirrors). Convex mirrors are used where a wide field of view is needed (rear-view mirrors in vehicles, security mirrors).

21. The focal length of a concave mirror is

- (A) Positive
- (B) Negative
- (C) both (A) and (B)
- (D) None of these

Correct Answer: (B) Negative

Solution:

Step 1: Understanding the Concept:

In optics, the New Cartesian Sign Convention is used to assign positive or negative signs to distances like object distance (u), image distance (v), and focal length (f).

Step 2: Detailed Explanation:

According to the sign convention:

1. The pole (P) of the mirror is taken as the origin.
2. The principal axis is the x-axis.
3. Light is assumed to travel from left to right.
4. All distances are measured from the pole.
5. Distances measured in the same direction as the incident light are positive.
6. Distances measured in the direction opposite to the incident light are negative.

For a **concave mirror**, the principal focus (F) is located in front of the reflecting surface. To measure the focal length (the distance from P to F), one must travel from the pole to the left, which is opposite to the direction of the incident light.

Therefore, the focal length of a concave mirror is always taken as **negative**.

Step 3: Final Answer:

According to the standard sign convention, the focal length of a concave mirror is negative.

Quick Tip

A simple rule to remember: For mirrors and lenses, convergent devices (concave mirror, convex lens) have a real focus and their focal length is taken as negative for mirrors and positive for lenses. Divergent devices (convex mirror, concave lens) have a virtual focus and their focal length is positive for mirrors and negative for lenses. An easier rule: Concave Mirror $f < 0$, Convex Mirror $f > 0$.

22. Which mirror always forms an image smaller than the object?

- (A) Concave
- (B) Plane
- (C) Convex
- (D) None of these

Correct Answer: (C) Convex

Solution:

Step 1: Understanding the Concept:

The size of the image formed by a mirror depends on the type of mirror and the position of the object. The question asks which mirror *always* produces a diminished (smaller) image.

Step 2: Detailed Explanation:

- **Plane Mirror:** A plane mirror always forms a virtual, erect image that is of the **same size** as the object.
- **Concave Mirror:** A concave mirror can form images of different sizes. It can form a diminished, same-sized, or magnified real image, as well as a magnified virtual image, depending on the object's distance from the mirror. Therefore, it does not always form a smaller image.
- **Convex Mirror:** A convex mirror always forms a virtual, erect, and **diminished (smaller)** image, regardless of where the object is placed in front of it.

Step 3: Final Answer:

A convex mirror is the only type of mirror that always forms an image smaller than the object.

Quick Tip

Convex mirrors are used as rear-view mirrors in vehicles precisely because they always provide a smaller, upright image and offer a wider field of view, allowing the driver to see more of the area behind them.

23. The speed of light in air as compared to vacuum is

- (A) Less
- (B) More
- (C) Same
- (D) None of these

Correct Answer: (A) Less

Solution:

Step 1: Understanding the Concept:

The speed of light is constant in a vacuum but changes when it travels through a transparent medium. The refractive index (n) of a medium describes how much the speed of light is reduced

in that medium.

Step 2: Key Formula or Approach:

The refractive index (n) is defined as the ratio of the speed of light in a vacuum (c) to the speed of light in the medium (v):

$$n = \frac{c}{v}$$

Step 3: Detailed Explanation:

By definition, the refractive index of a vacuum is exactly 1. Air is a physical medium, and its refractive index is slightly greater than 1 (approximately $n_{air} \approx 1.0003$).

Using the formula, $v = \frac{c}{n}$. Since $n_{air} > 1$, the speed of light in air (v_{air}) will be slightly less than the speed of light in a vacuum (c).

Although for many calculations the speed of light in air is approximated to be the same as in a vacuum, it is technically and factually less.

Step 4: Final Answer:

The speed of light in air is less than the speed of light in a vacuum.

Quick Tip

Light travels fastest in a vacuum. Any medium, including air, will slow it down. The denser the optical medium, the slower the light travels.

24. Which phenomenon exhibited by light is demonstrated in the twinkling of stars ?

- (A) Reflection
- (B) Dispersion
- (C) Scattering
- (D) Refraction

Correct Answer: (D) Refraction

Solution:

Step 1: Understanding the Concept:

The twinkling of stars is an optical phenomenon caused by the Earth's atmosphere. Stars are very far away and act as point sources of light.

Step 2: Detailed Explanation:

The phenomenon responsible is **atmospheric refraction**.

- The Earth's atmosphere is composed of layers of air with different temperatures and densities, and thus different refractive indices.
- As the light from a distant star enters the atmosphere, it continuously bends or **refracts** as it passes through these constantly changing layers.
- This continuous refraction causes the apparent position of the star to shift slightly and the amount of light reaching the observer's eye to fluctuate.
- This fluctuation in the light's intensity and apparent position is perceived as twinkling.

Step 3: Final Answer:

The twinkling of stars is caused by the atmospheric refraction of starlight.

Quick Tip

Planets do not twinkle because they are much closer to Earth and appear as extended sources of light (a collection of many point sources). The twinkling effect from each point averages out, resulting in a steady glow.

25. An aqueous solution of an acid conducts electricity because acid in water

- (A) gets ionized
- (B) is soluble
- (C) is insoluble
- (D) none of these

Correct Answer: (A) gets ionized

Solution:

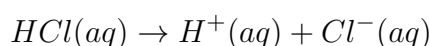
Step 1: Understanding the Concept:

The question asks about the behavior of an acid when dissolved in water. The defining characteristic of an Arrhenius acid is its ability to produce hydrogen ions (H^+) or hydronium ions (H_3O^+) in an aqueous solution.

Step 2: Detailed Explanation:

When an acid (e.g., HCl) is dissolved in water, its molecules dissociate or **ionize**. This means the acid molecule breaks apart into ions.

For example, hydrochloric acid (HCl) ionizes in water as follows:



The hydrogen ion (H^+) then combines with a water molecule to form a hydronium ion (H_3O^+). This process of forming ions is called ionization. The presence of these mobile ions is what allows acidic solutions to conduct electricity. While most acids are soluble (B), the most fundamental

chemical process occurring is ionization (A). Insolubility (C) is incorrect.

Step 3: Final Answer:

An acid in an aqueous solution gets ionized.

Quick Tip

Acids only show their acidic properties (like turning blue litmus red or conducting electricity) in the presence of water because water facilitates their ionization to produce H^+ ions.

26. Which of the following is not an olfactory indicator ?

- (A) Clove oil
- (B) Vanilla
- (C) Sweet potato
- (D) All of these

Correct Answer: (C) Sweet potato

Solution:

Step 1: Understanding the Concept:

An olfactory indicator is a substance whose smell (odor) changes depending on whether it is mixed with an acidic or a basic solution. They are used to identify the nature of a solution when a visual indicator is not suitable.

Step 2: Detailed Explanation:

- **Clove oil:** Has a characteristic smell. It loses its smell in a basic solution but retains it in an acidic solution. Thus, it is an olfactory indicator.
- **Vanilla extract:** Has a pleasant smell which is retained in an acidic solution but vanishes in a basic solution. Thus, it is an olfactory indicator.
- **Sweet potato:** Is a vegetable. It does not have a characteristic strong odor that changes predictably in acidic or basic media. Therefore, it cannot be used as an olfactory indicator.

Step 3: Final Answer:

Sweet potato is not an olfactory indicator.

Quick Tip

Common olfactory indicators include onion, vanilla extract, and clove oil. Remember that their key feature is a change in smell in response to pH changes.

27. Which acid is found in ant sting?

- (A) Citric acid
- (B) Acetic acid
- (C) Methanoic acid
- (D) None of these

Correct Answer: (C) Methanoic acid

Solution:

Step 1: Understanding the Concept:

The question asks to identify the specific acid present in the sting of an ant, which causes irritation and pain.

Step 2: Detailed Explanation:

- **Methanoic acid ($HCOOH$):** This is the systematic IUPAC name for the simplest carboxylic acid. Its common name is **formic acid**. It is injected by ants and stinging nettles and is responsible for the burning sensation.
- **Citric acid:** A weak organic acid found naturally in citrus fruits like lemons and oranges.
- **Acetic acid (CH_3COOH):** The main component of vinegar.

The acid found in an ant's sting is methanoic acid (formic acid).

Step 3: Final Answer:

Methanoic acid is found in ant stings.

Quick Tip

The common name for methanoic acid is formic acid, derived from the Latin word for ant, "formica". Knowing this etymology can help you remember the answer.

28. Which of the following is kept immersed in water ?

- (A) White phosphorus
- (B) Red phosphorus
- (C) Iodine
- (D) Sulphur

Correct Answer: (A) White phosphorus

Solution:

Step 1: Understanding the Concept:

Some highly reactive elements need to be stored under specific conditions to prevent them from reacting with the environment (like air).

Step 2: Detailed Explanation:

- **White phosphorus:** This allotrope of phosphorus is highly reactive. It has a low ignition temperature (around 30°C) and ignites spontaneously upon exposure to air, burning with a yellow flame to produce dense white fumes of phosphorus pentoxide (P_4O_{10}). To prevent this, it is stored under water, with which it does not react.
- **Red phosphorus:** Is much more stable and less reactive than white phosphorus. It does not ignite in air at room temperature and can be stored normally.
- **Iodine and Sulphur:** Are relatively stable solids at room temperature and do not need to be stored under water.

Step 3: Final Answer:

White phosphorus is kept immersed in water for safe storage.

Quick Tip

Remember the storage conditions for highly reactive elements. Alkali metals like Sodium (Na) and Potassium (K) are stored under kerosene or paraffin oil because they react violently with water. White Phosphorus reacts with air, not water, so it's stored under water.

29. The substances, present as impurities in on ore, are called

- (A) Slag
- (B) Gangue

- (C) Mineral
(D) None of these

Correct Answer: (B) Gangue

Solution:

Step 1: Understanding the Concept:

This question relates to the terminology used in metallurgy, the science of extracting metals from their ores.

Step 2: Detailed Explanation:

- **Ore:** A naturally occurring rock or mineral from which a metal or valuable mineral can be profitably extracted.
- **Mineral:** A naturally occurring, inorganic solid with a definite chemical composition and a crystalline structure. An ore is a type of mineral.
- **Gangue (or matrix):** The commercially worthless material (like sand, rock, clay) that surrounds, or is closely mixed with, a wanted mineral in an ore deposit. These are the impurities that need to be removed.
- **Slag:** A glassy, non-metallic byproduct formed during the smelting of an ore. It is formed when a flux is added to react with the gangue, creating a molten substance that can be easily separated from the molten metal.

Therefore, the impurities present in an ore are called gangue.

Step 3: Final Answer:

The impurities present in an ore are called gangue.

Quick Tip

Do not confuse Gangue and Slag. Gangue is the natural impurity *in* the ore. Slag is the man-made waste product *after* processing the ore with a flux.

30. Which of the following metals can be easily cut with a knife ?

- (A) Na
(B) Cu

- (C) Ni
- (D) Al

Correct Answer: (A) Na

Solution:

Step 1: Understanding the Concept:

The question asks to identify a metal that is soft enough to be cut with a standard knife. This property is characteristic of a specific group of metals in the periodic table.

Step 2: Detailed Explanation:

- **Na (Sodium):** Sodium is an alkali metal (Group 1). Alkali metals are known for being very soft and having low densities. Sodium is soft enough to be easily cut with a knife, revealing a shiny surface that quickly tarnishes in air.
- **Cu (Copper), Ni (Nickel), Al (Aluminum):** These are transition and post-transition metals. They are much harder and stronger than alkali metals and cannot be cut with a simple knife. They possess typical metallic properties like high tensile strength and hardness.

Step 3: Final Answer:

Sodium (Na) can be easily cut with a knife.

Quick Tip

Remember that the alkali metals (Group 1), such as Lithium (Li), Sodium (Na), and Potassium (K), are exceptionally soft metals. This is a key distinguishing physical property.

31. Which metal is mixed with gold to make an alloy ?

- (A) Fe
- (B) Cu
- (C) Zn
- (D) Ag

Correct Answer: (B) Cu

Solution:

Step 1: Understanding the Concept:

Pure gold (24 karat) is a very soft metal, making it unsuitable for durable jewelry. To increase its hardness and change its color, it is mixed with other metals to form an alloy.

Step 2: Detailed Explanation:

The most common metals alloyed with gold for jewelry are copper, silver, nickel, and zinc.

- **Cu (Copper):** Is a primary metal used to alloy with gold. It increases the hardness and gives the gold a reddish tint, creating "rose gold" in higher concentrations.
- **Ag (Silver):** Is also commonly used. It hardens the gold and gives it a whitish or greenish tint, leading to "white gold" or "green gold".
- **Fe (Iron) and Zn (Zinc):** While zinc is used in some gold alloys, iron is not typically used.

Both Copper (Cu) and Silver (Ag) are correct options, but Copper is the most common and essential alloying metal for standard yellow and rose gold. Given that Cu is an option, it is a very strong candidate.

Step 3: Final Answer:

Copper (Cu) is a common metal mixed with gold to make an alloy for jewelry.

Quick Tip

The "karat" system measures gold purity. 24 karat is pure gold. 18 karat gold is 18/24 parts gold (75%) and 6/24 parts (25%) other metals like copper or silver.

32. Silicon is a/an

- (A) Non-metal
- (B) Metal
- (C) Alloy
- (D) Metalloid

Correct Answer: (D) Metalloid

Solution:

Step 1: Understanding the Concept:

Elements in the periodic table are broadly classified into metals, non-metals, and metalloids

based on their properties.

