UPSC CDS EXAM 2019 TO 2024

PREVIOUS YEAR QUESTIONS *for* Chemistry

Last 11 PYQs Papers in ONE LECTURE

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EX: AC, BSF

CDS 2019 (1 and 2) PYQs Chemistry

Q. Match List-I with List-II and select the correct answer using the code given below the Lists: [2019-II]

List I (Compound/Molecule)	List II (Shape of Molecule)
(a) CH_3F	1. Trigonal planar
(b) HCHO	2. Tetrahedral
(c) HCN	3. Trigonal pyramidal
(d) NH_3	4. Linear

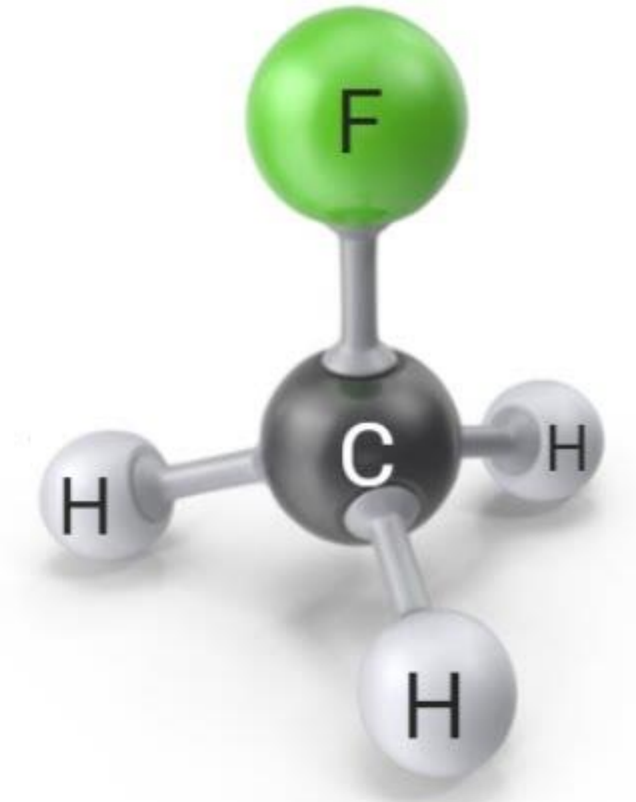
CODES :-

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

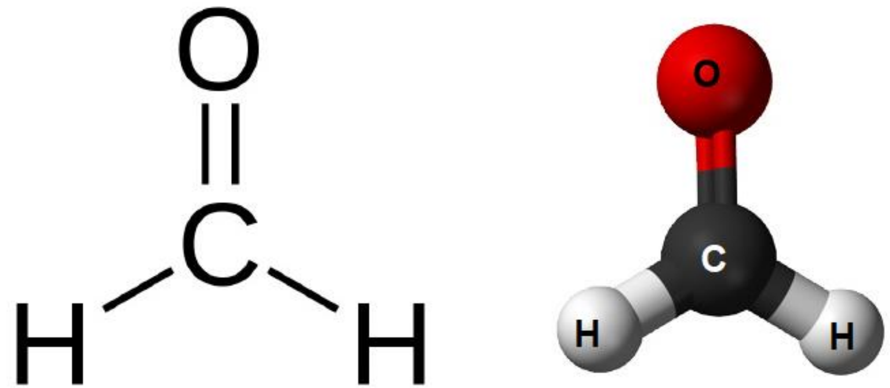
Hybridization	LP	Molecular Geometry (Regular/Normal)	Approximate Bond Angles (Degree)	Examples	LP	Molecular Geometry (Sub-normal)	Approximate Bond Angles (Degree)	Example
sp	0	Linear	180	CO_2, CS_2, $BeCl_2$, $HgCl_2$	-	-	-	-
sp^2	0	Trigonal Planar or Triangular planar	120	BH_3, $AlCl_3$, C_2H_4, BCl_3, BF_3, NO_3^-, CO_3^{2-}	01	Angular or V-shape	<120	SO_2, NO_2^-
sp^3	0	Tetrahedral	109.5	BH_4^-, BF_4^-, $SnCl_4$, H_2SO_4, $HClO_4$, $SiCl_4$	01	Pyramidal	<109.5	NH_3, PH_3, AsH_3
					02	Bent shape or V-shape	<109.5	H_2O, H_2S, H_2Se
					03	Linear	180	ICl, BrF, ClF
sp^3d	0	Trigonal bipyramid	120 (equatorial) 90 (axial)	PF_5, PCl_5	01	See-Saw	<120 (equatorial) <90 (axial)	SF_4
					02	T-shape	<90	ICl_3, F_3Cl
					03	Linear	180	XeF_2, I_3^-
sp^3d^2	0	Octahedral	90	SF_6, WF_6, SeF_6, $SnCl_6^{2-}$	01	Square pyramidal	<90	IF_5, BrF_5
					02	Square planar	90	XeF_4
sp^3d^3	0	Pentagonal bipyramid	72 & 90	IF_7	01	Pentagonal Pyramidal or Distorted octahedral	72 & 90	XeF_6

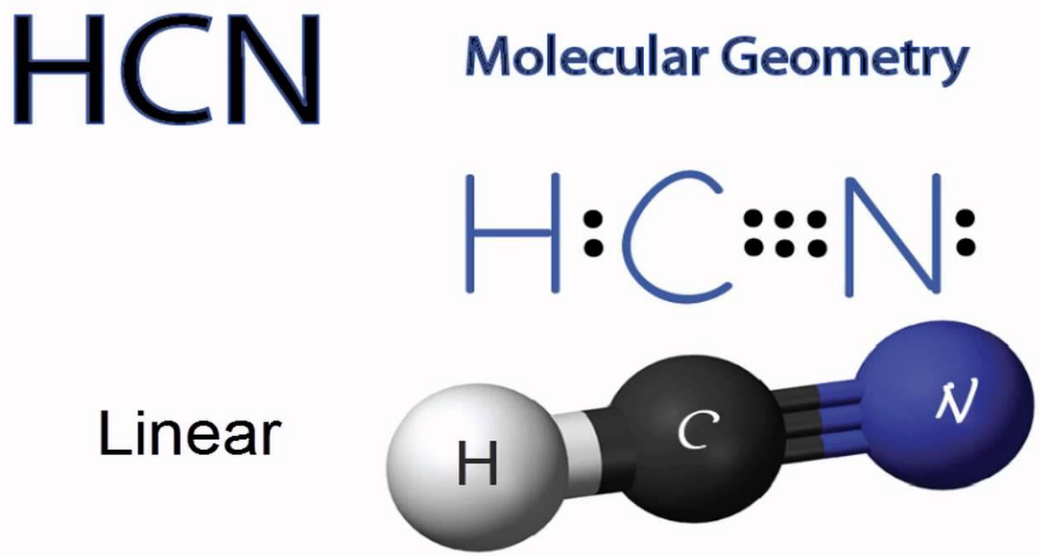
Answer. (b)

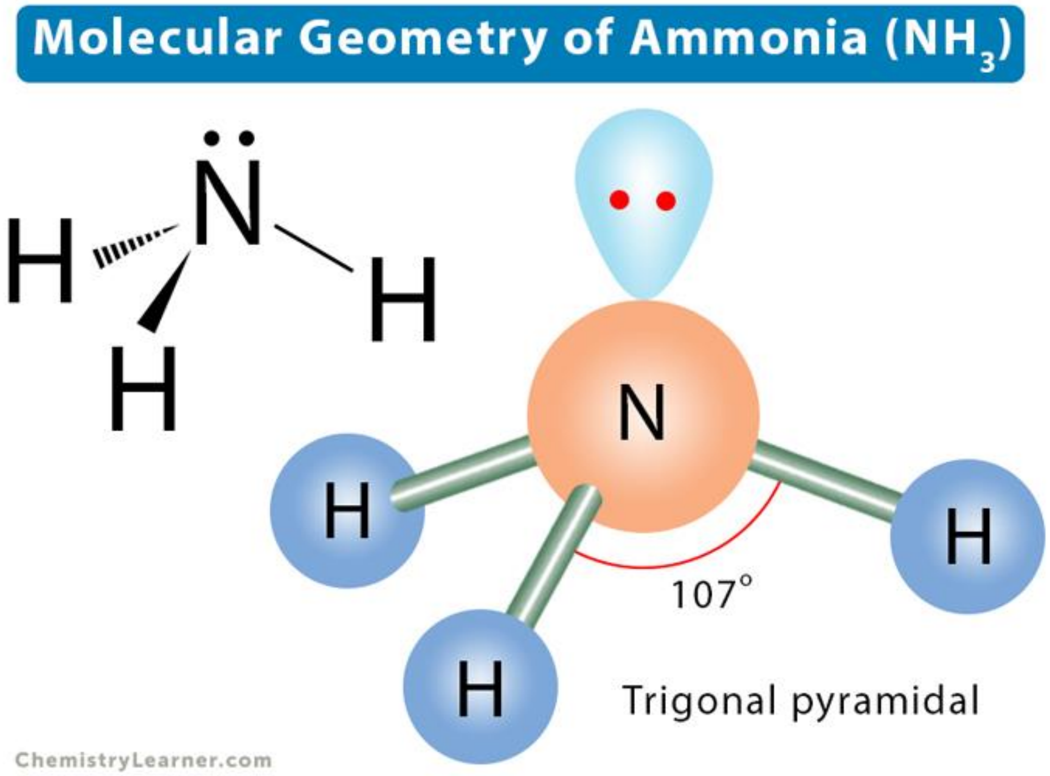
CH_3F Polar or NonPolar



GEOMETRY OF MOLECULES


O
C
H
H
O
C
H
H


HCN
Molecular Geometry
H:C:::N:
Linear
H
C
N


Molecular Geometry of Ammonia (NH3)
N
H
H
H
N
H
H
H
107°
Trigonal pyramidal
ChemistryLearner.com

Q. Very small insoluble particles in a liquid may be separated from it by using [2019-I]

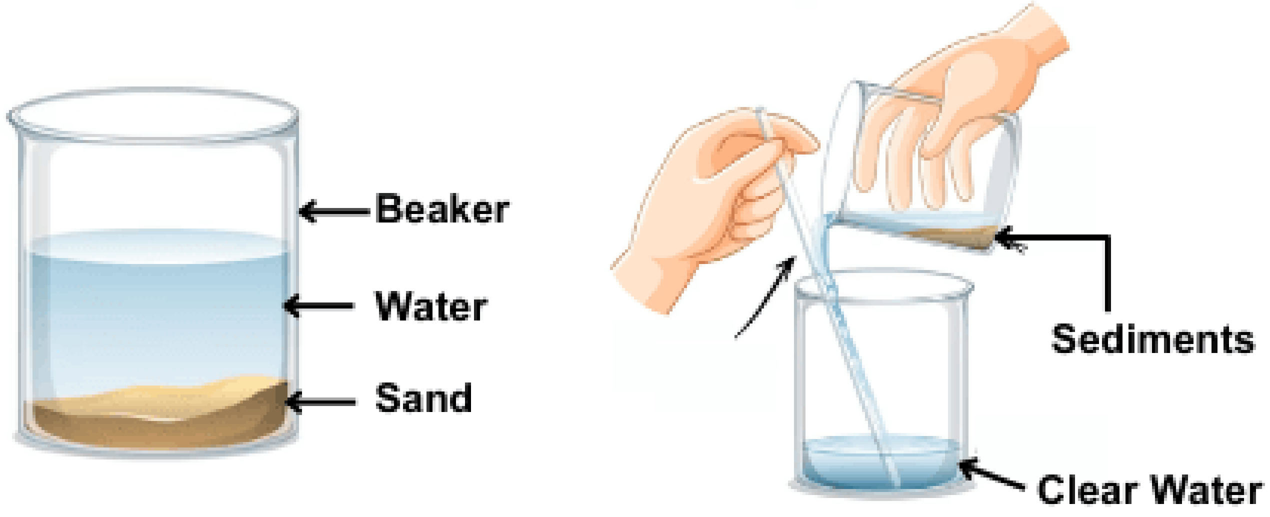
(a) crystallization

(b) fractional distillation

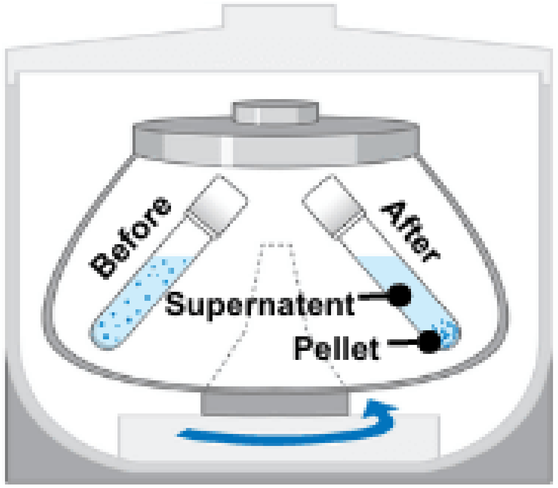
(c) centrifugation

(d) decantation

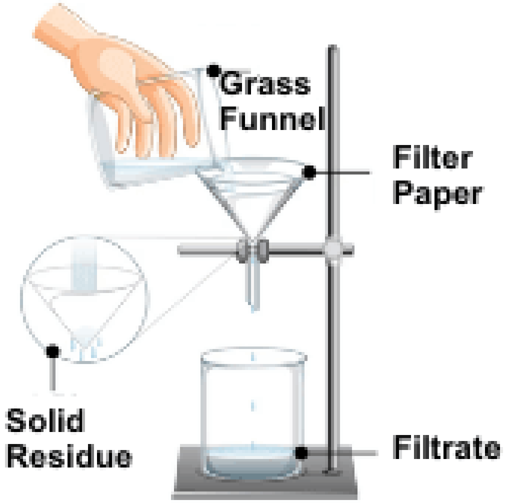
- Answer. (c)
- Centrifugation is a method used to separate insoluble solids from a liquid.
- **Crystallization**: A process where a dissolved substance forms solid crystals as it cools or evaporates.
- **Fractional Distillation**: A method to separate mixtures based on differences in boiling points using a distillation column.
- **Centrifugation**: A technique that separates components of a mixture by spinning them at high speeds to create a density gradient.
- **Decantation**: The process of gently pouring off a liquid from a settled solid or another liquid to separate them.



Sedimentation and Decantation



Centrifugation



Filtration

Q. Which one of the following elements cannot be detected by "Lassaigne's test"? [2019-I]

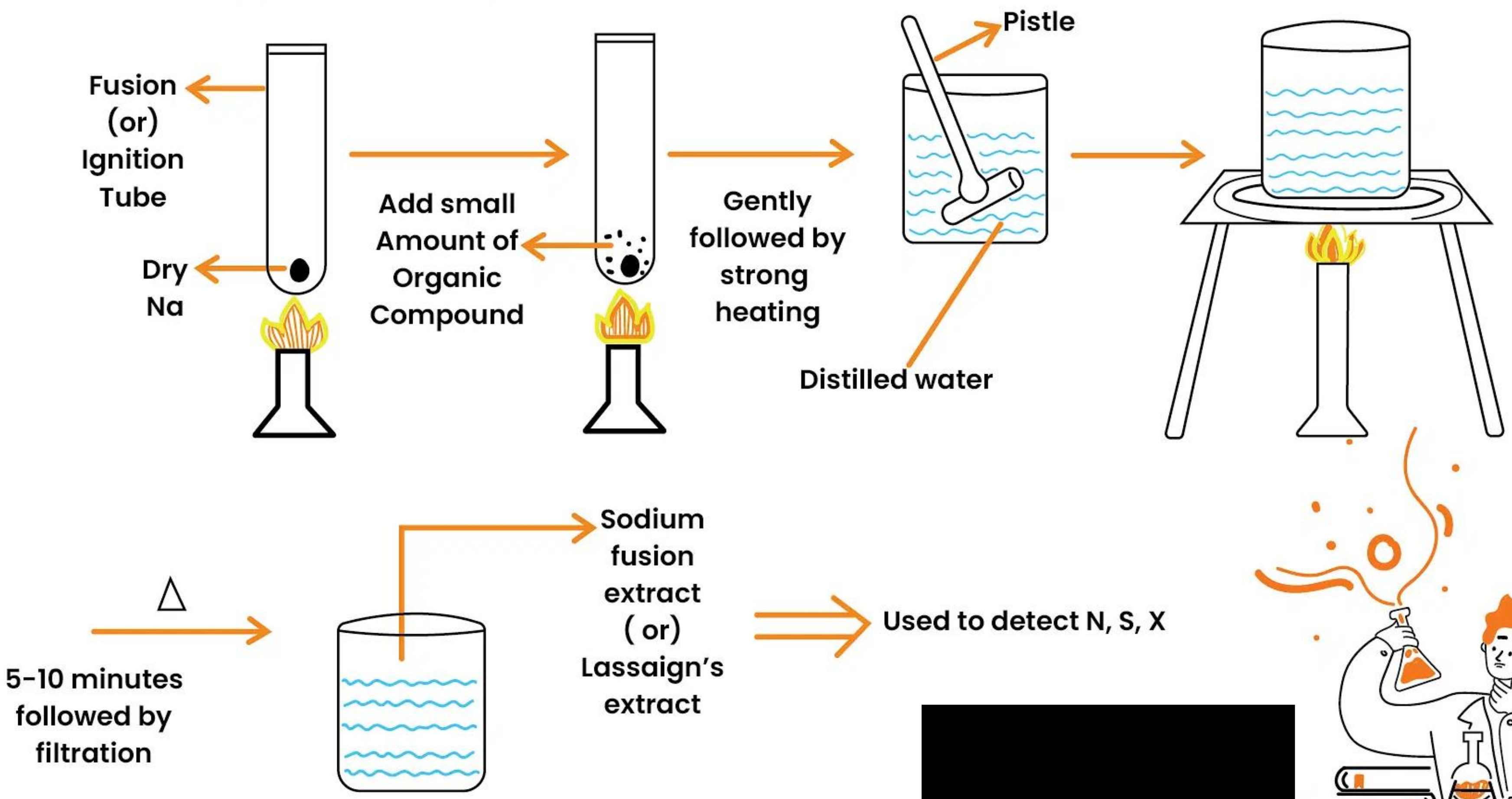
(a) I

(b) Cl

(c) S

(d) F

- Answer. (d)
- Fluorine does not give Lassaigne's test because it does not form Precipitate like other halogens (chlorine, Bromine, Iodine).
- Lassaigne's test is a qualitative analytical method used to detect the presence of nitrogen, sulfur, and halogens in organic compounds.
- **What Is the Lassaigne's Test?**
- Nitrogen, sulphur, and halogens present in organic compounds are detected by Lassaigne's test. Here, a small piece of Na metal is heated in a fusion tube with the organic compound.
- The principle is that, in doing so, Na converts all the elements present into ionic form.
- $Na + C + N \rightarrow NaCN$
- $2Na + S \rightarrow Na_2S$
- $Na + X \rightarrow NaX$ (X= Cl, Br, or I)
- The formed ionic salts are extracted from the fused mass by


Fusion
(or)
Ignition
Tube
Dry
Na
Add small
Amount of
Organic
Compound
Gently
followed by
strong
heating
Pistle
Distilled water
△
5-10 minutes
followed by
filtration
Sodium
fusion
extract
(or)
Lassaign's
extract
Used to detect N, S, X

[redacted]

Q In which of the following functional group isomerism is not possible? [2019-I]

(a) Alcohols

(b) Aldehydes

(c) Alkyl halides

(d) Cyanides

- Answer. (c)
- Alkyl halides do not exhibit functional isomerism because there is only one way to attach a halogen to a carbon chain—via a single bond. Halogens cannot form multiple bonds to carbon in typical organic compounds.
- In contrast, functional isomers can occur in alcohols and ethers; aldehydes and ketones; and cyanides and isocyanides, as these groups have more varied bonding possibilities.

Isomerism

- **Structural**
  - Chain
  - Positional
  - Functional
  - Metamerism
  - Tautomerism
  - Ring-chain
- **Stereo**
  - **Geometric**: Isomers differ in their spatial arrangement about a double bond.
  - **Optical**: Isomers differ in the arrangement of atoms in 3D space which create mirror images of each other.

