N 840– SCIENCE AND TECHNOLOGY (72) - 2025 Question Paper with Solutions

Time Allowed :2 Hours	**Maximum Marks :**40

General Instructions

Read the following instructions very carefully and strictly follow them:

1. All questions are compulsory.
2. Use of a calculator is not allowed.
3. The numbers to the right of the questions indicate full marks.
4. Scientifically correct, labelled diagrams should be drawn wherever necessary.

---

1. (A) Choose the correct alternative:
(i) Alkaline earth metals have valency 2. This means that their position in the modern periodic table is in ..... .
(A) Group 2
(B) Group 16
(C) Period 2
(D) d-block

Answer: Alkaline Earth Metals have valency 2 → They belong to Group 2.

Alkaline earth metals are a group of elements located in Group 2 of the periodic table. The elements in this group include beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra). These metals share several key characteristics:
- They have two electrons in their outermost electron shell, which gives them a valency of 2. - These elements tend to lose their two valence electrons to form cations with a +2 charge when they react, which is a characteristic feature of metals.
- Their reactivity increases as you move down the group, with radium being the most reactive, and beryllium being the least reactive.
- They form ionic compounds, where they combine with nonmetals to form salts, like calcium chloride (CaCl) or magnesium oxide (MgO).

Since they all have two valence electrons, they are classified as Group 2 elements in the periodic table. These metals are important in various chemical reactions, especially in the formation of basic oxides and hydroxides, and they play crucial roles in biology and industry.

Answer: (A) Group 2.

Quick Tip

Quick Tip: The alkaline earth metals are important in the production of materials like cement, glass, and in the development of alloys. Their ionic nature makes them effective in forming a variety of salts and compounds.

(ii) The reaction in which ions in the reactants are exchanged to form a precipitate is called as ..... reaction.
(A) Combination
(B) Decomposition
(C) Displacement
(D) Double Displacement

Answer: The reaction in which ions are exchanged to form a precipitate → Double Displacement reaction.

A double displacement reaction, also called a double replacement reaction, occurs when two ionic compounds in aqueous solution exchange ions to form new compounds. This type of reaction involves the replacement of one element in each compound by another. If one of the products is insoluble in water, it will form a precipitate.
- In a double displacement reaction, the positive and negative ions of two ionic compounds swap places, resulting in the formation of two new compounds.
- One of these new compounds, typically a salt, may not dissolve in water, thus forming a solid precipitate.
- A classic example is when solutions of silver nitrate (AgNO) and sodium chloride (NaCl) are mixed. Silver chloride (AgCl), a white precipitate, forms because it is insoluble in water.

This reaction can be summarized as follows:

$$AB(aq) + CD(aq) \rightarrow AD(s) + CB(aq)$$

Where "s" denotes the solid precipitate, and "aq" denotes an aqueous solution.

Answer: (D) Double Displacement.

Quick Tip

Quick Tip: Double displacement reactions are important in analytical chemistry for identifying unknown compounds through precipitate formation. These reactions are also essential in water treatment processes, where unwanted ions are removed.

(iii) ..... is used to make a solenoid type coil in an electric bulb.
(A) Nichrome
(B) Copper

(C) Tungsten
(D) Aluminium

Answer: A solenoid-type filament in an electric bulb is made of Tungsten (because of its high melting point).

The filament in electric bulbs is typically made of tungsten due to its remarkable properties. Tungsten has the highest melting point of all metals, approximately 3422°C (6192°F), which is essential for its use in light bulbs. When current flows through the filament, it heats up due to the resistance it offers to the electric current, and it begins to glow, producing light.
- The high melting point of tungsten allows the filament to reach high temperatures without melting. This is crucial because light bulbs need to operate at high temperatures to produce visible light.
- Tungsten also has excellent durability and resistance to thermal shock, meaning it can withstand rapid temperature changes, which is common when light bulbs are turned on and off. - Additionally, tungsten has a low vapor pressure at high temperatures, which ensures that the filament does not evaporate easily, allowing it to last longer.

For these reasons, tungsten is the material of choice for electric bulb filaments.

Answer: (C) Tungsten.

Quick Tip

Quick Tip: Tungsten's high melting point and resilience make it ideal not only for light bulbs but also for other high-temperature applications, such as in electrical contacts, heating elements, and aerospace technologies.

(iv) Light changes its direction when going from one transparent medium to another transparent medium. This process is called ..... .
(A) Reflection
(B) Dispersion
(C) Scattering
(D) Refraction

Answer: Light changes direction when going from one medium to another → Refraction.

Refraction is the bending of light when it passes from one medium into another. This occurs because light travels at different speeds in different media. The change in speed causes the light ray to change direction.
- The amount of bending depends on the angle at which the light enters the new medium and the refractive index of the two media involved. The refractive index is a measure of how much the speed of light is reduced inside the medium.
- For example, when light passes from air (a less dense medium) into water (a denser medium),

the light slows down and bends towards the normal (the perpendicular line to the surface). Conversely, when light moves from water to air, it speeds up and bends away from the normal.
- This phenomenon is described by Snell's Law, which mathematically relates the angles of incidence and refraction to the refractive indices of the two media.