Step 2: Detailed Explanation:

- **Metals:** Are typically shiny, malleable, ductile, and good conductors of heat and electricity (e.g., Iron, Copper).
- **Non-metals:** Are typically dull, brittle, and poor conductors (insulators) (e.g., Oxygen, Sulphur).
- **Alloy:** Is a mixture of metals or a metal and another element. It is not a pure element itself.
- **Metalloids (or semi-metals):** These are elements that have properties intermediate between those of metals and non-metals. They are located along the zig-zag line separating metals and non-metals in the periodic table. Silicon (Si) is a classic example. It is a semiconductor of electricity (a property between a conductor and an insulator), and it is brittle but has a metallic luster.

Step 3: Final Answer:

Silicon is a metalloid.

Quick Tip

The main metalloids to remember are Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb), and Tellurium (Te). Silicon and Germanium are famous for their use in semiconductors.

33. A horizontal magnet hanging freely in air always comes to rest in

- (A) Any direction
- (B) East-West direction
- (C) North-South direction
- (D) None of these

Correct Answer: (C) North-South direction

Solution:

Step 1: Understanding the Concept:

A freely suspended magnet always aligns itself with the Earth's magnetic field. The Earth

behaves like a giant bar magnet with its magnetic poles located near its geographic poles.

Step 2: Detailed Explanation:

When a magnet is suspended freely, its north pole is attracted to the Earth's magnetic south pole (which is near the geographic North Pole), and its south pole is attracted to the Earth's magnetic north pole (which is near the geographic South Pole).

This causes the magnet to align itself in the geographic North-South direction. This principle is the basis for how a magnetic compass works.

Step 3: Final Answer:

Therefore, a horizontal magnet hanging freely in the air always comes to rest in the North-South direction.

Quick Tip

Remember that the Earth's geographic North Pole is actually its magnetic South Pole, and vice versa. This is a common point of confusion. A magnet's North pole points towards the geographic North.

34. If a compass is placed near a wire carrying electric current, the compass needle

- (A) Will be deflected
- (B) The current carrying wire will be deflected
- (C) Will not be deflected
- (D) None of these

Correct Answer: (A) Will be deflected

Solution:

Step 1: Understanding the Concept:

This question relates to the magnetic effect of electric current, a fundamental principle discovered by Hans Christian Oersted.

Step 2: Detailed Explanation:

An electric current flowing through a conductor (like a wire) produces a magnetic field in the region surrounding it.

A compass needle is a small magnet that aligns itself with any external magnetic field.

When the compass is brought near the current-carrying wire, the magnetic field produced by the current interacts with the compass needle's own magnetic field.

This interaction exerts a torque on the needle, causing it to deflect from its usual North-South alignment.

Step 3: Final Answer:

Hence, if a compass is placed near a wire carrying an electric current, the compass needle will be deflected.

Quick Tip

The direction of deflection can be determined using the Right-Hand Thumb Rule (or Ampere's swimming rule). Point your thumb in the direction of the current; your curled fingers will indicate the direction of the magnetic field lines.

35. Faraday made many revolutionary discoveries, including

- (A) Electromagnetic induction
- (B) Law of electrolysis
- (C) Both (A) and (B)
- (D) None of these

Correct Answer: (C) Both (A) and (B)

Solution:**Step 1: Understanding the Concept:**

This question tests the knowledge of the scientific contributions of Michael Faraday, a key figure in the history of physics and chemistry.

Step 2: Detailed Explanation:

Electromagnetic Induction: Faraday's law of induction is a basic law of electromagnetism predicting how a changing magnetic field will interact with an electric circuit to produce an electromotive force (EMF). This is the fundamental principle behind electric generators, inductors, and transformers.

Laws of Electrolysis: Faraday also established two fundamental laws of electrolysis. The first law states that the mass of a substance altered at an electrode during electrolysis is directly proportional to the quantity of electricity transferred. The second law relates the masses of different elements liberated by the same quantity of electricity.

Step 3: Final Answer:

Since Michael Faraday is credited with both the discovery of electromagnetic induction and the laws of electrolysis, the correct answer is that he discovered both.

Quick Tip

Faraday's contributions are vast. Linking his name to "electromagnetic induction" and "electrolysis" is a key association for physics and chemistry exams.

36. An electric motor converts

- (A) Chemical energy into electrical energy
- (B) Electrical energy into mechanical energy
- (C) Mechanical energy into electrical energy
- (D) Electrical energy into chemical energy

Correct Answer: (B) Electrical energy into mechanical energy

Solution:

Step 1: Understanding the Concept:

The question asks about the energy conversion that takes place in an electric motor. An electric motor is a device designed to produce motion.

Step 2: Detailed Explanation:

An electric motor operates on the principle that a current-carrying conductor placed in a magnetic field experiences a force.

It takes electrical energy from a source (like a battery or mains supply) and uses it to create a rotating magnetic field or to pass a current through a coil in a static magnetic field.

This process generates a torque on a rotor, causing it to spin. The spinning of the rotor is a form of mechanical energy (rotational kinetic energy).

Therefore, the net energy conversion is from electrical energy to mechanical energy.

Step 3: Final Answer:

An electric motor converts electrical energy into mechanical energy.

Quick Tip

Don't confuse an electric motor with an electric generator. A generator does the opposite: it converts mechanical energy into electrical energy. A battery converts chemical energy into electrical energy.

37. In Fleming's left-hand rule, the index finger of the left hand indicates

- (A) Direction of magnetic field
- (B) Direction of electric force applied on the conductor

- (C) Direction of electric current flowing in the conductor
(D) None of these

Correct Answer: (A) Direction of magnetic field

Solution:

Step 1: Understanding the Concept:

Fleming's left-hand rule is a mnemonic used to find the direction of the force (or motion) on a current-carrying conductor in a magnetic field. This is the principle behind electric motors.

Step 2: Detailed Explanation:

To use the rule, you orient your left hand so that the thumb, index finger (forefinger), and middle finger are mutually perpendicular to each other.

- The **T**humb represents the direction of the **T**hrust or **F**orce (**F**ather).
- The **F**orefinger (Index finger) represents the direction of the magnetic **F**ield (**M**other).
- The **C**entre finger (Middle finger) represents the direction of the **C**urrent (**C**hild).

So, the index finger indicates the direction of the magnetic field.

Step 3: Final Answer:

According to Fleming's left-hand rule, the index finger points in the direction of the magnetic field.

Quick Tip

A common mnemonic is FBI: Force (Thumb), B-Field (Index), Current (Middle). 'B' is the symbol for magnetic field density. This helps remember the association for each finger. Remember, Left Hand is for Motors, Right Hand is for Generators.

38. When electric current flows through a conducting wire, what type of magnetic field is generated above and below the wire ?

- (A) Opposite type
(B) Similar type
(C) Not of any kind
(D) None of these

Correct Answer: (A) Opposite type

Solution:

Step 1: Understanding the Concept:

The magnetic field around a straight, current-carrying conductor consists of concentric circles. The direction of this field is determined by the Right-Hand Thumb Rule.

Step 2: Detailed Explanation:

Imagine a horizontal wire with current flowing from left to right.

According to the Right-Hand Thumb Rule, if you point your thumb in the direction of the current (left to right), your fingers will curl around the wire in the direction of the magnetic field lines.

- **Above the wire:** Your fingers point *into* the page.
- **Below the wire:** Your fingers point *out of* the page.

The directions "into the page" and "out of the page" are opposite to each other. Therefore, the magnetic fields above and below the wire are in opposite directions.

Step 3: Final Answer:

The magnetic field generated above and below the wire are of the opposite type (i.e., in opposite directions).

Quick Tip

Always use the Right-Hand Thumb Rule for finding the direction of the magnetic field around a current-carrying wire. It's a quick and reliable method for solving such problems.

39. What type of energy source is hydroelectric energy ?

- (A) Renewable
- (B) Non-renewable
- (C) Both (A) and (B)
- (D) None of these

Correct Answer: (A) Renewable

Solution:

Step 1: Understanding the Concept:

Energy sources are classified as renewable or non-renewable.

Renewable sources are those that are replenished naturally over a relatively short period. Examples include solar, wind, hydro, geothermal, and biomass.

Non-renewable sources are those that are finite and are consumed much faster than they are formed. Examples include fossil fuels (coal, oil, natural gas) and nuclear fuel (uranium).

Step 2: Detailed Explanation:

Hydroelectric energy is generated from the kinetic energy of flowing water or the potential energy of water stored in a dam.

The water used in this process is part of the Earth's water cycle, which is driven by solar energy. Rain and snow replenish the rivers and reservoirs.

Since the water cycle is a continuous and natural process, hydroelectric energy is considered a renewable source of energy.

Step 3: Final Answer:

Hydroelectric energy is a renewable energy source.

Quick Tip

To easily identify renewable sources, think about whether the source is naturally and quickly replenished. Sun shines, wind blows, water flows, and plants grow—all are renewable. Fossil fuels are formed over millions of years, making them non-renewable on a human timescale.

40. Which gas is responsible for global warming?

- (A) Nitrogen
- (B) Carbon dioxide
- (C) Oxygen
- (D) None of these

Correct Answer: (B) Carbon dioxide

Solution:**Step 1: Understanding the Concept:**

Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere.

Step 2: Detailed Explanation:

The primary gases responsible for the greenhouse effect include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone.

While Nitrogen (N_2) and Oxygen (O_2) make up about 99% of the atmosphere, they are not significant greenhouse gases because their molecular structure does not allow them to effectively absorb long-wave (infrared) radiation.

Carbon dioxide (CO_2), produced mainly from the burning of fossil fuels, deforestation, and industrial processes, is the most significant long-lived greenhouse gas in Earth's atmosphere, making it the main driver of global warming.

Step 3: Final Answer:

Among the given options, Carbon dioxide is the gas primarily responsible for global warming.

Quick Tip

While other gases like methane are more potent greenhouse gases per molecule, Carbon Dioxide (CO_2) is the most significant contributor to global warming due to its vast abundance and long persistence in the atmosphere.

41. Magnesium is a member of which group of the periodic table ?

- (A) Group VIII
- (B) Group I
- (C) Group II
- (D) Nonmetallic element

Correct Answer: (C) Group II

Solution:**Step 1: Understanding the Concept:**

The group number of an element in the periodic table is determined by its number of valence electrons.

Step 2: Detailed Explanation:

- The element Magnesium (Mg) has an atomic number of 12.
- Its electronic configuration is 2, 8, 2.
- It has 2 electrons in its outermost shell (valence shell).
- Elements with 2 valence electrons belong to **Group 2** of the periodic table.
- Group 2 elements are also known as the Alkaline Earth Metals.
- Option (D) is incorrect as Magnesium is a metal.

Step 3: Final Answer:

Magnesium is a member of Group II (or Group 2) of the periodic table.

Quick Tip

For the main group elements, the number of valence electrons directly tells you the group. 1 valence electron = Group 1 (Alkali Metals), 2 valence electrons = Group 2 (Alkaline Earth Metals).

42. How many periods are there in the periodic table ?

- (A) 12
- (B) 9
- (C) 8
- (D) 7

Correct Answer: (D) 7

Solution:

Step 1: Understanding the Concept:

The periodic table is organized into horizontal rows and vertical columns. The question asks for the number of horizontal rows.

Step 2: Detailed Explanation:

- The horizontal rows in the periodic table are called **periods**.
- The vertical columns are called **groups**.
- In the modern periodic table, there are a total of **7 periods**.
- The period number of an element signifies the principal energy level for its outermost electrons.

Step 3: Final Answer:

There are 7 periods in the modern periodic table.

Quick Tip

Remember the basic structure of the modern periodic table: 7 periods (rows) and 18 groups (columns).

43. Which of the following is not an ancient method of water harvesting?

- (A) Katta
- (B) Kulh
- (C) Dug well
- (D) Irish

Correct Answer: (D) Irish

Solution:

Step 1: Understanding the Concept:

The question asks to identify the option that is not a traditional or ancient method of water harvesting, particularly in the context of India.

Step 2: Detailed Explanation:

- **Katta:** These are traditional temporary check dams built across streams and rivers, commonly found in parts of Karnataka. This is an ancient method.
- **Kulh:** These are traditional surface water channels used for irrigation in hilly regions, especially in Himachal Pradesh. This is an ancient method.
- **Dug well:** Digging wells to access groundwater is one of the oldest methods of water sourcing known to humanity.
- **Irish:** This term is not associated with any known ancient water harvesting method in India. While there are methods like an "Irish drain" (a type of French drain), these are modern drainage techniques, not ancient harvesting systems.

Step 3: Final Answer:

Katta, Kulh, and Dug well are all ancient methods of water management. "Irish" is not recognized as one of them.

Quick Tip

Familiarize yourself with traditional Indian water harvesting systems like Khadins and Johads (Rajasthan), Bandharas and Tals (Maharashtra), Ahar-Pynes (Bihar), and Eris (Tamil Nadu).

44. What was the objective of construction of Tehri Dam ?

- (A) Electricity generation
- (B) Land irrigation
- (C) Water supply
- (D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding the Concept:

Large dams like the Tehri Dam are typically constructed as multi-purpose projects, meaning

they are designed to serve several functions simultaneously.

Step 2: Detailed Explanation:

The Tehri Dam, built on the Bhagirathi River in Uttarakhand, was constructed with multiple objectives in mind:

- **Electricity generation:** It has a large hydroelectric power plant to generate electricity.
- **Land irrigation:** It provides water for the irrigation of large agricultural areas in Uttar Pradesh and Uttarakhand.
- **Water supply:** It supplies drinking water to several urban areas, including Delhi.

Since the dam serves all the purposes listed in the options, the correct answer is "All of these".

Step 3: Final Answer:

The objectives for the construction of the Tehri Dam include electricity generation, land irrigation, and water supply.

