

MH Board 2024 Science and Technology Part 1 (N640) Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :40	Total Questions :28
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General Instructions

Read the following instructions very carefully and strictly follow them:

- (i) *All questions are compulsory.*
- (ii) Use of a calculator is not allowed.
- (iii) The numbers to the right of the questions indicate full marks.
- (iv) In case of MCQs [Q. No. 1(A)] only the first attempt will be evaluated and will be given credit.
- (v) Scientifically correct, labeled diagrams should be drawn wherever necessary.

Q.1 (A) (i) The SI unit of heat is

[1]

- (A) Calorie
- (B) Joule
- (C) Kcal/kg °C
- (D) Cal/g °C

Correct Answer: (B) Joule

Solution:

Step 1: Understanding the SI unit of heat

The SI (International System of Units) unit for heat is **Joule (J)**. Heat is a form of energy, and in the SI system, energy is measured in Joules.

Step 2: Evaluating the given options

- **Calorie** is a non-SI unit of heat.
- **Joule** is the SI unit of heat.
- **Kcal/kg °C** is a unit of specific heat capacity, not heat itself.
- **Cal/g °C** is also a unit of specific heat capacity.

Thus, the correct answer is **Joule**.

💡 Quick Tip

The SI unit of heat is **Joule (J)**, while **Calorie** is a commonly used non-SI unit. Always remember, energy in physics is measured in Joules.

Q.1 (A) (ii) We can see the sun even when it is a little below the horizon because of

[1]

.....

(A) Reflection of light

(B) Refraction of light

(C) Dispersion of light

(D) Absorption of light

Correct Answer: (B) Refraction of light

Solution:

Step 1: Understanding atmospheric refraction

The phenomenon responsible for seeing the sun even when it is below the horizon is **atmospheric refraction**. The Earth's atmosphere consists of multiple layers of air with varying densities.

Step 2: How refraction causes the effect

When light from the sun enters the Earth's atmosphere, it bends due to the change in the optical density of air layers. This refraction makes the sun appear higher than its actual position, allowing us to see it even when it is geometrically below the horizon.

Step 3: Evaluating the given options

- **Reflection of light** occurs when light bounces off a surface, which is not responsible for this phenomenon.

- **Refraction of light** is the correct answer since bending of light in the atmosphere causes the effect.

- **Dispersion of light** refers to the splitting of white light into different colors, which is not relevant here.

- **Absorption of light** refers to the process in which light energy is absorbed and converted to heat, which is also incorrect.

Thus, the correct answer is **Refraction of light**.

 Quick Tip

Atmospheric refraction causes the apparent shift in the position of celestial objects. It is the reason why the sun appears to rise earlier and set later than its actual geometric position.

Q.1 (A) (iii) is the functional group of carboxylic acid.

[1]

(A) $-COOH$

(B) $-CO-$

(C) $-CHO-$

(D) $-OH$

Correct Answer: (A) $-COOH$

Solution:

Step 1: Understanding functional groups

A functional group is a specific group of atoms within a molecule that is responsible for the characteristic chemical reactions of that molecule.

Step 2: Identifying the functional group of carboxylic acids

Carboxylic acids are organic compounds that contain the **carboxyl functional group** ($-COOH$). This group consists of a carbonyl ($-C = O$) and a hydroxyl ($-OH$) group attached to the same carbon atom.

Step 3: Evaluating the given options

- $-COOH$ is the correct answer since it is the carboxyl functional group.
- $-CO-$ represents a carbonyl group, found in ketones but not exclusive to carboxylic acids.
- $-CHO-$ represents an aldehyde functional group, not carboxyl.
- $-OH$ represents a hydroxyl group, found in alcohols but not the defining functional group of carboxylic acids.

Thus, the correct answer is **$-COOH$** .

💡 Quick Tip

The carboxyl functional group ($-COOH$) is characteristic of carboxylic acids. It consists of both a carbonyl ($-C = O$) and hydroxyl ($-OH$) group attached to the same carbon atom.

Q.1 (A) (iv) In a simple microscope, lens is used.

[1]

- (A) Concave
- (B) Plano concave
- (C) Plano convex
- (D) Convex

Correct Answer: (D) Convex

Solution:

Step 1: Understanding the working of a simple microscope

A simple microscope is an optical device used to magnify small objects. It consists of a **single convex lens** that produces an enlarged, virtual, and erect image of the object.

Step 2: Identifying the correct lens

A **convex lens** converges light rays, making it suitable for magnification. When an object is placed between the **focus and the optical center** of a convex lens, it forms a virtual, upright, and magnified image, which is essential for a simple microscope.

Step 3: Evaluating the given options

- **Concave lens:** Produces a diminished, virtual image, not used in simple microscopes.
- **Plano concave lens:** Used for beam expansion but does not magnify images.
- **Plano convex lens:** Has one flat and one convex surface, used in optical applications but not commonly for simple microscopes.
- **Convex lens:** Correct choice as it magnifies objects when used in simple microscopes.

Thus, the correct answer is **Convex lens**.

💡 Quick Tip

A **convex lens** is used in a simple microscope because it converges light rays and magnifies the object, producing a virtual and enlarged image.

Q.1 (A) (v) In process, a layer of molten tin is deposited on metals. [1]

(A) **Anodization**

(B) **Tinning**

(C) **Galvanizing**

(D) **Alloying**

Correct Answer: (B) Tinning

Solution:

Step 1: Understanding the process of tinning

Tinning is the process of coating a metal, usually iron or steel, with a thin layer of molten tin to prevent corrosion and enhance durability.

