Mizoram Board Class 10 Science Question Paper with Solutions(Memory Based)

Time Allowed :3 Hour	**Maximum Marks :**70	**Total Questions :**24

General Instructions

Read the following instructions very carefully and strictly follow them:

- Answers to this Paper must be written on the paper provided separately.

- You will not be allowed to write during the first 15 minutes

- This time is to be spent in reading the question paper.

- The time given at the head of this Paper is the time allowed for writing the answers,

- The paper has four Sections.

- Section A is compulsory - All questions in Section A must be answered.

- You must attempt one question from each of the Sections B, C and D and one other question from any Section of your choice.

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1. State the Laws of Reflection and Laws of Refraction of light.

Solution:
Concept: Light is a form of energy that travels in the form of waves. When light encounters the boundary between two media, it may be reflected or refracted. The behavior of light during reflection and refraction follows specific laws known as the **laws of reflection** and the **laws of refraction (Snell's law)**.
Step 1: Laws of Reflection of Light.
Reflection of light occurs when a ray of light strikes a surface and bounces back into the same medium.
The laws of reflection are:

- **First Law:** The incident ray, the reflected ray, and the normal at the point of incidence all lie in the same plane.

- **Second Law:** The angle of incidence is equal to the angle of reflection.

Mathematically,

$$\angle i = \angle r$$

where i is the angle of incidence and r is the angle of reflection.

Step 2: Laws of Refraction of Light.
Refraction of light occurs when a ray of light passes from one transparent medium to another and changes its direction due to a change in speed.
The laws of refraction are:

- **First Law:** The incident ray, the refracted ray, and the normal at the point of incidence lie in the same plane.

- **Second Law (Snell's Law):** For a given pair of media, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant.

Mathematically,

$$\frac{\sin i}{\sin r} = \text{constant}$$

This constant is known as the **refractive index** of the second medium with respect to the first medium.

> **Quick Tip**
>
> Reflection follows the rule $i = r$, while refraction follows Snell's law $\frac{\sin i}{\sin r} = \text{constant}$, which determines how light bends when it passes between two media.

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2. Define Power of a Lens and state its S.I. unit.

Solution:
Concept: The ability of a lens to bend or converge/diverge light rays is known as the **power of the lens**. It indicates how strongly a lens can converge or diverge light. Power of a lens depends on its focal length; a lens with a smaller focal length has greater power.
Step 1: Definition of Power of a Lens.
The **power of a lens** is defined as the reciprocal of its focal length (in metres).
Mathematically,

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

where,

- P = Power of the lens

- f = Focal length of the lens (in metres)

If the focal length is small, the lens bends light more strongly and therefore has greater power.

Step 2: S.I. Unit of Power of a Lens.
The S.I. unit of power of a lens is **Dioptre (D)**.

$$1 \text{ Dioptre} = 1 \text{ m}^{-1}$$

Thus, a lens having a focal length of 1 metre has a power of 1 dioptre.

- Convex lenses have **positive power**.

- Concave lenses have **negative power**.

> **Quick Tip**
>
> Power of a lens is the reciprocal of its focal length: $P = \frac{1}{f}$. The S.I. unit of power is **Dioptre (D)**, where $1D = 1\,m^{-1}$.

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3. Explain Myopia and Hypermetropia with their causes and correction methods.

Solution:
Concept: Defects of vision occur when the eye is unable to focus light properly on the retina. Two common defects of vision are **Myopia (short-sightedness)** and **Hypermetropia (long-sightedness)**. These defects arise due to changes in the shape of the eyeball or the focal length of the eye lens and can be corrected using suitable lenses.
Step 1: Myopia (Short-sightedness).
Myopia is a defect of vision in which a person can see **near objects clearly** but **distant objects appear blurred**.
Cause:

- The eyeball becomes **elongated**, or

- The focal length of the eye lens becomes **too small**.

Because of this, the image of distant objects is formed **in front of the retina** instead of on the retina.
Correction:

- Myopia is corrected using a **concave (diverging) lens**.