Quick Tip

For questions about major dams, remember they are almost always multi-purpose projects. If the options include power generation, irrigation, and water supply, "All of these" is a very likely correct answer.

45. What is the new concept of waste management ?

- (A) Reuse
- (B) Recycle
- (C) Reduce
- (D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding the Concept:

Modern waste management is guided by a principle known as the "3Rs of Waste Management". This concept provides a hierarchy for managing waste in the most environmentally friendly way.

Step 2: Detailed Explanation:

The 3Rs stand for:

- **Reduce:** This is the first and most important step. It means minimizing the amount of waste generated in the first place. For example, buying products with less packaging.

- **Reuse:** This is the second priority. It involves using items more than once instead of throwing them away after a single use. For example, using a reusable water bottle instead of disposable ones.
- **Recycle:** This is the third option. It is the process of converting waste materials into new materials and objects. For example, recycling paper, plastic, and glass.

Since all three concepts—Reduce, Reuse, and Recycle—are integral parts of the modern approach to waste management, the correct option is "All of these".

Step 3: Final Answer:

The new concept of waste management includes Reduce, Reuse, and Recycle.

Quick Tip

Remember the hierarchy of the 3Rs: Reduce ; Reuse ; Recycle. The most effective way to manage waste is to not create it in the first place (Reduce). Recycling is the last resort among the three.

46. Which of the following is a renewable resource ?

- (A) Coal
- (B) Forest
- (C) Petroleum
- (D) None of these

Correct Answer: (B) Forest

Solution:

Step 1: Understanding the Concept:

Natural resources are categorized as renewable or non-renewable.

- **Renewable resources** are those that can be replenished or regenerated naturally over a relatively short period.
- **Non-renewable resources** are those that exist in a fixed quantity and are consumed much faster than they are formed, taking millions of years to be created.

Step 2: Detailed Explanation:

Let's analyze the given options:

- **Coal** and **Petroleum** are fossil fuels. They were formed from the remains of ancient organisms over millions of years and are therefore non-renewable resources.

- A **Forest** is a biological resource. Trees can be planted and regrown in a relatively short time frame (decades). If managed sustainably, a forest can provide resources indefinitely, making it a renewable resource.

Step 3: Final Answer:

Among the given options, a forest is a renewable resource.

Quick Tip

While forests are renewable, it is crucial to manage them sustainably. Deforestation at a rate faster than reforestation can lead to the depletion of this valuable resource.

47. Which of the following is the main component of biogas ?

- (A) Carbon dioxide
- (B) Hydrogen sulphide
- (C) Water vapour
- (D) Methane

Correct Answer: (D) Methane

Solution:

Step 1: Understanding the Concept:

Biogas is a type of biofuel that is produced from the breakdown of organic matter (such as animal waste, plant material, and sewage) in the absence of oxygen, a process called anaerobic digestion.

Step 2: Detailed Explanation:

The composition of biogas can vary depending on the feedstock and production conditions, but it typically consists of:

- **Methane (CH_4):** 50% - 75% (This is the primary flammable component that makes biogas a useful fuel).
- **Carbon dioxide (CO_2):** 25% - 50%
- **Trace gases:** Small amounts of Nitrogen (N_2), Hydrogen (H_2), Hydrogen sulphide (H_2S), and Water vapour (H_2O).

Since methane constitutes the largest percentage of the gas mixture, it is considered the main component of biogas.

Step 3: Final Answer:

The main component of biogas is Methane.

Quick Tip

Do not confuse biogas with other fuel gases. The main component of Biogas and CNG is Methane (CH_4), while the main component of LPG is Butane (C_4H_{10}).

48. Peptic ulcer can be caused by

- (A) Eating less food
- (B) Eating normal food
- (C) Prolonged starvation
- (D) None of these

Correct Answer: (C) Prolonged starvation

Solution:

Step 1: Understanding the Concept:

A peptic ulcer is a sore on the lining of the stomach, small intestine, or esophagus. It occurs when stomach acid damages the lining of the digestive tract. The question asks for a potential cause among the given lifestyle-related options.

Step 2: Detailed Explanation:

The primary causes of peptic ulcers are now known to be an infection with the bacterium *Helicobacter pylori* and the long-term use of NSAID pain relievers (like ibuprofen). However, other factors can contribute to their development or exacerbate them.

- The stomach produces hydrochloric acid to digest food. The stomach lining is protected by a layer of mucus.
- During **prolonged starvation**, the stomach continues to produce acid, but there is no food to buffer or neutralize it.
- This excess, unneutralized acid can erode the protective mucous layer and damage the stomach lining, leading to gastritis and potentially the formation of an ulcer.
- "Eating less food" might have a similar, but less severe, effect. "Eating normal food" is generally not a cause.

Therefore, among the choices provided, prolonged starvation is the most plausible cause.

Step 3: Final Answer:

Peptic ulcer can be caused by prolonged starvation, as it leads to damage of the stomach lining by unneutralized stomach acid.

Quick Tip

While the options point to lifestyle factors, remember for your exams that the most common cause of peptic ulcers is a bacterial infection by *H. pylori*. This was a Nobel Prize-winning discovery.

49. Bile juice is secreted by

- (A) Oral cavity
- (B) Liver
- (C) Small intestine
- (D) Stomach

Correct Answer: (B) Liver

Solution:

Step 1: Understanding the Concept:

This question asks about the origin of bile juice, an important digestive fluid in the human body.

Step 2: Detailed Explanation:

Bile juice is a dark green to yellowish-brown fluid that aids in the digestion of lipids (fats) in the small intestine.

It is produced continuously by the **liver**.

The produced bile is then stored and concentrated in a small organ called the **gallbladder**.

When fat enters the small intestine (duodenum), the gallbladder releases the bile into the small intestine to emulsify the fats, breaking them down into smaller droplets for easier digestion by enzymes.

Step 3: Final Answer:

Bile juice is secreted by the liver.

Quick Tip

A common mistake is to think the gallbladder produces bile. Remember: the Liver **produces** bile, and the Gallbladder **stores** it.

50. What is the function of the villi located in small intestine ?

- (A) Blocking absorption
- (B) Reducing the surface area of absorption
- (C) Increasing the surface area of absorption

(D) None of these

Correct Answer: (C) Increasing the surface area of absorption

Solution:

Step 1: Understanding the Concept:

The small intestine is the primary site for the chemical digestion of food and the absorption of nutrients into the bloodstream. Its structure is highly specialized to maximize this absorption process.

Step 2: Detailed Explanation:

The inner wall of the small intestine is not smooth. It is covered with millions of tiny, finger-like projections called **villi** (singular: villus).

Each villus is further covered with even smaller hair-like projections called **microvilli**.

This folded structure of villi and microvilli drastically increases the total surface area of the inner lining of the small intestine.

A larger surface area allows for more efficient and rapid absorption of digested nutrients (like glucose, amino acids, fatty acids) into the capillaries and lacteals within each villus.

Step 3: Final Answer:

The primary function of the villi is to increase the surface area available for the absorption of nutrients.

Quick Tip

Think of the villi and microvilli like the bristles of a brush. They create a huge surface area in a small space, which is a key principle in biology for processes like absorption and gas exchange.

51. The posterior part of the oral cavity is

- (A) Esophagus
- (B) Pharynx
- (C) Duodenum
- (D) Pancreas

Correct Answer: (B) Pharynx

Solution:

Step 1: Understanding the Concept:

The question asks to identify the anatomical structure located at the back (posterior) of the

oral cavity (the mouth).

Step 2: Detailed Explanation:

- **Oral Cavity:** This is the mouth, the beginning of the digestive tract.
- **Pharynx:** The pharynx, commonly called the throat, is a muscular tube that connects the nasal and oral cavities to the esophagus and larynx. It is located directly behind the mouth and nasal cavity.
- **Esophagus:** This is the tube that connects the pharynx to the stomach. It is posterior and inferior to the pharynx.
- **Duodenum:** This is the first section of the small intestine, located after the stomach.
- **Pancreas:** This is a gland located behind the stomach.

Based on the anatomical positions, the pharynx is the immediate posterior part of the oral cavity.

Step 3: Final Answer:

Therefore, the posterior part of the oral cavity is the pharynx.

Quick Tip

Visualize the path of food: Mouth (Oral Cavity) → Throat (Pharynx) → Food Pipe (Esophagus) → Stomach. This sequence helps remember the order and location of these parts.

52. The transfer of O_2 from outside environment to cells and removal of CO_2 is referred to as

- (A) Exhalation
- (B) Respiration
- (C) Inhalation
- (D) None of these

Correct Answer: (B) Respiration

Solution:

Step 1: Understanding the Concept:

The question describes the overall process of gas exchange between an organism and its environment.

Step 2: Detailed Explanation:

- **Inhalation:** The act of breathing in, taking air (and oxygen) into the lungs.
- **Exhalation:** The act of breathing out, expelling air (with carbon dioxide) from the lungs.
- **Breathing:** The mechanical process of inhalation and exhalation.
- **Respiration:** This is a broader term. It includes breathing (external respiration) as well as the process at the cellular level (cellular respiration) where cells use oxygen to break down glucose and produce energy, releasing carbon dioxide as a waste product. The question describes the entire process of getting O_2 to the cells and removing CO_2 , which is best defined as respiration.

Step 3: Final Answer:

The complete process of transferring oxygen to cells and removing carbon dioxide is called respiration.

Quick Tip

Remember that "breathing" is just the physical act of moving air in and out of the lungs. "Respiration" encompasses the entire gas exchange process, from the environment to the individual cells.

53. The basic source of oxygen in photosynthesis is

- (A) Chlorophyll
- (B) CO_2
- (C) Water
- (D) Solar energy

Correct Answer: (C) Water

Solution:

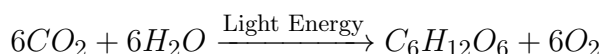
Step 1: Understanding the Concept:

Photosynthesis is the process used by plants, algae, and some bacteria to convert light energy

into chemical energy, through a process that converts carbon dioxide and water into glucose (sugar) and oxygen.

Step 2: Key Formula or Approach:

The overall chemical equation for photosynthesis is:



Step 3: Detailed Explanation:

During the light-dependent reactions of photosynthesis, light energy is used to split water molecules in a process called photolysis.

The splitting of water (H_2O) releases electrons, protons (H^+), and oxygen atoms. The oxygen atoms then combine to form molecular oxygen (O_2), which is released as a byproduct.

The oxygen in carbon dioxide (CO_2) ends up in the glucose ($C_6H_{12}O_6$) and in the water molecules produced during the process, not in the released oxygen gas.

Step 4: Final Answer:

Therefore, the source of the oxygen gas released during photosynthesis is water.

Quick Tip

A common misconception is that the oxygen comes from CO_2 . Remember that photosynthesis *splits water* to release oxygen. Experiments using isotopes of oxygen (like ^{18}O) have confirmed this.

54. Which of the following is known as the 'energy currency' of the cell?

- (A) ATP
- (B) ADP
- (C) DTP
- (D) None of these

Correct Answer: (A) ATP

Solution:

Step 1: Understanding the Concept:

Cells need a readily available source of energy to power various metabolic processes. This energy is stored in a specific molecule that can be easily used, much like currency is used for transactions.

Step 2: Detailed Explanation:

- **ATP (Adenosine Triphosphate):** This molecule is the primary energy carrier in all living organisms. It stores energy in its high-energy phosphate bonds. When a cell needs energy, it breaks the third phosphate bond of ATP, releasing energy and forming ADP (Adenosine Diphosphate) and a free phosphate group.
- **ADP (Adenosine Diphosphate):** This is the "discharged" version of ATP, with only two phosphate groups. It can be "recharged" back into ATP using energy from cellular respiration.
- **DTP (Deoxythymidine Triphosphate):** This is a nucleoside triphosphate used in the synthesis of DNA, not as a general energy currency.

Because ATP is used to power the vast majority of energy-requiring cellular reactions, it is universally known as the 'energy currency' of the cell.

Step 3: Final Answer:

ATP is the energy currency of the cell.

Quick Tip

Think of ATP as a rechargeable battery. When it's fully charged, it's ATP. When it's used, it becomes ADP (a partially discharged battery), which can then be recharged by cellular respiration.

55. Xylem in plant is responsible for

- (A) Carrying of food
- (B) Carrying of oxygen
- (C) Carrying of amino acid
- (D) Carrying of water

Correct Answer: (D) Carrying of water

Solution:

Step 1: Understanding the Concept:

Plants have a vascular system composed of specialized tissues for transporting substances throughout the plant. The two main tissues are xylem and phloem.

Step 2: Detailed Explanation:

- **Xylem:** This tissue is responsible for the transport of water and dissolved minerals from the roots to the rest of the plant (stem, leaves). The movement is typically unidirectional (upwards). Xylem also provides structural support to the plant.
- **Phloem:** This tissue is responsible for the transport of sugars (food), produced during photosynthesis in the leaves, to other parts of the plant where they are needed for growth or storage. This process is called translocation and can be multidirectional. Amino acids are also transported via phloem.

Therefore, the function of xylem is the transport of water.

Step 3: Final Answer:

Xylem in plants is responsible for carrying water.

Quick Tip

A simple mnemonic: 'Xylem' transports water, which starts with 'w', a letter found near 'x' in the alphabet. 'Phloem' transports food, which starts with 'f', similar to 'ph'.

56. Apart from plasma, which of the following is found in blood ?

- (A) White Blood Cells (WBC)
- (B) Red Blood Cells (RBC)
- (C) Blood platelets
- (D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding the Concept:

Blood is a specialized body fluid with two main components: plasma and formed elements. The question asks to identify the formed elements.