Step 2: Why tinning is used

- Tin is corrosion-resistant and protects the base metal from rusting. - It is commonly used for food containers, kitchen utensils, and electrical components.

Step 3: Evaluating the given options

- **Anodization:** Electrochemical process used to thicken the oxide layer on metals like aluminum, not related to tin coating.

- **Tinning:** Correct choice as it involves applying molten tin to a metal surface.

- **Galvanizing:** Coating metal with zinc, not tin.

- **Alloying:** Mixing metals to form an alloy, not a coating process.

Thus, the correct answer is **Tinning**.

 Quick Tip

Tinning is a process where a thin layer of tin is applied to metal surfaces to prevent corrosion. It is different from **galvanizing**, which uses zinc instead of tin.

Q.1 (B) Answer the following:

Q.1 (B) (i) Write the name of the atom having the smallest size. [1]

Correct Answer: Hydrogen

Solution:

Step 1: Understanding atomic size

The size of an atom is determined by the distance of the outermost electrons from the nucleus. It is influenced by the number of protons, electrons, and energy levels.

Step 2: Identifying the smallest atom

- **Hydrogen** (H) has only one proton and one electron, making it the smallest atom in the periodic table. - It has only one energy level ($n = 1$), which is the closest possible shell to the nucleus. - As there are no inner electrons to shield the nucleus, the electron remains tightly bound, resulting in a small atomic radius.

Step 3: Comparison with other elements

- **Helium** (He) has a small atomic size but experiences greater nuclear attraction due to two protons, making it slightly smaller in some cases but still comparable to hydrogen. - **Lithium** (Li) and other elements have larger atomic radii due to additional energy levels.

Thus, the correct answer is **Hydrogen**.

💡 Quick Tip

The atomic size of an element depends on the number of protons, electrons, and occupied energy levels. **Hydrogen** has the smallest atomic radius because it has only one proton and one electron in the first energy level.

Q.1 (B) (ii) Write the molecular formula of calcium carbonate.

[1]

Correct Answer: CaCO_3

Solution:

Step 1: Understanding calcium carbonate

Calcium carbonate is a chemical compound composed of calcium (Ca), carbon (C), and oxygen (O).

Step 2: Writing the molecular formula

- Calcium (Ca^{2+}) is a divalent cation. - Carbonate (CO_3^{2-}) is a polyatomic anion. - Since their charges balance each other (+2 and -2), they combine in a 1:1 ratio, forming the molecular formula CaCO_3 .

Thus, the correct molecular formula of calcium carbonate is CaCO_3 .

💡 Quick Tip

Calcium carbonate (CaCO_3) is commonly found in limestone, chalk, and marble. It is used in construction, medicine (as an antacid), and as a key ingredient in cement.

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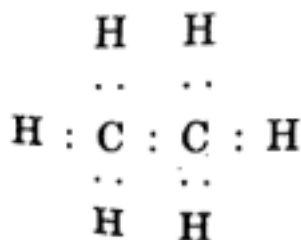
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💡 Quick Tip

Calcium carbonate (CaCO_3) is commonly found in limestone, chalk, and marble. It is used in construction, medicine (as an antacid), and as a key ingredient in cement.

Q.1 (B) (iv) Identify the hydrocarbon from the given electron-dot structure:

[1]



Correct Answer: Ethene (C₂H₄)

Solution:

Step 1: Understanding the given electron-dot structure

The given structure consists of: - Two **carbon** (C) atoms, each forming a double bond. - Four **hydrogen** (H) atoms surrounding the carbon atoms. - Each carbon shares two electrons with the other carbon, forming a **double bond** (C = C).

Step 2: Identifying the hydrocarbon

- Hydrocarbons are compounds made up of **carbon and hydrogen** atoms. - The presence of a **double bond** between two carbon atoms indicates it belongs to the **alkene** family. - The molecular formula of this compound is C₂H₄, which corresponds to **ethene (ethylene)**. Thus, the correct answer is **Ethene** (C₂H₄).

💡 Quick Tip

Alkanes have only single bonds, **alkenes** contain double bonds, and **alkynes** contain triple bonds. **Ethene** (C₂H₄) is the simplest alkene with a **C=C** double bond.

Q.1 (B) (v) Match the Columns:

[1]

Column 'A'	Column 'B'
Refractive index of water	(a) 1.31
	(b) 1.36
	(c) 1.33

Correct Answer: Refractive index of water = (c) 1.33

Solution:

Step 1: Understanding the refractive index

The refractive index (*n*) of a medium is the ratio of the speed of light in a vacuum to the speed of light in that medium.

Step 2: Identifying the correct value for water

- The standard refractive index of **water** is **1.33**. - This value is determined experimentally and used in optics calculations.

Step 3: Matching with given options

- **1.31** is close but corresponds to some organic liquids. - **1.36** is typical for some oils and other transparent liquids. - **1.33** is the correct refractive index of water.

Thus, the correct match is **Refractive index of water = (c) 1.33**.

💡 Quick Tip

The **refractive index** of a material measures how much light bends when entering it. The refractive index of **water is 1.33**, meaning light slows down and bends when passing through water.

Q.2 (A) Give scientific reasons (any two): [4]

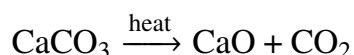
Q.2 (A) (i) When the gas formed on heating limestone is passed through freshly prepared lime water, the lime water turns milky. [2]

Correct Answer: The gas formed on heating limestone is carbon dioxide (CO₂), which reacts with lime water (Ca(OH)₂) to form calcium carbonate (CaCO₃), making the solution appear milky.