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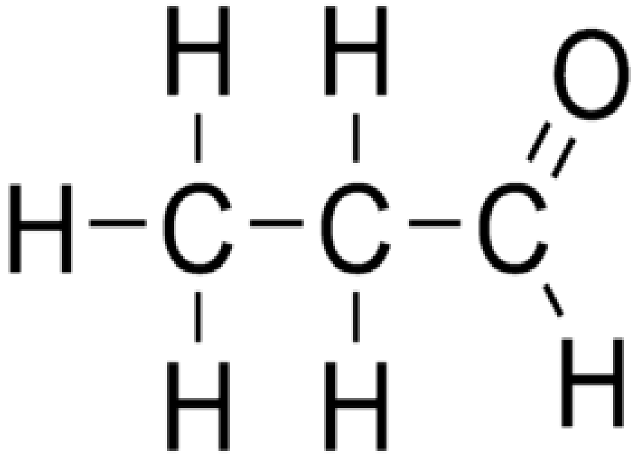
Functional isomerism is a type of isomerism in organic chemistry where compounds have the same molecular formula but differ in the functional groups they contain. This results in different chemical properties and reactivities for each isomer. Here's a breakdown of functional isomerism:

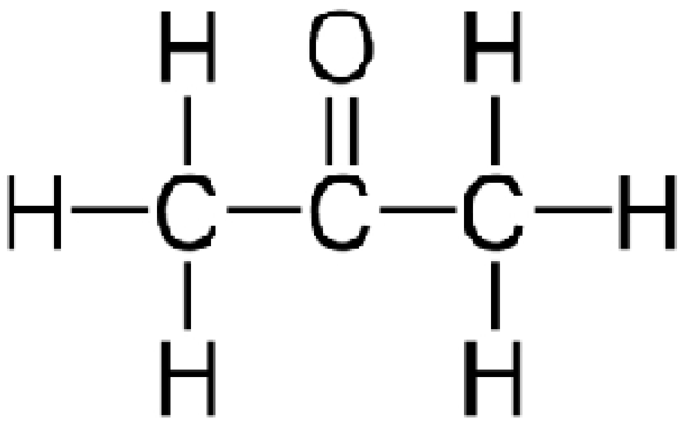
Key Points of Functional Isomerism:

1. **Different Functional Groups**: Functional isomers have different functional groups. For example, alcohols and ethers are functional isomers. Both groups may have the **same molecular formula, but the presence of different functional groups** (hydroxyl group in alcohols and an ether group in ethers) results in different chemical properties.
2. **Example of Functional Isomers**:
   1. **Alcohol and Ether**: $C_4H_{10}O$ can represent both an alcohol (butanol) and an ether (dimethyl ether).
      1. **Butanol**: $CH_3(CH_2)_3OH$
      2. **Dimethyl Ether**: CH_3OCH_3
   2. **Aldehyde and Ketone**: C_3H_6O can represent both an aldehyde (propanal) and a ketone (acetone).
      1. **Propanal**: CH_3CH_2CHO
      2. **Acetone**: $(CH_3)_2CO$

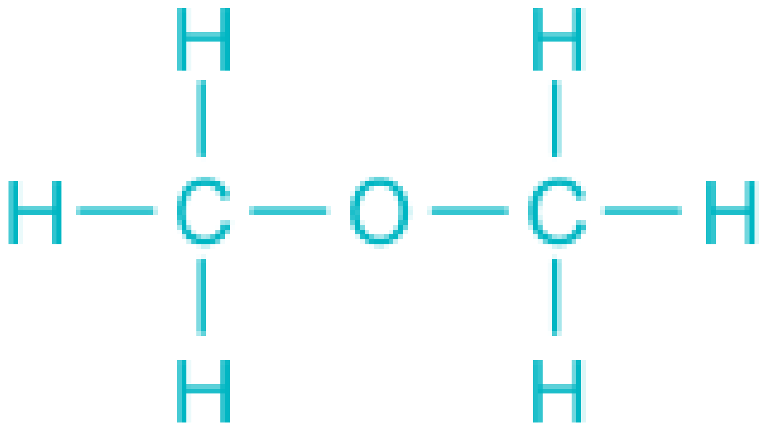
3. **Different Chemical Properties**: Because functional isomers have different functional groups, they often exhibit different reactivities and physical properties, such as boiling points, solubility, and reactivity with other chemicals.
4. **Structural Formulas**: Drawing the structural formulas helps in visualizing the difference between functional isomers. Each isomer will have a distinct structure due to the different functional groups present.



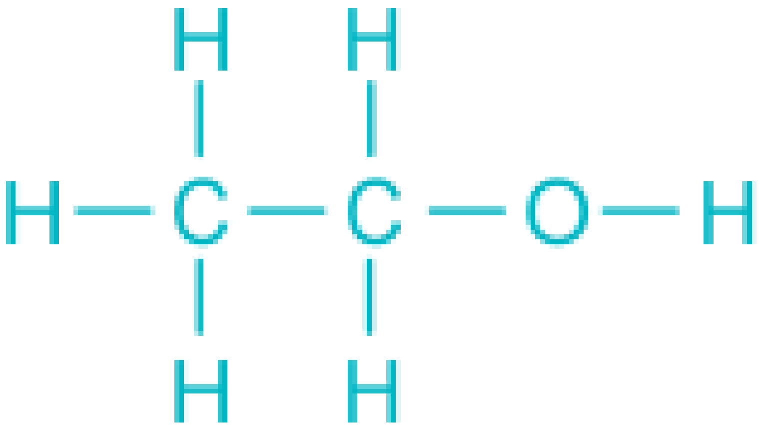
Propanal



Propanone



Dimethyl ether

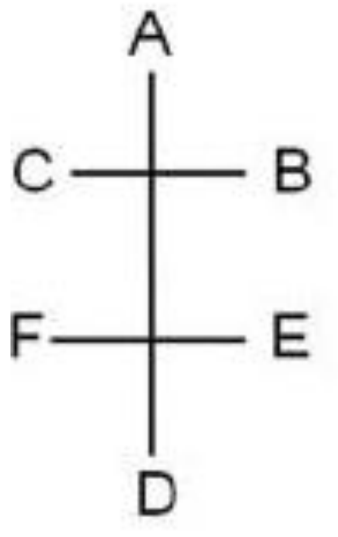


Ethanol

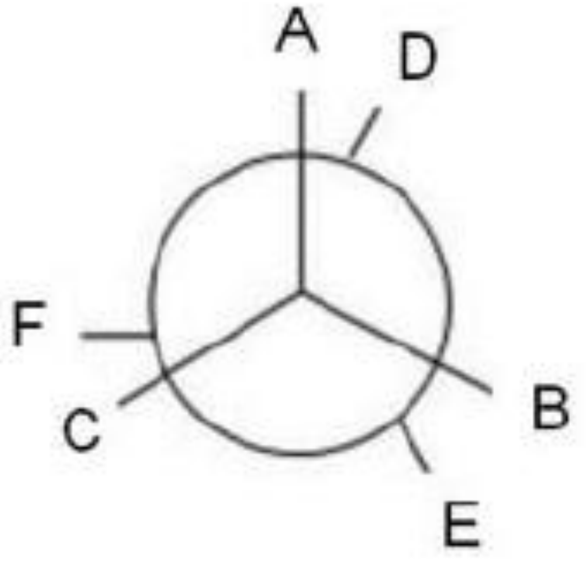
Q. Which one of the following statements is not correct? [2019-I]

a) Fishcher projection represents the molecule in an eclipsed conformation.
b) Newman projection can be represented in an eclipsed, staggered and skew conformations.
c) Fischer projection of the molecule is its most stable conformation.
d) In Sawhorse projections, the lines are inclined at an angle of 120° to each other.

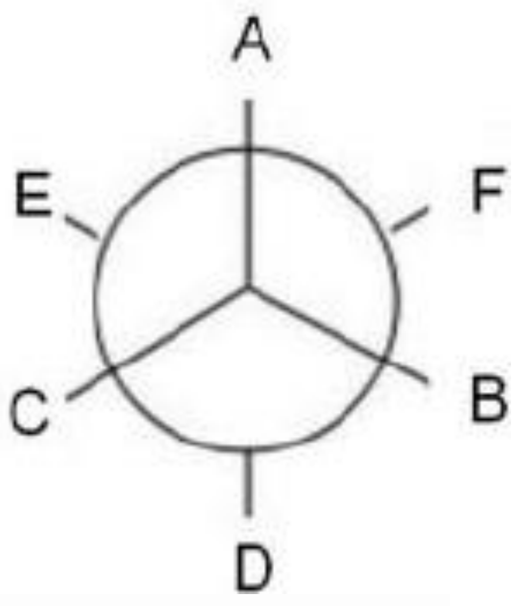
- Answer (c)
- The most stable conformation of a molecule is in the form of a Newman Projection.
- A Newman projection is a way to visualize the spatial arrangement of atoms in a molecule, particularly useful for analyzing conformations of alkanes.
- It depicts the molecule as viewed along a specific carbon-carbon bond.

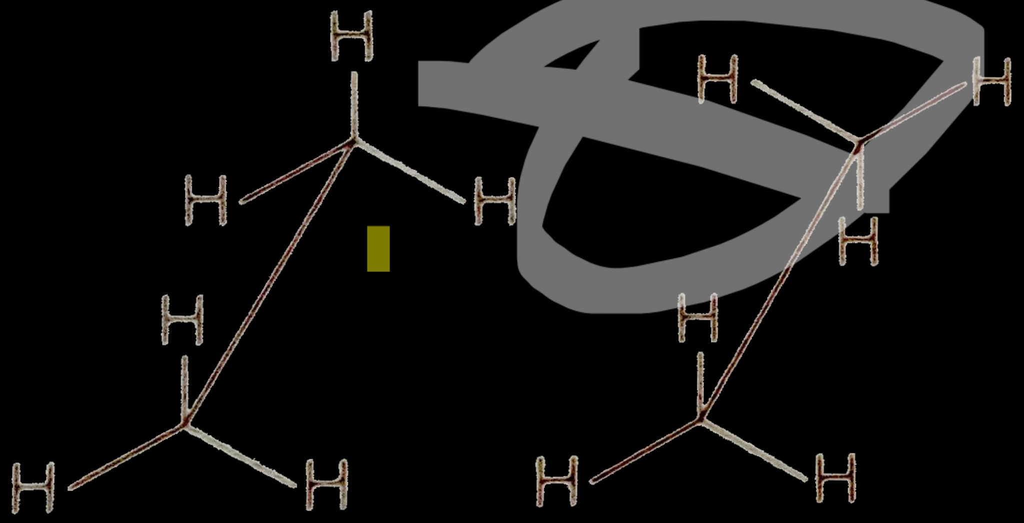


Eclipsed



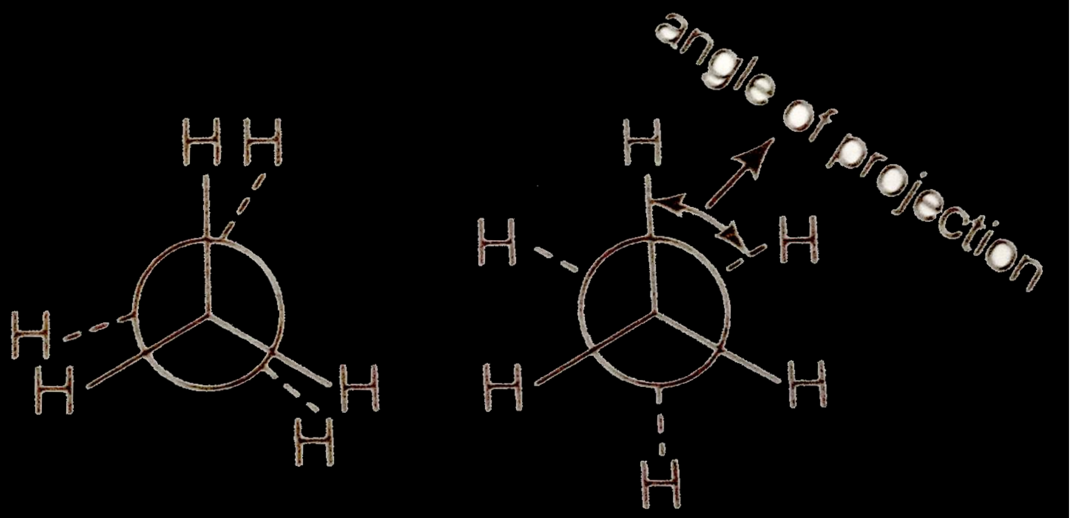
Staggered





Eclipsed Staggered

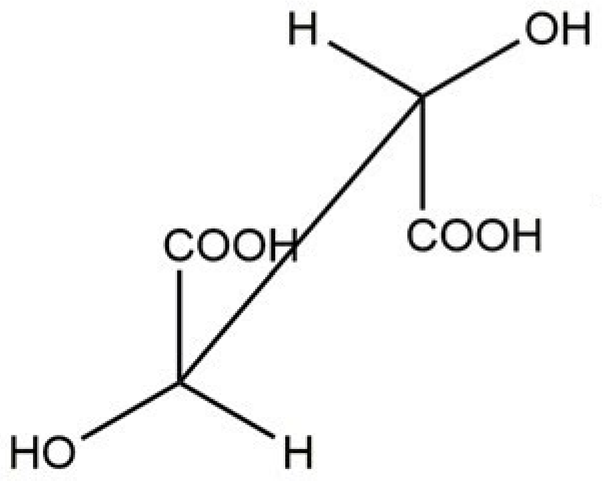
Sawhorse projections of ethane



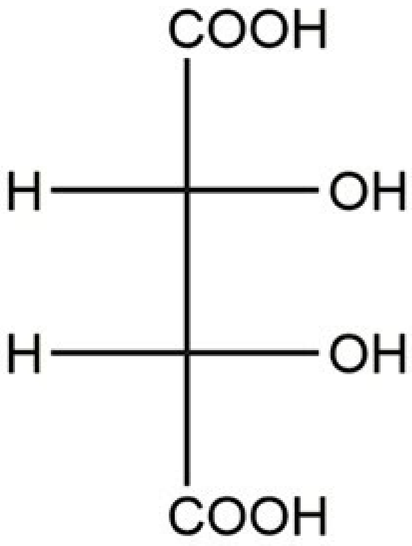
Eclipsed Staggered

Newman projections of ethane

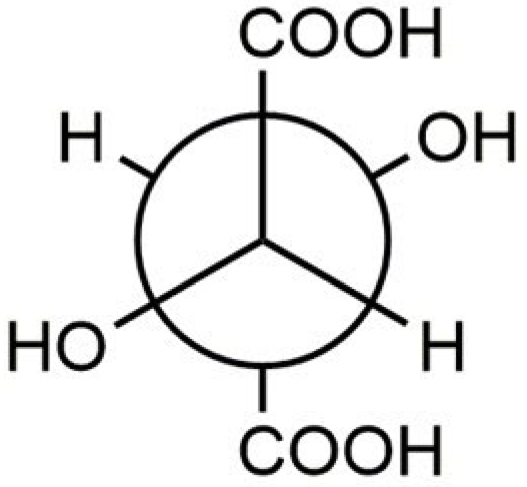
Fischer formula to Sawhorse and Newman Formula



Sawhorse Formula



Fischer Formula



Newman Formula

Q. The monomer / monomers used for the synthesis of Nylon 6 is / are [2019-I]

(a) hexamethylenediamine and adipic acid

(b) caprolactam

(c) urea and formaldehyde

(d) phenol and formaldehyde

- Answer. (b)
- Nylon 6 is made from only one kind of monomer, called caprolactam.

Q. The PCl_5 molecule has trigonal bipyramidal structure. Therefore, the hybridization of p orbitals should be [2019-I]

(a) Sp^2

(b) sp^3

(c) dsp^2

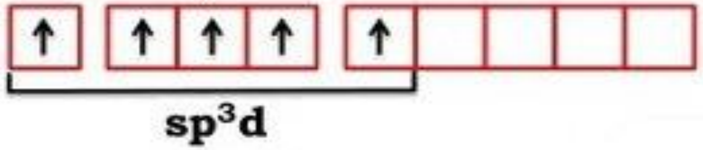
(d) dsp^3

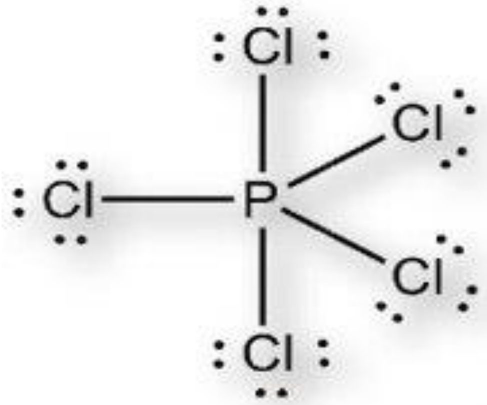
- Answer. (d)
- In PCl_5, the phosphorus atom undergoes **sp^3d** hybridization.
- This involves the mixing of one s orbital, three p orbitals, and one d orbital from the phosphorus atom to form five sp^3d hybrid orbitals.

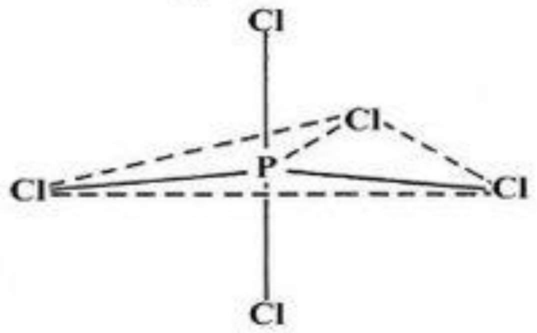
One 's', three 'p' and one 'd' orbitals of same shell participates to give sp^3d hybd. with trigonal bipyramidal shape with bond angles 90° & 120°. **Example:** PF_5 & PCl_5,

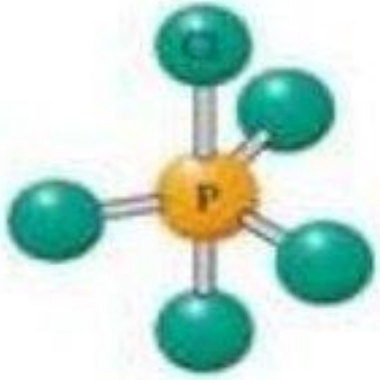
P(G.S.) = $1s^2 2s^2 2p^6 3s^2 3p^3$

P(E.S.) = $1s^2 2s^2 2p^6 3s^1$ $3p^3$ $3d^1$









Approach 2: Electrons-in-boxes

The ground-state electronic configuration of P is shown below.

		3s	3p			3d				
P :	[Ne]	$\uparrow\downarrow$	$\uparrow$	$\uparrow$	$\uparrow$					

The 3s orbital and the three 3p orbitals hybridizes to give four sp^3 orbitals.

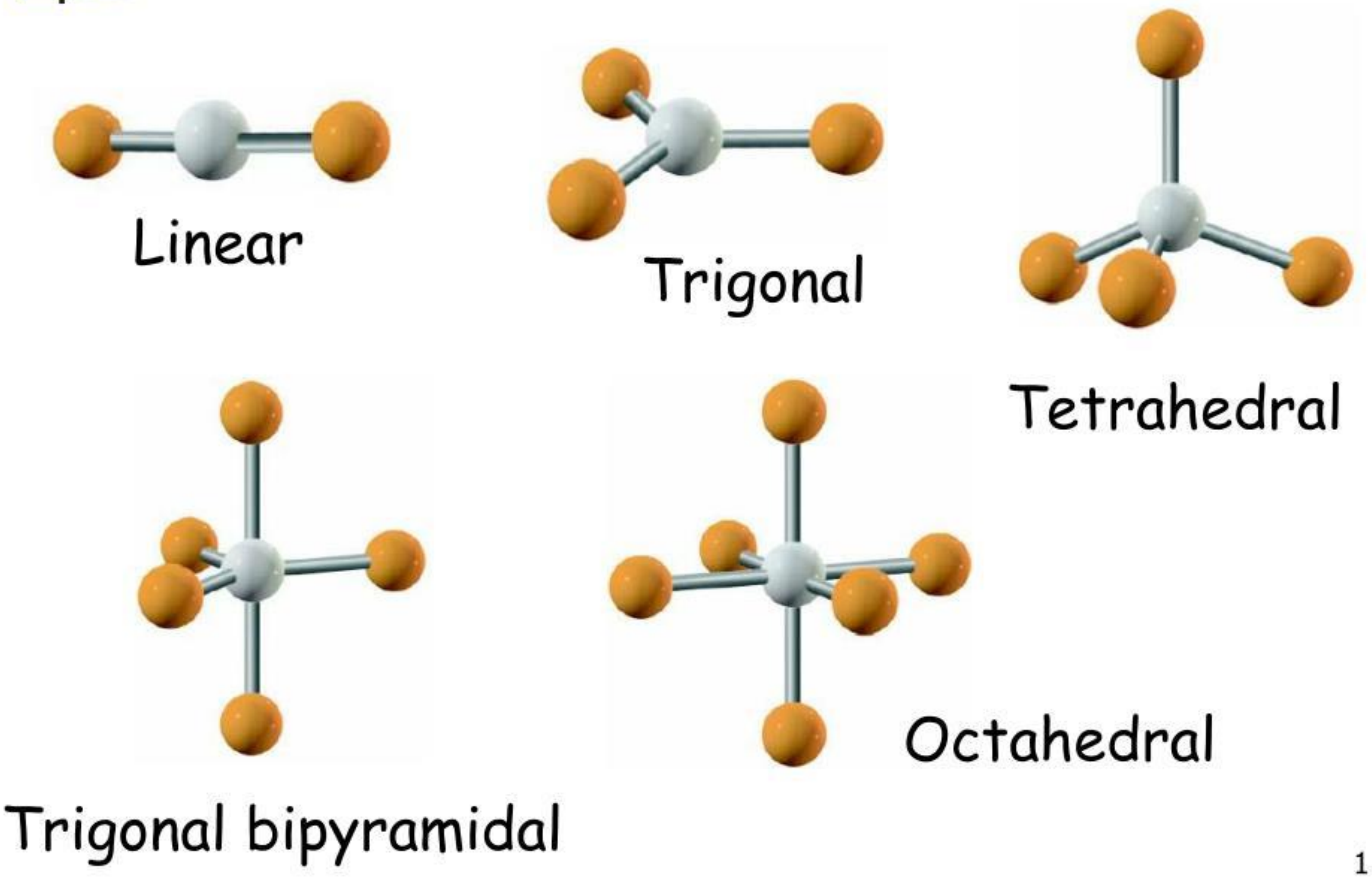
		sp^3				3d				
P* :	[Ne]	$\uparrow\downarrow$	$\uparrow$	$\uparrow$	$\uparrow$					

The three sp^3 orbitals with unpaired electrons are used to make three P–F bonds, and rest sp^3 orbital with paired electrons is used to make a lone pair of electrons.

Conclusively, the central P atom is ***sp^3 hybridized***.