Refraction is responsible for many optical phenomena, such as the formation of rainbows, the apparent bending of objects underwater, and the focusing of light in lenses.

Answer: (D) Refraction.

Quick Tip

Quick Tip: Refraction is crucial in the design of optical instruments like glasses, microscopes, and cameras, where precise control of light's path is required for proper functionality.

(v) $CaO + H_2O \rightarrow Ca(OH)_2$ + Heat is an example of ..... reaction.
(A) Exothermic
(B) Electrolysis
(C) Decomposition
(D) Endothermic

Answer: CaO + HO → Ca(OH) + Heat (heat is evolved) → Exothermic reaction.

The reaction between calcium oxide (CaO) and water (HO) is an exothermic reaction, meaning that it releases energy in the form of heat. When calcium oxide (commonly known as quicklime) reacts with water, calcium hydroxide (Ca(OH)) is formed, and a significant amount of heat is released during the process.
- Exothermic reactions are characterized by the release of energy, typically in the form of heat, light, or both. The heat released in this reaction is so significant that it is used in industrial processes such as the production of cement.
- In this specific reaction, the calcium oxide undergoes a chemical transformation with water, releasing energy as the new bonds are formed in the calcium hydroxide product. This is a typical feature of many metal oxide reactions with water.

This reaction is also an example of a hydration reaction, where water is added to a substance to form a new product.

Answer: (A) Exothermic.

Quick Tip

Quick Tip: Exothermic reactions are essential in many chemical processes, including combustion, neutralization, and in the industrial production of chemicals like cement and soap.

(B) Answer the following questions:

(i) State whether true or false:
A redox reaction takes place during cellular respiration.

Answer: The statement is **True**.

Cellular respiration is a biochemical process that occurs in living cells to convert biochemical energy from nutrients into adenosine triphosphate (ATP), which is used as a source of chemical energy. During this process, a redox reaction takes place:
- Glucose ($C_6H_{12}O_6$) is oxidized, meaning it loses electrons and is converted into carbon dioxide (CO_2).
- Oxygen (O_2) is reduced, meaning it gains electrons and is converted into water (H_2O).

The complete redox reaction for cellular respiration is represented as:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy (ATP)}$$

This illustrates both oxidation (glucose losing electrons) and reduction (oxygen gaining electrons), thus confirming that cellular respiration involves a redox reaction.

Answer: True.

Quick Tip

Quick Tip: Redox reactions are essential in both biological processes, like cellular respiration, and industrial processes, such as combustion and corrosion.

(ii) Find the odd one out:
Loudspeaker, microphone, electric motor, magnet.

Answer : The odd one out is **Magnet**.

Here's why:
- A **loudspeaker** is an electronic device that converts electrical signals into sound.
- A **microphone** is an electronic device that converts sound into electrical signals.
- An **electric motor** is an electronic device that converts electrical energy into mechanical energy to produce motion.

However, a **magnet** is not an electronic device; it is a material that produces a magnetic field. While magnets are often used in electronic devices like loudspeakers and motors, they themselves do not perform electrical functions but rather provide magnetic properties.

Answer: Magnet.

Quick Tip

Quick Tip: Magnets are used in many electronic devices, but they are not considered electronic devices themselves because they do not involve electricity or circuits directly.

(iii) What is the reason for twinkling of stars?

Answer : The twinkling of stars, also known as stellar scintillation, is caused by the **atmospheric refraction of starlight**.

The Earth's atmosphere consists of several layers of air, each with a different temperature and density. When starlight passes through these layers, it bends (refracts) due to the changing refractive indices. As the light moves through the atmosphere, it is refracted in irregular ways because of the constantly changing air conditions. This causes the brightness and position of the star to appear to fluctuate, leading to the twinkling effect.

- The effect is more pronounced for stars because they are so far away that they appear as point sources of light. As a result, the bending of light is more noticeable.
- Planets, on the other hand, appear as small disks, so the light they emit is less affected by atmospheric refraction, and they do not twinkle as much as stars.

Twinkling of stars is due to atmospheric refraction of starlight.

Quick Tip

Quick Tip: Twinkling is most noticeable on clear nights, especially when stars are low in the sky. It's less noticeable in planets, which tend to shine with a steadier light.

(iv) Match the columns:

Column 'A'	**Column 'B'**
Simple microscope	(a) used to observe minute objects
	(b) used to see distant objects
	(c) used for watch repair

(v) Name the behaviour of water between its temperature from 0°C to 4°C.
Answer: The behaviour of water between 0°C to 4°C is called anomalous expansion of water.

Water exhibits an anomalous expansion between 0°C and 4°C. Normally, most substances expand when heated, but water behaves differently in this temperature range. When water is

cooled from 4°C to 0°C, it contracts like most substances. However, as it continues to cool below 4°C, it starts expanding again until it reaches 0°C.

The reasons for this anomaly are due to the unique hydrogen bonds in water. At temperatures below 4°C, the water molecules arrange themselves in a more open hexagonal structure due to hydrogen bonding, which increases the volume and decreases the density of the water. At 4°C, water reaches its maximum density because the molecules are packed most efficiently.

Water contracts instead of expanding when heated from 0°C to 4°C, reaching maximum density at 4°C.