- The concave lens diverges the incoming light rays so that the image is formed exactly on the retina.

Step 2: Hypermetropia (Long-sightedness).
Hypermetropia is a defect of vision in which a person can see **distant objects clearly** but **near objects appear blurred**.
Cause:

- The eyeball becomes **shorter than normal**, or

- The focal length of the eye lens becomes **too large**.

As a result, the image of nearby objects is formed **behind the retina**.
Correction:

- Hypermetropia is corrected using a **convex (converging) lens**.

- The convex lens converges the light rays so that the image is formed on the retina.

Step 3: Difference between Myopia and Hypermetropia.

- **Vision:** Myopia affects distant vision, while hypermetropia affects near vision.

- **Image formation:** In myopia, the image forms in front of the retina, whereas in hypermetropia the image forms behind the retina.

- **Corrective lens:** Myopia is corrected with a concave lens, while hypermetropia is corrected with a convex lens.

> **Quick Tip**
>
> Myopia causes difficulty in seeing distant objects and is corrected with a concave lens, while hypermetropia causes difficulty in seeing near objects and is corrected with a convex lens.

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4. State Ohm's Law and describe its V-I graph.

Solution:
Concept: Ohm's Law explains the relationship between electric current, voltage, and resistance in an electrical circuit. It states that the current flowing through a conductor is directly proportional to the potential difference across it, provided the temperature and other physical conditions remain constant.

Step 1: Statement of Ohm's Law.
Ohm's Law states that:

> The current flowing through a conductor is directly proportional to the potential difference across its ends, provided the temperature remains constant.

Mathematically,

$$V \propto I$$

or

$$V = IR$$

where,

- V = Potential difference across the conductor (in volts)

- I = Electric current flowing through the conductor (in amperes)

- R = Resistance of the conductor (in ohms)

Thus, the ratio of potential difference to current remains constant and is equal to the resistance of the conductor.

Step 2: V-I Graph of Ohm's Law.
The relationship between voltage (V) and current (I) can be represented graphically using a **V-I graph**.

- In the graph, potential difference (V) is taken along the **vertical axis** and current (I) along the **horizontal axis**.

- The graph obtained is a **straight line passing through the origin**.

This straight-line graph indicates that the potential difference is directly proportional to the current.

The **slope of the V-I graph** represents the resistance of the conductor.

$$R = \frac{V}{I}$$

Thus, a steeper slope indicates greater resistance.

> **Quick Tip**
>
> Ohm's Law states $V = IR$. The V–I graph is a straight line passing through the origin, showing that voltage is directly proportional to current and the slope of the graph represents resistance.

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5. State Fleming's Left-Hand Rule and explain the principle of an electric motor.

Solution:
Concept: An electric motor is a device that converts electrical energy into mechanical energy. The working of an electric motor is based on the principle that a current-carrying conductor placed in a magnetic field experiences a force. The direction of this force is determined using **Fleming's Left-Hand Rule**.

Step 1: Fleming's Left-Hand Rule.
Fleming's Left-Hand Rule is used to determine the direction of force acting on a current-carrying conductor placed in a magnetic field.
The rule states:

> If the thumb, forefinger, and middle finger of the left hand are stretched mutually perpendicular to each other, then:

- The **forefinger** represents the direction of the magnetic field.

- The **middle finger** represents the direction of current.

- The **thumb** represents the direction of the force (or motion) acting on the conductor.

This rule helps in predicting the motion of the conductor in an electric motor.

Step 2: Principle of an Electric Motor.
The electric motor works on the principle that:

> A current-carrying conductor placed in a magnetic field experiences a mechanical force.

When electric current flows through a coil placed between the poles of a magnet:

- The magnetic field interacts with the magnetic field produced by the current.

- This interaction produces a force on the sides of the coil.

- The forces act in opposite directions on the two sides of the coil, causing the coil to rotate.

Thus, electrical energy supplied to the coil is converted into mechanical energy in the form of rotational motion.