Five Basic Geometries

[redacted]



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Atoms of any element consist of sub atomic species, like electrons, protons, and neutrons. Protons and neutrons are found in the nucleus of an atom. While electrons are found in the sub shells of atoms, that consist of orbitals.
Each orbital contains 2 electrons which is denoted by a letter of the sub – shell and a number that represents its energy level.
There are 4 types of sub – shells that consist of a particular number of orbitals in which electrons are placed in pairs.
The 4 sub – shells that have orbitals are s, p, d, and f.
s orbital is called as sharp. It has a spherical orientation in space near the nucleus of an atom. s orbitals consist of various numbers like 1s, 2s, 3s, etc. An s orbital can accommodate a maximum of 2 electrons in its orbital.
p orbital is called as principle.

After the filling of s orbital the electron goes to the p orbital. There are **3 types of p orbitals, px, py and pz**, these 3 accommodates 2 electrons each, hence the maximum electrons that are placed in p orbital is 6.

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There are **3 types of p orbitals, px, py and pz**, these 3 accommodates 2 electrons each, hence the maximum electrons that are placed in p orbital is 6.
d orbital is called diffused. It is the higher level orbital. It has **5 types, dxy, dxz, dyz, $dx_2-y_2dx2-y2$, and dz_2dz2**, that consist of 2 electrons each and hence they contain a maximum 10 electrons.
f orbital is the fundamental orbital of a higher energy level. There are **7 types of f orbitals that accommodate 2 electrons each**, and thus 14 electrons are the maximum number placed in f orbital.
Hence, s, p, d, f orbital in any atom is the place where electrons are placed. The orbitals are of varied energy levels that are denoted by numbers and letters, s, p, d, f.

Q. Which one of the following is monatomic? [2019-II]

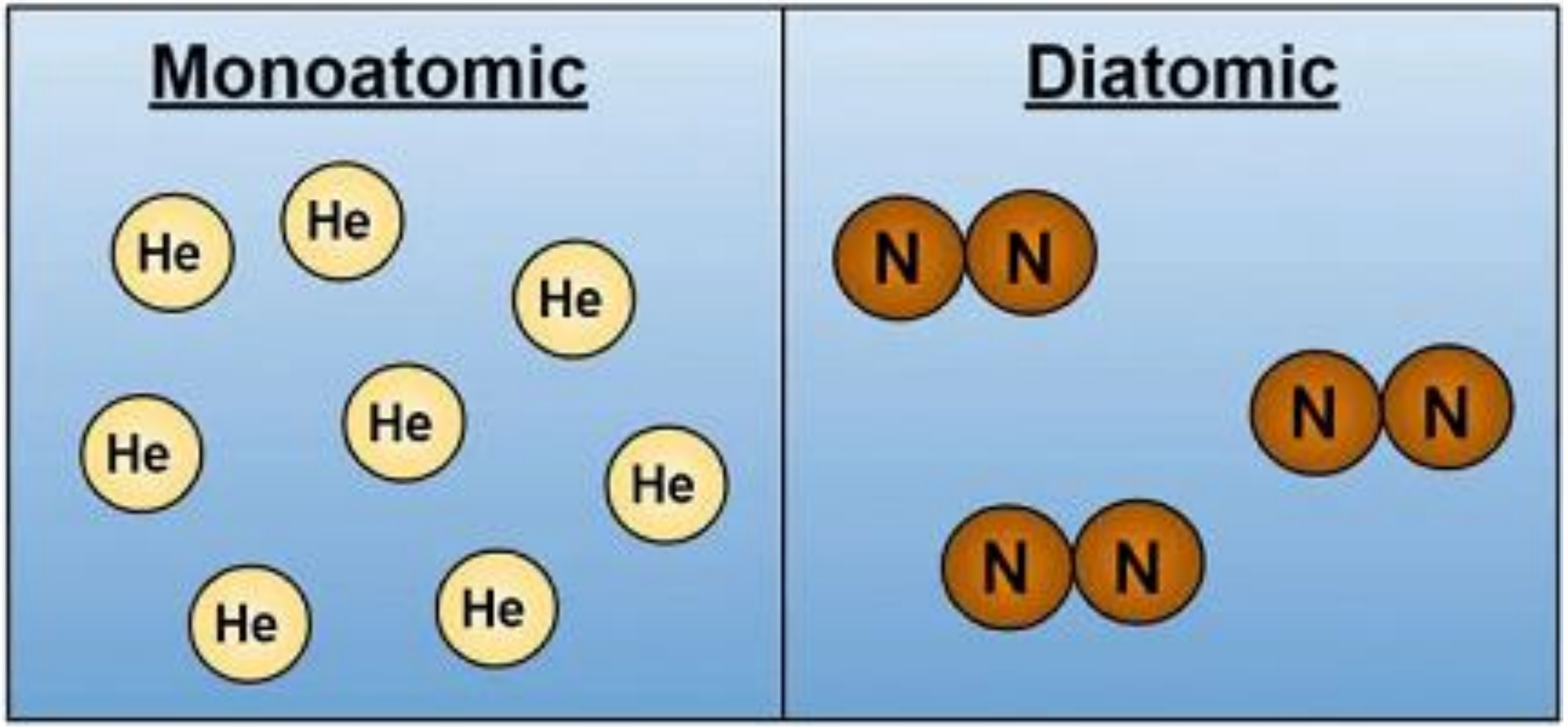
(a) Hydrogen

(b) Sulphur

(c) Phosphorus

(d) Helium

- Answer. (d)
- The noble gases—helium, neon, argon, krypton, xenon, and radon—are monatomic gases at STP.
- Helium, like the other noble gases, has a filled outer electron shell.
- Helium is a monatomic gas, meaning it consists of single, uncombined atoms. In contrast, hydrogen (H_2), sulfur (S_8), and phosphorus (P_4) typically exist as molecules or polyatomic forms.



Q. In graphite, each carbon atom is bonded to three other carbon atoms [2019-II]

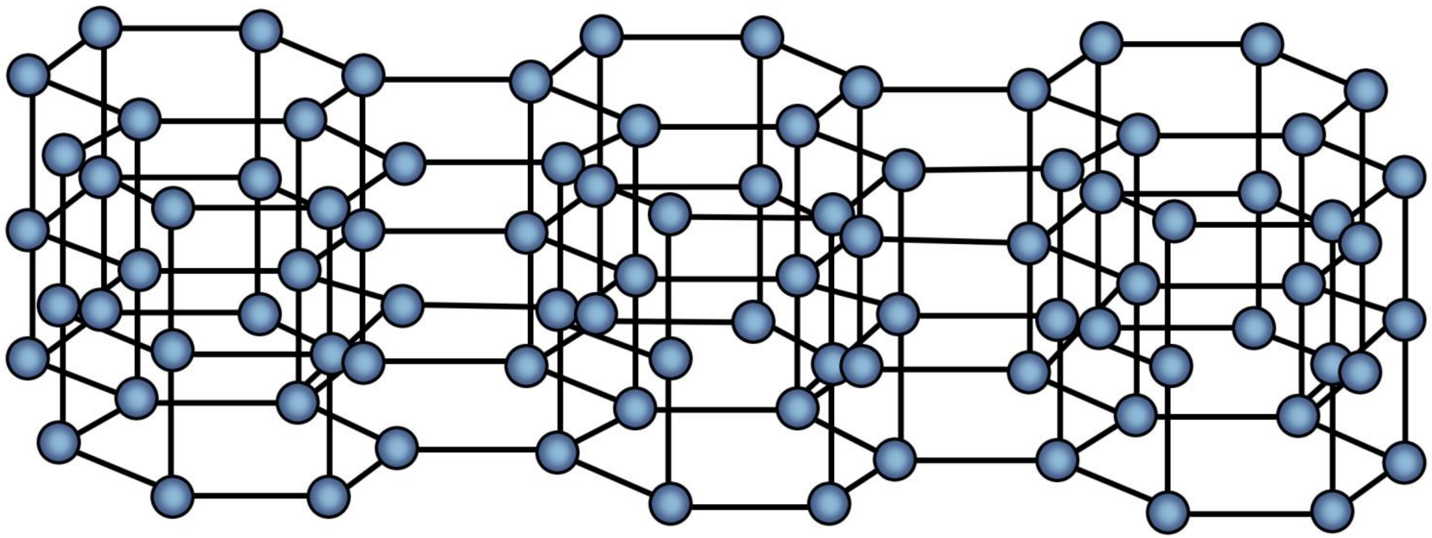
(a) forming a three-dimensional structure

(b) in the same plane giving a hexagonal array

(c) in the same plane giving a square array

(d) in the same plane giving a pentagonal array

- Answer. (b)
- In graphite, each carbon atom forms three bonds with other carbon atoms in the same plane, creating a hexagonal pattern.



Structure of graphite

Q. Employing Chromatography, one cannot separate [2019-II]

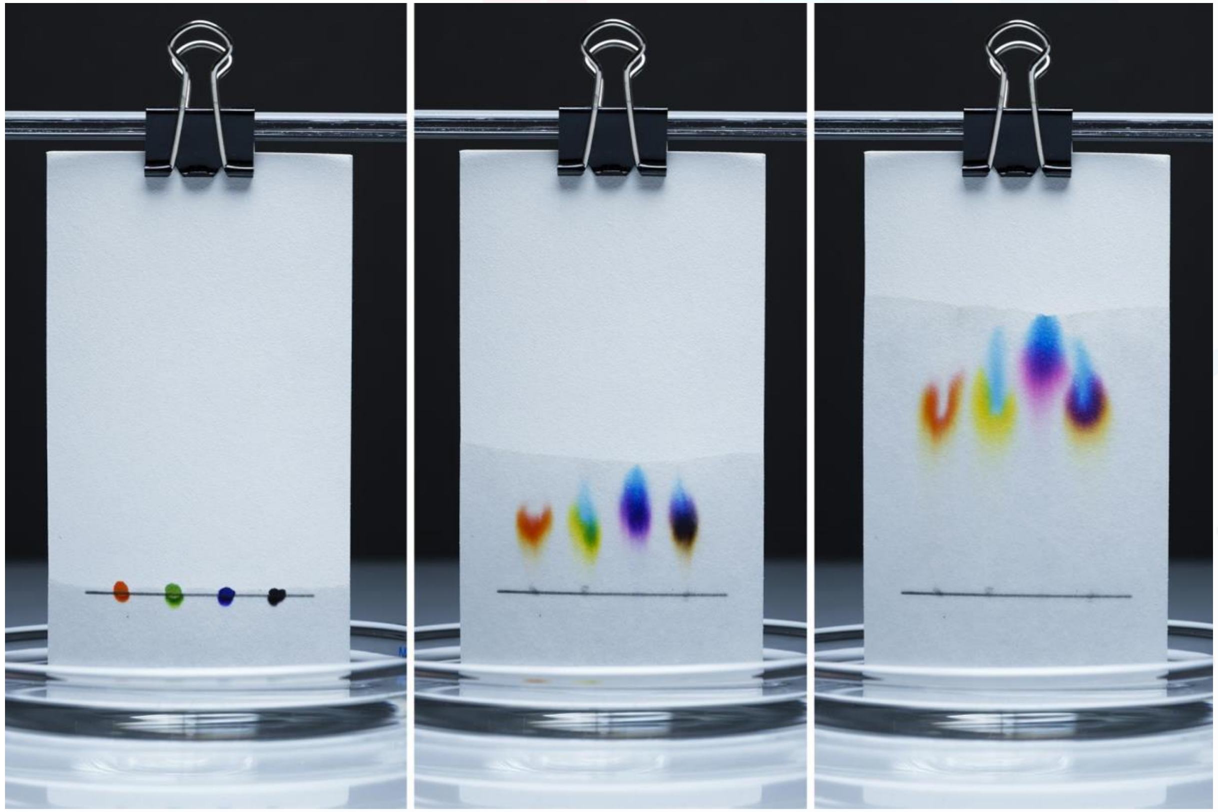
(a) radio-isotopes

(b) colours from a dye

(c) pigments from a natural colour

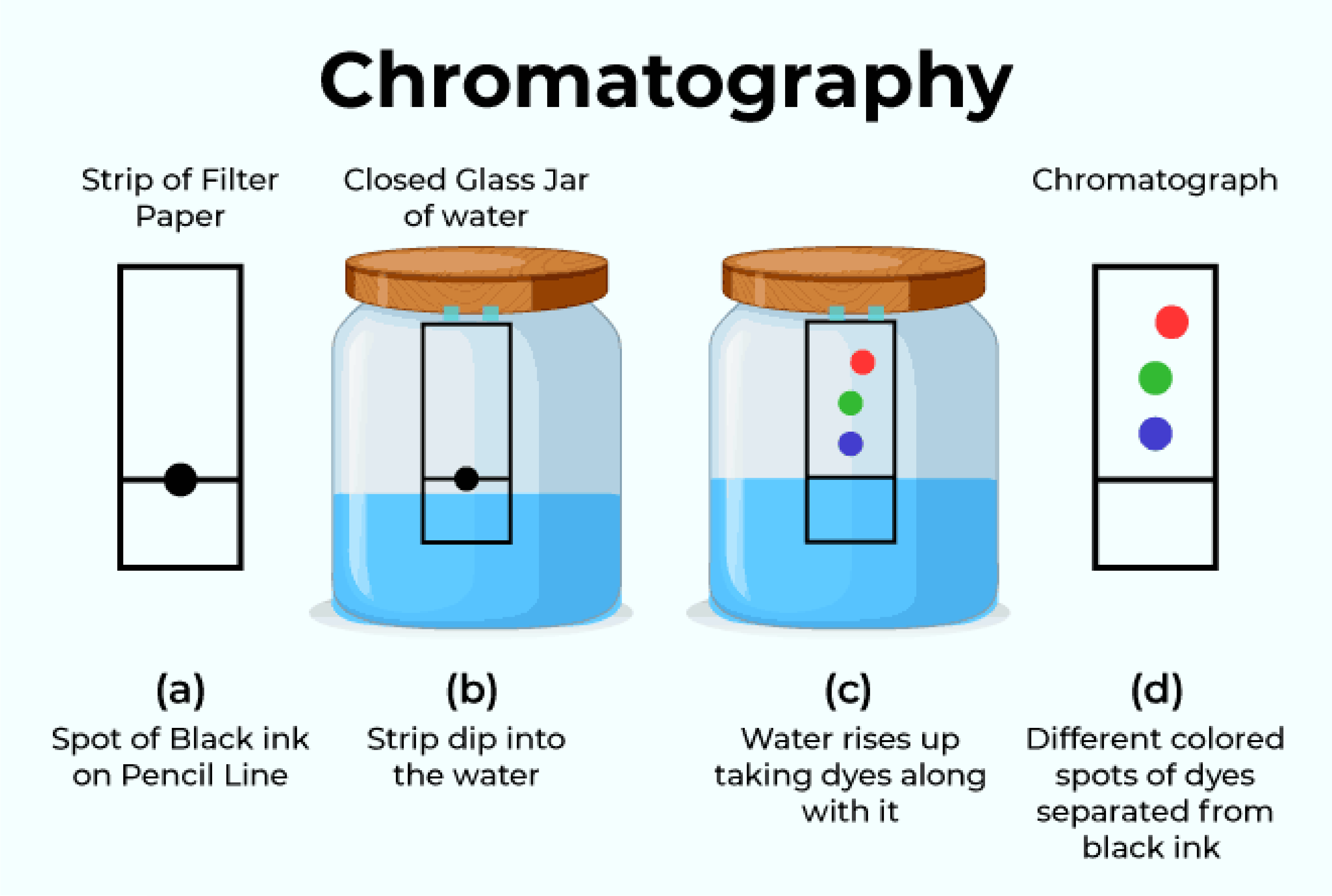
(d) drugs from blood

- Answer. (a)
- Since isotopes of the same element have the same chemical properties, they can't be separated using chemical methods.
- Instead, they are distinguished by mass-based methods like mass spectrometry.



CHROMATOGRAPHY

- Is a technique used to separate and identify the components of a mixture.
- Works by allowing the molecules present in the mixture to distribute themselves between a stationary and a mobile medium.
- Molecules that spend most of their time in the mobile phase are carried along faster.
- Chroma -"color" and graphein - "to write”.
- Colour bands - separation of individual compounds



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Uses for Chromatography

- **Real-life examples of uses for chromatography:**

- **Pharmaceutical Company** – determine amount of each chemical found in new product
- **Hospital** – detect blood or alcohol levels in a patient's blood stream
- **Law Enforcement** – to compare a sample found at a crime scene to samples from suspects
- **Environmental Agency** – determine the level of pollutants in the water supply
- **Manufacturing Plant** – to purify a chemical needed to make a product

Q. Consider the following statement: [2019-II]

"Atomic number of an element is a more fundamental property than its atomic mass." Who among the following scientists has made the above statement ?

(a) Dmitri Mendeleev

(b) Henry Moseley

(c) J.J. Thomson

(d) Ernest Rutherford

- Answer. (b)
- Moseley's law advanced atomic, nuclear, and quantum physics by offering experimental support for Niels Bohr's theory beyond the hydrogen atom spectrum.
- It refined Rutherford's and van den Broek's model, which posits that an atom's nucleus contains a number of positive charges equal to its atomic number.
- This model remains widely accepted today.

- **Dmitri Mendeleev**: Developed the Periodic Table of Elements, organizing them by increasing atomic mass and predicting undiscovered elements.
- **Henry Moseley**: Revised the Periodic Table by arranging elements according to atomic number, which resolved inconsistencies in Mendeleev's table.
- **J.J. Thomson**: Discovered the electron and proposed the "plum pudding" model of the atom, where electrons are embedded in a positively charged sphere.
- **Ernest Rutherford**: Conducted the gold foil experiment, leading to the discovery of the atomic nucleus and the development of the Rutherford model of the atom.

Q. Rate of evaporation increases with [2019-II]

(a) an increase of surface area

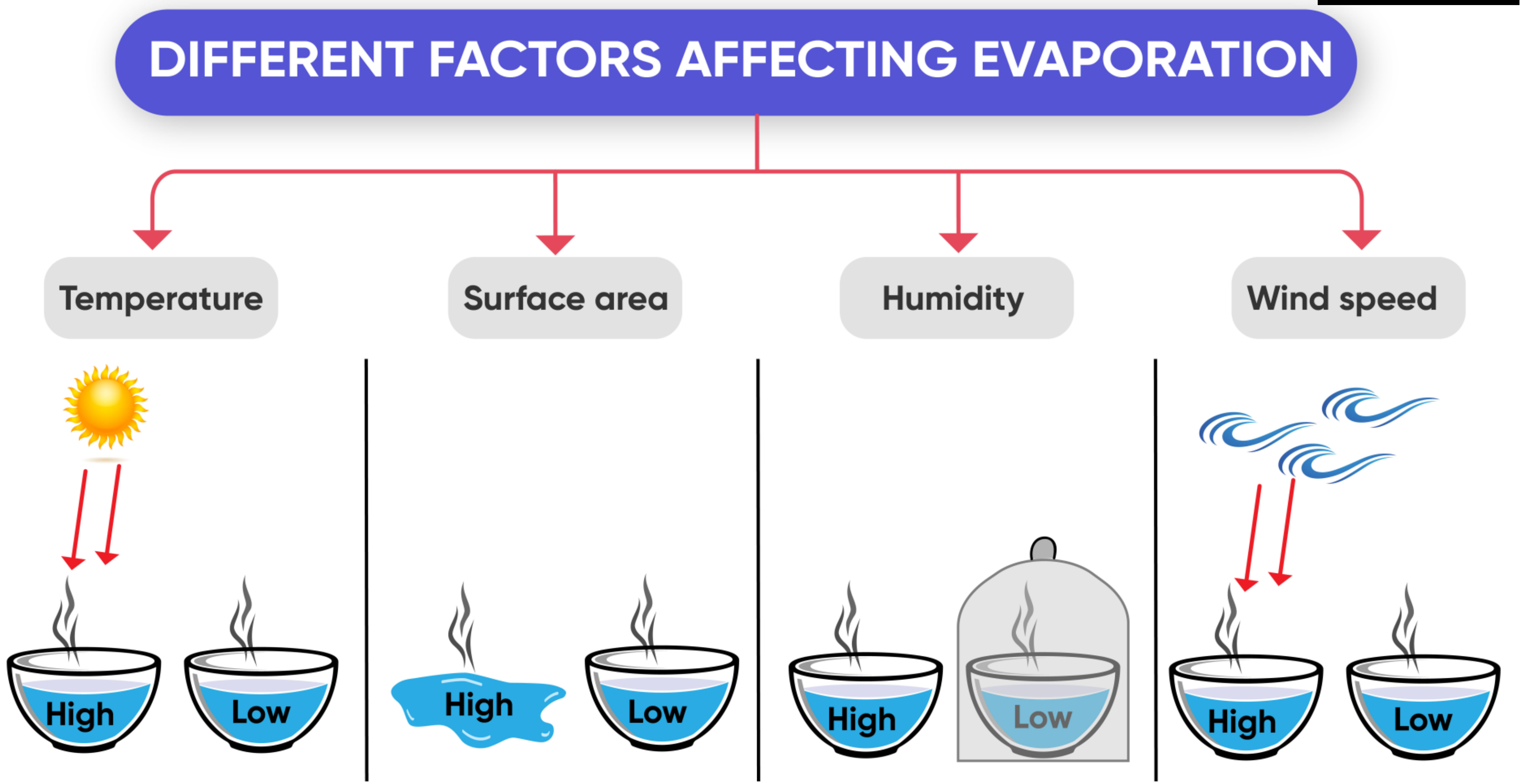
(b) an increase in humidity

(c) a decrease in wind speed

(d) a decrease of temperature

- Answer. (a)
- Evaporation is the process where water turns from a liquid into a gas or vapor, reentering the water cycle as atmospheric water vapor.
- The rate of evaporation is influenced by: **Temperature:** Higher temperatures increase the rate of evaporation.
- **Surface Area**: A larger surface area speeds up evaporation.
- **Humidity**: Higher humidity levels reduce the rate of evaporation.