Step 2: Detailed Explanation:

- **Plasma:** This is the liquid matrix of blood, making up about 55% of its volume. It consists of water, proteins, salts, hormones, and waste products.
- **Formed Elements:** These are the cells and cell fragments suspended in the plasma, making up about 45% of blood volume. They include:

- **Red Blood Cells (RBCs or Erythrocytes):** Responsible for transporting oxygen.
- **White Blood Cells (WBCs or Leukocytes):** Part of the immune system, fighting infection.
- **Blood Platelets (Thrombocytes):** Cell fragments that are essential for blood clotting.

Since WBCs, RBCs, and platelets are all components of blood apart from plasma, the correct answer is 'All of these'.

Step 3: Final Answer:

White Blood Cells, Red Blood Cells, and Blood platelets are all found in blood in addition to plasma.

Quick Tip

Remember the main components of blood: Plasma (the liquid) and Formed Elements (the 'solid' parts: RBCs, WBCs, and platelets).

57. (The changes that occur during adolescence are called)

- (A) Diversity
- (B) Germination
- (C) Puberty
- (D) None of these

Correct Answer: (C) Puberty

Solution:

Step 1: Understanding the Concept:

The question asks for the term used to describe the period of rapid physical and hormonal changes that occur during adolescence, leading to sexual maturity.

Step 2: Detailed Explanation:

- **Puberty :** This is the correct biological term for the process of physical changes through which a child's body matures into an adult body capable of sexual reproduction. It is initiated by hormonal signals from the brain to the gonads (the ovaries in a female, the testes in a male).

- **Diversity** : This refers to variety or the state of being different. It is not related to the developmental changes of adolescence.
- **Germination** : This is the process by which a plant grows from a seed. It is a botanical term.

Step 3: Final Answer:

The changes that occur during adolescence are called puberty.

Quick Tip

Puberty is the key biological transition from childhood to adulthood. The English question provided below the Hindi one makes the answer clear.

58. Which of the following is an effective measure used in family planning?

- (A) Diaphragm
- (B) Condom
- (C) Copper T and loop
- (D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding the Concept:

Family planning involves the use of contraceptive methods to control the number of children a couple has and the intervals between their births. The question asks to identify which of the given options are effective contraceptive measures.

Step 2: Detailed Explanation:

The options represent different types of contraceptive methods:

- **Diaphragm:** This is a barrier method of contraception. It is a dome-shaped cup that is inserted into the vagina before sex to cover the cervix and block sperm from entering the uterus.
- **Condom:** This is also a barrier method. It is a thin sheath, typically made of latex, worn over the penis during sex to prevent semen from entering the vagina. It also protects against sexually transmitted infections (STIs).

- **Copper T and loop:** These are types of Intrauterine Devices (IUDs). They are small T-shaped or loop-shaped devices inserted into the uterus by a healthcare professional. They work by preventing fertilization or implantation.

Since all three options are recognized and effective methods of contraception used in family planning, the correct choice is "All of these".

Step 3: Final Answer:

Diaphragm, Condom, and Copper T/loop are all effective measures used in family planning.

Quick Tip

Contraceptive methods are broadly categorized into barrier methods (condoms, diaphragms), hormonal methods (pills, injections), IUDs (Copper T), and surgical methods (vasectomy, tubectomy). Be familiar with examples from each category.

59. What is the meaning of atavism ?

- (A) Inheritance of parental characteristics in progeny
- (B) No inheritance of parental characteristics in progeny
- (C) Inheritance of ancestral characteristics in progeny, which are not in parents
- (D) All of these

Correct Answer: (C) Inheritance of ancestral characteristics in progeny, which are not in parents

Solution:

Step 1: Understanding the Concept:

Atavism is a term used in evolutionary biology. It refers to the reappearance of a trait that was present in a distant ancestor but was lost in the organism's immediate ancestors.

Step 2: Detailed Explanation:

Atavism, also known as reversion, is the tendency to revert to an ancestral type. It is the reappearance of an ancestral trait in an organism after several generations of absence. These traits are often from evolutionary ancestors.

For example, the appearance of a tail in a human baby, or the appearance of hind limbs in snakes or whales. These traits are not present in the parents but were present in the distant evolutionary ancestors of the species.

Option (A) describes normal heredity. Option (B) is incorrect. Option (C) accurately describes atavism as the inheritance of ancestral traits that skip intermediate generations.

Step 3: Final Answer:

The meaning of atavism is the inheritance of ancestral characteristics in progeny, which are not present in the immediate parents.

Quick Tip

Think of atavism as a "throwback" trait. The gene for the trait was present but dormant or suppressed for many generations and has suddenly been re-expressed.

60. The genetic structure of an organism is called

- (A) Phenotype
- (B) Genotype
- (C) Heredity
- (D) Diversity

Correct Answer: (B) Genotype

Solution:

Step 1: Understanding the Concept:

This question asks for the correct genetic term for the complete set of genes that an organism possesses.

Step 2: Detailed Explanation:

- **Genotype:** This term refers to the genetic makeup of an organism. It describes the organism's complete set of heritable genes, or the alleles an individual has for a particular trait. For example, for the pea plant height trait, the genotype could be TT, Tt, or tt.
- **Phenotype:** This term refers to the observable physical or biochemical characteristics of an organism, as determined by both its genotype and environmental influences. For example, the phenotype for a pea plant with genotype TT or Tt is 'tall'.
- **Heredity:** This is the broader concept of the passing of genetic traits from parents to offspring.
- **Diversity:** This refers to the variation within a population or species.

Step 3: Final Answer:

The genetic structure of an organism is called its genotype.

Quick Tip

A simple way to remember: **Gen**otype is the **gen**etic code. **Phen**otype is the **ph**ysical appearance.

61. The evolution of organisms by natural selection is called

- (A) Mendelism
- (B) Lamarckism
- (C) Micro-development
- (D) Darwinism

Correct Answer: (D) Darwinism

Solution:

Step 1: Understanding the Concept:

The question asks for the name of the scientific theory that explains evolution primarily through the mechanism of natural selection.

Step 2: Detailed Explanation:

- **Darwinism:** This is the theory of biological evolution developed by Charles Darwin. Its central concept is **natural selection**, which states that organisms better adapted to their environment tend to survive and produce more offspring. Over generations, this process leads to the evolution of species.
- **Lamarckism:** Proposed by Jean-Baptiste Lamarck, this theory suggested that evolution occurred through the inheritance of acquired characteristics. For example, a giraffe stretching its neck would pass a longer neck to its offspring. This theory has been largely discredited.
- **Mendelism:** This refers to the principles of heredity (like the law of segregation and independent assortment) discovered by Gregor Mendel through his experiments with pea plants. It forms the basis of modern genetics but is not a theory of evolution itself, although it provides the mechanism for the variation on which natural selection acts.
- **Micro-development:** This is not a standard term for a theory of evolution.

Step 3: Final Answer:

The theory of evolution of organisms by natural selection is called Darwinism.

Quick Tip

Remember the key associations: Darwin → Natural Selection; Lamarck → Inheritance of Acquired Characteristics; Mendel → Laws of Inheritance (Genetics).

62. The chemical which shows biomagnification is

- (A) CFC
- (B) ADP
- (C) ATP
- (D) DDT

Correct Answer: (D) DDT

Solution:

Step 1: Understanding the Concept:

Biomagnification (or bioamplification) is the process by which the concentration of a toxin increases in the tissues of organisms at successively higher levels in a food chain. For a chemical to biomagnify, it must be long-lived, mobile, soluble in fats, and biologically active.

Step 2: Detailed Explanation:

- **DDT (Dichlorodiphenyltrichloroethane):** This is a synthetic pesticide. It is a persistent organic pollutant that is fat-soluble and breaks down very slowly. When it enters an ecosystem (e.g., a lake), it is absorbed by small organisms like plankton. Fish eat the plankton, and birds eat the fish. At each trophic level, the DDT accumulates in the fatty tissues, so its concentration becomes much higher in top predators. DDT is the classic textbook example of a chemical that shows biomagnification.
- **CFC (Chlorofluorocarbon):** These are chemicals known for causing ozone layer depletion. They do not typically biomagnify.
- **ADP (Adenosine Diphosphate) and ATP (Adenosine Triphosphate):** These are essential molecules for energy transfer within cells. They are part of normal metabolism and do not biomagnify.

Step 3: Final Answer:

DDT is a well-known chemical that shows biomagnification.

Quick Tip

When you see "biomagnification" in a question, the most likely answers will be pesticides like DDT or heavy metals like mercury. These substances are persistent and accumulate in food chains.

63. Primary consumers are called

- (A) Decomposer
- (B) Omnivorous
- (C) Carnivorous
- (D) Vegetarian

Correct Answer: (D) Vegetarian

Solution:

Step 1: Understanding the Concept:

In an ecosystem, organisms are classified into different trophic levels based on their feeding habits.

- **Producers:** Organisms that produce their own food, usually through photosynthesis (e.g., plants).
- **Primary Consumers:** Organisms that feed on producers. These are also known as herbivores.
- **Secondary Consumers:** Organisms that feed on primary consumers. These are carnivores or omnivores.
- **Tertiary Consumers:** Organisms that feed on secondary consumers.
- **Decomposers:** Organisms that break down dead organic matter (e.g., bacteria, fungi).

Step 2: Detailed Explanation:

Primary consumers are organisms that get their energy by eating plants (producers).

- A **carnivore** eats other animals.
- An **omnivore** eats both plants and animals.

- A **vegetarian** or **herbivore** is an organism that feeds on plants.

Therefore, primary consumers are vegetarians (herbivores).

Step 3: Final Answer:

Based on the definitions of trophic levels, primary consumers feed on plants and are thus called vegetarians or herbivores.

Quick Tip

Remember the flow of energy in a food chain: Producer → Primary Consumer (Herbivore) → Secondary Consumer (Carnivore/Omnivore).

64. CFC is widely used in

- (A) Jet engines
- (B) Refrigerators
- (C) Air conditioners
- (D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding the Concept:

CFC stands for Chlorofluorocarbon. These are synthetic compounds that were widely used in the 20th century due to their properties like being non-toxic, non-flammable, and chemically stable.

Step 2: Detailed Explanation:

The primary applications of CFCs were:

- **Refrigerants:** They were used as the cooling fluid in **refrigerators** and **air conditioners**.
- **Aerosol Propellants:** They were used in spray cans for products like deodorants and insecticides.
- **Foam Blowing Agents:** Used in the production of insulating foams.

Since CFCs are used in both refrigerators (B) and air conditioners (C), the option "All of these" is the most appropriate choice, as it encompasses both major uses. While not a primary use, some cleaning solvents containing CFCs might be used in the maintenance of complex machinery like jet engines, making (D) the most comprehensive answer.

Step 3: Final Answer:

CFCs were widely used as refrigerants in both refrigerators and air conditioners. Thus, "All of these" is the best fit.

Quick Tip

Remember that despite their usefulness, CFCs were phased out by the Montreal Protocol because they cause significant damage to the Earth's ozone layer.

65. If the focal length of the lens is f and power is P then

- (A) $f + P = 0.5$
- (B) $f \times P = 1$
- (C) $P + f = 1$
- (D) $P + f = 2$

Correct Answer: (B) $f \times P = 1$

Solution:

Step 1: Understanding the Concept:

The power (P) of a lens is a measure of its ability to converge or diverge light. It is defined as the reciprocal of its focal length (f).

Step 2: Key Formula or Approach:

The formula relating the power of a lens and its focal length is:

$$P = \frac{1}{f}$$

A crucial condition for this formula is that the focal length f must be measured in **meters (m)** for the power P to be in **diopeters (D)**.

Step 3: Detailed Explanation:

Starting with the formula $P = \frac{1}{f}$.

If we multiply both sides of the equation by f , we get:

$$\begin{aligned} P \times f &= \frac{1}{f} \times f \\ P \times f &= 1 \end{aligned}$$

This relationship holds true as long as the units are consistent (focal length in meters and power in diopters).

Step 4: Final Answer:

Therefore, the correct relationship between the focal length f and power P of a lens is $f \times P = 1$.

Quick Tip

Always remember the unit convention for the power of a lens formula. If the focal length is given in centimeters (cm), you must convert it to meters before calculating the power in diopters. The formula becomes $P(D) = \frac{100}{f(cm)}$.

66. Which part of camera acts like the retina of the eye ?

- (A) Aperture
- (B) Lens
- (C) Film
- (D) Shutter

Correct Answer: (C) Film

Solution:

Step 1: Understanding the Concept:

This question draws an analogy between the human eye and a camera, asking to identify the camera component that has the same function as the retina in the eye.

Step 2: Detailed Explanation:

Let's compare the parts:

- **Retina (Eye):** A light-sensitive layer at the back of the eye where the lens forms an image. It contains photoreceptor cells (rods and cones) that detect light and convert it into neural signals.
- **Film/Sensor (Camera):** A light-sensitive material (in traditional cameras) or an electronic sensor (in digital cameras) placed at the focal plane. It captures the image focused by the camera lens. This is the direct equivalent of the retina.
- **Lens (Eye vs. Camera):** Both have a lens to focus light and form an image. So, the camera lens is analogous to the eye's lens.

- **Aperture (Camera):** An adjustable opening that controls the amount of light entering the camera. It is analogous to the **pupil** in the eye.
- **Shutter (Camera):** A mechanism that controls the duration for which the film/sensor is exposed to light. It is analogous to the **eyelid**.

Step 3: Final Answer:

The film (or digital sensor) in a camera performs the same function as the retina in the eye, which is to capture the light image.

Quick Tip

To remember the analogies: Retina $\leftrightarrow$ Film/Sensor, Lens $\leftrightarrow$ Lens, Pupil $\leftrightarrow$ Aperture, Eyelid $\leftrightarrow$ Shutter.