Step 3: Working of an Electric Motor (Brief).

- A rectangular coil is placed between the poles of a magnet.

- When current passes through the coil, forces act on opposite sides of the coil.

- These forces produce a turning effect that rotates the coil.

- A **split-ring commutator** reverses the direction of current after every half rotation to maintain continuous motion.

Thus, the electric motor converts electrical energy into mechanical energy using the interaction between magnetic fields and electric current.

> **Quick Tip**
>
> Fleming's Left-Hand Rule helps determine the direction of force on a current-carrying conductor in a magnetic field. Electric motors work on the principle that a current-carrying conductor placed in a magnetic field experiences a force.

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6. Define Oxidation and Reduction with suitable examples.

Solution:
Concept: Oxidation and reduction are important chemical processes that occur together in many chemical reactions. These processes involve the transfer of electrons, addition or removal of oxygen, or removal or addition of hydrogen. Such reactions are collectively known as **redox reactions**.
Step 1: Oxidation.
Oxidation is defined as the **loss of electrons**, or the **addition of oxygen**, or the **removal of hydrogen** from a substance during a chemical reaction.
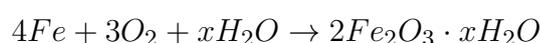**Examples:**

- When magnesium reacts with oxygen to form magnesium oxide:

$$2Mg + O_2 \rightarrow 2MgO$$
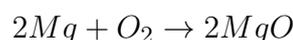
  In this reaction, magnesium combines with oxygen, so magnesium is **oxidized**.

- Rusting of iron is another example of oxidation:

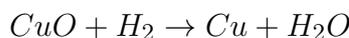$$4Fe + 3O_2 + xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$$

  Here iron combines with oxygen and gets oxidized to form rust.

Step 2: Reduction.
Reduction is defined as the **gain of electrons**, or the **removal of oxygen**, or the **addition of hydrogen** to a substance during a chemical reaction.
Examples:

- When copper oxide is heated with hydrogen:

$$CuO + H_2 \rightarrow Cu + H_2O$$

  In this reaction, copper oxide loses oxygen and forms copper, so copper oxide is **reduced**.

- Reduction also occurs during the extraction of metals from their ores.

Step 3: Relationship between Oxidation and Reduction.
Oxidation and reduction always occur together in a chemical reaction.

- When one substance undergoes oxidation, another substance undergoes reduction.

- Therefore, such reactions are called **redox reactions**.

> **Quick Tip**
>
> Oxidation involves loss of electrons or addition of oxygen, while reduction involves gain of electrons or removal of oxygen. Both processes occur simultaneously in redox reactions.

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7. Write the chemical names, formulas, and uses of Baking Soda, Washing Soda, and Bleaching Powder.

Solution:
Concept: Many common household substances used in daily life are important chemical compounds. **Baking soda, washing soda, and bleaching powder** are widely used chemicals that have specific chemical names, formulas, and applications in various fields such as cleaning, bleaching, and food preparation.
Step 1: Baking Soda.
Chemical Name: Sodium Hydrogen Carbonate
Chemical Formula: $NaHCO_3$
Uses:

- Used in baking as a component of baking powder to make bread and cakes soft and fluffy.

- Used as an antacid to relieve acidity in the stomach.

- Used in soda-acid fire extinguishers.

Step 2: Washing Soda.
Chemical Name: Sodium Carbonate Decahydrate
Chemical Formula: $Na_2CO_3 \cdot 10H_2O$
Uses:

- Used as a cleaning agent for washing clothes.

- Used in the manufacture of glass, soap, and paper.

- Used to remove permanent hardness of water.

Step 3: Bleaching Powder.
Chemical Name: Calcium Oxychloride
Chemical Formula: $CaOCl_2$
Uses:

- Used for bleaching cotton, linen, and wood pulp.

- Used as a disinfectant for drinking water.

- Used as an oxidizing agent in chemical industries.