[redacted]


DIFFERENT FACTORS AFFECTING EVAPORATION
Temperature
Surface area
Humidity
Wind speed
High
Low
High
Low
High
Low
High
Low

Q. Consider the following statements about mixture : [2019-II]

1. A substance can be separated into other kinds of matter by any physical process.

2. Dissolved sodium chloride can be separated from water by the physical process of evaporation.

Which of the statements given above is/are correct ?

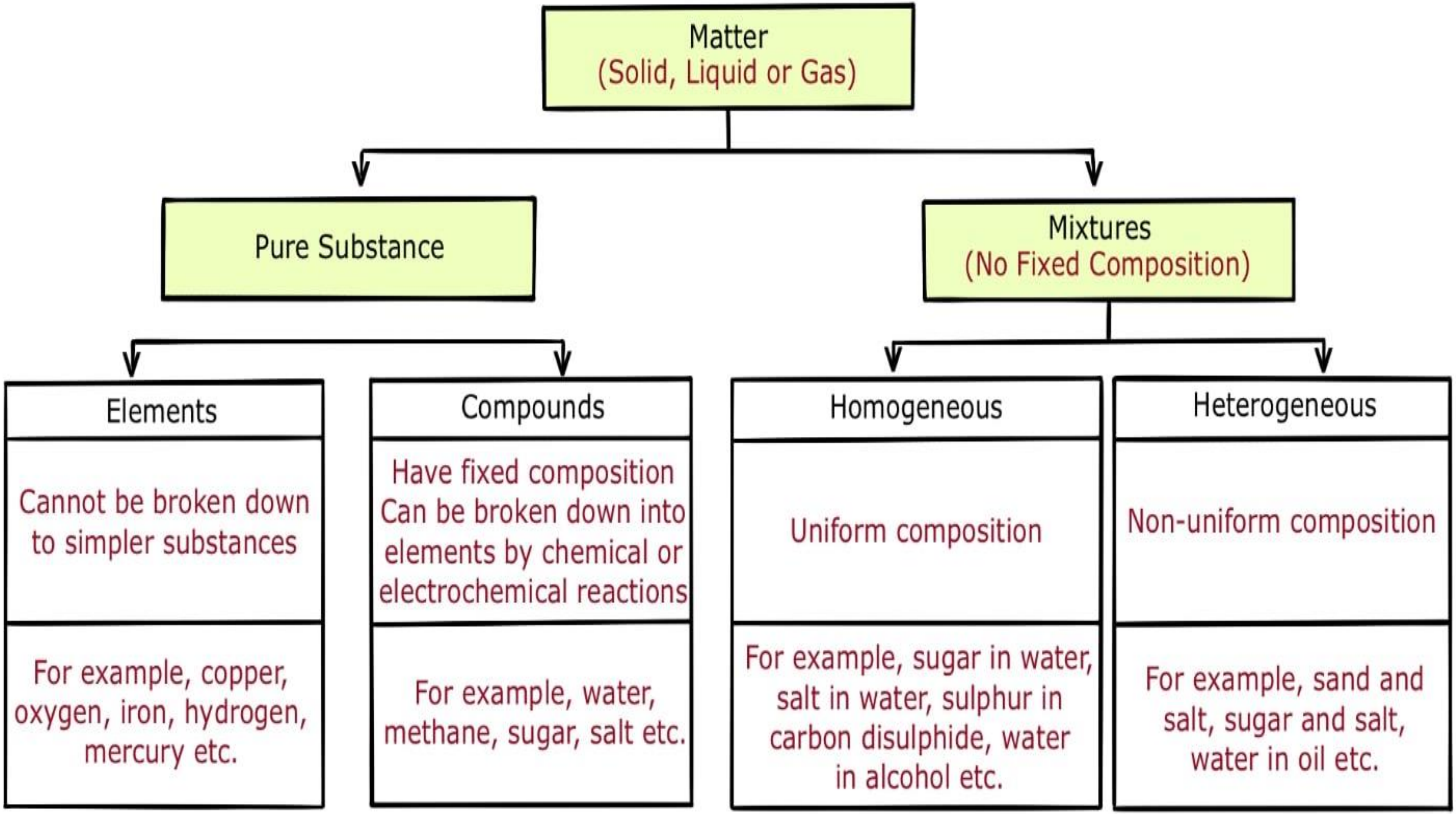
(a) 1 only

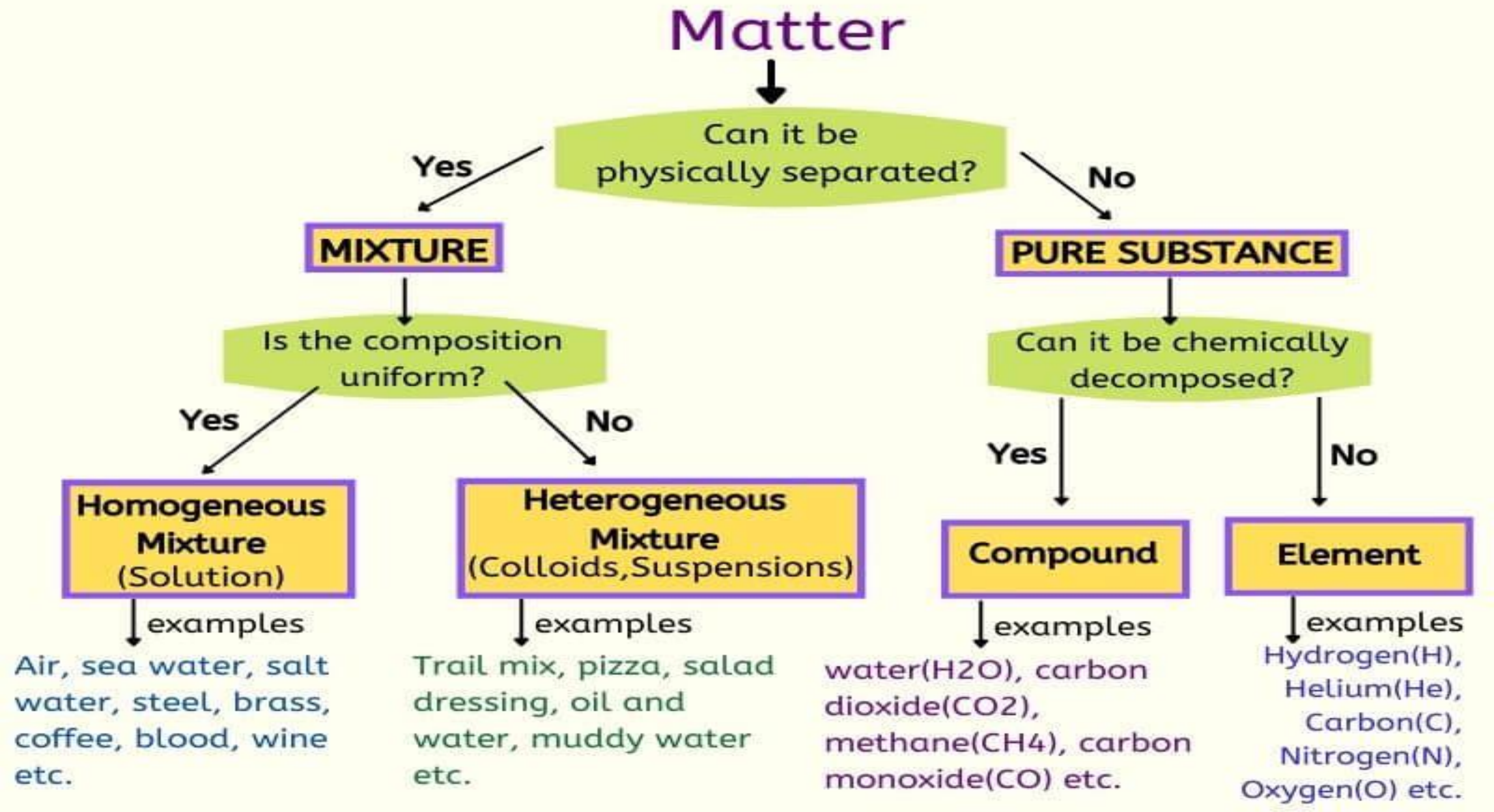
(b) 2 only

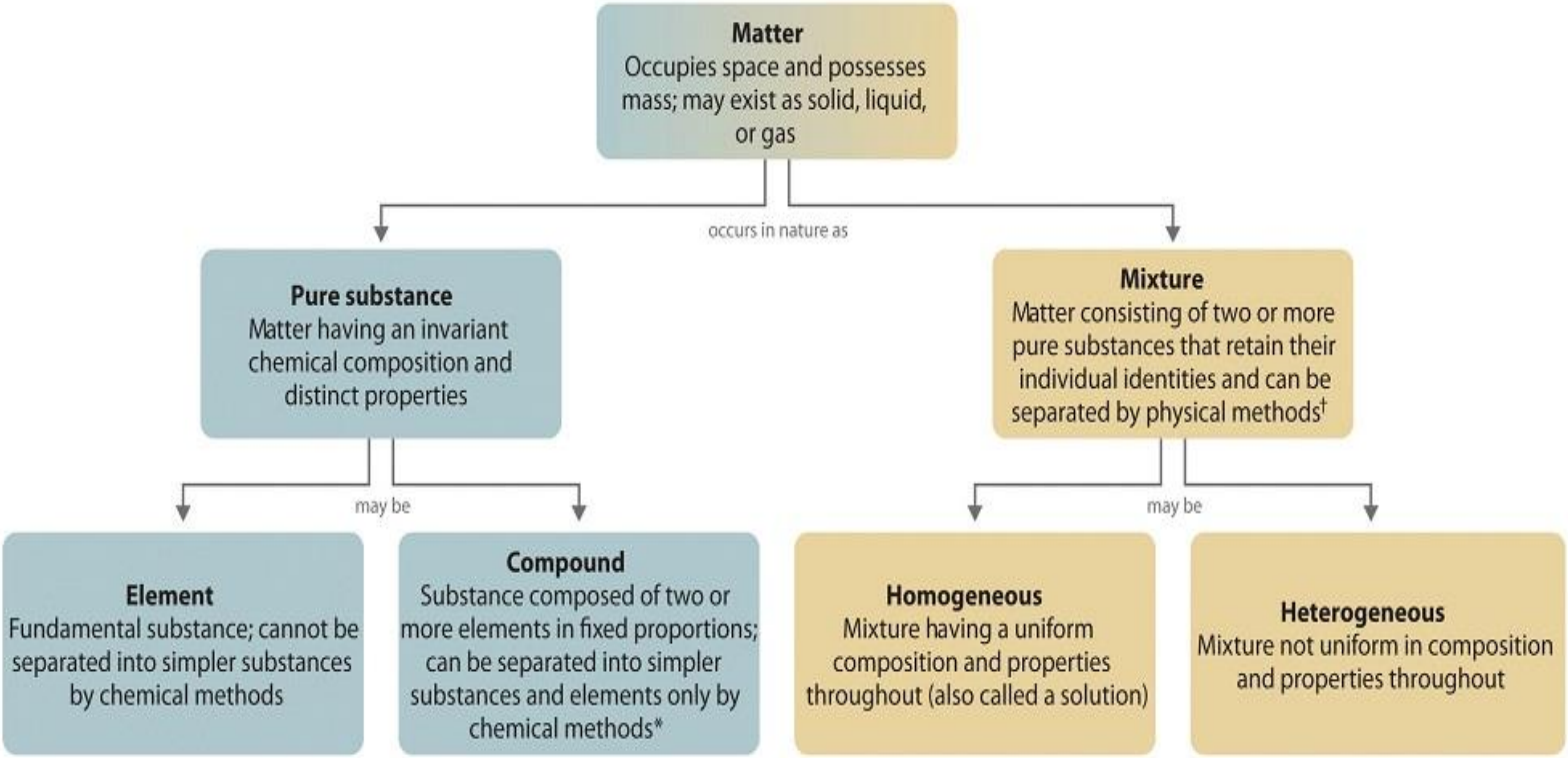
(c) Both 1 and 2

(d) Neither 1 nor 2

- Answer. (b)
- In chemistry, a mixture consists of two or more substances combined physically, without chemical changes.
- These substances, which retain their individual properties, can form solutions, suspensions, or colloids.
- Mixtures arise from blending elements or compounds, and their physical properties, like melting points, can differ from those of the individual components.
- They can often be separated by physical methods.


Matter
(Solid, Liquid or Gas)
Pure Substance
Mixtures
(No Fixed Composition)
Elements
Cannot be broken down to simpler substances
For example, copper, oxygen, iron, hydrogen, mercury etc.
Compounds
Have fixed composition
Can be broken down into elements by chemical or electrochemical reactions
For example, water, methane, sugar, salt etc.
Homogeneous
Uniform composition
For example, sugar in water, salt in water, sulphur in carbon disulphide, water in alcohol etc.
Heterogeneous
Non-uniform composition
For example, sand and salt, sugar and salt, water in oil etc.


Matter
Can it be physically separated?
Yes
No
MIXTURE
PURE SUBSTANCE
Is the composition uniform?
Can it be chemically decomposed?
Yes
No
Yes
No
Homogeneous Mixture (Solution)
Heterogeneous Mixture (Colloids,Suspensions)
Compound
Element
examples
examples
examples
examples
Air, sea water, salt water, steel, brass, coffee, blood, wine etc.
Trail mix, pizza, salad dressing, oil and water, muddy water etc.
water(H2O), carbon dioxide(CO2), methane(CH4), carbon monoxide(CO) etc.
Hydrogen(H), Helium(He), Carbon(C), Nitrogen(N), Oxygen(O) etc.



** Chemical methods of separation include electrolysis.*

† Physical methods of separation include filtration, distillation, and crystallization.

Q. Which one of the following statements is not correct ? [2019-II]

(a) Elements are defined by the number of protons they possess.

(b) Isobars are atoms having the same atomic number but different mass number.

(c) The mass number of an atom is equal to the number of nucleons in its nucleus.

(d) Valency is the combining capacity of an atom.

Methods of Separating Mixtures

- Magnet
- Filter
- Decant
- Evaporation
- Centrifuge
- Chromatography
- Distillation

(a)

Difference Between Isotopes,Isobars & Isotones

Isotopes	Isobars	Isotones
Same Atomic Number	Same Atomic mass number	Same number of Neutrons
Number of protons & electrons are same. Neutrons only differ	All neutrons, protons, and electrons differ	Number of neutrons are same Number of electrons & Proton differ
Iso means Same, P stands for Protons	Iso means same, Baros means weight	Iso means same, N means Neutrons

- Answer. (b)
- A chemical element consists of atoms with the same number of protons in their nuclei.
- For instance, oxygen has 8 protons.
- There are 118 known elements.
- An atom, the smallest unit of matter for a chemical element, comprises a nucleus (with protons and neutrons) and orbiting electrons.
- Isobars are atoms of different elements with the same number of nucleons (protons plus neutrons) but different atomic numbers.
- Examples include 40S, 40Cl, 40Ar, 40K, and 40Ca.

Q. Rutherford's alpha particle scattering experiment on thin gold foil was responsible for the discovery of [2019-II]

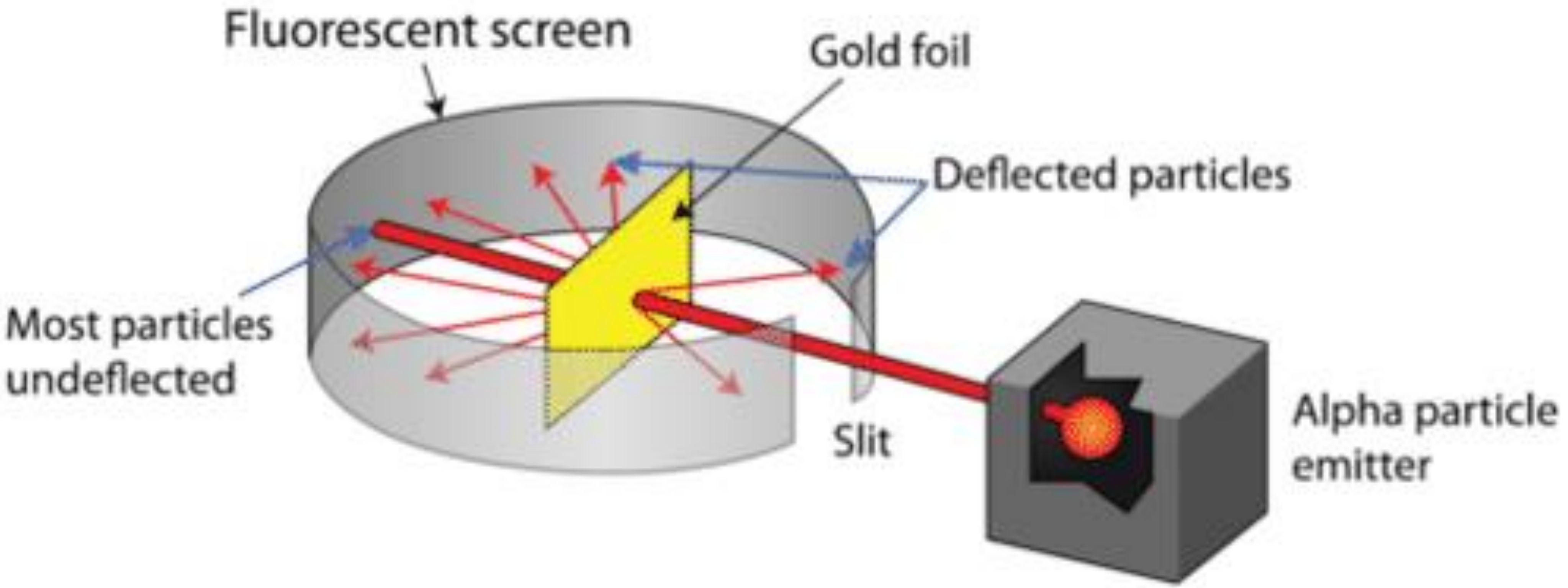
(a) electron

(b) proton

(c) atomic nucleus

(d) neutron

- Ans (c)
- In 1911, Rutherford challenged Thomson's model with his gold foil experiment, which revealed that the atom has a small, dense nucleus.
- Using alpha particles as probes, Rutherford found that while most particles passed through the gold foil, some were deflected.
- This led him to propose a new model where the atom consists of a central, highly charged region surrounded by orbiting electrons, though he did not use the term "nucleus" in his paper.



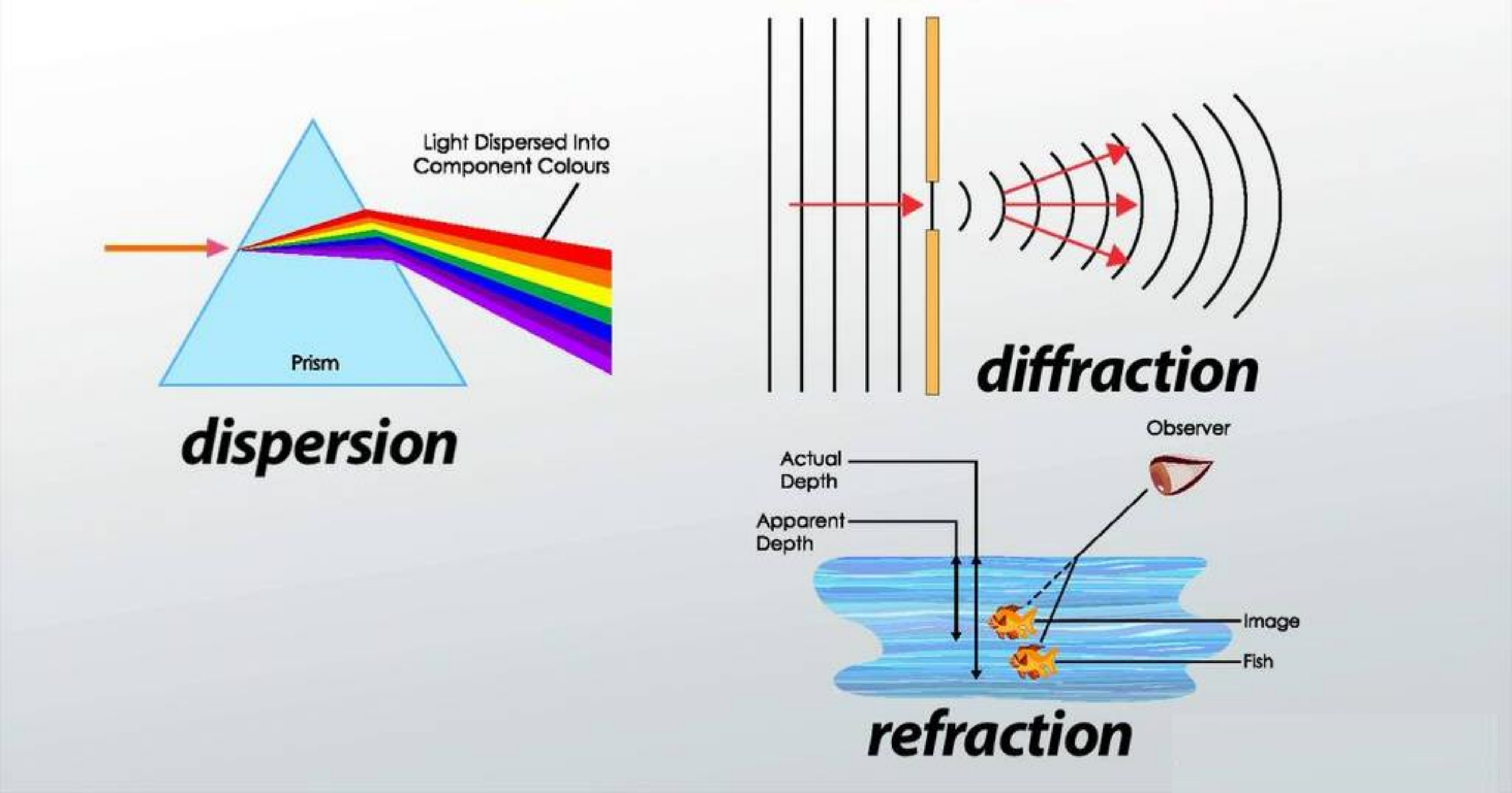
Fluorescent screen
Gold foil
Deflected particles
Most particles undeflected
Slit
Alpha particle emitter