Solution:

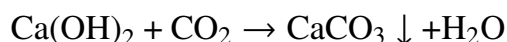
Step 1: Identifying the gas produced

- Limestone (CaCO₃) is heated to produce **carbon dioxide** gas. - The reaction is:



Step 2: Reaction with lime water

- The released CO₂ is bubbled through freshly prepared **lime water** (Ca(OH)₂). - A chemical reaction occurs:



- Calcium carbonate (CaCO₃) is **insoluble in water** and forms a white precipitate, making lime water appear milky.

Step 3: Conclusion

- The milkiness confirms the presence of CO₂. - If excess CO₂ is passed, the milkiness disappears due to the formation of **soluble calcium bicarbonate** (Ca(HCO₃)₂).

Thus, the lime water turns milky due to the formation of **insoluble calcium carbonate** (CaCO₃).

💡 Quick Tip

To test for **carbon dioxide** gas, pass it through freshly prepared **lime water**. If the solution turns **milky**, it confirms the presence of CO₂. Excess CO₂ dissolves the precipitate, making the solution clear again.

Q.2 (A) (ii) Tungsten metal is used to make a solenoid-type coil in an electric bulb. [2]

Correct Answer: Tungsten is used in electric bulbs because of its high melting point and ability to emit light efficiently when heated.

Solution:

Step 1: Understanding the choice of tungsten

- Tungsten (W) is a metal with a **very high melting point** of approximately **3422°C**. - When an electric current passes through tungsten, it gets heated to high temperatures and emits visible light.

Step 2: Why tungsten is used in the form of a solenoid-type coil

- The filament inside an electric bulb is a **coiled tungsten wire**.
- The coil shape: - **Increases the length** of the wire, allowing more resistance.
- **Concentrates heat**, increasing efficiency.
- **Reduces heat loss**, ensuring it remains at high temperatures to emit bright light.

Step 3: Properties making tungsten ideal for bulbs

- **High melting point**: Prevents it from melting under extreme heat.
- **High resistivity**: Converts electrical energy into heat effectively.
- **Low evaporation rate**: Ensures durability inside the vacuum/sealed gas bulb.

Thus, tungsten is used in electric bulbs due to its **high melting point, resistivity, and efficient light emission**.

💡 Quick Tip

Tungsten is ideal for electric bulbs because it has a **high melting point** (3422°C) and emits visible light efficiently when heated. The coiled filament structure maximizes brightness and durability.

Q.2 (A) (iii) On exposure to air, silver articles turn blackish after some time. [2]

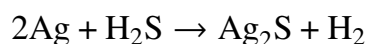
Correct Answer: Silver articles turn black due to the formation of silver sulfide (Ag_2S) when they react with hydrogen sulfide (H_2S) present in the air.

Solution:**Step 1: Understanding the blackening of silver**

Silver (Ag) is a metal that reacts slowly with sulfur-containing compounds in the air. One such compound is **hydrogen sulfide** (H_2S), which is present in polluted air or released from decaying organic matter.

Step 2: The chemical reaction involved

When silver comes in contact with hydrogen sulfide, it reacts to form **silver sulfide** (Ag_2S), a black compound:



This reaction causes the gradual **blackening** of silver articles.

Step 3: Preventive measures

- Storing silver articles in airtight containers or wrapping them in anti-tarnish cloths helps prevent tarnishing.
 - Regular cleaning with mild acids like vinegar or lemon juice can help remove silver sulfide.
- Thus, silver articles turn black due to the formation of **silver sulfide** (Ag_2S) when exposed to air containing **hydrogen sulfide** (H_2S).

💡 Quick Tip

Silver tarnishing occurs due to the reaction with **hydrogen sulfide** in the air, forming **silver sulfide** (Ag_2S), which is black. To prevent tarnishing, store silver in airtight containers and clean it regularly.

Q.2 (B) Answer the following (any three):**[6]**

Q.2 (B) (i) State Dobereiner's law of triads. Give *one* example of it. [2]

Correct Answer: Dobereiner's law of triads states that when elements are arranged in groups of three (triads) in increasing order of atomic masses, the atomic mass of the middle element is approximately the average of the atomic masses of the first and third elements.

Solution:

Step 1: Understanding Dobereiner's law of triads

In **1829**, Johann Wolfgang Dobereiner proposed the **law of triads** as an early attempt to classify elements. He observed that certain elements with **similar chemical properties** could be grouped into sets of three, called **triads**.

The key pattern in a triad is:

$$\text{Atomic mass of middle element} \approx \frac{\text{Atomic mass of first element} + \text{Atomic mass of third element}}{2}$$

Step 2: Example of a Dobereiner triad

One of the well-known triads is the **alkali metal triad**:

Element	Atomic Mass (u)
<i>Lithium</i> (Li)	7
<i>Sodium</i> (Na)	23
<i>Potassium</i> (K)	39

Here, the atomic mass of sodium (Na) is approximately the average of lithium (Li) and potassium (K):

$$\frac{7 + 39}{2} = 23$$

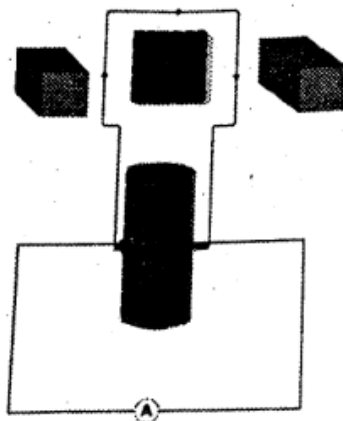
This follows Dobereiner's rule.