> **Quick Tip**
>
> Baking Soda ($NaHCO_3$) is used in baking and as an antacid, Washing Soda ($Na_2CO_3 \cdot 10H_2O$) is used as a cleaning agent and water softener, and Bleaching Powder ($CaOCl_2$) is used for bleaching and disinfecting water.

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8. Explain the Reactivity Series of metals and its importance in extraction.

Solution:
Concept: The reactivity series is a list of metals arranged in the decreasing order of their chemical reactivity. It shows the tendency of metals to lose electrons and form positive ions. The position of a metal in this series helps determine how easily it reacts with other substances and also indicates the method used for its extraction from ores.
Step 1: Reactivity Series of Metals.
The reactivity series arranges metals from the most reactive to the least reactive.
A commonly used reactivity series is:

$$K, Na, Ca, Mg, Al, Zn, Fe, Pb, Cu, Hg, Ag, Au$$

- Metals at the **top** of the series are highly reactive.

- Metals in the **middle** show moderate reactivity.

- Metals at the **bottom** are least reactive and are often found in the native state.

Step 2: Importance in Extraction of Metals.
The position of a metal in the reactivity series determines the method used for its extraction from ores.

- **Highly reactive metals** (such as potassium, sodium, and calcium) cannot be extracted by heating with carbon. They are extracted by **electrolysis** of their molten compounds.

- **Moderately reactive metals** (such as zinc, iron, and lead) are extracted by **reduction with carbon or carbon monoxide**.

- **Least reactive metals** (such as copper, silver, and gold) are often found in **native form** and may require only simple purification methods.

Step 3: Other Significance of the Reactivity Series.
The reactivity series also helps to:

- Predict the ability of a metal to displace another metal from its compound.

- Understand corrosion and rusting processes.

- Determine the reactivity of metals with water, acids, and oxygen.

Thus, the reactivity series is an important tool in metallurgy and chemical reactions involving metals.

Quick Tip

The reactivity series arranges metals in decreasing order of reactivity. It helps determine the method of extraction of metals: electrolysis for highly reactive metals, reduction with carbon for moderately reactive metals, and simple purification for least reactive metals.

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9. Describe the process of Photosynthesis and write its balanced chemical equation.

Solution:
Concept: Photosynthesis is the process by which green plants, algae, and some bacteria prepare their own food using sunlight, carbon dioxide, and water. This process takes place mainly in the leaves of plants in the presence of chlorophyll. During photosynthesis, light energy is converted into chemical energy in the form of glucose, and oxygen is released as a by-product.

Step 1: Absorption of Light Energy.
The leaves of plants contain a green pigment called **chlorophyll**. Chlorophyll absorbs sunlight, which provides the energy required for the photosynthesis process.

Step 2: Uptake of Raw Materials.
Plants require two main raw materials for photosynthesis:

- **Carbon dioxide** from the atmosphere, which enters the leaves through tiny pores called stomata.

- **Water** from the soil, which is absorbed by the roots and transported to the leaves through xylem tissues.

Step 3: Conversion into Food.
Using the absorbed sunlight energy, carbon dioxide and water combine in the chloroplasts of leaf cells to produce **glucose**. Glucose is the food produced by plants and may be stored as starch.

Step 4: Release of Oxygen.
During the process of photosynthesis, **oxygen** is produced as a by-product. This oxygen is released into the atmosphere through stomata.

Step 5: Balanced Chemical Equation of Photosynthesis.
The overall chemical reaction of photosynthesis can be written as:

$$6CO_2 + 6H_2O \xrightarrow{\text{Sunlight, Chlorophyll}} C_6H_{12}O_6 + 6O_2$$
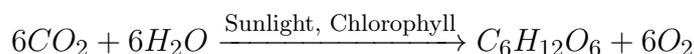
This equation shows that carbon dioxide and water combine in the presence of sunlight and chlorophyll to produce glucose and oxygen.

> **Quick Tip**
>
> Photosynthesis is the process by which plants convert carbon dioxide and water into glucose using sunlight and chlorophyll, releasing oxygen as a by-product.