Q. Soap solution used for cleaning purpose appears cloudy. This is due to the fact that soap micelles can

(a) refract light
(b) scatter light
(c) diffract light
(d) polarize light

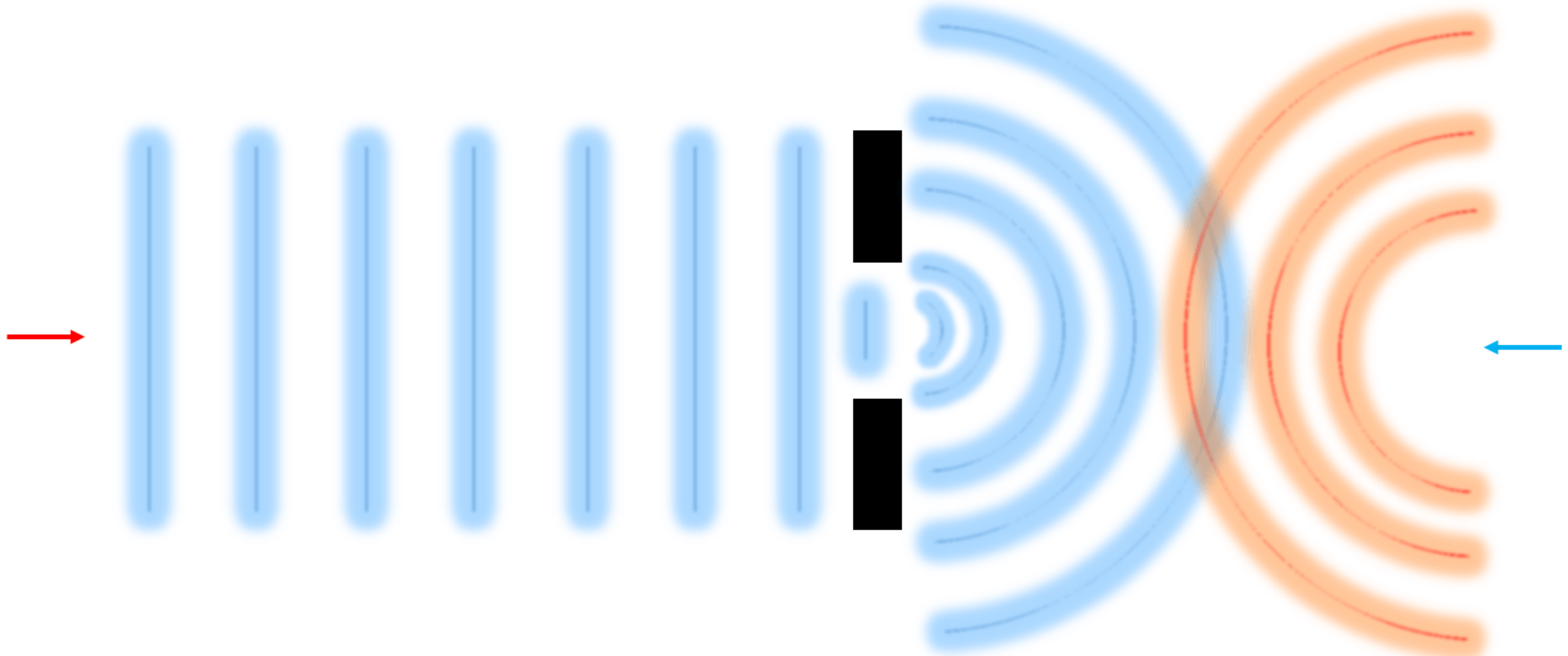
- Ans B
- They are very large and hence can scatter light.

- **Refract Light**: Change the direction of light as it passes through different media due to a change in its speed.
- **Scatter Light**: Redirect light in multiple directions when it interacts with small particles or irregularities in a medium.
- **Diffract Light**: Bend light around obstacles or through openings, causing the light waves to spread out.
- **Polarize Light**: Restrict light waves to oscillate in a single plane, typically achieved using polarizing filters.


Light Dispersed Into
Component Colours
Prism
dispersion
diffraction
Observer
Actual
Depth
Apparent
Depth
Image
Fish
refraction

Diffraction and Interference

Light travels in ***waves***. Like ripples in the ocean, light can bend around obstacles if needed. This bending is known as ***diffraction***. When waves interact with each other, this is known as ***interference***.



CDS 2020 (1 and 2)

PYQs

Chemistry

Q. The elements of which of the following pairs are isobars? [2020-I]

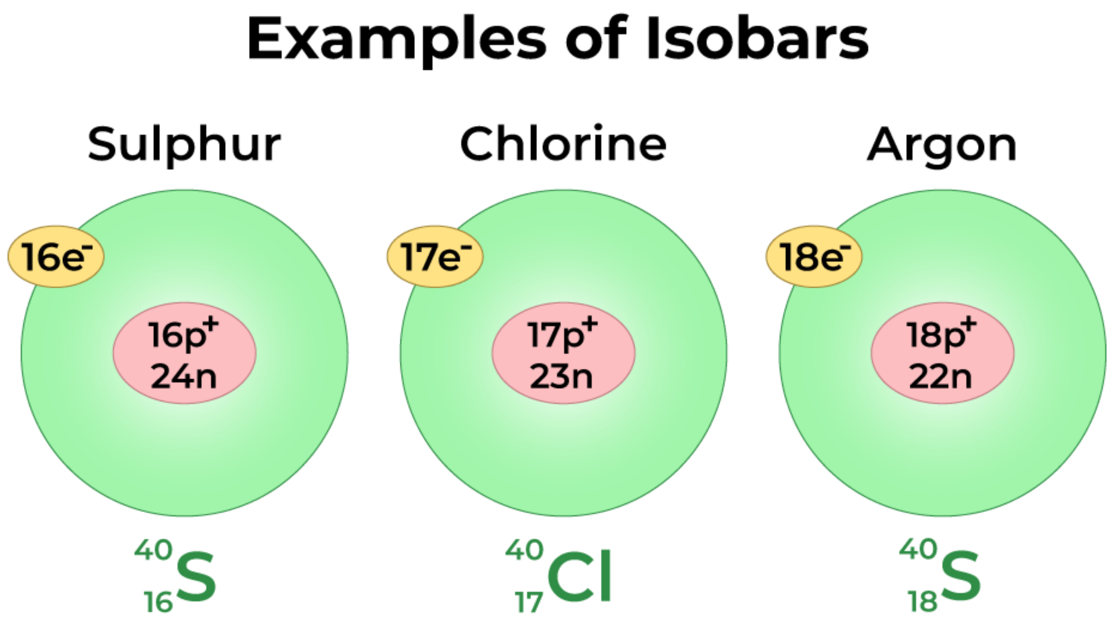
(a) ${}_{1}H^{1}$ and ${}_{1}H^{3}$

(b) ${}_{1}H^{1}$ and ${}_{1}H^{2}$

(c) ${}_{6}C^{12}$ and ${}_{6}C^{14}$

(d) ${}_{18}Ar^{40}$ and ${}_{20}Ca^{40}$

- Answer (d)
- Isobars are atoms of different elements that have the same atomic mass but different atomic numbers, meaning they possess the same number of nucleons.
- Among the given examples, Ca (calcium) has the same atomic mass.



(a) $_1H^1$ and $_1H^3$

Incorrect: These are isotopes, not isobars, because they have the same atomic number (1) but different mass numbers (1 and 3).

(b) $_1H^1$ and $_1H^2$

Incorrect: These are also isotopes because they have the same atomic number (1) but different mass numbers (1 and 2).

(c) $_6C^{12}$ and $_6C^{14}$

Incorrect: These are isotopes of carbon, having the same atomic number (6) but different mass numbers (12 and 14).

(d) $_{18}Ar^{40}$ and $_{20}Ca^{40}$

Correct: These are isobars because they have the same mass number (40) but different atomic numbers (18 for Argon and 20 for Calcium).

Isobar Examples

Ar	K	Ca
Z = 18	Z = 19	Z = 20
A = 40	A = 40	A = 40

Q. Which one of the following chemical reactions is not feasible? [2020-I]

(a) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

(b) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

(c) $Cu + PbCl_2 \rightarrow CuCl_2 + Pb$

(d) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

Answer. (c)

(a) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
Explanation: Iron (Fe) is more reactive than copper (Cu), so it can displace copper from copper sulfate ($CuSO_4$). This reaction is feasible.
(b) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Explanation: Zinc (Zn) is more reactive than copper (Cu), so it can displace copper from copper sulfate ($CuSO_4$). This reaction is feasible.
(c) $Cu + PbCl_2 \rightarrow CuCl_2 + Pb$
Explanation: Copper (Cu) is less reactive than lead (Pb), so it cannot displace lead from lead chloride ($PbCl_2$). This reaction is not feasible.
(d) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$
Explanation: Magnesium (Mg) is more reactive than copper (Cu), so it can displace copper from copper sulfate ($CuSO_4$). This reaction is feasible.

Reactivity series of metals

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Increasingly reactive
Fe	Ferum	
Sn	Tin	
Pb	Lead	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

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SHAPING CAREERS WITH DEVOTION

Mnemonic for learning reactivity series.

Most Reactive

PLEASE	⟶	Potassium
STOP	⟶	Sodium
CALLING	⟶	Calcium
Me	⟶	Magnesium
A	⟶	Aluminium
Careless	⟶	(Carbon)
Zebra	⟶	Zinc
Instead	⟶	Iron
Try	⟶	Tin
Learning	⟶	Lead
How	⟶	Hydrogen
Copper	⟶	Copper
Saves	⟶	Silves
Gold	⟶	Gold

Least Reactive

Q. A solution having pH equal to zero is known as [2020-I]

(a) highly alkaline solution

(b) highly acidic solution

(c) weakly acidic solution

(d) neutral solution

Answer. (b) **Highly acidic solution**

(a) Highly alkaline solution

Explanation: Alkaline (or basic) solutions have a pH greater than 7. A pH of 0 is extremely low, so this option is incorrect.

(b) Highly acidic solution

Explanation: The pH scale ranges from 0 to 14, with 0 being the most acidic. A pH of 0 indicates a very high concentration of hydrogen ions (H^+), making the solution highly acidic. This option is correct.

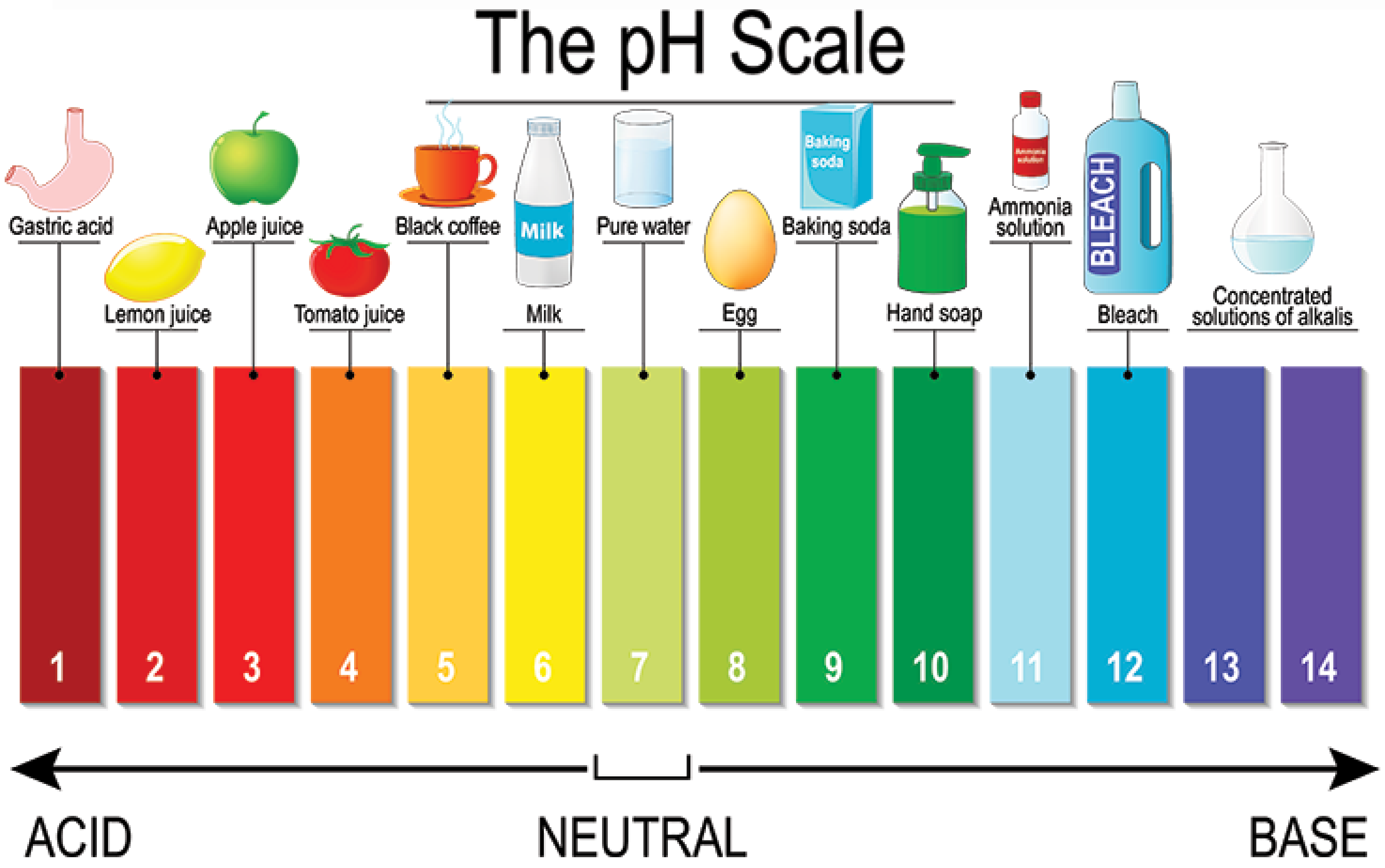
(c) Weakly acidic solution

Explanation: Weakly acidic solutions have a pH slightly below 7. A pH of 0 indicates a strong acid, not a weak one, so this option is incorrect.

(d) Neutral solution

Explanation: A neutral solution has a pH of 7. Since the pH in question is 0, this option is incorrect.

- $pH = -\log [H^+]$



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SHAPING CAREERS WITH DEVOTION

Q. Match List-I with List-II and select the correct answer using the code given below the Lists : [2020-I]

List-I (Compound)	List-II (Use)
A. Boric acid	1. Antiseptic
B. Citric acid	2. Food preservative
C. Magnesium hydroxide	3. Antacid
D. Acetic acid	4. Pickle

Codes:

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

- Answer A
- **Boric acid** is used as an **antiseptic**.
- **Citric acid** is widely used as a **food preservative**.
- **Magnesium hydroxide** is used as an **antacid**.
- **Acetic acid** is used in **pickles**.
- Therefore, the correct matching is:
- **A: 1**
  B: 2
  C: 3
  D: 4
- The corresponding code is:
- **(a) 1 2 3 4**

[redacted]

USES OF ACIDS

Carbonic acid –
Aerated drinks

Sulphuric acid –
Car batterie & paint

Tartaric acid –
Wine manufacturing

Nitric acid –
Fertilizers

Hydrochloric acid –
Digestion

Salicylic acid –
Aspirin

Acetic acid –
Vinegar

Citric acid –
Citrus fruits

Acids used in –
Labs

Q. When air is blown from mouth into a test tube containing limewater, the limewater turns milky. This is due to the presence of [2020-I]

(a) water vapor

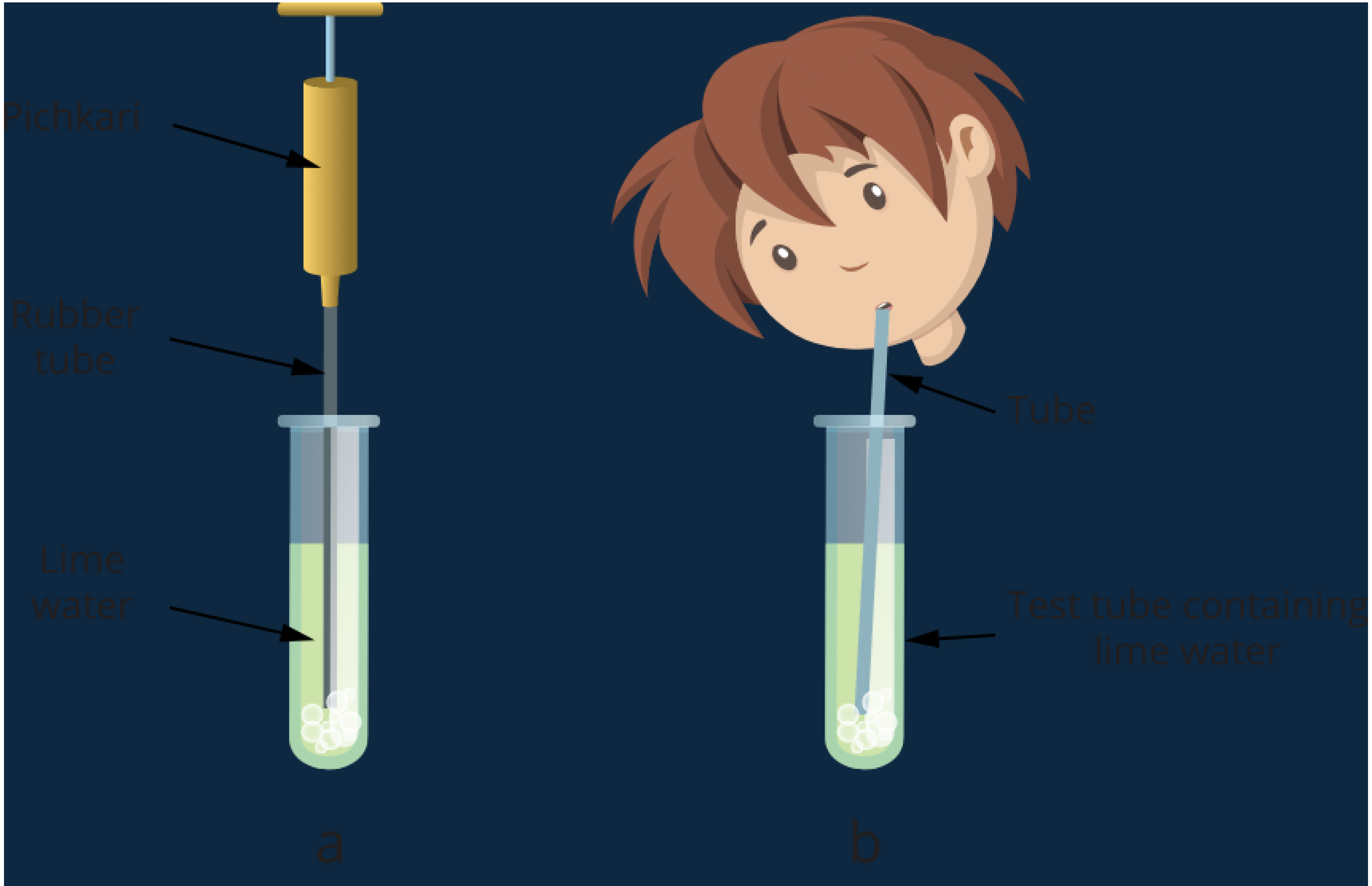
(b) oxygen

(c) carbon dioxide

(d) carbon monoxide

Answer C

(a) Water vapour
Explanation: Water vapour does not cause limewater to turn milky. It has no effect on the solution. This option is incorrect.
(b) Oxygen
Explanation: Oxygen does not react with limewater to produce a milky appearance. This option is incorrect.
(c) Carbon dioxide
Explanation: Carbon dioxide (CO_2) reacts with limewater (calcium hydroxide) to form calcium carbonate, which is insoluble and appears as a milky precipitate. This option is correct
$Ca(OH)_2 + CO_2 \rightarrow CaCO_3(solid) + H_2O$.
(d) Carbon monoxide
Explanation: Carbon monoxide does not react with limewater to produce a milky appearance. This option is incorrect.



a) Air being passed into lime water with a pichkari/syringe

b) Air being exhaled into lime water

TEAM NISHTHA

SHAPING CAREERS WITH DEVOTION

Q. Silver articles become black after some time when exposed to air because
[2020-I]

(a) silver gets oxidized to silver oxide

(b) silver reacts with moist carbon dioxide in the air to form silver carbonate

(c) silver reacts with sulphur in the air to form a coating of silver sulphide

(d) silver reacts with nitrogen oxides in the air to form silver nitrate

Answer C

(a) Silver gets oxidized to silver oxide

Incorrect: Silver oxide does not form easily just by exposure to air.

(b) Silver reacts with moist carbon dioxide in the air to form silver carbonate

Incorrect: Silver carbonate isn't responsible for the black tarnish.

(c) Silver reacts with sulphur in the air to form a coating of silver sulphide

Correct: Silver reacts with sulfur in the air to form black silver sulfide, causing tarnish.