Thus, Dobereiner's triads provided early evidence of periodic relationships between elements.

💡 Quick Tip

Dobereiner's **law of triads** was an early attempt to classify elements based on their atomic masses. Although limited in scope, it laid the foundation for future periodic table developments.

Q.2 (B) (ii) Identify the figure and explain its use. [2]



Correct Answer: The given figure represents an **electric bell**. It is used to convert electrical energy into sound energy through electromagnetism.

Solution:

Step 1: Identifying the figure

The diagram shows an **electric bell**, a common application of electromagnets in daily life.

Step 2: Working principle

- When an electric current passes through the coil, it acts as an **electromagnet**. - The electromagnet attracts the iron armature, causing the hammer to strike the bell. - This movement breaks the circuit momentarily, deactivating the electromagnet. - The armature returns to its original position, reconnecting the circuit and repeating the process, producing a continuous ringing sound.

Step 3: Uses of an electric bell

- Used in **schools, homes, and industries** as a signaling device. - Used in **alarm systems** for security alerts. - Common in **telephone ringers** and buzzers.

Thus, the electric bell operates using the **principle of electromagnetism** to produce sound.

💡 Quick Tip

An **electric bell** converts electrical energy into sound energy using **electromagnets**. It operates by attracting and releasing a metal armature repeatedly to strike a bell.

Q.2 (B) (iii) What is meant by satellite launch vehicle? Name any *one* Indian satellite launch vehicle. [2]

Correct Answer: A satellite launch vehicle is a rocket designed to transport satellites into space. One example of an Indian satellite launch vehicle is the **Polar Satellite Launch Vehicle (PSLV)**.

Solution:

Step 1: Understanding satellite launch vehicles

A **satellite launch vehicle** is a special type of rocket used to place artificial satellites into their designated orbits around the Earth. These vehicles provide the thrust required to overcome Earth's gravity.

Step 2: Working of a satellite launch vehicle

- The launch vehicle consists of multiple **stages** that ignite sequentially to propel the satellite into orbit. - It operates using **liquid or solid propellants** for thrust. - Once the satellite reaches its orbit, the rocket detaches, allowing the satellite to function independently.

Step 3: Example of an Indian satellite launch vehicle

One of India's most successful satellite launch vehicles is the **Polar Satellite Launch Vehicle (PSLV)**. It was developed by the **Indian Space Research Organisation (ISRO)** and is known for its reliability and capability to launch multiple satellites in a single mission. Thus, a satellite launch vehicle helps deploy satellites into space, and **PSLV** is a widely used launch vehicle in India.

💡 Quick Tip

The **Polar Satellite Launch Vehicle (PSLV)** is India's most successful satellite launch vehicle, used to place satellites into polar orbits. Another example is the **Geosynchronous Satellite Launch Vehicle (GSLV)**, which is used for heavier payloads.

Q.2 (B) (iv) What is free fall? When is it possible? [2]

Correct Answer: Free fall is the motion of a body under the influence of gravity alone, without any external force. It is possible in the absence of air resistance, such as in a vacuum.

Solution:

Step 1: Understanding free fall

- When an object falls freely under the influence of **gravity alone**, it is said to be in **free fall**.
- There is no external force like air resistance acting on it. - The only force acting on the object is its **weight**, which causes it to accelerate downward with an acceleration equal to $g = 9.8 \text{ m/s}^2$.

Step 2: When is free fall possible?

- Free fall occurs in the **absence of air resistance**. This means that objects falling in a **vacuum** experience true free fall. - In reality, on Earth, air resistance affects falling objects. However, in space or vacuum chambers, objects experience pure free fall. - A good example is **astronauts in orbit**. They are in a continuous state of free fall around Earth, experiencing weightlessness.

Thus, free fall is the motion of an object under gravity alone, and it is possible when air resistance is negligible or in a vacuum.

💡 Quick Tip

Free fall occurs when an object moves under the influence of **gravity alone**. It is truly possible in a **vacuum** where there is no air resistance.

Q.2 (B) (v) The focal length of a convex lens is 20 cm. What is its power? [2]

Correct Answer: The power of the convex lens is $+5D$.

Solution:

Step 1: Understanding lens power formula

The power (P) of a lens is given by the formula:

$$P = \frac{100}{f}$$

where: - P = power of the lens (in diopters, D), - f = focal length of the lens (in centimeters).

Step 2: Substituting the given values

The given focal length is:

$$f = 20 \text{ cm} = 0.20 \text{ m}$$

Applying the formula:

$$P = \frac{100}{20} = 5D$$

Step 3: Determining the sign of power

- A **convex lens** has a **positive focal length**, so the power is **positive**. - Thus, the final answer is:

$$+5D$$

Thus, the power of the convex lens is **+5 diopters (D)**.

💡 Quick Tip

The power (P) of a lens is calculated using $P = \frac{100}{f}$. A **convex lens** has **positive power**, while a **concave lens** has **negative power**.

Q.3 Answer the following (any five):

[15]

Q.3 (i) Select the appropriate options and complete the following paragraph:

[3]

Options: (Metals, non-metals, metalloids, four, seven, s-block, p-block, d-block, f-block)

On the basis of electronic configuration, elements in the modern periodic table are classified into **four** blocks. Groups 1 and 2 elements are included in the **s-block** and all these elements are metals (except Hydrogen).