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10. Differentiate between Aerobic and Anaerobic respiration.

Solution:
Concept: Respiration is the biological process by which living organisms break down food (glucose) to release energy required for various life activities. Respiration can occur in the presence or absence of oxygen. Based on this, respiration is classified into **aerobic respiration** and **anaerobic respiration**.

Step 1: Aerobic Respiration.
Aerobic respiration is the process of breakdown of glucose in the **presence of oxygen** to release energy.
Characteristics:

- Oxygen is required for the process.

- Complete breakdown of glucose occurs.

- A large amount of energy is released.

- The end products are **carbon dioxide** and **water**.

Example:
Aerobic respiration occurs in most plants and animals.
The general equation is:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Step 2: Anaerobic Respiration.
Anaerobic respiration is the breakdown of glucose in the **absence of oxygen** to release energy.
Characteristics:

- Oxygen is not required.

- Incomplete breakdown of glucose occurs.

- Less energy is released compared to aerobic respiration.

- The end products may be **alcohol and carbon dioxide** (in yeast) or **lactic acid** (in muscle cells).

Examples:

- Fermentation in yeast produces alcohol and carbon dioxide.

- In human muscles, anaerobic respiration produces lactic acid during vigorous exercise.

Step 3: Difference between Aerobic and Anaerobic Respiration.

- **Oxygen requirement:** Aerobic respiration requires oxygen, whereas anaerobic respiration occurs without oxygen.

- **Breakdown of glucose:** Aerobic respiration causes complete breakdown of glucose, while anaerobic respiration causes incomplete breakdown.

- **Energy released:** Aerobic respiration releases more energy, whereas anaerobic respiration releases less energy.

- **End products:** Aerobic respiration produces carbon dioxide and water, while anaerobic respiration produces alcohol and carbon dioxide or lactic acid.

> **Quick Tip**
>
> Aerobic respiration occurs in the presence of oxygen and releases large amounts of energy, while anaerobic respiration occurs without oxygen and releases less energy with products like alcohol or lactic acid.

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11. Describe the structure of a Neuron and explain Reflex Action.

Solution:
Concept: The nervous system controls and coordinates various activities of the body. The basic structural and functional unit of the nervous system is the **neuron** (nerve cell). Neurons transmit electrical impulses throughout the body. A rapid, automatic response to a stimulus that does not involve conscious thinking is called a **reflex action**.
Step 1: Structure of a Neuron.
A neuron is a specialized cell designed to transmit nerve impulses. It consists of three main parts:

- **Cell Body (Cyton):** It contains the nucleus and cytoplasm and controls the activities of the neuron.

- **Dendrites:** These are short, branched extensions that receive nerve impulses from other neurons and transmit them toward the cell body.

- **Axon:** It is a long fiber-like extension that carries nerve impulses away from the cell body to another neuron, muscle, or gland.

Some axons are covered by a protective fatty layer called the **myelin sheath**, which helps in faster transmission of nerve impulses.

Step 2: Reflex Action.
Reflex action is a quick and automatic response of the body to a stimulus without the involvement of conscious thinking.
Examples:

- Pulling the hand away immediately after touching a hot object.

- Blinking of eyes when dust enters the eye.

Step 3: Reflex Arc.
The pathway followed by nerve impulses during a reflex action is called a **reflex arc**. It includes the following components:

- **Receptor:** Detects the stimulus.

- **Sensory neuron:** Carries impulses from the receptor to the spinal cord.

- **Interneuron:** Located in the spinal cord and processes the impulse.

- **Motor neuron:** Carries impulses from the spinal cord to the effector.

- **Effector:** Muscle or gland that produces the response.

Reflex actions are mainly controlled by the **spinal cord**, which allows the body to respond quickly to harmful stimuli.

> **Quick Tip**
>
> A neuron consists of a cell body, dendrites, and an axon. Reflex action is a rapid and automatic response to a stimulus controlled mainly by the spinal cord through a reflex arc.