Quick Tip

Quick Tip: The anomalous expansion of water is crucial for life on Earth because it allows ice to float on water, insulating aquatic life during freezing temperatures.

---

2. (A) Give scientific reasons (any two):

(i) While going from left to right within a period, the size of the atom decreases.

Answer: As we move across a period in the periodic table from left to right, the number of protons in the nucleus increases, leading to an increase in the nuclear charge. This stronger nuclear charge exerts a greater attractive force on the electrons in the outer shell, pulling them closer to the nucleus.

However, the number of electron shells remains the same across a period. As a result, the electrons are drawn closer to the nucleus, causing the atomic size to decrease. This is a general trend that can be observed in all elements across a period.

Nuclear charge increases, pulling electrons closer to the nucleus, hence atomic size decreases.

Quick Tip

Quick Tip: The decrease in atomic size across a period is one of the key trends in the periodic table and plays a major role in determining the chemical properties of elements.

(ii) For electric power transmission, copper or aluminium wire is used.

Answer: Copper and aluminium are commonly used materials for electric power transmission due to their excellent electrical properties. They both have low resistivity, meaning they offer minimal resistance to the flow of electricity, allowing for efficient transmission of electrical power.

- **Copper** has better conductivity than aluminium, making it ideal for high-efficiency transmission in smaller cross-sections. However, copper is heavier and more expensive.
- **Aluminium**, on the other hand, is lighter and more cost-effective than copper. It is often used in high-voltage power transmission lines, where its lower cost and lighter weight make it advantageous.

Both metals also have good mechanical properties, such as flexibility and durability, which are essential for maintaining and repairing power transmission lines.

Both have low resistivity and high conductivity, so they allow electricity to pass with minimum energy loss.

Quick Tip

Quick Tip: While copper has better conductivity, aluminium's lower cost and lighter weight make it a preferred choice for long-distance power transmission.

(iii) In some countries, ethanol is used as an additive to increase the efficiency of petrol.

Answer: Ethanol is often added to petrol to improve its combustion efficiency. Ethanol has a high octane rating, which allows it to withstand higher compression in the engine without knocking. This leads to a more efficient combustion process.

- The addition of ethanol ensures complete combustion of petrol, which reduces the formation of harmful byproducts like carbon monoxide and unburned hydrocarbons.
- Ethanol is also an oxygenated fuel, meaning it contains more oxygen than petrol, which helps the fuel burn more completely, reducing air pollution and increasing fuel efficiency.
- In addition to improving combustion efficiency, ethanol is a renewable biofuel, making it more environmentally friendly compared to pure gasoline.

Ethanol has high octane number and good combustion properties; it ensures complete combustion of petrol, reduces pollution, and improves fuel efficiency.

Quick Tip

Quick Tip: Ethanol-blended fuels not only improve efficiency but also help reduce the carbon footprint of fossil fuel-based transportation.

(B) Answer the following (any three):

(i) Name and state the principle used to measure the specific heat capacity of a substance.

Answer : Principle - Method of Mixtures.

The method of mixtures is commonly used to measure the specific heat capacity of a substance. This principle is based on the fact that when a hot body is mixed with a cold body, heat lost by the hot body equals the heat gained by the cold body, provided no heat is lost to the surroundings. This can be expressed mathematically as:

$$\text{Heat lost by hot body} = \text{Heat gained by cold body}$$

Mathematically, the heat transferred can be calculated using the formula:

$$m_1 c_1 \Delta T_1 = m_2 c_2 \Delta T_2$$

Where:
- m_1, m_2 are the masses of the hot and cold bodies, respectively, - c_1, c_2 are the specific heat capacities of the hot and cold bodies, respectively, - $\Delta T_1, \Delta T_2$ are the temperature changes of the hot and cold bodies, respectively.

In this method, the specific heat capacity of the unknown substance can be calculated if the heat lost or gained by the other substance (whose specific heat is known) is measured.

Answer: Method of Mixtures.

Quick Tip

Quick Tip: The method of mixtures is a practical application of the conservation of energy, where energy lost equals energy gained. It is often used in calorimetry to determine specific heat capacities.

(ii) What is done to prevent rusting of iron door of your house?

Answer: Rusting of iron occurs due to the reaction of iron with moisture and oxygen in the atmosphere. It forms iron oxide, commonly known as rust. To prevent rusting of iron doors or other iron objects, various methods can be employed:

1. **Applying Paint, Oil, or Grease Coating:** One of the most common methods to prevent rusting is by applying a protective layer of paint, oil, or grease. This coating prevents the direct contact of iron with moisture and oxygen in the environment, thus stopping the rusting process.
2. **Galvanization (Coating with Zinc):** Galvanization involves coating the iron or steel with a thin layer of zinc. The zinc acts as a sacrificial anode, corroding instead of the iron. Even if the coating is scratched, the zinc will continue to protect the exposed iron.
3. **Electroplating with Another Metal:** Another method is electroplating the iron surface with a corrosion-resistant metal such as chromium or nickel. This adds a protective metallic layer that prevents the iron from coming into contact with corrosive agents.

4. **Regular Maintenance:** Regular maintenance, including cleaning and removing any rust spots, can help in preventing moisture from accumulating on the surface, reducing the chances of rust formation.