67. For a healthy human eye, the near point and far point are respectively

- (A) 0 and infinity
- (B) 25 cm and 250 cm
- (C) 25 cm and infinity
- (D) 0 and 25 cm

Correct Answer: (C) 25 cm and infinity

Solution:

Step 1: Understanding the Concept:

The question asks for the standard values of the near point and far point for a normal, healthy human eye.

- **Near Point:** The closest distance at which an object can be seen clearly without any strain on the eye. This is also known as the least distance of distinct vision.
- **Far Point:** The farthest distance at which an object can be seen clearly.

Step 2: Detailed Explanation:

For a young adult with normal vision (emmetropia):

- The eye can focus on objects as close as approximately **25 cm**. If an object is brought closer than this, the image becomes blurry. So, the near point is 25 cm.

- The eye can see objects at a very large distance, theoretically up to **infinity**, without any strain. This is because when viewing a distant object, the ciliary muscles are relaxed, and the eye lens has its maximum focal length. So, the far point is infinity.

Step 3: Final Answer:

The near point for a healthy human eye is 25 cm, and the far point is infinity.

Quick Tip

Remember these standard values: Near Point = 25 cm, Far Point = Infinity. Defects of vision like myopia (nearsightedness) and hypermetropia (farsightedness) occur when these points shift from their normal positions.

68. To an astronaut standing on the moon, the sky appears to be

- (A) Red
- (B) Blue
- (C) Black
- (D) White

Correct Answer: (C) Black

Solution:

Step 1: Understanding the Concept:

The color of the sky as seen from a planet's surface depends on the presence and composition of an atmosphere. The color is a result of the scattering of sunlight by atmospheric particles.

Step 2: Detailed Explanation:

On Earth, the sky appears blue because the molecules in the atmosphere (mostly nitrogen and oxygen) are very small. They scatter shorter wavelengths of light (blue and violet) more effectively than longer wavelengths (red and orange). This phenomenon is called Rayleigh scattering.

The Moon, however, has no significant atmosphere. There are no particles to scatter the sunlight. In the absence of scattering, light from the sun travels in a straight line.

An astronaut on the Moon would see the sun as a very bright disc, but the rest of the sky, where there is no direct sunlight, would appear completely **black**, just like the void of outer space.

Step 3: Final Answer:

Since there is no atmosphere on the Moon to scatter sunlight, the sky appears black to an astronaut.

Quick Tip

Sky color is an atmospheric phenomenon. No atmosphere = No scattering = Black sky.
This is true for the Moon and for outer space in general.

69. The decreased accommodative ability of the eye causes

- (A) Farsightedness
- (B) Presbyopia
- (C) Nearsightedness
- (D) Colourblindness

Correct Answer: (B) Presbyopia

Solution:

Step 1: Understanding the Concept:

Accommodation is the ability of the eye lens to change its focal length to focus on objects at varying distances. This ability naturally decreases with age. The question asks for the name of the condition caused by this decrease.

Step 2: Detailed Explanation:

- **Presbyopia:** This is an age-related vision defect. As a person ages, the ciliary muscles weaken, and the eye lens gradually loses its flexibility. This reduces the eye's power of accommodation. As a result, the near point of the eye recedes, making it difficult to see nearby objects clearly. This is the direct result of decreased accommodative ability.
- **Farsightedness (Hypermetropia):** This can occur at any age and is typically caused by the eyeball being too short or the lens system having too little refractive power, causing the image of a nearby object to form behind the retina.
- **Nearsightedness (Myopia):** This can occur at any age and is typically caused by the eyeball being too long or the lens system having too much refractive power, causing the image of a distant object to form in front of the retina.
- **Colourblindness:** This is a genetic condition where the person is unable to distinguish between certain colors due to a defect in the cone cells of the retina. It is not related to accommodation.

Step 3: Final Answer:

The decreased accommodative ability of the eye, typically due to aging, causes Presbyopia.

Quick Tip

Associate "Presbyopia" with "old age". It's the reason why many older people need reading glasses. While its effect is similar to farsightedness, its cause (loss of accommodation) is distinct.

70. The unit of resistivity in a conductor is

- (A) $\Omega \text{ m}$
- (B) Ω/m
- (C) Ω^{-1}
- (D) None of these

Correct Answer: (A) $\Omega \text{ m}$

Solution:

Step 1: Understanding the Concept:

Resistivity (symbol ρ) is a fundamental property of a material that quantifies how strongly it resists the flow of electric current. It is different from resistance (R), which depends on the material's shape and size.

Step 2: Key Formula or Approach:

The resistance (R) of a conductor is related to its resistivity (ρ), length (L), and cross-sectional area (A) by the formula:

$$R = \rho \frac{L}{A}$$

Step 3: Detailed Explanation:

To find the unit of resistivity (ρ), we can rearrange the formula:

$$\rho = R \frac{A}{L}$$

Now, let's substitute the SI units for each quantity:

- Unit of Resistance (R) is Ohm (Ω).
- Unit of Area (A) is square meter (m^2).
- Unit of Length (L) is meter (m).

Substituting these into the rearranged formula:

$$\text{Unit of } \rho = \Omega \frac{\text{m}^2}{\text{m}} = \Omega \cdot \text{m}$$

The unit Ω^{-1} is the unit of conductance, Siemens (S).

Step 4: Final Answer:

The SI unit of resistivity is the Ohm-meter ($\Omega \text{ m}$).

Quick Tip

Don't confuse resistance and resistivity. Resistance is a property of an *object* (e.g., a wire), while resistivity is a property of the *material* the object is made of (e.g., copper).

71. How many calories are there in 1 joule ?

- (A) 0.23
- (B) 0.19
- (C) 0.21
- (D) 0.25

Correct Answer: (A) 0.23

Solution:

Step 1: Understanding the Concept:

Joules (J) and calories (cal) are both units of energy. The question asks for the conversion factor from joules to calories.

Step 2: Key Formula or Approach:

The standard conversion factor between calories and joules is:

$$1 \text{ calorie} \approx 4.184 \text{ joules}$$

To find how many calories are in 1 joule, we need to calculate the reciprocal of this value.

Step 3: Detailed Explanation:

$$1 \text{ joule} = \frac{1}{4.184} \text{ calories}$$

$$1 \text{ joule} \approx 0.2389 \text{ calories}$$

Rounding this value to two decimal places gives 0.24. However, looking at the options, 0.23 is the closest available answer. The exact value depends on the definition of the calorie being used (e.g., thermochemical calorie vs. 15°C calorie), but they are all very close to this value. The common approximation used is $1 \text{ J} \approx 0.24 \text{ cal}$ or sometimes rounded to 0.23.

Step 4: Final Answer:

Based on the standard conversion, 1 joule is approximately 0.239 calories. The closest option

is 0.23.

Quick Tip

Remember the approximate relationship: 1 calorie = 4.2 joules. This is easy to remember and useful for quick estimations in exams. From this, 1 joule = $1/4.2 \approx 0.24$ calories.

72. The filament in an electric bulb is made of which of the following metals?

- (A) Iron
- (B) Aluminium
- (C) Tungsten
- (D) Copper

Correct Answer: (C) Tungsten

Solution:

Step 1: Understanding the Concept:

An incandescent electric bulb works by heating a thin wire, called a filament, to a very high temperature until it glows brightly (incandescence). The material for the filament must have specific properties to withstand these conditions.

Step 2: Detailed Explanation:

The key properties required for a filament material are:

1. **High Melting Point:** The filament must be heated to over 2000°C to produce a significant amount of visible light. The material must not melt at these temperatures.
2. **High Resistivity:** High resistance is needed so that it heats up significantly when current passes through it (based on the heating effect of current, $H = I^2Rt$).
3. **Ductility:** The ability to be drawn into a thin wire.
4. **Low Rate of Evaporation:** To ensure a long life for the bulb.

Tungsten (W) is the metal of choice because it fits these criteria perfectly. It has an extremely high melting point (approximately 3422°C) and high resistivity. Iron, Aluminium, and Copper have much lower melting points and would melt quickly.

Step 3: Final Answer:

The filament in an electric bulb is made of Tungsten.

Quick Tip

Associate "bulb filament" with "Tungsten". Its very high melting point is the primary reason for its use. Also, the bulb is filled with an inert gas (like Argon or Nitrogen) to reduce the evaporation of the tungsten filament and increase its lifespan.

73. In which state is the Kalpakkam Nuclear Power Plant located ?

- (A) Karnataka
- (B) Tamil Nadu
- (C) Uttar Pradesh
- (D) Gujarat

Correct Answer: (B) Tamil Nadu

Solution:

Step 1: Understanding the Concept:

This is a general knowledge question about the locations of major nuclear power plants in India.

Step 2: Detailed Explanation:

The Kalpakkam Nuclear Power Plant, officially known as the Madras Atomic Power Station (MAPS), is located in Kalpakkam, which is situated on the coast of the Bay of Bengal in the state of **Tamil Nadu**. It is about 80 kilometers south of Chennai.

For reference, other major nuclear plants are:

- Kaiga Nuclear Power Plant is in Karnataka.
- Narora Atomic Power Station is in Uttar Pradesh.
- Kakrapar Atomic Power Station is in Gujarat.

Step 3: Final Answer:

The Kalpakkam Nuclear Power Plant is located in Tamil Nadu.

Quick Tip

It is useful to memorize the locations of India's major nuclear power stations as they are common questions in general knowledge sections. Key stations include Tarapur (Maharashtra), Rawatbhata (Rajasthan), Kalpakkam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat), and Kaiga (Karnataka).

74. The main component of domestic gas (LPG) is

- (A) Ethane
- (B) Propane
- (C) Butane
- (D) Methane

Correct Answer: (C) Butane

Solution:

Step 1: Understanding the Concept:

LPG stands for Liquefied Petroleum Gas. It is the fuel used in domestic gas cylinders for cooking and heating. It is a mixture of hydrocarbon gases.

Step 2: Detailed Explanation:

LPG is primarily a mixture of **propane** (C_3H_8) and **butane** (C_4H_{10}). The exact composition can vary depending on the source and the climate. However, butane is generally the major component in the mixture.

- **Methane** (CH_4): This is the main component of Natural Gas (CNG - Compressed Natural Gas) and biogas.
- **Ethane** (C_2H_6): A minor component of natural gas.

Therefore, among the given options, butane is considered the main component of LPG.

Step 3: Final Answer:

The main component of domestic gas (LPG) is Butane.

Quick Tip

Remember the difference: LPG is mainly Propane + Butane. CNG is mainly Methane. A foul-smelling substance like ethyl mercaptan is added to LPG to help detect leaks, as the fuel gases themselves are odorless.

75. The two non-renewable sources of energy are

- (A) Gobar gas and biomass
- (B) Coal and petroleum
- (C) Biomass and petroleum
- (D) None of these

Correct Answer: (B) Coal and petroleum

Solution:

Step 1: Understanding the Concept:

Energy sources are classified as renewable or non-renewable.

- **Renewable sources** can be replenished naturally in a short period (e.g., solar, wind, biomass).
- **Non-renewable sources** are finite and formed over millions of years, so they cannot be replenished on a human timescale (e.g., fossil fuels).

Step 2: Detailed Explanation:

Let's analyze the options:

- **Gobar gas and biomass:** Both are derived from organic matter and are considered renewable.
- **Coal and petroleum:** Both are fossil fuels, formed from the remains of ancient organisms over millions of years. They are non-renewable.
- **Biomass and petroleum:** Biomass is renewable, while petroleum is non-renewable.

The question asks for a pair of non-renewable sources.

Step 3: Final Answer:

Coal and petroleum are both non-renewable sources of energy.

Quick Tip

All fossil fuels—coal, petroleum (oil), and natural gas—are non-renewable. Most energy sources derived from plants or animal waste (biomass, gobar gas) are renewable.

76. Which type of reaction is respiration ?

- (A) Combination
- (B) Reduction
- (C) Endothermic
- (D) Oxidation

Correct Answer: (D) Oxidation

Solution:

Step 1: Understanding the Concept:

Cellular respiration is the metabolic process by which organisms obtain energy from food (like

glucose). The overall chemical reaction is:



Step 2: Detailed Explanation:

Let's analyze the reaction type:

- In this process, glucose ($C_6H_{12}O_6$) reacts with oxygen and is broken down into carbon dioxide. This breakdown by reaction with oxygen is a form of **oxidation**.
- Since energy is released during this process, it is an **exothermic** reaction, not endothermic (which absorbs heat).
- It is not a combination reaction, as one complex reactant breaks down. It is a type of combustion reaction.
- While it is a redox reaction (oxygen is reduced), the primary process concerning the fuel (glucose) is oxidation.

Given the options, oxidation is the most accurate description of what happens to the food molecule to release energy.

Step 3: Final Answer:

Respiration is a type of oxidation reaction.

Quick Tip

Remember that respiration is an exothermic process because it releases energy. It is also considered an oxidation process because food molecules are broken down using oxygen.

77. Compounds formed by transfer of electrons are called

- (A) Organic
- (B) Covalent
- (C) Electrovalent
- (D) None of these

Correct Answer: (C) Electrovalent

Solution:

Step 1: Understanding the Concept:

This question is about the types of chemical bonds formed between atoms. The nature of the bond depends on how the valence electrons of the atoms interact.

Step 2: Detailed Explanation:

- **Covalent Compounds:** Formed when atoms **share** electrons to achieve a stable electron configuration. This typically occurs between non-metal atoms.
- **Electrovalent Compounds (or Ionic Compounds):** Formed when there is a complete **transfer** of one or more electrons from one atom (typically a metal) to another (typically a non-metal). This transfer results in the formation of charged ions (a cation and an anion) that are held together by strong electrostatic forces of attraction.