Group 13 to 18 elements are included in the **p-block**. This block contains metals, non-metals, and metalloids.

Group 3 to 10 elements are included in the **d-block** and all the elements are metals.

f-block elements shown at the bottom of the periodic table i.e. Lanthanides and Actinides constitute the **f-block**, and all these elements are metals.

💡 Quick Tip

The modern periodic table classifies elements into **four** blocks (**s, p, d, and f**) based on their **electronic configuration**. The **s-block** contains alkali and alkaline earth metals, while the **p-block** includes metals, non-metals, and metalloids.

Q.3 (ii) (a) What are the factors affecting the rate of chemical reaction?

[2]

Correct Answer: The factors affecting the rate of a chemical reaction are:

- **Concentration of reactants**

- **Temperature**
- **Surface area of reactants**
- **Presence of a catalyst**
- **Pressure (for gaseous reactions)**
- **Nature of reactants**
- **Light (for photochemical reactions)**

Solution:

Step 1: Understanding reaction rate

The **rate of a chemical reaction** refers to how quickly reactants are converted into products. Various factors influence the reaction speed.

Step 2: Explanation of factors

- **Concentration:** Higher reactant concentration increases the rate due to more frequent collisions.
- **Temperature:** Raising temperature increases particle movement, leading to more effective collisions.
- **Surface area:** Smaller particle size exposes more surface area, increasing the reaction rate.
- **Catalyst:** A catalyst speeds up a reaction without being consumed.
- **Pressure:** In gaseous reactions, higher pressure increases the reaction rate.
- **Nature of reactants:** Some substances react faster due to their chemical properties.
- **Light:** Some reactions, like photosynthesis, require light energy.

Q.3 (ii) (b) Explain any *one* factor.

[2]

Correct Answer: Effect of Temperature: Increasing temperature increases the reaction rate by providing particles with more energy to collide and react.

Solution:

Step 1: How temperature affects reaction rate

- When temperature increases, molecules move **faster** due to increased kinetic energy. - Faster movement results in **more frequent and energetic collisions** between reactant molecules. - The activation energy barrier is more easily overcome, leading to a higher reaction rate.

Step 2: Example

- The reaction between hydrochloric acid and magnesium occurs **faster at higher temperatures**. - Food spoils quicker in warm conditions due to faster chemical decomposition.

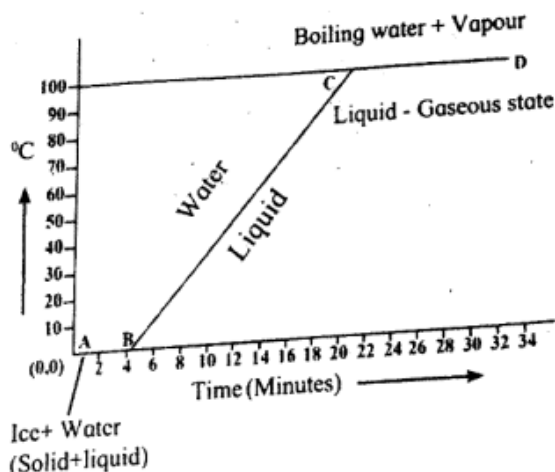
Thus, increasing temperature significantly increases the rate of a chemical reaction.

💡 Quick Tip

The **rate of a chemical reaction** depends on multiple factors. **Temperature** is one of the most important—higher temperatures increase particle movement, leading to **faster reactions**.

Q.3 (iii) Observe the following graph and answer the following questions:

[3]



(a) What does the graph represent? [1]

Correct Answer: The graph represents the **heating curve of water**, showing phase changes from solid (ice) to liquid (water) and then to gaseous state (steam).

Solution:

Step 1: Understanding the graph

- The graph shows **temperature vs. time** for water during heating. - It illustrates the phase transitions of water from **solid** to **liquid** and then to **gas**. - The flat portions indicate **phase changes**, where heat energy is used to break intermolecular bonds instead of increasing temperature.

Thus, this graph is a **heating curve** that demonstrates the phase transitions of water.

(b) What does the line AB represent? [1]

Correct Answer: The line **AB** represents the **melting process** where ice converts into water at 0°C .

Solution:

Step 1: Identifying the line AB

- The segment **AB** is a horizontal line, indicating a phase change. - This shows the **melting of ice** at a constant temperature of 0°C . - During this process, heat is absorbed to break the bonds in ice, converting it into liquid water.

Thus, **AB** represents the **melting of ice into water** at 0°C .

(c) What does the line BC represent? [1]

Correct Answer: The line **BC** represents the **heating of water**, where its temperature increases from 0°C to 100°C .

Solution:

Step 1: Identifying the line BC

- The segment **BC** is an upward-sloping line, indicating an increase in temperature. - This represents the **heating of water** after complete melting. - Water absorbs heat energy, which increases its temperature from 0°C to 100°C .

Thus, **BC** represents the **heating of water** from 0°C to 100°C , preparing for boiling.

💡 Quick Tip

The **heating curve of water** shows phase changes at **constant temperature**. The line **AB** represents melting at 0°C , while **BC** represents heating of water up to 100°C .