Applying paint, oil, or grease coating. Galvanisation (coating with zinc) or electroplating with another metal. Regular maintenance to prevent moisture contact.

Quick Tip

Quick Tip: Galvanization is particularly effective for outdoor objects like gates and fences, while oiling and painting work well for indoor objects where exposure to moisture is minimal.

(iv) The 'rocket' is a type of fire cracker used in Diwali.

(a) Name the launcher.
(b) Name the law on which its working is based.

Answer : The 'rocket' is a type of firecracker used in Diwali.

(a) Launcher: A straight, guiding tube or stick (acts as launcher).

A rocket firecracker is a type of firework that is launched into the air. The launcher, typically a straight tube or stick, guides the rocket as it ascends. The rocket is propelled by the force produced when the chemical fuel inside burns and releases gas. The force from the expelled gases provides thrust, propelling the rocket upwards.

(b) Law: Newton's Third Law of Motion (Every action has an equal and opposite reaction).

Newton's Third Law of Motion is key to the functioning of a rocket. It states that "for every action, there is an equal and opposite reaction." When the rocket's fuel burns, it expels gases downward, creating a reaction force that propels the rocket upwards. The launch of the rocket is a perfect example of this principle, as the rocket moves upward due to the downward expulsion of gases.

Newton's Third Law of Motion.

Quick Tip

Quick Tip: Newton's Third Law is not only essential in rocketry but also explains many everyday phenomena, such as the recoil of a gun or the pushback when you jump off a boat.

(v) What is meant by decomposition reaction? Write the chemical reaction of decomposition of sugar on heating.

Answer : A decomposition reaction is a type of chemical reaction in which a single compound breaks down into two or more simpler substances when heated or by other means such as electrolysis. In a decomposition reaction, one reactant is broken down into multiple products.

Example: Decomposition of Sugar on Heating:
When sugar (sucrose, $C_{12}H_{22}O_{11}$) is heated, it decomposes into carbon (C) and water vapor (H_2O). This is a classic example of a thermal decomposition reaction, where heat is required to break down the sugar.
The reaction can be written as:

$$C_{12}H_{22}O_{11} \xrightarrow{\Delta} 12C + 11H_2O$$

Here:
- $C_{12}H_{22}O_{11}$ is sucrose (sugar),
- Δ represents heat,
- $12C$ is carbon, and
- $11H_2O$ is water vapor.

A decomposition reaction is a type of chemical reaction in which a single compound breaks down into two or more simpler substances when heated or by other means.

Quick Tip

Quick Tip: Decomposition reactions are used in many industrial processes, such as the production of oxygen from potassium chlorate ($KClO_3$) and the breakdown of organic matter in composting.

---

3. Answer the following (any five):

(i) An iron ball of mass 3 kg is released from a height of 125 m and falls freely to the ground. Assuming that the value of g is 10 m/s^2, calculate:

(a) Time taken by the ball to reach the ground.
(b) Velocity of the ball on reaching the ground.

(ii) Write the name and symbol of the element from the description:

(a) The most electronegative atom.

Answer: Fluorine, F
Fluorine is the most electronegative element in the periodic table, with an electronegativity value of 3.98 on the Pauling scale. Electronegativity is a measure of an atom's ability to attract electrons in a chemical bond. Fluorine has a high tendency to attract electrons due to its small atomic size and high effective nuclear charge.

(b) The atom having smallest atomic mass.

Answer: Hydrogen, H
Hydrogen is the lightest element in the periodic table with an atomic mass of approximately

1.008 u. It consists of just one proton and one electron in its simplest form, making it the smallest and lightest atom.

(c) The noble gas with the smallest atomic radius.

Answer: Helium, He
Helium, being the lightest noble gas with only two electrons, has the smallest atomic radius.

Due to its small size and the strong attraction between the nucleus and electrons, helium's atomic radius is smaller than other noble gases. Its atomic radius is around 31 pm (picometers).

(iii) (a) What happens when copper reacts with concentrated nitric acid? What is the colour of the gas released during the reaction?

Answer: Reaction Description and Gas Color

When copper (Cu) reacts with concentrated nitric acid (HNO_3), it undergoes an oxidation reaction. In this reaction, the copper metal dissolves, forming a blue solution of copper(II) nitrate. Simultaneously, a reddish-brown gas is released. This gas is nitrogen dioxide (NO_2), which is toxic and has a characteristic reddish-brown color.

The reaction involves the oxidation of copper metal, where copper loses electrons to form copper ions (Cu^{2+}). Nitric acid provides the oxidizing agent (nitrogen in the acid), which is reduced to nitrogen dioxide (NO_2).

The gas produced is nitrogen dioxide (NO_2), which is reddish-brown.

Quick Tip

Quick Tip: Nitrogen dioxide (NO_2) is a toxic gas, so reactions involving concentrated nitric acid should be performed in a well-ventilated area or under a fume hood.

(b) Write its balanced chemical equation.

Answer: The balanced chemical equation for the reaction between copper and concentrated nitric acid is as follows:

$$Cu(s) + 4HNO_3(conc) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

In this equation: - $Cu(s)$ represents solid copper. - $HNO_3(conc)$ is concentrated nitric acid. - $Cu(NO_3)_2(aq)$ is the copper(II) nitrate formed in the solution. - $NO_2(g)$ is nitrogen dioxide gas released during the reaction. - $H_2O(l)$ is water produced as a byproduct.