(d) Silver reacts with nitrogen oxides in the air to form silver nitrate

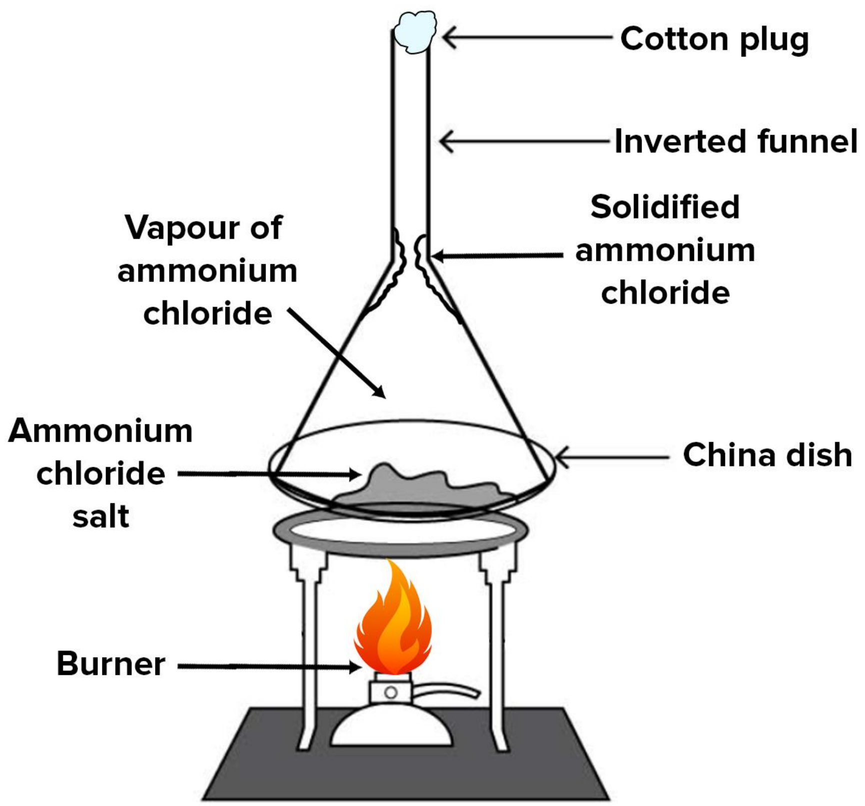
Incorrect: Silver nitrate forms in different conditions, not from air exposure.

CDS - 2 2020

Q. A mixture of sodium chloride (salt) and ammonium chloride can be separated by

(a) sublimation
(b) filtration
(c) chromatography
(d) distillation

- **Answer :- (A)**
- Ammonium chloride sublimates (changes from solid to gas) upon heating, while sodium chloride remains solid.
- **Filtration**: This method separates based on particle size and won't work because both sodium chloride and ammonium chloride are in solid form and have similar sizes.
- **Chromatography**: This method is used for separating substances based on their different affinities to a stationary phase and a mobile phase.
- It is not typically used for separating salts.
- **Distillation**: This method separates based on differences in boiling points, which is not applicable here because both substances are solid and not in a liquid state at normal conditions.


Cotton plug
Inverted funnel
Solidified ammonium chloride
Vapour of ammonium chloride
Ammonium chloride salt
China dish
Burner

Sublimation

Definition: Sublimation is a process where a substance transitions directly from a solid to a gas phase without passing through a liquid phase.

Use in Separation:

- **Application**: Sublimation is used to separate a sublimable substance from a mixture. For example, in the purification of iodine or dry ice, or separating a solid like ammonium chloride from a non-sublimable solid.
- **Procedure**: The mixture is heated, causing the sublimable substance to vaporize. The gas is then cooled and condensed back into a solid, leaving behind other non-sublimable components.

Filtration

Definition: Filtration is a mechanical or physical process used to separate solids from liquids or gases using a filter medium that allows only the fluid to pass through.

Use in Separation:

- **Application**: Filtration is commonly used to separate solid particles from liquids or gases. For example, separating sand from water or coffee grounds from brewed coffee.
- **Procedure**: A mixture is poured through a filter paper or membrane. The solid particles are trapped by the filter, while the liquid or gas passes through.

Chromatography

Definition: Chromatography is a technique used to separate components of a mixture based on their different affinities for a stationary phase and a mobile phase.

Types:

- **Paper Chromatography**: Uses a piece of paper as the stationary phase and a solvent as the mobile phase. It is often used for separating pigments in inks or dyes.
- **Thin-Layer Chromatography (TLC)**: Uses a thin layer of adsorbent material (e.g., silica gel) on a plate. It's used in organic chemistry for separating and analyzing compounds.
- **Column Chromatography**: Uses a column packed with a stationary phase (e.g., silica or alumina) through which the mixture is passed. Components are separated based on their differential affinities for the stationary phase.

Use in Separation:

- **Application**: Chromatography is used in various fields, including chemistry, biology, and environmental science, for separating and analyzing mixtures of substances. For example, separating complex mixtures of chemicals or purifying compounds.

Distillation

Definition: Distillation is a process that separates components of a liquid mixture based on differences in their boiling points.

Types:

- **Simple Distillation**: Used to separate a liquid from a mixture based on boiling point differences. Ideal for separating liquids with significantly different boiling points.
- **Fractional Distillation**: Used for separating a mixture of liquids with closer boiling points. It involves a fractionating column to provide multiple condensation and vaporization steps.

Use in Separation:

- **Application**: Distillation is commonly used in chemical laboratories and industries to purify liquids, such as separating alcohol from a fermented mixture or desalting seawater.
- **Procedure**: The mixture is heated, and the component with the lower boiling point evaporates first. The vapor is then condensed back into a liquid and collected

Q. Symbol of element was introduced by

(a) John Dalton
(b) Antoine Lavoisier
(c) Jons Jacob Berzelius
(d) Robert Boyle

Answer :- (C)

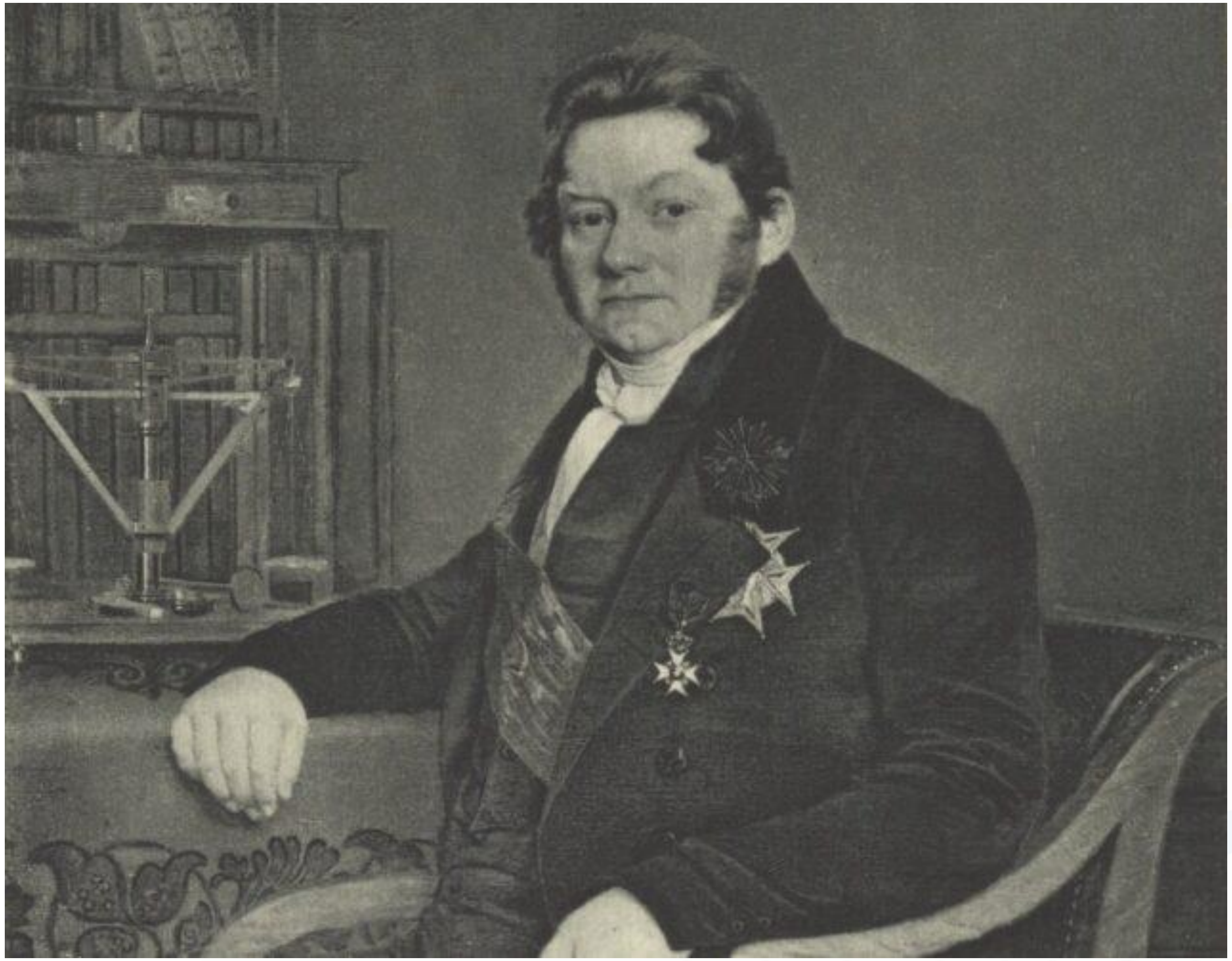
(a) John Dalton: Proposed atomic theory but did not introduce element symbols.

(b) Antoine Lavoisier: Developed chemical nomenclature but did not create element symbols.

(c) Jons Jacob Berzelius: Introduced the modern system of element symbols.

(d) Robert Boyle: Known for Boyle's Law, not element symbols.

So, the correct answer is **(c) Jons Jacob Berzelius**.



TEAM NISHTHA
SHAPING CAREERS WITH DEVOTION

Comparative Table of the Specific Weights of Elementary Bodies.

Names.	Symbols.	Weight in form of gas.	Ditto at a minimum.	Ditto at a maximum.	Sp. gr. in a solid form.
Oxygen	O	100·00	....	....	....
Sulphur	S	201·00	200·00	210·00	1·998
Phosphorus	P	167·512	167·3	....	1·714
Muriatic radicle	M	139·56	....	157·7	....
Fluoric radicle	F	60·	....	....	....
Boron	B	73·273	....	....	....
Carbon	C	75·1	73·6	75·9	3·5
Nitric radicle	N	79·54	75·51	....	....
Hydrogen	H	6·636	....	7·63	....
Arsenic	As	839·9	....	852·2	8·81
Molybdenum	Mo	601·56	....	....	8·6
Chromium	Ch	708·045	....	....	5·9 ?
Tungsten	Tn	2424·24	....	....	17·22
Antimony	Sb	1612·96	....	....	6·7
Tellurium	Te	806·48	....	819·	6·115
Columbium	Cl	....	....	....	....
Titanium	Ti	1801·	....	....	....
Zirconium	Zr	....	....	....	....
Silicium	Si	216·66	....	....	....
Osmium	Os	....	....	....	....
Iridium	I	....	....	....	....
Rhodium	Rh	1490·31	....	....	11·
Platinum	Pl	1206·7	....	....	21·65
Gold	Au	2483·8	....	....	19·361
Palladium	Pa	1407·56	....	....	11·871
Silver	Ag	2688·17	....	2718·31	10·51
Mercury	Hg	2531·6	2503·13	2536·1	13·56
Copper	Cu	806·48	800·	....	8·722
Nickel	Ni	733·8	....	....	8·666
Cobalt	Co	732·61	....	....	8·7
Bismuth	Bi	1774·	....	....	9·88
Lead	Pb	2597·4	....	2620·2	11·445

Q. Identify the correct pair of elements among the following which are liquid at room temperature and standard pressure.

(a) Bromine and fluorine
(b) Mercury and rubidium
(c) Bromine and thallium
(d) Bromine and mercury

Answer :- (D)

Bromine and mercury

Bromine (Br): A reddish-brown liquid at room temperature.

Mercury (Hg): A silvery liquid metal at room temperature.

The other options are incorrect because:

(a) **Bromine and fluorine**: Fluorine is a gas at room temperature.

(b) **Mercury and rubidium**: Rubidium is a solid at room temperature.

(c) **Bromine and thallium**: Thallium is a solid at room temperature.


Bromine
Mercury
Corrosive
Toxic

Q. Which one of the following oxides shows both acidic and basic behaviour?

(a) Zinc oxide
(b) Copper oxide
(c) Magnesium oxide
(d) Calcium oxide

- **Answer :- (A)**

- Zinc oxide
- Zinc oxide is an amphoteric oxide, meaning it can react ***with both acids and bases***.
- The other options are:
- (b) **Copper oxide**: Generally behaves as a basic oxide.
- (c) **Magnesium oxide:** Typically behaves as a basic oxide.
- (d) **Calcium oxide**: Also behaves as a basic oxide.

$$\underset{\text{Zinc oxide}}{ZnO(s)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2(aq)} + \underset{\text{Water}}{H_2O(l)}$$

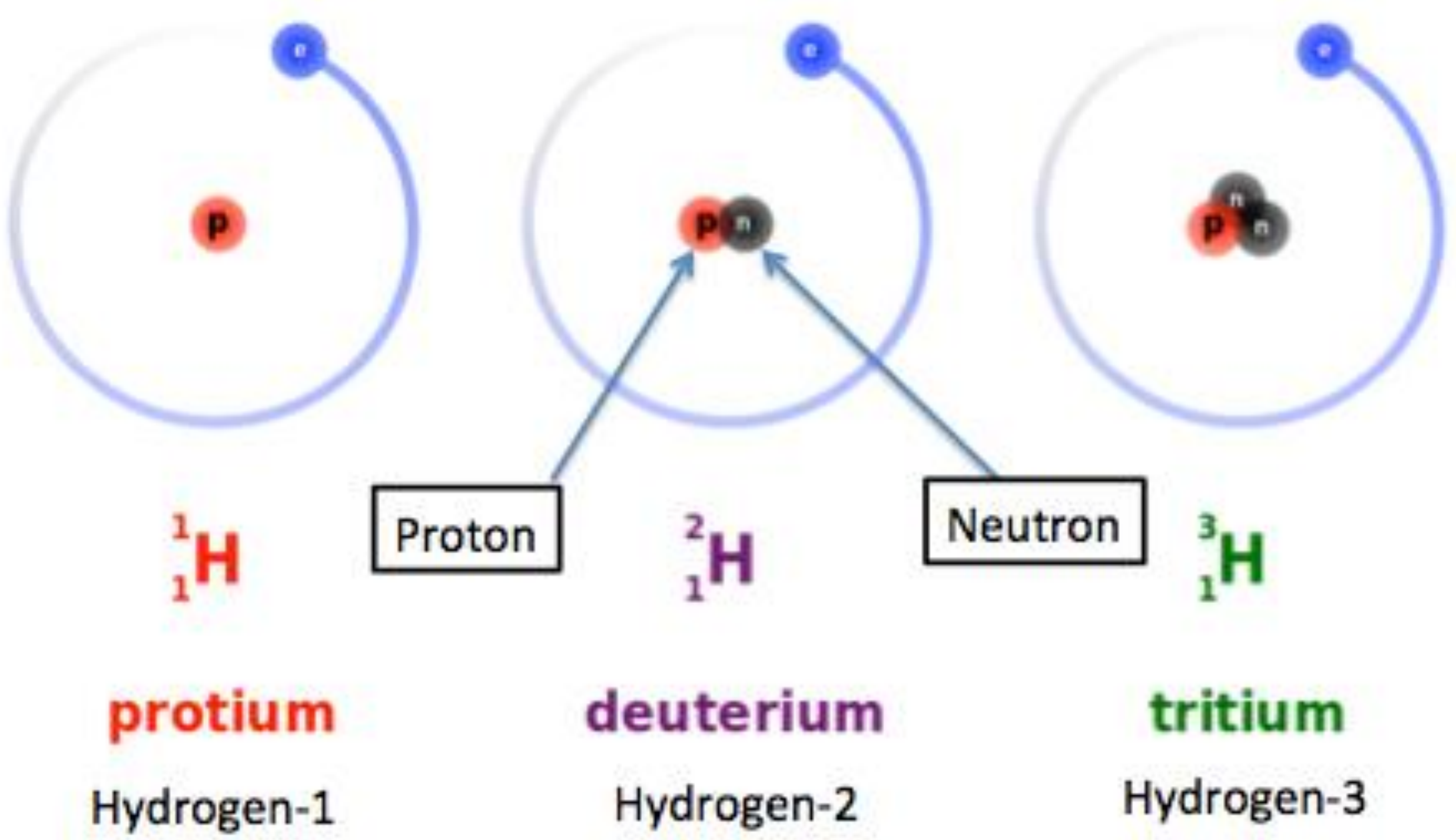
$$\underset{\text{Zinc oxide}}{ZnO(s)} + \underset{\text{Sodium hydroxide}}{2NaOH(aq)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2(aq)} + \underset{\text{Water}}{H_2O}$$

Q. The radioactive isotope of hydrogen is

(a) protium
(b) deuterium
(c) tritium
(d) hydronium

- **Answer :- (C)**

- The radioactive isotope of hydrogen is:
- **<u>(c) Tritium</u>**
- Tritium is a **radioactive isotope** of hydrogen, while **protium and deuterium are non-radioactive isotopes**, and **hydronium is a molecule** rather than an isotope.


p
p n
p n n
Proton
Neutron
$^{1}_{1}H$
$^{2}_{1}H$
$^{3}_{1}H$
protium
deuterium
tritium
Hydrogen-1
Hydrogen-2
Hydrogen-3

Q. Which one of the following is used for storing biological tissues?

(a) Liquid nitrogen
(b) Liquid helium
(c) Liquid argon
(d) Liquid bromine

- **Answer :- (A)**

(a) Liquid nitrogen

Correct: Liquid nitrogen is commonly used to store biological tissues because it provides extremely low temperatures (-196°C) that preserve the tissues without causing damage.

(b) Liquid helium

Incorrect: Liquid helium is used for cooling in applications like MRI machines.

(c) **Liquid Argon**: Used as an inert shielding gas in welding and in the production of semiconductor materials.

(d) **Liquid Bromine**: Employed in the production of flame retardants and as a disinfectant in water treatment.

TEAM NISHTHA
SHAPING CAREERS WITH DEVOTION

Q. Which one of the following does not form oxide on reaction with oxygen?

(a) Magnesium
(b) Lead
(c) Tin
(d) Silver

Answer :- (D)

(a) Magnesium

Incorrect: Magnesium reacts readily with oxygen to form magnesium oxide (MgO).

(b) Lead

Incorrect: Lead reacts with oxygen to form lead oxide (PbO or PbO_2).

(c) Tin

Incorrect: Tin reacts with oxygen to form tin oxide (SnO or SnO_2).

(d) Silver

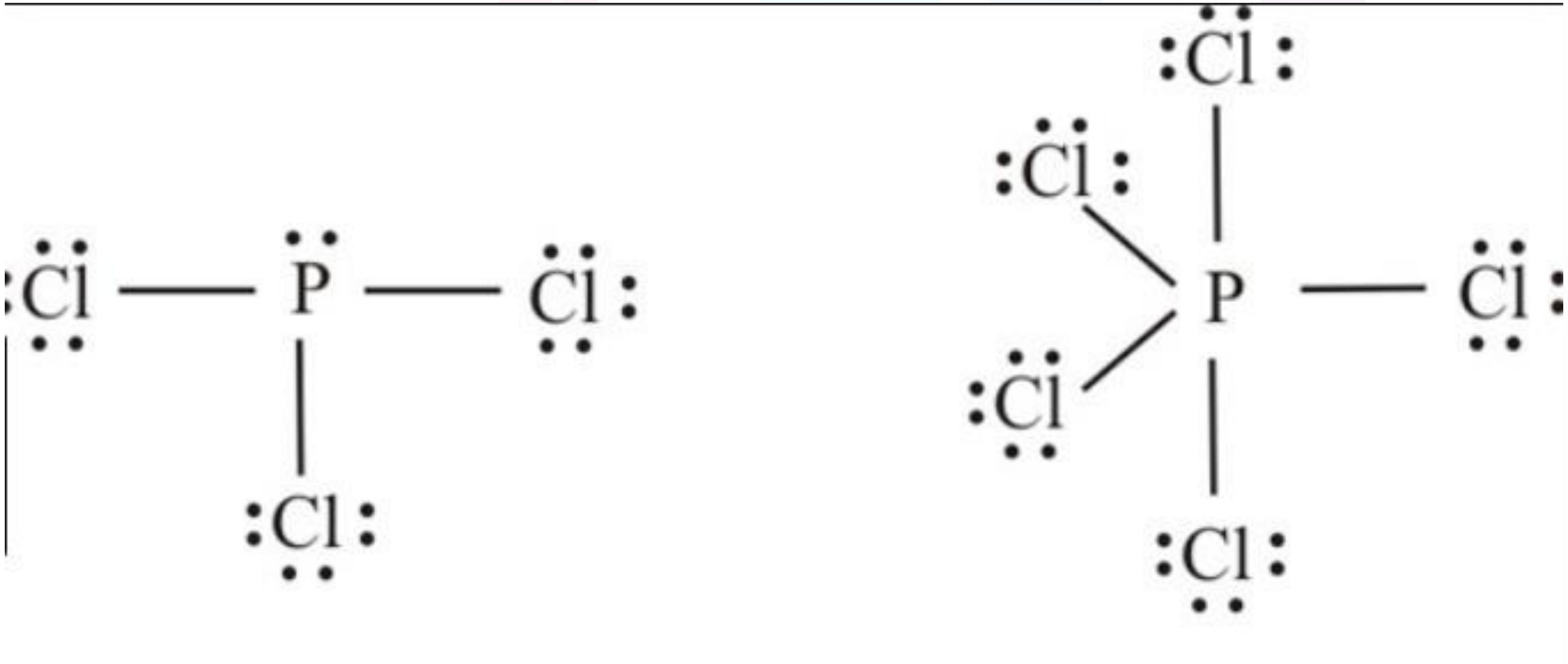
Correct: Silver does not readily form an oxide with oxygen under normal conditions. Instead, it forms a tarnish (silver sulfide) in the presence of sulfur compounds in the air.