Q.3 (iv) Complete the following table by observing the given figures:

[3]

Points	Figure 1	Figure 2
(a) Name of the defect	_____	_____
(b) Position of the image	_____	_____
(c) Lens used to correct the defect	_____	_____

Figure 1:

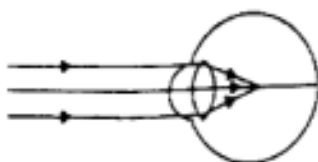
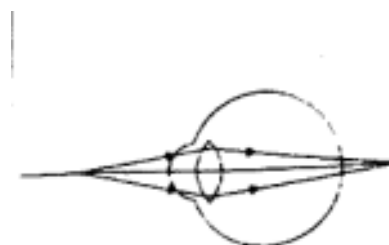


Figure 2:



Correct Answer:

- **Figure 1:** Myopia (Nearsightedness)
- **Figure 2:** Hypermetropia (Farsightedness)

Solution:

Step 1: Understanding eye defects

Human vision defects occur when light rays do not focus properly on the retina. Two common defects are:

- **Myopia (Nearsightedness):** The eye can see nearby objects clearly but distant objects appear blurred.
- **Hypermetropia (Farsightedness):** The eye can see distant objects clearly but nearby objects appear blurred.

Step 2: Explanation of the figures

Figure 1 - Myopia: - The image forms **in front** of the retina. - This happens due to the **elongation** of the eyeball or excessive curvature of the lens. - Corrected using a **concave lens**, which diverges light rays before they enter the eye, shifting the image onto the retina.

Figure 2 - Hypermetropia: - The image forms **behind** the retina. - This occurs due to the **shortening** of the eyeball or insufficient curvature of the lens. - Corrected using a **convex lens**, which converges light rays before entering the eye, shifting the image onto the retina.

Step 3: Completing the table

Points	Figure 1 (Myopia)	Figure 2 (Hypermetropia)
(a) Name of the defect	Myopia (Nearsightedness)	Hypermetropia (Farsightedness)
(b) Position of the image	In front of the retina	Behind the retina
(c) Lens used to correct the defect	Concave lens	Convex lens

💡 Quick Tip

Myopia is corrected using a **concave lens**, while **hypermetropia** is corrected using a **convex lens**. Both defects are due to improper focusing of light on the retina.

Q.3 (v) Write any *three* general properties of ionic compounds.

[3]

Correct Answer: The three general properties of ionic compounds are:

- **High melting and boiling points**
- **Solubility in water**
- **Electrical conductivity in molten or dissolved state**

Solution:

Step 1: Understanding ionic compounds

- Ionic compounds are formed due to the **electrostatic attraction** between positively charged ions (**cations**) and negatively charged ions (**anions**). - This strong attraction gives ionic compounds unique properties.

Step 2: General properties of ionic compounds

1. **High melting and boiling points:** - Ionic bonds are **strong** and require a large amount of energy to break. - This results in high melting and boiling points. - Example: Sodium chloride (NaCl) has a high melting point of 801°C.

2. **Solubility in water:** - Ionic compounds dissolve in **polar solvents** like water. - Water molecules separate the positive and negative ions, allowing them to disperse.

3. **Electrical conductivity in molten or dissolved state:** - In solid form, ionic compounds **do not conduct electricity** because ions are fixed in a lattice. - In molten or aqueous solution, the ions are free to move, allowing them to **conduct electricity**.

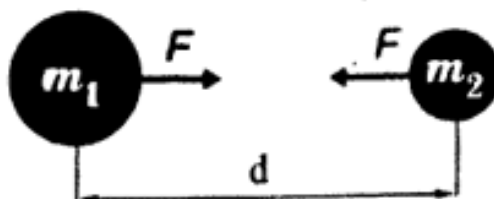
Thus, ionic compounds exhibit **high melting points, solubility in water, and electrical conductivity in liquid state**.

💡 Quick Tip

Ionic compounds have **strong electrostatic forces**, leading to **high melting points**. They conduct electricity only in **molten or dissolved state** due to free-moving ions.

Q.3 (vi) Observe the figure and answer the questions:

[3]



(a) State Newton's universal law of gravitation.

[1]

Correct Answer: Newton's universal law of gravitation states that every mass in the universe attracts every other mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Solution:

Step 1: Understanding Newton's law of gravitation

- According to Newton's universal law of gravitation, the gravitational force (F) between two objects of masses m_1 and m_2 separated by a distance d is given by:

$$F = G \frac{m_1 m_2}{d^2}$$

where G is the universal gravitational constant.

- This law explains that: - The force increases with increasing mass (m_1 and m_2). - The force decreases as the distance (d) between the masses increases.

Thus, every object in the universe exerts a gravitational force on every other object.

(b) If the distance between the two bodies is tripled, how will the gravitational force between them change?

[1]

Correct Answer: If the distance is tripled, the gravitational force decreases by a factor of 9.

Solution:

Step 1: Applying the inverse square law

- The gravitational force is inversely proportional to the **square of the distance**:

$$F \propto \frac{1}{d^2}$$

Step 2: Effect of tripling the distance

- If the original distance is d , and it is tripled to $3d$, then:

$$F' = G \frac{m_1 m_2}{(3d)^2}$$

- This simplifies to:

$$F' = \frac{F}{9}$$

Thus, the gravitational force decreases to $\frac{1}{9}$ th of its original value.

(c) What will happen to the gravitational force if the mass of one of the objects is doubled?

[1]

Correct Answer: If the mass of one object is doubled, the gravitational force also doubles.