Since the question specifies the formation is by "transfer of electrons," the resulting compounds are electrovalent.

Step 3: Final Answer:

Compounds formed by the transfer of electrons are called electrovalent compounds.

Quick Tip

Associate "transfer" with "ions" and therefore "ionic bond". The term "electrovalent" is another name for "ionic". Associate "sharing" with "covalent bond".

78. Which of the following reactions is an example of decomposition reaction ?

- (A) $H_2 + I_2 \rightarrow 2HI$
 (B) $NH_4CNO \rightarrow H_2NCONH_2$
 (C) $NaOH + HCl \rightarrow NaCl + H_2O$
 (D) $2KClO_3 \rightarrow 2KCl + 3O_2$

Correct Answer: (D) $2KClO_3 \rightarrow 2KCl + 3O_2$

Solution:

Step 1: Understanding the Concept:

A decomposition reaction is a type of chemical reaction in which a single compound breaks down into two or more simpler substances. The general form is $AB \rightarrow A + B$.

Step 2: Detailed Explanation:

Let's analyze the given reaction options:

- **(A) $H_2 + I_2 \rightarrow 2HI$:** This is a **combination reaction**, where two reactants combine to form a single product.
- **(B) $NH_4CNO \rightarrow H_2NCONH_2$:** This is a **rearrangement or isomerization reaction**, where the atoms of a single compound are rearranged to form a new compound.
- **(C) $NaOH + HCl \rightarrow NaCl + H_2O$:** This is a **neutralization reaction** (a type of double displacement reaction), where an acid and a base react to form salt and water.

- **(D) $2KClO_3 \rightarrow 2KCl + 3O_2$:** This is a **decomposition reaction**, where a single reactant, potassium chlorate ($KClO_3$), breaks down into two simpler products, potassium chloride (KCl) and oxygen (O_2).

Step 3: Final Answer:

The reaction $2KClO_3 \rightarrow 2KCl + 3O_2$ is an example of a decomposition reaction.

Quick Tip

To quickly identify a decomposition reaction, look for the equation that has only one chemical species on the reactant (left) side and multiple species on the product (right) side.

79. In which of the following is tartaric acid found ?

- (A) Orange
- (B) Tamarind
- (C) Tomato
- (D) Vinegar

Correct Answer: (B) Tamarind

Solution:

Step 1: Understanding the Concept:

This question tests the knowledge of naturally occurring acids found in common food items.

Step 2: Detailed Explanation:

- **Orange:** Like other citrus fruits, oranges are rich in **citric acid**.
- **Tamarind:** Tamarind has a distinct sour taste due to the presence of **tartaric acid**. Grapes are also a good source of tartaric acid.
- **Tomato:** Tomatoes contain several acids, primarily **oxalic acid** and citric acid.
- **Vinegar:** Vinegar is a dilute solution of **acetic acid**.

Step 3: Final Answer:

Tartaric acid is found in tamarind.

Quick Tip

It is helpful to memorize a list of common acids and their natural sources: Acetic acid (Vinegar), Citric acid (Citrus fruits), Lactic acid (Sour milk/Curd), Oxalic acid (Tomatoes, Spinach), Tartaric acid (Tamarind, Grapes), Formic acid (Ant sting).

80. What is the chemical name of slaked lime ?

- (A) Calcium oxychloride
- (B) Calcium chloride
- (C) Calcium oxide
- (D) Calcium hydroxide

Correct Answer: (D) Calcium hydroxide

Solution:

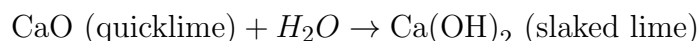
Step 1: Understanding the Concept:

This question asks for the systematic chemical name corresponding to the common name "slaked lime".

Step 2: Detailed Explanation:

Let's identify the compounds:

- **Calcium oxide (CaO):** Its common name is quicklime.
- When quicklime reacts with water, it forms slaked lime. The process is called slaking.



- The chemical name for the compound $Ca(OH)_2$ is **Calcium hydroxide**.
- **Calcium oxychloride ($CaOCl_2$):** This is bleaching powder.
- **Calcium chloride ($CaCl_2$):** This is a salt.

Step 3: Final Answer:

The chemical name of slaked lime is Calcium hydroxide.

Quick Tip

Remember the "lime" family: Limestone = Calcium Carbonate ($CaCO_3$); Quicklime = Calcium Oxide (CaO); Slaked Lime = Calcium Hydroxide ($Ca(OH)_2$).

Section - B

Physics

1. Why do planets not twinkle ? Explain.

Solution:

The reason planets do not twinkle is due to their proximity to Earth compared to stars.

1. **Stars as Point Sources:** Stars are extremely far from Earth, so they appear as single point sources of light. As starlight enters the Earth's atmosphere, it is continuously refracted (bent) by the different layers of air which have varying densities and temperatures. This atmospheric turbulence causes the light path to shift randomly, making the star's apparent position and brightness fluctuate. This fluctuation is perceived as twinkling.
2. **Planets as Extended Sources:** Planets, being much closer to Earth, appear as extended sources of light, essentially a collection of many point sources.
3. **Averaging Effect:** While the light from each individual point on the planet's surface also twinkles, the effects from all the points average out. A momentary increase in brightness from one point is cancelled out by a decrease in brightness from another point.
4. **Conclusion:** This nullification of the twinkling effect from numerous points results in the planet appearing to shine with a steady, constant light.

Quick Tip

For exams, the key distinction to remember is: Stars appear as **point sources**, so their light is easily affected by atmospheric refraction, causing twinkling. Planets appear as **extended sources** (collections of points), so the twinkling effect from different points averages out, leading to a steady glow.

2. What is called absolute refractive index ?**Solution:**

The absolute refractive index of a medium is a measure of how much the speed of light is reduced inside that medium compared to its speed in a vacuum.

- **Definition:** It is defined as the ratio of the speed of light in a vacuum (c) to the speed of light in the given medium (v).
- **Formula:** The absolute refractive index (n) is given by the formula:

$$n = \frac{\text{Speed of light in vacuum } (c)}{\text{Speed of light in medium } (v)}$$

- **Properties:**

- It is a dimensionless quantity as it is a ratio of two similar quantities.
- Since the speed of light is maximum in a vacuum, the absolute refractive index of any medium is always greater than or equal to 1. It is exactly 1 for a vacuum.

Quick Tip

Remember that the term "absolute" signifies that the reference medium is a vacuum. If the reference is any other medium, it's called the "relative refractive index". The formula $n = c/v$ and the fact that $n \geq 1$ are crucial points to recall.

3. What is farsightedness ?

Solution:

Farsightedness, also known by its medical term hypermetropia, is a common defect of vision.

- **Definition:** It is a condition in which a person can see distant objects clearly but finds it difficult to see nearby objects distinctly. The near point of a farsighted eye is farther away than the normal near point (25 cm).
- **Causes:** This defect arises due to one of two reasons:
 1. The focal length of the eye lens is too long.
 2. The eyeball has become too short.
- **Effect:** Due to these causes, the light rays from a nearby object are focused at a point behind the retina, not on the retina itself, resulting in a blurred image.
- **Correction:** Farsightedness is corrected by using spectacles with a **convex lens** of a suitable focal length. The convex lens provides the additional converging power required to form the image on the retina.

Quick Tip

A simple mnemonic: Farsightedness (Hypermetropia) means you can see **FAR** objects clearly. The correction is a **CONVEX** lens. In contrast, Nearsightedness (Myopia) means you can see **NEAR** objects clearly, and the correction is a **CONCAVE** lens.

4. What do you understand by electromagnetic induction ?

Solution:

Electromagnetic induction is a fundamental principle of electromagnetism discovered by Michael Faraday in 1831.

- **Definition:** It is the phenomenon of producing an induced electromotive force (e.m.f.), and hence an electric current, in a closed electrical circuit by changing the magnetic field (or magnetic flux) linked with the circuit.
- **Methods of Induction:** A current can be induced in a coil by:
 1. Moving the coil in a stationary magnetic field.
 2. Moving a magnet relative to a stationary coil.
 3. Changing the magnetic field around a stationary coil (e.g., by changing the current in a nearby coil).
- **Principle:** The core idea is that a changing magnetic environment creates an electric field, which drives the current. The magnitude of the induced e.m.f. is proportional to the rate of change of magnetic flux (Faraday's Law of Induction).
- **Applications:** This principle is the basis for the operation of electric generators, dynamos, transformers, and induction motors.

Quick Tip

The key phrase for electromagnetic induction is "changing magnetic field". A stationary magnet near a stationary coil will not induce any current. There must be relative motion or a change in the field's strength. This principle is how almost all commercial electricity is generated.

5. Why is inert gas filled in electric bulb ?**Solution:**

An inert gas, such as argon or nitrogen, is filled in an incandescent electric bulb to increase its lifespan and efficiency.

1. **Function of the Filament:** The bulb produces light when its filament, made of tungsten, is heated to a very high temperature (around 2500°C) by the electric current.
2. **Problem with Vacuum:** If the bulb were a vacuum, the hot tungsten filament would evaporate (a process called sublimation) at these high temperatures. This would thin the filament, causing it to break quickly, and also deposit a black layer on the inside of the

glass, reducing the light output.

3. **Problem with Air:** If the bulb were filled with air, the oxygen in the air would cause the hot tungsten filament to oxidize rapidly and burn out almost instantly.
4. **Solution with Inert Gas:** To overcome these problems, the bulb is filled with a chemically unreactive (inert) gas. The pressure of the inert gas suppresses the evaporation of the tungsten filament, allowing it to be heated to a higher temperature for brighter light and significantly increasing its operational life.

Quick Tip

Remember the two main reasons for using inert gas: 1. To prevent the filament from burning out (oxidation) which would happen in air. 2. To reduce the evaporation (sublimation) of the filament which would happen in a vacuum. Both effects extend the bulb's life.

6. What do you understand by potential difference ?

Solution:

Potential difference is a fundamental concept in electricity that describes the driving force for electric current.

- **Definition:** The electric potential difference between two points in an electric circuit is defined as the amount of work done to move a unit positive charge from one point to the other.
- **Formula:** It is represented by the symbol V and is calculated as:

$$V = \frac{W}{Q}$$

where W is the work done (in Joules) and Q is the magnitude of the charge (in Coulombs).

- **Unit:** The SI unit of potential difference is the **volt (V)**. One volt is defined as the potential difference between two points when one joule of work is done to move a charge of one coulomb between them.
- **Analogy:** It is analogous to pressure difference in a water pipe. Just as a pressure difference is needed for water to flow, a potential difference is needed for electric charge (current) to flow.

- **Measurement:** It is measured using an instrument called a **voltmeter**, which is always connected in parallel across the two points where the potential difference is to be measured.

Quick Tip

Think of potential difference as "electrical pressure". The formula $V = W/Q$, the unit "volt", and the measurement device "voltmeter" (connected in parallel) are key points to remember for exams.

7. What is called the best source of energy ?

Solution:

There is no single "best" source of energy, as the ideal choice depends on factors like geographical location, intended use, and economic conditions. However, a good or ideal source of energy is one that possesses most of the following characteristics:

1. **High Energy Output (Calorific Value):** It should produce a large amount of useful energy per unit mass or volume.
2. **Availability and Accessibility:** It should be readily available in sufficient quantities and easy to obtain.
3. **Economic Feasibility:** It should be inexpensive to harness and use.
4. **Safety and Convenience:** It should be safe to handle, store, and transport without excessive risk.
5. **Low Environmental Impact:** It should cause minimal pollution and damage to the environment. It should be clean and sustainable.

In the modern context, sources like **solar energy** are often cited as one of the best sources because they are renewable, abundant, and have a very low environmental impact during operation, increasingly satisfying the criteria above.

Quick Tip

For exam questions asking about the characteristics of an ideal fuel or energy source, remember these keywords: high calorific value, low cost, easy availability, safe to use, and eco-friendly.

8. What is dynamo ? What is its use ?

Solution:

What is a Dynamo?

A dynamo is an electrical machine that converts mechanical energy into electrical energy. Specifically, the term "dynamo" is historically and technically used for a generator that produces **direct current (DC)**.

It consists of a rotating coil of wire (armature) placed in a magnetic field and a commutator, which is a key component that reverses the direction of the current to produce DC instead of alternating current (AC).

What is its use?

- **Primary Use:** The fundamental use of a dynamo is to generate direct current electricity from mechanical rotation.
- **Historical Significance:** Dynamos were the first electric generators capable of delivering power for industry. They were crucial in the early days of electricity for powering factories, charging batteries, and for electroplating.
- **Modern Applications:** While AC generators (alternators) are more common for large-scale power generation, small dynamos are still used in applications like bicycle lights (bottle dynamo) and hand-cranked chargers for electronic devices, where a simple DC output is required.

Quick Tip

Remember the key distinction: Dynamo = DC Generator. The component that makes it produce DC is the **split-ring commutator**. An AC generator (alternator) uses slip rings instead.

9. What are defects of vision ? What are their types ? How are the defects resolved ?

Solution:

Defects of Vision

Defects of vision are conditions where the eye loses its ability to focus light correctly on the retina, leading to blurred or impaired vision.

Types of Defects and their Resolution

The three common refractive defects of vision are:

1. Myopia (Nearsightedness):

- **Condition:** A person can see nearby objects clearly but cannot see distant objects distinctly. The image of a distant object is formed in front of the retina.
- **Resolution:** This defect is corrected by using a **concave lens** of a suitable power. The concave lens diverges the light rays before they enter the eye, allowing the eye lens to focus them correctly on the retina.