The coefficients are balanced to ensure that the number of atoms of each element is the same on both sides of the reaction. The reaction is an example of a redox process, where copper is oxidized and nitric acid is reduced.

The balanced chemical equation for the reaction is:

$$Cu(s) + 4HNO_3(conc) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

Quick Tip

Quick Tip: In redox reactions, the substance being oxidized loses electrons, and the substance being reduced gains electrons. In this case, copper is oxidized, and nitrogen in nitric acid is reduced.

(c) Write the names of reactants and products.

Answer : Reactants:

1. Cu: Copper – A transition metal that reacts with concentrated nitric acid.
2. HNO_3: Concentrated Nitric Acid – A strong oxidizing acid that reacts with copper to produce copper(II) nitrate and nitrogen dioxide.

Products:

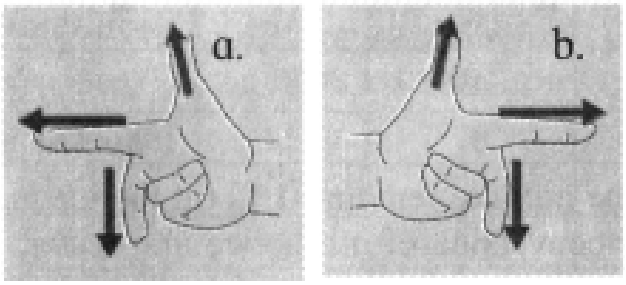
1. $Cu(NO_3)_2$: Copper(II) Nitrate – A blue solution formed by dissolving copper in nitric acid.
2. NO_2: Nitrogen Dioxide – A toxic, reddish-brown gas produced during the reaction.
3. H_2O: Water – A byproduct of the reaction.

- **Reactants:** Copper (Cu), Concentrated Nitric Acid (HNO_3)
- **Products:** Copper(II) Nitrate ($Cu(NO_3)_2$), Nitrogen Dioxide (NO_2), Water (H_2O)

Quick Tip

Quick Tip: Copper(II) nitrate is commonly used in laboratories for various reactions and as a precursor for other copper compounds.

(iv) Name the following diagrams and explain the concept behind them:



(a) Fleming's Left-Hand Rule

Answer : Fleming's Left-Hand Rule (for motors)

Concept: Fleming's Left-Hand Rule is used to determine the direction of force or motion experienced by a current-carrying conductor when it is placed in a magnetic field. This rule is crucial in understanding how electric motors work. In a motor, the current in the conductor interacts with the magnetic field to produce a force, which causes the conductor to move or rotate.

According to this rule, if the left hand is positioned with the thumb, forefinger, and middle finger all perpendicular to each other:

- **Thumb:** Points in the direction of the **motion (force)** of the conductor, i.e., the direction the conductor will move.
- **Forefinger:** Points in the direction of the **magnetic field**, which is from the North pole to the South pole of the magnet.
- **Middle finger:** Points in the direction of the **current flow**, which is from the positive terminal to the negative terminal of the battery or power supply.

This rule applies when a conductor (such as a wire or coil) carrying an electric current is placed within a magnetic field. The interaction between the current and the magnetic field produces a force on the conductor, which results in motion. The direction of motion is determined using this rule.

In an electric motor, the force generated by the current and magnetic field causes the armature (a coil of wire) to rotate. The direction of this rotation is determined by the orientation of the magnetic field and current through the motor's components.

Fleming's Left-Hand Rule is used to determine the direction of force on a current-carrying conductor in a magnetic field, which applies in electric motors.

Quick Tip

Quick Tip: The Left-Hand Rule is used specifically for motors. If you are working with a device that converts electrical energy into mechanical motion (like a fan or motor), this rule is key to understanding how the force is generated.

(b) Fleming's Right-Hand Rule

Name: Fleming's Right-Hand Rule (for generators)

Concept: Fleming's Right-Hand Rule is used to determine the direction of the induced current when a conductor moves within a magnetic field. This rule is essential in understanding how electric generators work. In a generator, mechanical energy is converted into electrical energy by moving a conductor through a magnetic field.

According to this rule, if the right hand is positioned with the thumb, forefinger, and middle finger all perpendicular to each other:

- **Thumb:** Points in the direction of the **motion of the conductor**, that is, the direction in which the conductor is moving through the magnetic field.
- **Forefinger:** Points in the direction of the **magnetic field**, which is from the North pole to the South pole of the magnet.
- **Middle finger:** Points in the direction of the **induced current** in the conductor. This is the direction in which the current flows through the conductor as a result of its motion in the magnetic field.

In a generator, when the conductor moves through the magnetic field, it cuts through magnetic field lines. This movement induces a current in the conductor due to the process of electromagnetic induction. The direction of this induced current is determined using the Right-Hand Rule.

The induced current can be used to power electrical devices. The mechanical motion (such as turning a coil inside a magnetic field) is converted into electrical energy through this process. The magnitude and direction of the induced current depend on the speed of the motion and the strength of the magnetic field.