Q. The valency of phosphorus is

(a) 2,3
(b) 3,4
(c) 4,5
(d) 3,5

Answer :- (D)

Phosphorus commonly exhibits a valency of 3 in compounds like *phosphorus trichloride (PCl_3)* and a valency of 5 in compounds like *phosphorus pentachloride (PCl_5).*



(PCl_3) (PCl_5)

Q. Lead nitrate on heating gives

(a) PbO_2 and NO_2
(b) PbO and NO_2
(c) PbO and NO
(d) PbO_2 and NO

- **Answer :- (B)**

- When lead nitrate is heated, it decomposes to give:
- (b) PbO and NO_2
- The decomposition reaction is:
- $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

Safety and Environmental Concerns

- **Toxicity**: Lead nitrate is toxic and poses significant health risks, including lead poisoning. It can affect various body systems, particularly the nervous and cardiovascular systems.
- **Regulations**: Due to its toxicity, the use of lead nitrate is heavily regulated in many countries. It is important to handle it with proper safety precautions, including using personal protective equipment and working in well-ventilated areas.

CDS 2021 (1 and 2)

PYQs

Chemistry

CDS-1 2021

Q. Which one of the following substances do silver articles react with, that makes the silver articles black ?

(a) Sulphur
(b) Oxygen
(c) Carbon dioxide
(d) Phosphorus

- **Answer :- (A)**
- Silver articles turn black due to a reaction with **sulphur**. The black tarnish is primarily silver sulfide (Ag_2S), which forms when silver reacts with sulfur compounds in the air.
- Sulphur: Silver reacts with sulphur to form silver sulphide (Ag_2S), which causes tarnishing on silver objects.
- $2Ag + S \rightarrow Ag_2S$
- Oxygen: Silver does not react significantly with oxygen under normal conditions, as it is relatively stable and resistant to oxidation.
- Carbon Dioxide: Silver does not react with carbon dioxide under normal conditions.
- Phosphorus: Silver does not react with phosphorus under standard conditions. However, silver compounds can be affected by phosphorus in more complex chemical environments.

Q. Which one of the following metals is kept immersed in Kerosene oil to protect it and to prevent accidental fire ?

(a) Calcium
(b) Sodium
(c) Vanadium
(d) Magnesium

- **Answer :- (B)**
- The metal that is kept immersed in kerosene oil to protect it and prevent accidental fires is **sodium**.
- Sodium reacts violently with water and can even catch fire when exposed to air, so it's stored under kerosene to prevent such reactions.

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1. **Calcium**: Reacts with water and air but is not typically kept in kerosene.
2. **Sodium**: Highly reactive with water and air, so it is stored under kerosene oil to prevent contact with moisture and air, reducing the risk of fire and explosions.
3. **Vanadium**: Not highly reactive and does not require storage in kerosene.
4. **Magnesium**: Reacts with water but is usually stored dry or in specialized containers rather than kerosene.

Sodium's high reactivity makes kerosene an essential protective medium for safe handling and storage.

[redacted]

SODIUM, POTASSIUM AND LITHIUM METALS IMMERSED IN KEROSENE OIL

Sodium

Lithium

Potassium

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Q. A solution contains 20 g of solute in 180 g of solvent. If the solvent is water, what is the concentration of the solution in terms of mass by mass percentage ?

(a) 11.1%
(b) 22.2%
(c) 10%
(d) 2%

- **Answer :- (C)**

- Mass by mass percentage=(Mass of solute) /
- Total Mass of solution)×100%
- Here, the mass of the solute is 20 g and the mass of the solvent is 180g
- solute+Mass of solvent=20 g+180 g=200 g
- Mass by mass percentage = $\frac{20}{200}$×100%=10%
- (c) 10%

Q. Which one of the following elements is a non-metal but is lustrous ?

(a) Carbon
(b) Silicon
(c) Germanium
(d) Iodine

- **Answer :- (D)**
- **Iodine** is a non-metal that exhibits a lustrous appearance. It has a metallic sheen when in its solid form.

1. **Carbon**: Typically non-metallic in its common forms (graphite, diamond) but not generally described as lustrous in its most familiar allotropes.
2. **Silicon**: A metalloid with a metallic luster, not a non-metal.
3. **Germanium**: A metalloid with a metallic luster, not a non-metal.
4. **Iodine**: A non-metal that exhibits a lustrous appearance as a solid, with a shiny, metallic sheen.

Iodine is unique among the listed options for being a non-metal with a lustrous appearance.

Boron, silicon, germanium, arsenic, antimony, and tellurium are commonly recognised as metalloids.

Q. Which one of the following metals has both malleability and ductility properties ?

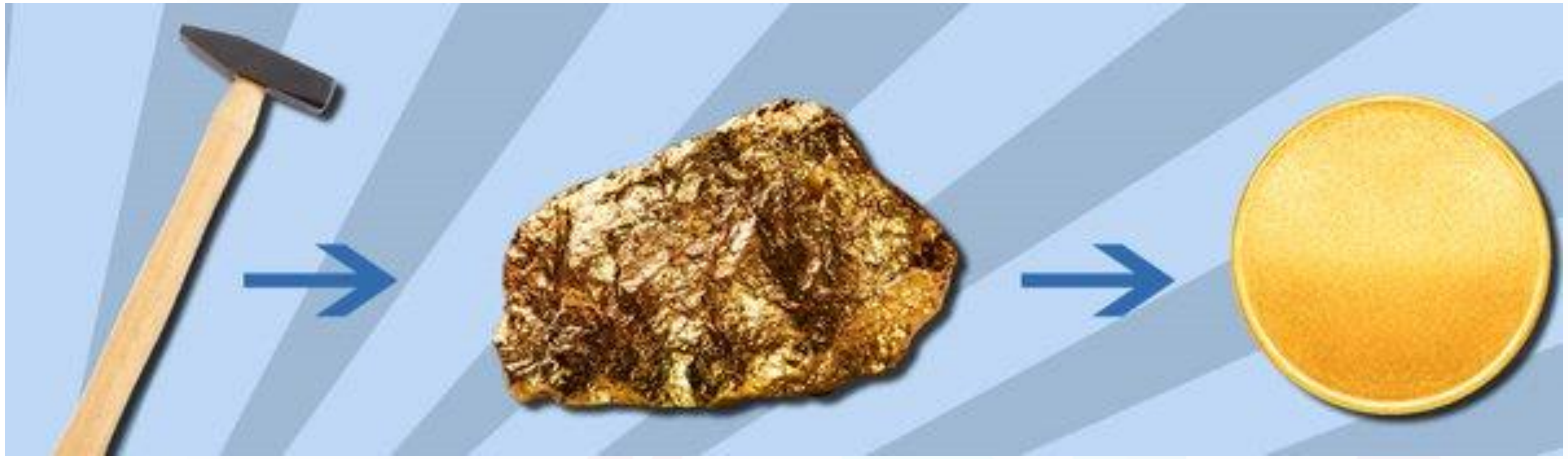
(a) Na
(b) Au
(c) Ce
(d) Hg

- **Answer :- (B)**

- Among the metals listed, **gold (Au)** is known for its malleability and ductility.
- Gold can be hammered into thin sheets (malleability) and drawn into thin wires (ductility), which are characteristic properties of metals.

1. **Na (Sodium)**: A **highly reactive alkali metal** that is neither very malleable nor ductile; it is **soft and can be cut with a knife**.
2. **Au (Gold)**: Known for its high malleability and ductility, allowing it to be hammered into thin sheets and drawn into wires.
3. **Ce (Cerium)**: A **rare earth metal with some malleability** but less so compared to gold; **it is not as ductile**.
4. **Hg (Mercury)**: **A liquid metal at room temperature**, so it does not exhibit malleability or ductility in the traditional sense.

Gold is renowned for its ability to be shaped into thin sheets and drawn into wires while retaining its integrity, making it a prime example of both malleability and ductility.



Q. Which one of the following naturally occurring acids is found in abundance in tomato ?

(a) Acetic acid
(b) Citric acid
(c) Oxalic acid
(d) Tartaric acid

- **Answer :- (C)**

- It contains several types of acids, including citric acid, malic acid, ascorbic acid, and oxalic acid.
- An average-sized tomato contains approximately 50 mg of oxalic acid.
- Generally, riper tomatoes have higher levels of oxalic acid compared to less ripe ones.

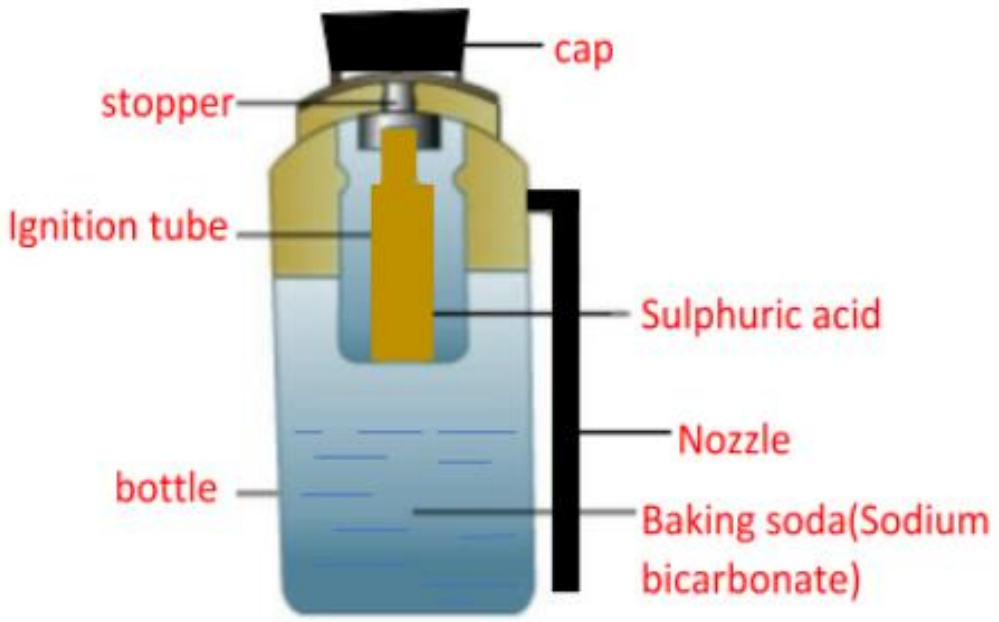
Substance	Acid present
1. Orange, lemon	Citric acid, ascorbic acid (vitamin C)
2. Apple	Malic acid
3. Tamarind (imli), grape	Tartaric acid
4. Vinegar	Acetic acid
5. Curd	Lactic acid
6. Tomato	Oxalic acid
7. Gastric juice	Hydrochloric acid
8. Tea	Tannic acid
9. Red ants	Formic acid

Q. Which one of the following is used in soda-acid fire extinguishers ?

(a) Sodium chloride
(b) Sodium hydrogen carbonate
(c) Calcium hydroxide
(d) Acetic acid

- **Answer :- (B)**

- In soda-acid fire extinguishers, the key component used is **sodium hydrogen carbonate**, commonly known as baking soda.
- This reacts with acetic acid to produce carbon dioxide, which helps to extinguish the fire.



SODA-ACID FIRE EXTINGUISHER

1.Sodium Chloride: Common table salt, not used in fire extinguishers.
2.Sodium Hydrogen Carbonate: Also known as baking soda, it reacts with acids to produce carbon dioxide, which helps smother fires in soda-acid fire extinguishers.
3.Calcium Hydroxide: Used in other applications such as water treatment and agriculture, not in soda-acid fire extinguishers.
4.Acetic Acid: An acid used in vinegar; it is not used in soda-acid fire extinguishers but can be part of the reaction when combined with sodium hydrogen carbonate.
Sodium hydrogen carbonate reacts with the acid in the fire extinguisher to produce carbon dioxide, which helps extinguish the fire.

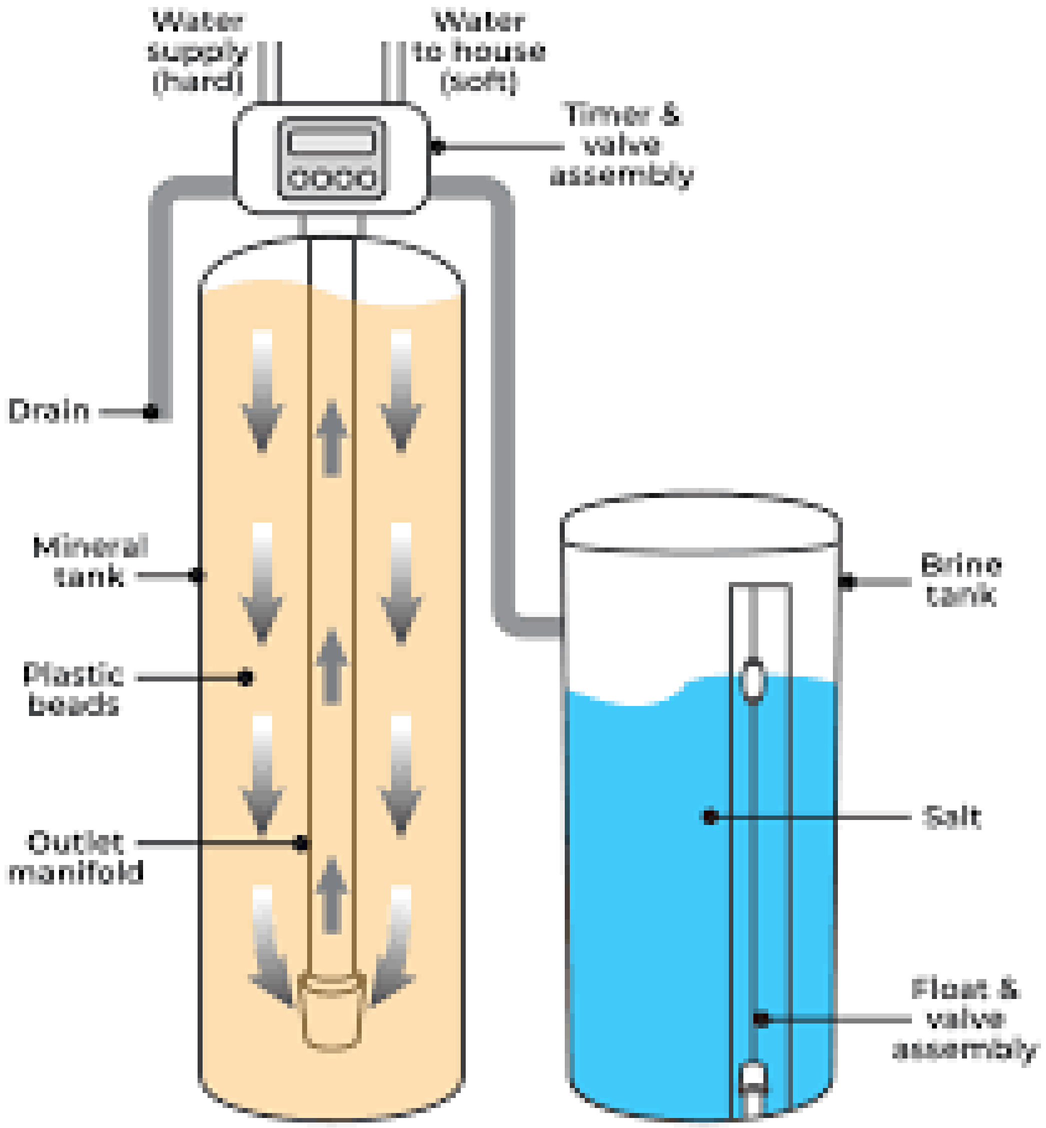
Q. Which one of the following sodium compounds is used for softening hard water?

(a) Na_2CO_3
(b) $NaHCO_3$
(c) NaOH
(d) Na_2SO_4

- **Answer :- (A)**
- The sodium compound used for softening hard water is **sodium carbonate** (Na_2CO_3) also known as washing soda.
- It reacts with the calcium and magnesium ions in hard water to form insoluble carbonates, which precipitate out, thus softening the water.

1. **Na_2CO_3 (Sodium Carbonate)**: Also known as washing soda, it reacts with calcium and magnesium ions in hard water to form insoluble precipitates, thereby softening the water.
2. **$NaHCO_3$ (Sodium Bicarbonate)**: Used as a baking soda and mild alkali, but not typically used for softening hard water.
3. **NaOH (Sodium Hydroxide)**: A strong base used in various chemical processes, but not specifically for softening hard water.
4. **Na_2SO_4 (Sodium Sulfate)**: Used in detergents and as a laxative, but not effective in softening hard water.

Sodium carbonate effectively reduces water hardness by precipitating out calcium and magnesium ions.


Water supply (hard)
Water to house (soft)
Timer & valve assembly
Drain
Mineral tank
Plastic beads
Outlet manifold
Brine tank
Salt
Float & valve assembly

Q. Calcium oxide reacts vigorously with water to produce slaked lime whose solution is used for white-washing walls. This slaked lime reacts with component (A) in air to form a thin layer of component (B) to give a shiny finish. What are the components (A) and (B) ?

(a) A-O_2; B-$CaCO_3$
(b) A-CO_2; B- $Ca(OH)_2$
(c) A-O_2; B-$Ca(OH)_2$
(d) A-CO_2; B-$CaCO_3$

- **Answer :- (D)**

- To elaborate, after calcium oxide (CaO) reacts with water to form calcium hydroxide (Ca(OH)2), this slaked lime reacts with carbon dioxide (CO2) from the air to form calcium carbonate (CaCO3).
- Calcium carbonate forms a thin layer on the surface, which gives a shiny finish and is often used in whitewashing

CDS – 2 2021

Q. Which of the following statements about universal indicator is/are true ?

1. It is a mixture of several indicators.
2. It shows different colours at different concentrations of hydrogen ions in solution.
3. It helps to determine the strength of given acid and base in titration.
Select the correct answer using the code given below:

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1,2 and 3

Universal indicators are a type of pH indicator that changes color over a broad range of pH values, providing a visual representation of the acidity or basicity of a solution.

Key Points:

1.**Range**: Universal indicators span a wide pH range, typically from pH 1 to 14, covering strong acids to strong bases.

2.**Color Change**: They exhibit a range of colors corresponding to different pH levels. For example, they may change from red in strong acids to green in neutral solutions to blue or purple in strong bases.

3.**Components**: Universal indicators are usually a mixture of several different indicators, such as phenolphthalein, methyl orange, and bromothymol blue, each contributing to the overall color change across the pH spectrum.

4.**Uses**: Commonly used in laboratories and educational settings to determine the pH of solutions. They are available in various forms, including solutions, paper strips, and tablets.

Examples: One popular universal indicator is the **pH indicator paper** or **litmus paper**, which shows a range of colors depending on the pH of the solution tested.

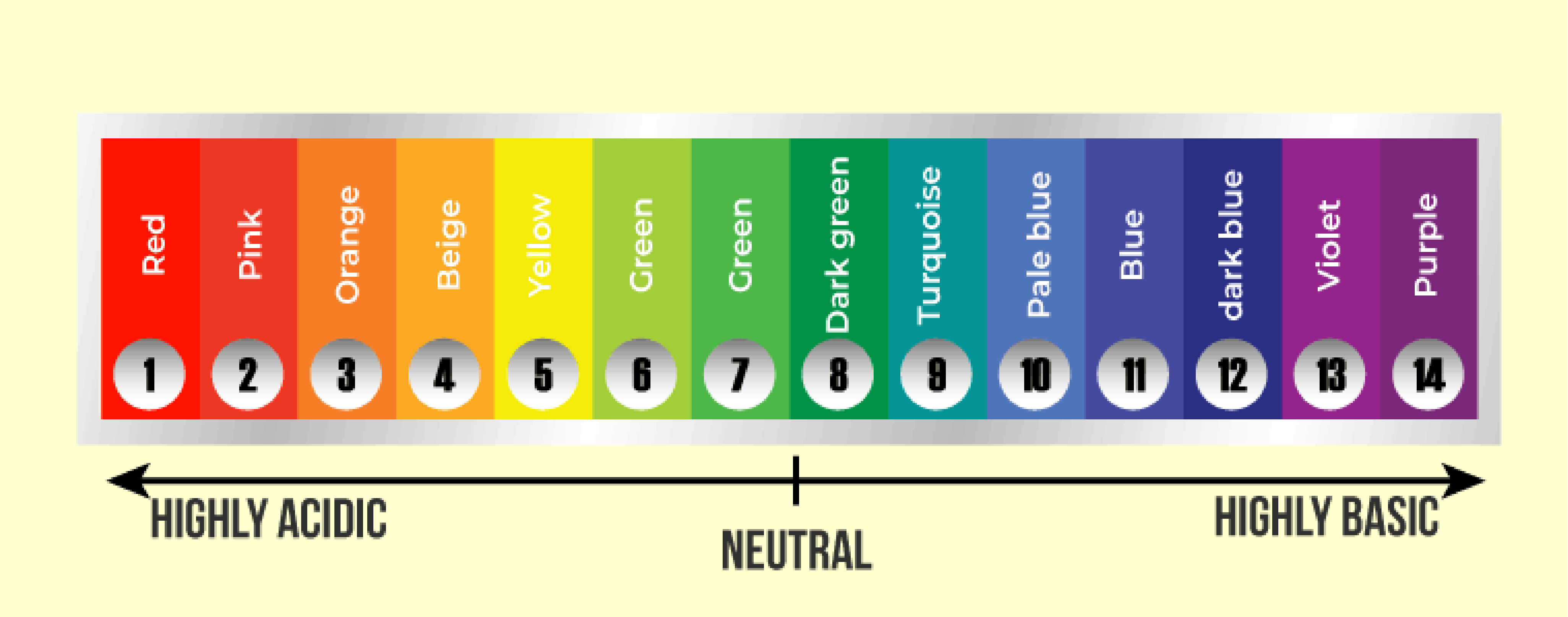
Visual Representation:

Acidic Solutions (pH < 7): Typically show colors ranging from red to orange to yellow.