2. Hypermetropia (Farsightedness):

- **Condition:** A person can see distant objects clearly but finds it difficult to see nearby objects. The image of a nearby object is formed behind the retina.
- **Resolution:** This defect is corrected by using a **convex lens** of a suitable power. The convex lens converges the light rays, providing the additional focusing power needed to form the image on the retina.

3. Presbyopia:

- **Condition:** This is an age-related defect where the eye's power of accommodation decreases. It becomes difficult to see nearby objects comfortably and distinctly.
- **Resolution:** It is corrected using a **convex lens** for near vision. Sometimes, a person may suffer from both myopia and hypermetropia, in which case **bifocal lenses** (containing both concave and convex parts) are used.

Quick Tip

For quick recall, create a table:

- **Myopia:** Sees NEAR, Image IN FRONT of retina, Corrected by CONCAVE lens.
- **Hypermetropia:** Sees FAR, Image BEHIND retina, Corrected by CONVEX lens.
- **Presbyopia:** AGE-related, problem with NEAR vision, Corrected by CONVEX/BIFOCAL lens.

10. Describe the structure and working method of a biogas plant.

Solution:

Structure of a Biogas Plant

A typical fixed-dome type biogas plant consists of the following parts:

1. **Mixing Tank:** Located above ground level, this is where the raw organic material (like cow dung, called feedstock) is mixed with water to form a slurry.
2. **Inlet Chamber:** A pipe or chamber that feeds the prepared slurry into the main tank.

3. **Digester Tank:** A large, underground, sealed tank made of bricks and cement. It is where the anaerobic decomposition of the slurry takes place. It is built underground to maintain a relatively constant temperature.
4. **Gas Holder (Dome):** The digester is covered by a dome-shaped roof which acts as a gas holder where the produced biogas collects.
5. **Outlet Chamber and Overflow Tank:** The spent slurry flows into the outlet chamber and then to an overflow tank for collection.
6. **Gas Outlet Pipe:** A pipe with a valve on top of the dome to supply the biogas for use.

Working Method

1. **Slurry Preparation:** The feedstock (e.g., cow dung) is mixed with an equal quantity of water in the mixing tank.
2. **Feeding the Digester:** This slurry is fed into the digester tank through the inlet chamber until the tank is filled to the required level.
3. **Anaerobic Digestion:** Inside the airtight digester, in the absence of oxygen, anaerobic microorganisms decompose the complex organic compounds present in the slurry. This process takes 40-60 days to complete and releases a mixture of gases.
4. **Gas Collection:** The produced gas, known as biogas, is mainly a mixture of methane (CH_4) and carbon dioxide (CO_2). Being lighter than the slurry, it collects in the dome. As more gas is produced, it exerts pressure on the slurry.
5. **Gas Supply:** The collected biogas can be drawn through the gas outlet pipe and used as a fuel for cooking and lighting.
6. **Manure Removal:** The pressure of the gas forces the spent slurry into the outlet chamber and then to the overflow tank. This spent slurry is a nutrient-rich manure that can be used as fertilizer for crops.

Quick Tip

Remember the key inputs and outputs: The input is a slurry of organic waste (like cow dung) and water. The process is **anaerobic digestion**. The main outputs are **biogas** (primarily methane) used as fuel, and a nutrient-rich **slurry** used as fertilizer.

Chemistry

11. Write three information obtained from chemical equation.

Solution:

A balanced chemical equation provides several pieces of crucial information, both qualitative and quantitative. Three key pieces of information are:

1. **Reactants and Products:** The equation identifies the substances that are consumed in the reaction (the **reactants**, written on the left side) and the substances that are formed (the **products**, written on the right side). For example, in $2H_2 + O_2 \rightarrow 2H_2O$, we know hydrogen and oxygen are reactants, and water is the product.
2. **Stoichiometric Relationship (Mole Ratio):** The coefficients in front of the chemical formulas in a balanced equation represent the mole ratio in which reactants combine and products are formed. In $2H_2 + O_2 \rightarrow 2H_2O$, the equation tells us that 2 moles of hydrogen gas react with 1 mole of oxygen gas to produce 2 moles of water. This allows for quantitative calculations.
3. **Physical States:** The physical state of each substance can be indicated by symbols in parentheses. These symbols are (s) for solid, (l) for liquid, (g) for gas, and (aq) for an aqueous solution (dissolved in water). For example, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ tells us that solid calcium carbonate decomposes into solid calcium oxide and carbon dioxide gas.

Quick Tip

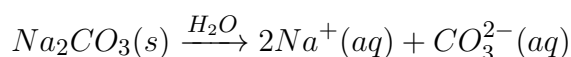
To easily remember the information from a chemical equation, use the acronym **RPS**: **R**ectants & **P**roducts, **P**roportions (mole ratios/stoichiometry), and **S**tates of matter. Sometimes, reaction conditions (like temperature, pressure, catalyst) are also written above or below the arrow.

12. Why is an aqueous solution of sodium carbonate alkaline ?

Solution:

An aqueous solution of sodium carbonate (Na_2CO_3) is alkaline (basic) due to the phenomenon of salt hydrolysis.

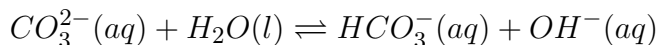
1. **Nature of the Salt:** Sodium carbonate is a salt formed from the reaction of a **strong base**, Sodium Hydroxide ($NaOH$), and a **weak acid**, Carbonic Acid (H_2CO_3).
2. **Dissociation in Water:** When Na_2CO_3 is dissolved in water, it completely dissociates into its constituent ions:



3. **Hydrolysis of Ions:** The resulting ions interact with water:
 - The sodium ion (Na^+) is the conjugate acid of a strong base ($NaOH$). It is a spectator ion and does not react with water.

- The carbonate ion (CO_3^{2-}) is the conjugate base of a weak acid (H_2CO_3). It is strong enough to accept a proton from a water molecule, leading to hydrolysis.

4. **Production of OH^- Ions:** The reaction of the carbonate ion with water is as follows:



This reaction produces an excess of hydroxide ions (OH^-) in the solution.

5. **Conclusion:** An increase in the concentration of hydroxide ions makes the solution alkaline, resulting in a pH greater than 7.

Quick Tip

A simple rule for salt hydrolysis: The "stronger" parent dictates the nature of the solution. For Na_2CO_3 , the parent base ($NaOH$) is strong and the parent acid (H_2CO_3) is weak. The strong base wins, making the solution basic (alkaline).

13. What is an indicator ? Write the name of an indicator.

Solution:

What is an indicator?

An indicator is a chemical substance that undergoes a distinct, observable change (usually a color change) when the conditions of its solution change. In the context of acid-base chemistry, an acid-base indicator is a substance that changes color depending on the pH of the solution it is in. It is used to visually determine whether a solution is acidic, basic, or neutral.

Name of an indicator:

A common and simple indicator is **Litmus**.

- **In an acidic solution (pH < 7):** Litmus turns **red**.
- **In a basic solution (pH > 7):** Litmus turns **blue**.
- **In a neutral solution (pH = 7):** It remains purple (the color of the extract).

Other examples include Phenolphthalein, Methyl Orange, and Turmeric.

Quick Tip

For exams, it's crucial to know the color changes for key indicators. A quick summary:

- **Litmus:** Red in Acid, Blue in Base (Remember **BAR**: Blue, Acid, Red).
- **Phenolphthalein:** Colourless in Acid, Pink in Base.
- **Methyl Orange:** Red in Acid, Yellow in Base.

14. What is the difference between an atom and an ion ?

Solution:

The main difference between an atom and an ion lies in their electrical charge, which is determined by the balance between their protons and electrons.

Atom	Ion
An atom is the smallest particle of an element that retains the chemical properties of that element.	An ion is an atom (or molecule) that has gained or lost one or more electrons.
It is electrically neutral . The number of positive protons equals the number of negative electrons.	It is electrically charged . The number of protons is not equal to the number of electrons.
It may or may not have a complete outer electron shell. Most atoms (except noble gases) are chemically reactive.	It has a complete (stable) outer electron shell, making it more stable than its parent atom.
Example: A sodium atom (Na) has 11 protons and 11 electrons.	Example: A sodium ion (Na^+) is formed when a sodium atom loses one electron. It has 11 protons and 10 electrons, giving it a +1 charge.

Quick Tip

The key difference is the **charge**. Atom = Neutral (Protons = Electrons). Ion = Charged (Protons $\neq$ Electrons). Remember: **Cations** are **p**awsitive (formed by losing electrons), and **anions** are **n**egative (formed by gaining electrons).

15. Define ores.

Solution:

Ores are naturally occurring rocks or minerals from which one or more valuable metals can be extracted economically and conveniently.

The key points in this definition are:

- **Natural Occurrence:** Ores are found in the Earth's crust as minerals.
- **High Concentration:** For a mineral to be considered an ore, it must contain a sufficiently high percentage of the desired metal.
- **Economic Viability:** The extraction of the metal from the ore must be profitable. If the cost of extraction is higher than the value of the metal obtained, the mineral is not considered an ore.

In essence, all ores are minerals, but not all minerals are ores.

Examples: Bauxite ($Al_2O_3 \cdot 2H_2O$) is the primary ore of aluminum. Hematite (Fe_2O_3) is an important ore of iron.

Quick Tip

The two most important keywords in the definition of an ore are "mineral" and "profitably" (or "economically"). An ore is a mineral from which a metal can be extracted profitably. This distinction is often tested.

16. Why have detergents replaced soap ?

Solution:

Detergents have largely replaced soaps for cleaning purposes, especially for laundry, primarily because of their superior performance in hard water.

1. Effectiveness in Hard Water:

- **Soaps:** Hard water contains dissolved calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions. Soaps react with these ions to form an insoluble, sticky precipitate called scum. This scum reduces the cleaning ability of the soap and leaves a deposit on fabrics.
- **Detergents:** Detergents are synthetic cleaning agents whose calcium and magnesium salts are soluble in water. Therefore, detergents do not form scum in hard water and maintain their cleansing action.

2. Effectiveness in Acidic Water:

Soaps are salts of weak acids (fatty acids) and can be decomposed by acidic water, reducing their effectiveness. Detergents are generally salts of strong acids and are not affected by the acidity of water.

3. Stronger Cleansing Action:

Detergents can be formulated to have a stronger cleansing action than soaps, making them more effective for a wider range of stains and fabrics.

Due to these advantages, particularly their effectiveness in hard water, detergents are more widely used than soaps.

Quick Tip

The number one reason to remember is **hard water**. Soaps form scum in hard water, while detergents do not. This makes detergents much more effective for general cleaning and laundry.

17. What are fossil fuels ?

Solution:

Fossil fuels are natural, combustible materials formed from the geological deposits of the remains of living organisms that died millions of years ago.

- **Formation:** They are formed from the anaerobic decomposition of buried dead organisms (plants and animals). Over millions of years, intense heat and pressure from the layers of rock and sediment above converted this organic matter into fuel.
- **Types:** The three main types of fossil fuels are:
 1. **Coal:** A solid fuel formed primarily from the remains of land-based plants.
 2. **Petroleum (Crude Oil):** A liquid fuel formed from the remains of small marine organisms like algae and zooplankton.
 3. **Natural Gas:** A gaseous fuel (mainly methane) formed under similar conditions as petroleum, often found alongside it.
- **Properties:** They are non-renewable energy sources because they take millions of years to form and are being consumed at a much faster rate. They have a high carbon content and high calorific value, making them an efficient source of energy. Their combustion, however, releases greenhouse gases and other pollutants.

Quick Tip

Remember the three main types: **Coal (solid)**, **Petroleum (liquid)**, and **Natural Gas (gas)**. They are all formed from ancient organic remains and are **non-renewable**. Their burning is a major source of air pollution and climate change.

18. What do you understand by short and long periods of periodic table ?

Solution:

The horizontal rows of the modern periodic table are called periods. They are classified as short, long, and very long based on the number of elements they contain, which relates to the

filling of electron shells.

- **Short Periods:**

- **1st Period:** Contains only 2 elements (Hydrogen, Helium). It is the shortest period, corresponding to the filling of the first energy shell ($n=1$).
- **2nd and 3rd Periods:** Each contains 8 elements. These are also considered short periods. They correspond to the filling of the second ($n=2$) and third ($n=3$) energy shells, respectively.

- **Long Periods:**

- **4th and 5th Periods:** Each contains 18 elements. These are called long periods. This is because, in addition to the 's' and 'p' orbitals, the 'd' orbitals of the penultimate shell also start filling, which accommodates 10 additional elements (the transition metals).

- **Very Long Periods:**

- **6th and 7th Periods:** Each contains 32 elements. These are the longest periods. In these periods, the 'f' orbitals of the ante-penultimate (second to last) shell are also filled, accommodating 14 more elements (the lanthanides in period 6 and actinides in period 7), which are usually placed separately below the main table.

Quick Tip

To easily recall the number of elements per period, remember the sequence: **2, 8, 8, 18, 18, 32, 32**. This corresponds to periods 1 through 7. Periods 1-3 are short, 4-5 are long, and 6-7 are very long.

19. Differentiate between metals and non-metals on the basis of physical and chemical properties.

Solution:

Metals and non-metals can be differentiated based on the following properties:

Property	Metals	Non-Metals
Physical Properties		
Lustre	Have a shiny surface (metallic lustre).	Are dull (non-lustrous), except iodine.
Hardness	Generally hard (except sodium, potassium).	Generally soft (except diamond).
State	Exist as solids at room temperature (except mercury).	Exist as solids, liquids, or gases.
Malleability	Can be beaten into thin sheets.	Are brittle and cannot be beaten into sheets.
Ductility	Can be drawn into thin wires.	Are non-ductile.
Conductivity	Good conductors of heat and electricity.	Poor conductors (except graphite).
Sonority	Produce a ringing sound when hit (sonorous).	Are not sonorous.
Chemical Properties		
Ion Formation	Tend to lose electrons to form positive ions (cations).	Tend to gain electrons to form negative ions (anions).
Nature of Oxides	Oxides are generally basic or amphoteric in nature.	Oxides are generally acidic or neutral in nature.
Reaction with Acids	Generally react with dilute acids to displace hydrogen gas.	Do not react with dilute acids to displace hydrogen.