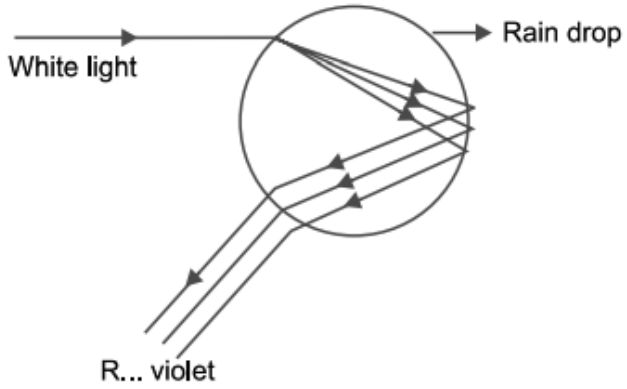
Fleming's Right-Hand Rule is used to determine the direction of the induced current in a conductor moving through a magnetic field, which applies in electric generators.

Quick Tip

Quick Tip: The Right-Hand Rule is used specifically for generators. When mechanical energy is used to rotate a coil inside a magnetic field, this rule helps you find the direction of the electrical current generated in the coil.

(v) Answer the following with respect to the 'Formation of Rainbow':

(a) Draw a neat diagram to show the formation of rainbow.



(b) Name any two natural processes involved in formation of rainbow.

Answer: Two natural processes involved:

1. **Refraction:** Light bends when passing from one medium (air) into another (water), and bends again when exiting the water droplet. This bending happens due to the change in the speed of light in different media.
2. **Dispersion:** White light is made up of various colours, which have different wavelengths. These colours bend by different amounts as they pass through the water droplet, leading to their separation. This produces the visible spectrum (rainbow).

(c) What does a small droplet of water act as?

A small droplet of water acts as a **prism** — more precisely, a spherical prism and lens. It refracts and disperses light while providing the internal reflection necessary to form a rainbow.

Quick Tip

Quick Tip: The formation of rainbows depends on the size of the water droplets and the position of the observer relative to the light source. Larger droplets tend to create brighter and more vivid colours.

(vi) Name the following:

(a) The two metals which can be cut with knife.

Answer: Sodium (Na) and Potassium (K).

Sodium and potassium are both alkali metals that are soft enough to be cut with a knife. These metals have a low melting point and low density, which makes them soft and easy to cut. They are highly reactive, especially with water, which is why they are stored under oil to prevent

contact with moisture in the air.

(b) A sound is produced when certain metals are struck. Name this property of metals.

Answer: Sonorous.

The property of metals that allows them to produce sound when struck is called **sonority**. Metals like iron, copper, and steel are sonorous, meaning they produce a ringing sound when struck. This property is due to their ability to vibrate freely, producing sound waves.

(c) The non-metallic substance which is a good conductor of electricity.

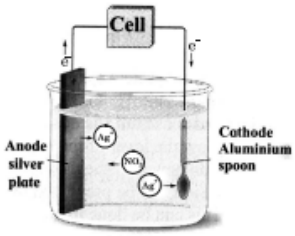
Answer: Graphite.

Graphite is an allotrope of carbon and is the only non-metal that is a good conductor of electricity. It has a unique structure in which carbon atoms are arranged in layers of hexagonal rings. These layers are weakly bonded to each other, allowing the free movement of electrons between the layers, which makes graphite a good conductor of electricity.

Quick Tip

Quick Tip: Graphite's electrical conductivity is why it is used in electrical applications like batteries, electrodes, and as a lubricant in mechanical systems.

(vii) Answer the following questions with the help of the given diagram:



(a) Name the process shown in the diagram.

Answer: The process shown in the diagram is **electroplating**.

Electroplating is a technique that uses an electric current to coat an object with a thin layer of metal. It is commonly used to enhance the appearance of objects, improve their durability, and protect them from corrosion.

Electroplating.

Quick Tip

Quick Tip: Electroplating is widely used in various industries, including jewelry, automotive, and electronics, to provide both aesthetic and functional benefits.

(b) How does this process take place?

Answer: Electroplating takes place in an **electrolytic cell** and relies on the principle of **electrolysis**.

The key components of the process are:
- **Anode:** This is the electrode connected to the positive terminal of the battery. The anode is made of the metal that you want to deposit onto the object (in this case, silver). At the anode, silver atoms lose electrons and become positive silver ions (Ag^+) that dissolve into the electrolyte solution.

- **Cathode:** The cathode is the object you want to plate, such as an aluminum spoon, and it is connected to the negative terminal of the battery. The negative charge at the cathode attracts the positive silver ions from the solution. At the cathode, these ions gain electrons and are reduced to solid silver atoms, which then deposit as a thin, uniform layer on the surface of the spoon.

- **Electrolyte:** The electrolyte is a solution that contains ions of the metal you wish to plate with (e.g., silver nitrate, $AgNO_3$). The electrolyte serves as the medium through which ions are conducted between the anode and cathode.

The electric current causes silver ions to move from the anode to the cathode, where they are reduced to form a metal coating on the object.

Electroplating takes place in an electrolytic cell, where metal ions from the electrolyte are deposited onto the cathode object due to the flow of electric current.