Solution:

Step 1: Effect of increasing mass

- The gravitational force is directly proportional to the product of the two masses:

$$F \propto m_1 m_2$$

Step 2: Doubling the mass

- If one mass (e.g., m_1) is doubled:

$$F' = G \frac{(2m_1)m_2}{d^2}$$

- This simplifies to:

$$F' = 2F$$

Thus, doubling the mass of one object doubles the gravitational force.

 Quick Tip

Gravitational force follows the inverse-square law. If distance is tripled, force reduces by a factor of **9**. If the mass of one object is doubled, the force **doubles**.

Q.3 (vii) The orbit of a satellite is exactly 35780 km above the Earth's surface and its tangential velocity is 3.08 km/s.

How much time will the satellite take to complete one revolution around the Earth?

(Radius of Earth = 6400 km.)

[3]

Correct Answer: The time taken by the satellite to complete one revolution around the Earth is **24** hours.

Solution:

Step 1: Understanding the given data

- **Height of the satellite's orbit:** $h = 35780$ km
- **Radius of Earth:** $R = 6400$ km
- **Tangential velocity:** $v = 3.08$ km/s

Step 2: Finding the orbital radius

The satellite moves in a circular orbit around Earth. The total orbital radius r is:

$$r = R + h$$

$$r = 6400 + 35780 = 42180 \text{ km}$$

Step 3: Finding the circumference of the orbit

The satellite travels along a circular path. The circumference (C) of the orbit is given by:

$$C = 2\pi r$$

$$C = 2 \times 3.1416 \times 42180$$

$$C \approx 264983.3 \text{ km}$$

Step 4: Calculating the time period

The time period T is the total distance traveled divided by the velocity:

$$T = \frac{\text{Circumference}}{\text{Velocity}}$$

$$T = \frac{264983.3}{3.08}$$

$$T \approx 86000 \text{ seconds}$$

Converting to hours:

$$T = \frac{86000}{3600} \approx 23.89 \text{ hours}$$

Thus, the time taken by the satellite to complete one revolution is approximately **24 hours**.

💡 Quick Tip

A geostationary satellite orbits at an altitude of **35780 km** and takes **24 hours** to complete one revolution, which matches Earth's rotation period.

Q.3 (viii) What is a solenoid? Draw a neat diagram and name its various components.
[3]

Correct Answer: A solenoid is a long coil of wire wound in the shape of a cylinder, which produces a magnetic field when an electric current passes through it.

Solution:

Step 1: Definition of a solenoid

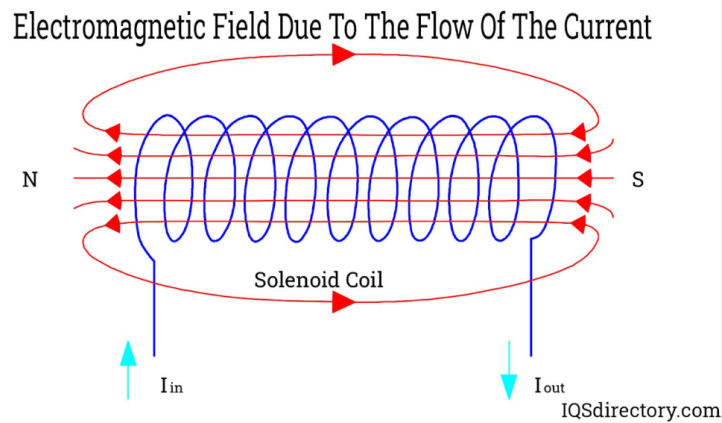
A **solenoid** is a cylindrical coil of insulated wire that acts like a magnet when an electric current flows through it. It produces a **uniform magnetic field** similar to a bar magnet, with a **north** and **south pole**.

Step 2: Working of a solenoid

When an electric current passes through the solenoid, it generates a **magnetic field** inside and around it. The field strength depends on:

- The number of turns in the coil.
- The current flowing through the coil.
- The core material inside the solenoid.

Step 3: Diagram of a solenoid



Step 4: Components of a solenoid

1. **Coil of wire** – Conducting wire wound in a cylindrical shape.
2. **Current source** – A battery or power supply providing electric current.
3. **Magnetic field lines** – Represent the magnetic field around the solenoid.
4. **Core (optional)** – A ferromagnetic material inside the coil to strengthen the field.

Step 5: Applications of a solenoid

- Used in **electromagnets, relays, and electric bells**. - Found in **MRI machines, solenoid valves, and inductors**.

Thus, a solenoid is an important component in electrical and magnetic applications.

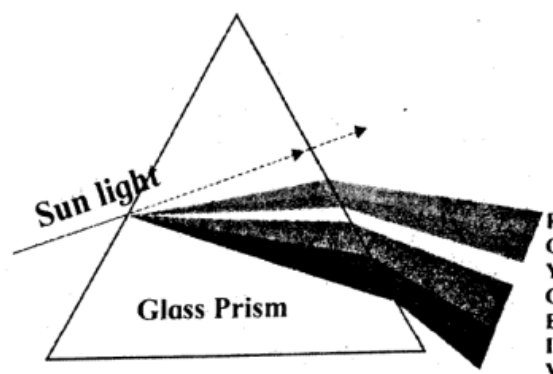
A **solenoid** is a coil of wire that generates a **magnetic field** when electricity flows through it. Adding an **iron core** strengthens the field, making it an **electromagnet**.

💡 Quick Tip

A **solenoid** is a coil of wire that generates a **magnetic field** when electricity flows through it. The field inside a solenoid is **strong and uniform**. Adding an **iron core** strengthens the field, making it an **electromagnet**.