Quick Tip

For exams, focus on the key distinguishing properties: Metals are lustrous, malleable, ductile, and good conductors, and they form basic oxides. Non-metals are the opposite. Also, remember the important exceptions: Mercury (liquid metal), Graphite (conductive non-metal), Iodine (lustrous non-metal), Diamond (hardest non-metal).

20. What is energy crisis ? Mention the measures to resolve it.

Solution:

What is Energy Crisis?

An energy crisis is a situation where the demand for energy outstrips the available supply, leading to a shortage. It can also refer to a steep rise in energy prices that affects the economy. This crisis is primarily caused by our heavy dependence on finite, non-renewable energy sources like fossil fuels (coal, petroleum, natural gas), which are depleting rapidly.

Measures to Resolve the Energy Crisis

The energy crisis can be resolved by a two-pronged approach: conserving existing resources and developing alternative ones.

1. **Conservation of Energy:** This involves reducing energy consumption and preventing its wastage.
 - Using energy-efficient appliances (e.g., LED bulbs, star-rated devices).
 - Switching off electrical appliances when not in use.
 - Promoting the use of public transport, carpooling, and cycling to save fuel.
 - Proper insulation of buildings to reduce heating and cooling needs.
2. **Increased Use of Renewable Energy Sources:** This involves shifting our dependence from fossil fuels to sustainable and non-polluting sources.
 - Harnessing **solar energy** using solar panels, solar cookers, and solar water heaters.
 - Utilizing **wind energy** to generate electricity through wind farms.
 - Generating electricity from **hydroelectric power plants**.
 - Using **biomass** (like gobar gas) and **geothermal energy**.
3. **Technological Advancement:** Developing new and more efficient technologies for energy generation and utilization. For example, improving the efficiency of engines and power plants.
4. **Public Awareness:** Educating the public about the importance of energy conservation and the benefits of renewable energy to encourage widespread adoption of sustainable practices.

Quick Tip

The solution to the energy crisis can be summarized in two main strategies: **1. Reduce Demand** (through conservation and efficiency) and **2. Switch Supply** (by transitioning from non-renewable fossil fuels to renewable sources like solar and wind).

Biology

21. Write the names of four organelles of a cell.

Solution:

Four major organelles of a cell are:

1. **Nucleus:** Often called the "control center" of the cell, the nucleus contains the cell's genetic material (DNA) and controls all the cell's activities, such as growth, metabolism, and reproduction.

2. **Mitochondria (singular: mitochondrion):** Known as the "powerhouse" of the cell, mitochondria are responsible for cellular respiration, a process that converts nutrients (like glucose) into energy in the form of ATP (adenosine triphosphate).
3. **Ribosomes:** These are small particles responsible for protein synthesis. They can be found floating freely in the cytoplasm or attached to the endoplasmic reticulum. They read the instructions from the nucleus to build proteins.
4. **Endoplasmic Reticulum (ER):** A network of membranes involved in protein and lipid synthesis. The Rough ER (studded with ribosomes) modifies proteins, while the Smooth ER synthesizes lipids and detoxifies the cell.

Quick Tip

To easily remember these, use simple analogies: Nucleus = Brain/CEO, Mitochondria = Power Plant, Ribosomes = Factories (making proteins), Endoplasmic Reticulum = Assembly Line.

22. Define respiration.

Solution:

Respiration is the biochemical process in which the cells of an organism obtain energy by combining oxygen and glucose, resulting in the release of carbon dioxide, water, and energy in the form of ATP.

It is a metabolic process that occurs in all living cells to release energy for various life processes. The overall chemical equation for aerobic respiration is:



It is important to distinguish this from breathing, which is the physical process of gas exchange (inhaling oxygen and exhaling carbon dioxide).

Quick Tip

Remember that "breathing" gets the oxygen in, but "respiration" is the chemical reaction inside your cells that actually uses the oxygen to get energy from food. It's an exothermic reaction because it releases energy.

23. What is the difference between xylem and phloem ?

Solution:

Xylem and phloem are the two types of vascular tissues in plants responsible for transport. The key differences are:

Feature	Xylem	Phloem
Function	Transports water and minerals from the roots to other parts of the plant.	Transports food (sugars) from the leaves to other parts of the plant.
Direction	Unidirectional (upwards only).	Bidirectional (up and down, from source to sink).
Components	Consists of tracheids, vessel elements, xylem parenchyma, and xylem fibres.	Consists of sieve tubes, companion cells, phloem parenchyma, and phloem fibres.
Nature of Tissue	Composed mostly of dead cells at maturity (tracheids and vessels).	Composed mostly of living cells (sieve tubes and companion cells).

Quick Tip

Use this mnemonic to remember their functions: 'Xylem' transports water, which starts with 'w', a letter close to 'x' in the alphabet. 'Phloem' transports food, which starts with 'f', phonetically similar to 'ph'.

24. What is excretion ? Write the names of its two main parts.**Solution:****What is excretion?**

Excretion is the biological process of removing harmful metabolic waste products from the body of an organism. These waste products, such as urea, uric acid, and carbon dioxide, are formed as a result of various chemical reactions occurring within the cells. It is essential for maintaining homeostasis (a stable internal environment).

Two main parts of the excretory system:

Assuming this refers to the human excretory system, two of its main parts are:

1. **Kidneys:** A pair of bean-shaped organs that are the primary excretory organs. They filter waste products from the blood and produce urine.
2. **Urinary Bladder:** A muscular sac that stores urine produced by the kidneys before it is eliminated from the body.

Quick Tip

Do not confuse excretion with egestion. **Excretion** is the removal of metabolic waste (e.g., urine). **Egestion** is the removal of undigested food (e.g., feces) from the digestive tract.

25. What is phototropism ?

Solution:

Phototropism is the directional growth of a plant, or part of a plant, in response to a light stimulus.

- It is a type of tropic movement, where the direction of the stimulus determines the direction of the response.
- **Positive Phototropism:** The growth of a plant part **towards** the light source. This is exhibited by the shoots and stems of plants, as it helps them maximize light absorption for photosynthesis.
- **Negative Phototropism:** The growth of a plant part **away** from the light source. This is exhibited by the roots of most plants.
- **Mechanism:** This response is mediated by the plant hormone **auxin**. Auxin accumulates on the shaded side of the stem, promoting cell elongation there. This differential growth causes the stem to bend towards the light.

Quick Tip

Break down the word to understand its meaning: **Photo-** means "light" and **-tropism** means "directional growth". So, phototropism is simply growth in response to light.

26. What is pollination ?

Solution:

Pollination is a crucial step in the sexual reproduction of flowering plants. It is defined as the process of transferring pollen grains from the male part of a flower (the anther) to the female part (the stigma).

There are two main types of pollination:

1. **Self-Pollination:** The transfer of pollen from the anther to the stigma of the same flower or another flower on the same plant.
2. **Cross-Pollination:** The transfer of pollen from the anther of a flower on one plant to the stigma of a flower on another plant of the same species.

This transfer is facilitated by agents such as wind, water, insects, birds, and other animals. After successful pollination, the process of fertilization can occur.

Quick Tip

Remember that pollination and fertilization are two different steps. Pollination is the **transfer** of pollen. Fertilization is the **fusion** of the male gamete (from the pollen) with the female gamete (the ovule). Pollination must happen before fertilization can take place.

27. How is DNA the basis of heredity ?

Solution:

DNA (Deoxyribonucleic acid) is the chemical basis of heredity in the following ways:

1. **Carrier of Genetic Information:** DNA is the molecule that carries the genetic instructions for the development, functioning, growth, and reproduction of all known organisms. This information is stored as a code in the sequence of its four nucleotide bases (Adenine, Guanine, Cytosine, Thymine).
2. **Genes and Traits:** A specific segment of DNA that codes for a particular protein or functional RNA molecule is called a gene. These proteins are responsible for expressing specific traits (e.g., eye color, height). Therefore, the traits of an organism are determined by its DNA.
3. **Accurate Replication:** DNA has the unique ability to make exact copies of itself through a process called replication. This ensures that when a cell divides, each new cell receives a complete and identical set of genetic instructions.
4. **Transmission to Offspring:** During sexual reproduction, each parent contributes half of their DNA to the offspring. This process ensures the transfer of genetic information from one generation to the next, which is the very definition of heredity.

Quick Tip

Think of DNA as a detailed "blueprint" for building and running an organism. A "gene" is a single instruction on that blueprint. This blueprint is copied and passed down from parents to children, which is why children inherit traits from their parents.

28. What are the harmful effects of aerosol chemicals ?

Solution:

Aerosol chemicals, particularly synthetic ones like chlorofluorocarbons (CFCs), have significant harmful effects on the environment and human health.

1. **Ozone Layer Depletion:** This is the most well-known harmful effect. When CFCs are released into the atmosphere, they rise to the stratosphere. There, ultraviolet (UV) radiation breaks them down, releasing chlorine atoms. These chlorine atoms act as catalysts, destroying thousands of ozone (O_3) molecules. The ozone layer protects the Earth from harmful UV radiation.
2. **Increased UV Radiation:** The depletion of the ozone layer allows more UV-B radiation to reach the Earth's surface. This can lead to:
 - **In Humans:** Increased risk of skin cancer, cataracts, and weakened immune systems.
 - **In Ecosystems:** Damage to phytoplankton (the base of the marine food web) and harm to plant life.
3. **Global Warming:** CFCs are also potent greenhouse gases. They trap heat in the atmosphere, contributing to the greenhouse effect and global warming.
4. **Air Pollution:** Some aerosol sprays release volatile organic compounds (VOCs) at ground level, which can contribute to the formation of smog and cause respiratory problems.

Quick Tip

For exams, the most critical harmful effect to associate with aerosol chemicals like CFCs is **Ozone Layer Depletion**. This is the primary reason for international agreements like the Montreal Protocol to phase them out.

29. What is photosynthesis ? Describe it with a suitable diagram.**Solution:****What is Photosynthesis?**

Photosynthesis is the process used by plants, algae, and some bacteria to convert light energy into chemical energy in the form of glucose (a sugar). This chemical energy is used to fuel the organism's activities. It is the foundation of nearly all life on Earth as it produces the oxygen we breathe and the food that consumers eat.

The overall balanced chemical equation for photosynthesis is:

**Description of the Process**

1. Plants take in carbon dioxide from the atmosphere through small pores in their leaves called stomata.
2. Water is absorbed from the soil through the roots and transported to the leaves via the xylem.
3. Inside the leaf cells, in organelles called chloroplasts, a green pigment called chlorophyll traps energy from sunlight.
4. This trapped light energy is used to split water molecules (photolysis) and combine the resulting components with carbon dioxide in a series of chemical reactions.
5. The final products are glucose, which the plant uses for energy and growth (and can store as starch), and oxygen, which is released into the atmosphere as a byproduct.

Diagram Description

(A simple diagram can be drawn to illustrate the process)

- Draw a simple plant with leaves, a stem, and roots in the soil.
- Draw the sun above the plant, with arrows representing **Sunlight** shining onto the leaves.
- Draw an arrow pointing into a leaf labeled " CO_2 **In**".
- Draw an arrow pointing out of a leaf labeled " O_2 **Out**".
- Draw arrows showing **Water** (H_2O) being absorbed by the roots and moving up the stem to the leaves.
- You can label a leaf to indicate that this process occurs in the chloroplasts containing chlorophyll.

Quick Tip

To remember the key components, think of photosynthesis as a recipe. The **ingredients** are carbon dioxide, water, and sunlight. The **special equipment** is chlorophyll. The **final dishes** are glucose (food) and oxygen (waste product).

30. Explain recycling of waste materials with examples.

Solution:

Explanation of Recycling

Recycling is the process of collecting waste materials, processing them, and turning them into new raw materials or products. Instead of being sent to a landfill, these materials are given a new life. Recycling is a key component of modern waste management and is the third "R" in the waste hierarchy: Reduce, Reuse, Recycle.

The process is crucial for several reasons:

- It conserves natural resources (like timber, water, and minerals).

- It saves energy, as making products from recycled materials often requires less energy than making them from new raw materials.
- It reduces the need for landfills and incinerators.
- It helps prevent air and water pollution by reducing the need to extract and process new raw materials.

Examples of Recycling

1. **Paper Recycling:** Waste paper (like old newspapers, magazines, and cardboard) is collected, cleaned, and processed into a pulp. This pulp is then used to manufacture new paper products such as newsprint, office paper, and cardboard boxes.
2. **Plastic Recycling:** Used plastic items (like PET bottles and milk jugs) are collected, sorted by type, cleaned, shredded, and then melted down. The resulting plastic pellets can be used to make new bottles, polyester fibres for clothing, carpets, or plastic lumber.
3. **Glass Recycling:** Waste glass containers are collected, sorted by color, crushed into small pieces called cullet, and then melted in a furnace to be molded into new glass bottles and jars.
4. **Metal Recycling:** Scrap metal, especially aluminum (from soda cans) and steel, is collected and melted down to produce new metal products. This saves a significant amount of energy compared to mining and processing virgin ore.

Quick Tip

When explaining recycling, always mention its benefits: **conserves resources**, **saves energy**, and **reduces pollution**. The easiest examples to remember are turning old paper into new paper, old plastic bottles into clothing, and old glass jars into new jars.