Quick Tip

Quick Tip: The thickness of the electroplated layer depends on the time the current is applied and the concentration of the metal ions in the electrolyte.

(c) Give two examples in which this process is used.

Answer: Examples of Electroplating:

1. **Jewelry and Ornaments:** Less expensive metals, such as brass or copper, are electroplated with a thin layer of precious metals like gold or silver. This gives the jewelry an attractive appearance at a lower cost and also provides protection from corrosion and tarnishing.

2. **Car Parts and Machinery:** Car parts, such as bumpers, rims, and faucets, are often electroplated with metals like chromium (chrome plating). This process provides a shiny, decorative finish and protects the parts from rust, corrosion, and wear, improving their durability and appearance.

- Jewelry and ornaments (gold or silver plating).
- Car parts and machinery (chromium plating).

Quick Tip

Quick Tip: Electroplating is an affordable way to give objects a luxurious finish without the cost of using pure precious metals.

(viii) Complete the following table:

	Type of the satellite	**Function of the satellite**	**The names of the Indian satellite series and their launch vehicles**
(a)	.....	Fix the location of any place on the earth's surface	.....
(b)	Weather satellite	.....	.....
(c)	.....	.....	IRS Launcher : PSLV

Answer :

Type of the satellite	Function of the satellite	The names of the Indian satellite series and their launch vehicles
Navigational satellite	Fix the location of any place on the earth's surface	IRNSS / NavIC, Launcher: PSLV
Weather satellite	Forecast weather, monitor cyclones, collect meteorological data	INSAT series, Launcher: GSLV
Remote sensing satellite	Collect information about natural resources, land use, agriculture, forestry, water resources, etc.	IRS, Launcher: PSLV

Navigational Satellite (NavIC): A navigational satellite determines the location on Earth using signals from multiple satellites. It helps users calculate their precise position (latitude, longitude, and altitude). The Indian Regional Navigation Satellite System (IRNSS), also known as NavIC, provides services for India and the surrounding region. These satellites are launched via the Polar Satellite Launch Vehicle (PSLV).

Weather Satellite (INSAT): Weather satellites monitor weather conditions, forecast cyclones, and collect meteorological data. The Indian National Satellite System (INSAT) series is primarily used for weather observation and communication. INSAT satellites are launched using the Geosynchronous Satellite Launch Vehicle (GSLV).

Remote Sensing Satellite (IRS): Remote sensing satellites gather data on Earth's resources, land use, agriculture, and the environment. The Indian Remote Sensing (IRS) satellites play a crucial role in observing these aspects for resource management. They are launched using PSLV.

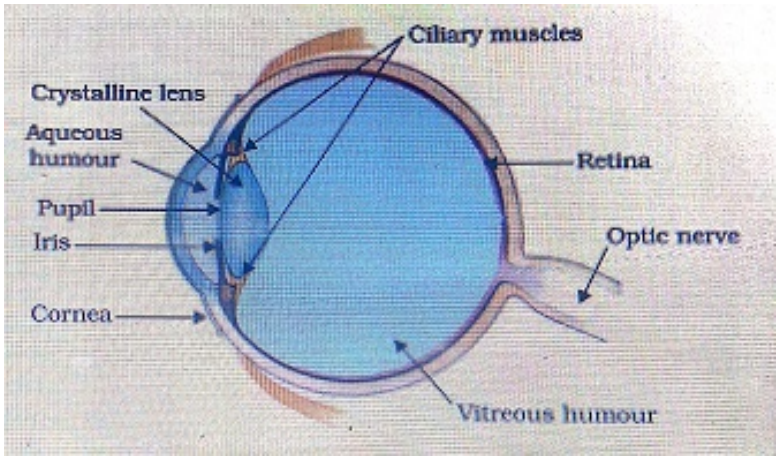
Quick Tip

Quick Tip: NavIC helps in accurate navigation, INSAT aids in weather forecasting, and IRS is essential for environmental monitoring and resource management.

---

4. Answer any one of the following:

(i) (a) Draw a neat labelled diagram of human eye.



(b) What is the minimum distance of distinct vision for a normal human eye?

Answer: Minimum Distance of Distinct Vision

The minimum distance of distinct vision is defined as the closest distance at which a normal human eye can clearly focus on an object without any strain. For a healthy human eye, this distance is approximately **25 cm**.

At this distance, the eye is able to focus the image of the object on the retina with ease. Any object placed closer than 25 cm cannot be seen clearly, and the eye would have to exert additional strain to focus. This is because the eye lens can no longer accommodate the light rays sufficiently to form a sharp image on the retina. For people with vision problems, this distance may vary.

Answer: The minimum distance of distinct vision for a normal human eye is 25 cm.

Quick Tip

Quick Tip: The minimum distance of distinct vision is an important factor in determining whether a person needs corrective lenses for close-up tasks, like reading.

(c) Name the capacity of the eye lens to change its focal length as per need.

Answer: Capacity of the Eye Lens

The capacity of the eye lens to adjust its focal length to focus on objects at varying distances is called **the power of accommodation** or simply **accommodation**.