Q.4 (i) Observe the given diagram and answer the questions:

[5]



(a) Name the process shown in the figure.

[1]

Correct Answer: The process shown in the figure is **Dispersion of Light**.

Solution:

Step 1: Understanding dispersion

- Dispersion of light occurs when **white light** passes through a **glass prism**, splitting into its component colors. - This happens due to **different refractive indices** for each wavelength of light in the prism material.

(b) Name the colour that deviates the most.

[1]

Correct Answer: **Violet** light deviates the most.

Solution:

Step 2: Why violet deviates the most?

- The refractive index of glass is highest for **violet light**, so it bends the most. - Shorter wavelengths experience **greater refraction**, causing violet to be at the bottom of the spectrum.

(c) Name the colour that deviates the least.

[1]

Correct Answer: **Red** light deviates the least.

Solution:

Step 3: Why red deviates the least?

- The refractive index of glass is lowest for **red light**, so it bends the least. - Longer wavelengths undergo **less refraction**, making red appear at the top of the spectrum.

(d) Name any *one* phenomenon in nature which is based on the above process.

[1]

Correct Answer: The **formation of a rainbow** is based on the dispersion of light.

Solution:

Step 4: How is a rainbow formed?

- A rainbow is formed when sunlight is dispersed by raindrops. - The water droplets act as **tiny prisms**, splitting sunlight into the spectrum of colors. - This creates a beautiful arc of colors in the sky.

(e) Define ‘spectrum’.

[1]

Correct Answer: A **spectrum** is the band of seven colors obtained when white light is dispersed.

Solution:

Step 5: Understanding the spectrum

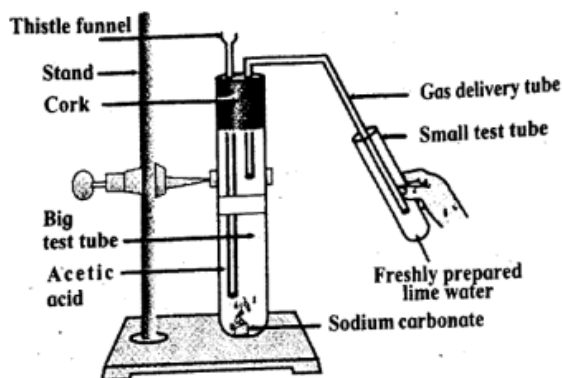
- The spectrum consists of **seven distinct colors**: Red, Orange, Yellow, Green, Blue, Indigo, and Violet (**VIBGYOR**). - These colors appear in order of their **wavelengths**, with red having the longest and violet the shortest.

💡 Quick Tip

Dispersion of light occurs when white light splits into its component colors. This happens due to the different **refractive indices** of colors in a medium, with **violet** bending the most and **red** bending the least.

Q.4 (ii) Observe the diagram given below and answer the questions:

[5]



(a) Name the reactants in this reaction. [1]

Correct Answer: The reactants in this reaction are **acetic acid** (CH_3COOH) and **sodium carbonate** (Na_2CO_3).

Solution:

Step 1: Identifying the reactants

- The experiment involves a reaction between **acetic acid** and **sodium carbonate**. - This reaction produces **carbon dioxide** gas along with a salt and water.

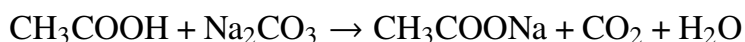
(b) Which gas comes out as effervescence in the bigger test tube? [1]

Correct Answer: The gas released in effervescence is **carbon dioxide** (CO_2).

Solution:

Step 2: Understanding the gas formation

- When sodium carbonate reacts with acetic acid, **carbon dioxide** gas is produced as a byproduct. - The reaction is:



- The bubbles observed in the reaction are due to the release of CO_2 .

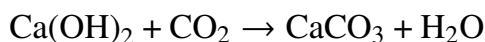
(c) What is the colour change in the lime water? [1]

Correct Answer: The lime water turns **milky** due to the presence of CO_2 .

Solution:

Step 3: Effect of CO_2 on lime water

- The carbon dioxide gas produced reacts with **lime water** ($\text{Ca}(\text{OH})_2$), forming **calcium carbonate** (CaCO_3). - The reaction is:



- Calcium carbonate is **insoluble**, giving lime water a **milky appearance**.

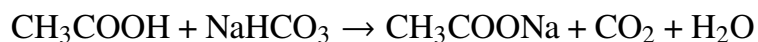
(d) In the above experiment, instead of sodium carbonate, which chemical can be used to get the same products? [1]

Correct Answer: **Sodium bicarbonate** (NaHCO_3) can be used instead of sodium carbonate.

Solution:

Step 4: Alternative reactant

- Sodium bicarbonate (NaHCO_3) also reacts with **acetic acid**, producing CO_2 , water, and a salt. - The reaction is:



- This reaction produces the same gas and effect as sodium carbonate.

(e) Write the use of acetic acid.**[1]**

Correct Answer: Acetic acid is commonly used in the preparation of **vinegar** and as a **preservative**.

Solution:

Step 5: Uses of acetic acid

- Acetic acid is a key component of **vinegar**, giving it its sour taste. - It is used as a **food preservative** to prevent spoilage. - In industry, it is used in **plastics, textiles, and pharmaceuticals**.

💡 Quick Tip

Carbon dioxide gas turns **lime water milky** due to the formation of **calcium carbonate**. This is a common test for detecting CO_2 .