Accommodation is achieved by changing the shape of the eye lens. The ciliary muscles surrounding the lens contract or relax, causing the lens to become more or less curved. When looking at nearby objects, the eye lens becomes more curved (increasing its focal power) to focus light onto the retina. When focusing on distant objects, the lens becomes flatter, reducing its focal power.

This ability to adjust the focus is critical for seeing objects clearly at different distances, such as while reading a book or looking at a distant object.

Answer: The capacity of the eye lens to change its focal length to focus on objects at varying distances is called the power of accommodation.

Quick Tip

Quick Tip: The power of accommodation decreases with age, which is why many people need reading glasses as they get older.

(d) Name the defect of eye vision in which the focussing power of eye lens decreases with age.

Answer: Age-Related Eye Defect

The defect of eye vision in which the focusing power of the eye lens decreases with age is called **presbyopia**.

As a person ages, the eye lens gradually loses its elasticity, and the ciliary muscles that control the shape of the lens become weaker. This reduces the lens's ability to change its curvature for focusing on close-up objects. As a result, people with presbyopia have difficulty focusing on things up close, such as reading a book or using a smartphone. This condition typically becomes noticeable after the age of 40.

Presbyopia can be corrected with reading glasses or bifocal lenses, which help the eye focus on close objects by compensating for the reduced accommodation power.

Answer: Presbyopia is caused by the gradual loss of elasticity of the eye lens and the weakening of the ciliary muscles.

Quick Tip

Quick Tip: Presbyopia is a natural part of aging, but it can be managed effectively with corrective lenses or by wearing reading glasses.

(ii) Atomic number of chlorine is 17.

(a) Write the electronic configuration of chlorine.

Answer: Electronic Configuration of Chlorine

The atomic number of chlorine is 17, which means it has 17 electrons. These electrons are arranged in shells around the nucleus. The electronic configuration of chlorine can be written as:

$$\text{Chlorine: } 2, 8, 7$$

This indicates that: - The first shell contains 2 electrons, - The second shell contains 8 electrons, and - The third shell contains 7 electrons, which are the valence electrons.
The configuration follows the Aufbau principle, which states that electrons fill orbitals from lower to higher energy levels.

The electronic configuration of chlorine is 2, 8, 7.

Quick Tip

Quick Tip: Chlorine has 7 valence electrons, making it highly reactive as it seeks to gain one more electron to achieve a stable octet configuration.

(b) What is the number of electrons in the valence shell of chlorine?

Answer: Valence Electrons of Chlorine

The number of valence electrons refers to the electrons in the outermost shell of an atom. For chlorine, the outermost shell (the third shell) contains 7 electrons. These valence electrons are responsible for the chemical behavior of chlorine, including its ability to form bonds with other atoms.

The number of valence electrons in a chlorine atom is 7.

Quick Tip

Quick Tip: The number of valence electrons determines the reactivity of an element. Chlorine, with 7 valence electrons, readily gains one electron to form a stable chloride ion (Cl^-).

(c) Write the molecular formula of chlorine.

Answer: Molecular Formula of Chlorine

Chlorine in its natural state exists as a diatomic molecule, meaning two chlorine atoms combine to form a molecule. The molecular formula for chlorine gas is written as:

$$\mathrm{Cl_2}$$

This diatomic nature arises because two chlorine atoms share a pair of electrons to complete their valence shells, forming a stable molecule.

The molecular formula of chlorine is $\mathrm{Cl_2}$.

Quick Tip

Quick Tip: Chlorine exists as a diatomic molecule ($\mathrm{Cl_2}$) in its elemental form due to the need for two chlorine atoms to share electrons and achieve a stable configuration.

(d) Name the type of bond in the formation of chlorine molecule.

Answer: Type of Bond in Chlorine Molecule

The type of bond formed in a chlorine molecule (Cl_2) is a **covalent bond**. This occurs because two chlorine atoms share a pair of electrons. By sharing electrons, both atoms achieve a stable electron configuration (octet rule), with each chlorine atom having 8 electrons in its valence shell.

The bond formed in a chlorine molecule (Cl_2) is a covalent bond.

Quick Tip

Quick Tip: In covalent bonding, atoms share electrons to achieve stability. The sharing of one pair of electrons in Cl_2 results in a single covalent bond.

(e) Draw the electron dot structure of a chlorine molecule.

Answer : Electron Dot Structure of a Chlorine Molecule
The electron dot structure, also known as the Lewis dot structure, of a chlorine molecule (Cl_2)

represents the sharing of electrons between two chlorine atoms. Each chlorine atom has 7 valence electrons, which can be shown as dots around the element symbol.

In the electron dot structure of Cl_2, the two chlorine atoms share one pair of electrons, forming a single covalent bond. The remaining six electrons on each chlorine atom are shown as non-bonding lone pairs.

Here, the shared pair of electrons is represented by the single line between the two Cl atoms, and the remaining non-bonding electrons are shown as dots around the atoms.

The electron dot structure of a chlorine molecule (Cl_2) shows two chlorine atoms sharing a single pair of electrons. Each chlorine atom has 7 valence electrons, with 6 electrons as lone pairs and 1 shared electron in the bond.

Quick Tip

Quick Tip: The electron dot structure helps visualize how atoms share electrons to form covalent bonds. In Cl_2, the shared pair of electrons gives each chlorine atom a full valence shell.