Neutral Solutions (pH ≈ 7): Show green.

Basic Solutions (pH > 7): Typically show colors ranging from blue to purple.

Universal indicators provide a straightforward method for determining the pH of a solution by comparing the color of the solution to a color chart.


Red
Pink
Orange
Beige
Yellow
Green
Green
Dark green
Turquoise
Pale blue
Blue
dark blue
Violet
Purple
1
2
3
4
5
6
7
8
9
10
11
12
13
14
HIGHLY ACIDIC
NEUTRAL
HIGHLY BASIC

- **Answer :- (D)**
- **It is a mixture of several indicators: This** is true.
- A universal indicator is indeed a mixture of several indicators that allows it to cover a broad range of pH levels and show a spectrum of colors.
- **It shows different colors at different concentrations of hydrogen ions in solution**: This is also true.
- The color changes in the universal indicator correspond to different pH levels, which reflect varying concentrations of hydrogen ions.
- **It helps to determine the strength of a given acid and base in titration**: it does help identify the pH range during titration, which can indirectly provide information about the relative strength of acids and bases in a solution. In practice, universal indicators are used to indicate the endpoint of a titration and thereby infer the strength of acids and bases based on the pH changes.

Q. Which of the following carbon allotropes is/are good conductor(s) of electricity ?

1. Diamond

2. Graphite

3. Fullerene

Select the correct answer using the code given below :

(a) 1 only

(b) 1 and 2 only

(c) 2 only

(d) 1 and 3 only

Answer :- (C)

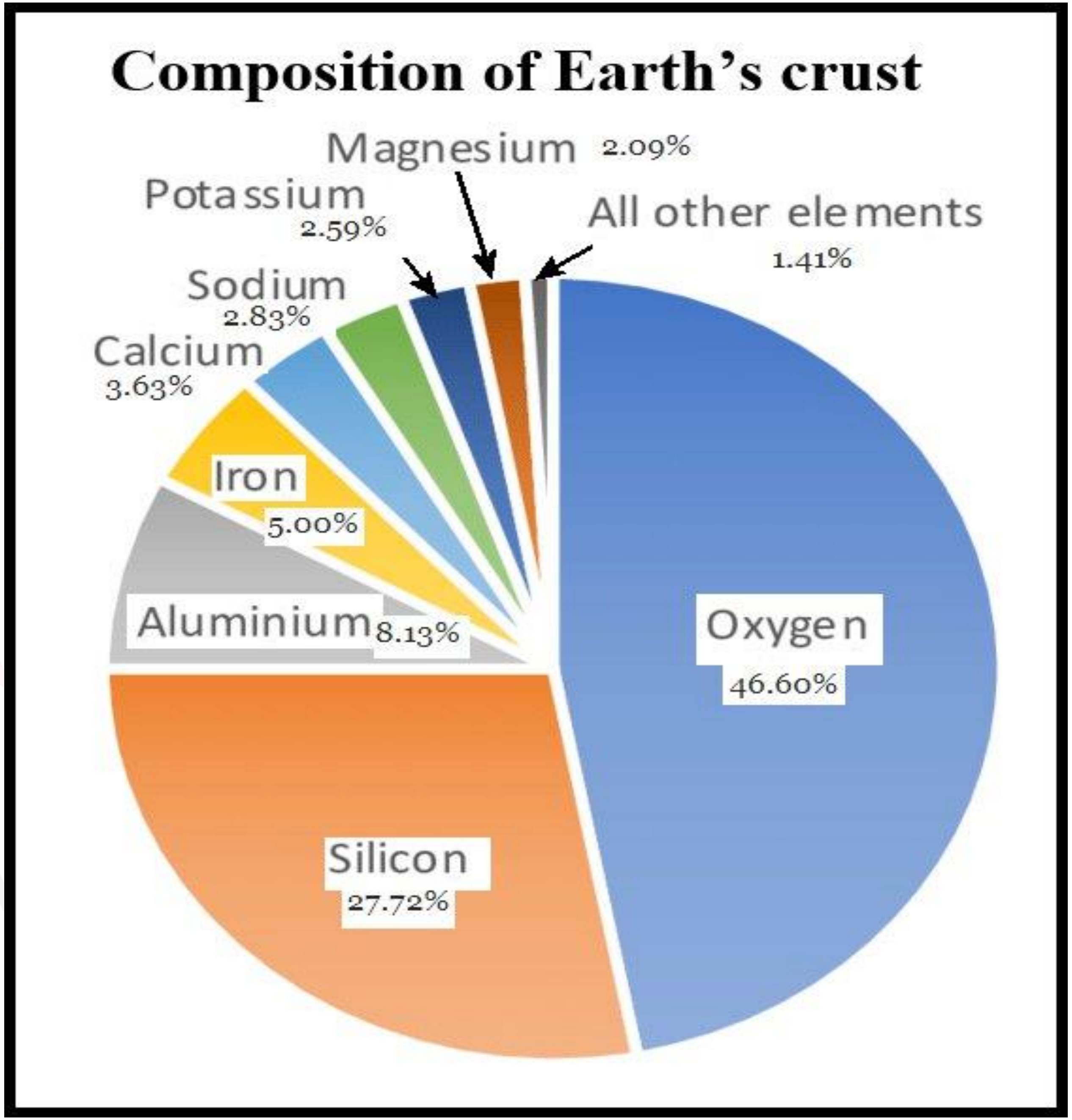
- **Diamond**: An allotrope of carbon where each carbon atom is bonded to four others in a rigid lattice structure, making it an excellent electrical insulator, not a conductor.
- **Graphite**: An allotrope of carbon where carbon atoms are arranged in layers of hexagonal lattices with free electrons, making it a good conductor of electricity.
- **Fullerene**: While some forms of fullerene (e.g., C_{60}) can exhibit some electrical conductivity, they are generally not as good conductors as graphite.

- **Diamond**: An allotrope of carbon where each carbon atom is bonded to four others in a rigid lattice structure, making it an excellent electrical insulator, not a conductor.
- **Graphite**: An allotrope of carbon where carbon atoms are arranged in layers of hexagonal lattices with free electrons, making it a good conductor of electricity.
- **Fullerene**: While some forms of fullerene (e.g., C_{60}) can exhibit some electrical conductivity, they are generally not as good conductors as graphite.

Q. What is the approximate percentage of carbon in the Earth's crust ?

(a) 0.045%
(b) 0.025%
(c) 0.015%
(d) 0.005%

Answer :- (B)


Composition of Earth's crust
Magnesium 2.09%
Potassium 2.59%
All other elements 1.41%
Sodium 2.83%
Calcium 3.63%
Iron 5.00%
Aluminium 8.13%
Oxygen 46.60%
Silicon 27.72%

Q. When copper reacts with moist carbon dioxide (CO_2) in air, it forms a green coating of which one of the following compounds ?

(a) Cupric carbonate
(b) Cuprous oxide
(c) Cupric oxide
(d) Copper sulphate

- **Answer :- (A)**

- When copper reacts with moist carbon dioxide (CO2) in the air, it forms a green coating of **cupric carbonate**.
- The reaction can be summarized as follows:
- $2Cu+CO_2+H_2O \rightarrow Cu_2(CO_3)(OH)_2$
- This compound is commonly known as **basic copper carbonate** or **malachite**

1. **Cupric Carbonate ($CuCO_3$)**: Forms a green coating on copper when it reacts with moist CO_2 in the presence of air, contributing to the patina on copper surfaces.
2. **Cuprous Oxide (Cu_2O)**: Typically forms a reddish coating on copper, not green.
3. **Cupric Oxide (CuO)**: Forms a black coating on copper, not green.
4. **Copper Sulphate ($CuSO_4$)**: Forms a blue solution or crystals, not a green coating.

Cupric carbonate, or copper carbonate, is responsible for the characteristic green patina that forms on copper over time.

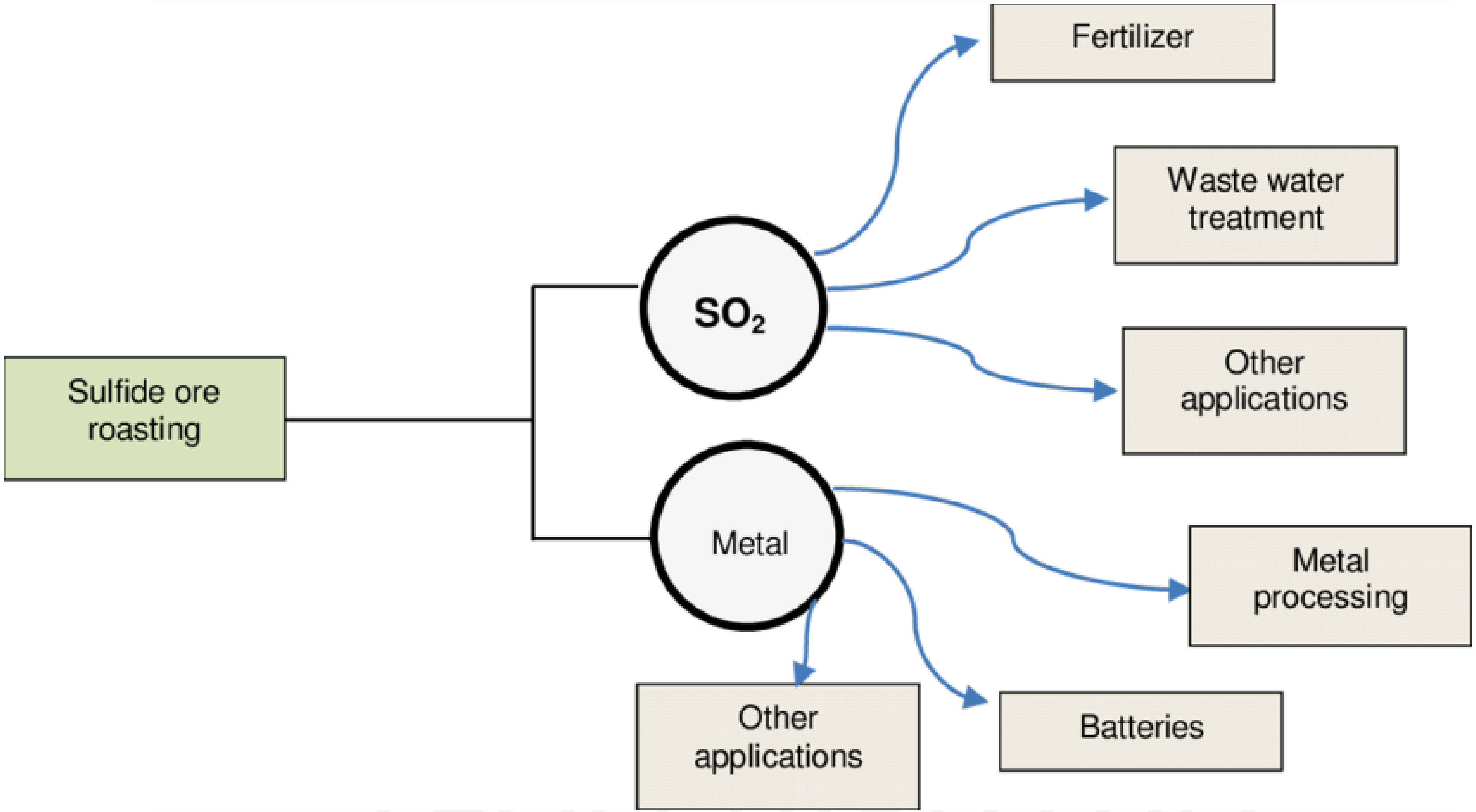
Q. What is the name of the process that converts sulphide ores into oxides by heating strongly in the presence of excess air ?

(a) Calcination
(b) Roasting
(c) Smelting
(d) Incineration

- **Answer :- (B)**

- (a) **Calcination**: Heats ores without air to remove volatile substances, like carbon dioxide from carbonates.
- (b) **Roasting**: Heats sulphide ores with excess air to convert them into oxides, often producing sulfur dioxide as a byproduct.
- (c) **Smelting**: Extracts metal from ores by heating with a reducing agent, typically following roasting.
- (d) **Incineration**: Burns organic material to reduce it to ash, not used for metal ore processing.

- **Calcination**: Heating of ores or substances in the absence of air to drive off volatile components and prepare them for further processing, often resulting in the formation of oxides.
- **Roasting**: Heating of sulfide ores in the presence of oxygen to convert them into oxides and release sulfur dioxide gas, preparing the ore for extraction of metal.
- **Smelting**: A process of extracting metal from its ore by heating and melting, often using a flux to separate impurities from the metal.
- **Incineration**: The combustion of waste materials at high temperatures to reduce them to ash, gases, and heat, often used for waste disposal and treatment.


Sulfide ore roasting
SO_2
Metal
Fertilizer
Waste water treatment
Other applications
Metal processing
Batteries
Other applications

Q. What are the constituents of alloy solder ?

(a) Pb and Zn
(b) Pb and Sn
(c) Pb and Si
(d) Pb and Co

Answer :- (B)

•**Bronze**: **Constituents**: Copper (Cu) and Tin (Sn).
•**Description**: An alloy known for its hardness and corrosion resistance; used in coins, statues, and bearings.
•**Brass**: **Constituents**: Copper (Cu) and Zinc (Zn).
•**Description**: A versatile alloy with good machinability and corrosion resistance; used in plumbing fixtures, musical instruments, and decorative items.
•**Steel**: **Constituents**: Iron (Fe) and Carbon (C), with possible additional elements like chromium (Cr), nickel (Ni), and manganese (Mn).
•**Description**: A strong and flexible alloy used in construction, tools, and machinery; variations include stainless steel (with chromium and nickel) and carbon steel.
•**Stainless Steel**: **Constituents**: Iron (Fe), Chromium (Cr), and Nickel (Ni).
•**Description**: An alloy with high resistance to corrosion and staining; used in cutlery, medical instruments, and kitchen appliances.
•**Aluminium Bronze**: **Constituents**: Copper (Cu) and Aluminium (Al).
•**Description**: An alloy with high strength and corrosion resistance; used in marine environments and aerospace components.

- **Duralumin**: **Constituents**: Aluminium (Al), Copper (Cu), with small amounts of manganese (Mn) and other elements.
- **Description**: A lightweight and strong alloy used in aircraft construction and automotive components.
- **Solder**: **Constituents**: Tin (Sn) and Lead (Pb), with possible small amounts of silver (Ag) or other elements.
- **Description**: An alloy used for joining metal parts, particularly in electronics and plumbing.
- **Pewter**: **Constituents**: Tin (Sn), with small amounts of lead (Pb), copper (Cu), and antimony (Sb).
- **Description**: A malleable alloy often used in decorative items and tableware.
- **Inconel**: **Constituents**: Nickel (Ni), Chromium (Cr), and Iron (Fe), with possible additions of other elements like molybdenum (Mo).
- **Description**: A high-temperature alloy known for its oxidation and corrosion resistance; used in jet engines and chemical processing.
- **Titanium Alloy**: **Constituents**: Titanium (Ti), with possible additions of aluminium (Al), vanadium (V), and other elements.
- **Description**: An alloy known for its high strength-to-weight ratio and corrosion resistance; used in aerospace, medical implants, and high-performance engineering applications.

Q. Which one of the following is the correct reactivity order of metals reacting with dilute HCI?

(a) Mg > Al > Zn > Fe
(b) Mg < Al < Zn < Fe
(c) Mg > Zn > Fe > Al
(d) Fe > Mg > Al > Zn

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- **Answer :- (A)**

- Magnesium (Mg) reacts very vigorously with dilute HCl.
- Aluminum (Al) reacts next, though its reaction can be initially slower due to an oxide layer.
- Zinc (Zn) reacts moderately with dilute HCl.Iron (Fe) reacts the least vigorously among these metals

Q. Which one of the following acids is secreted by leaves of Nettle that causes painful stings ?

(a) Methanoic acid
(b) Citric acid
(c) Tartaric acid
(d) Acetic acid

- **Answer :- (A)**
- The acid secreted by the leaves of the nettle plant that causes painful stings is:
- **Methanoic acid** (also known as formic acid).
- Formic acid is responsible for the stinging sensation when nettle leaves come into contact with the skin.

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Q. Which of the following statements is/are correct ?
1. All the bases are alkali.
2. All alkalis dissolve in water.
3. Alkalis are soapy to touch, bitter in taste and corrosive in nature.

Select the correct answer using the code given below :
(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 3 only

Answer :- (C)

<u>All the bases are alkali</u>: This is incorrect. Only soluble bases are alkalis; not all bases are soluble in water.

<u>All alkalis dissolve in water</u>: This is correct. Alkalis are bases that are soluble in water, producing hydroxide ions.

<u>Alkalis are soapy to touch, bitter in taste, and corrosive in nature</u>: This is correct. Alkalis have these properties, making them distinct.

Alkalis are bases that dissolve in water to produce hydroxide ions (OH^-), which make the solution basic. Here are some common examples:

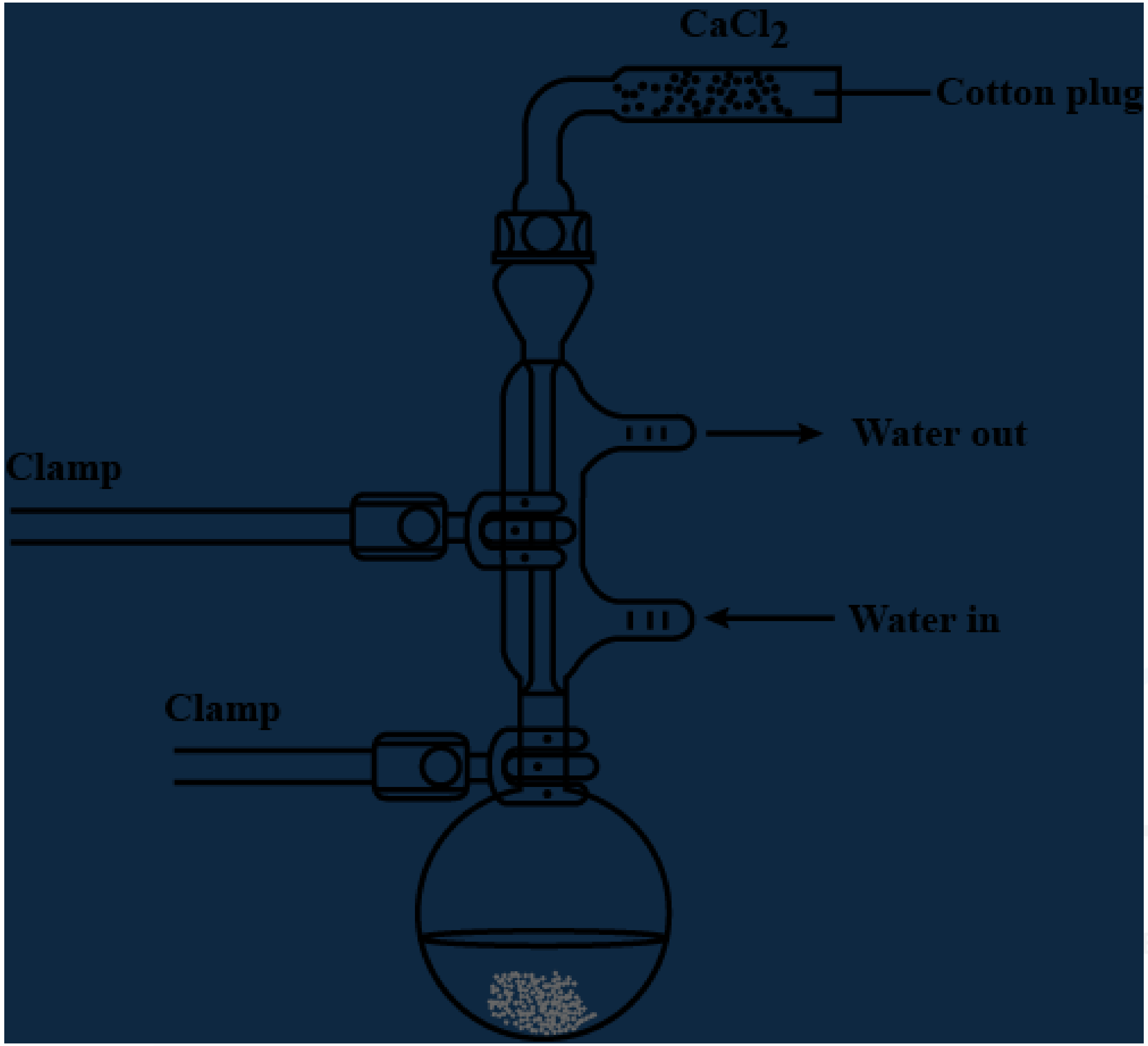
Examples of Alkalis:

1. **Sodium Hydroxide ($NaOH$)**:
   1. **Description**: Commonly known as caustic soda or lye, it is widely used in industry for cleaning, soap making, and as a chemical reagent.
2. **Potassium Hydroxide (KOH)**:
   1. **Description**: Known as caustic potash, it is used in the manufacture of potassium compounds and as a strong base in various chemical reactions.
3. **Calcium Hydroxide ($Ca(OH)_2$)**:
   1. **Description**: Also known as slaked lime or limewater, it is used in agriculture to neutralize soil acidity and in water treatment.
4. **Ammonium Hydroxide (NH_4OH)**:
   1. **Description**: A solution of ammonia in water, often used as a cleaning agent and in the manufacture of fertilizers.

Q. Which one of the following materials is present in a guard tube (drying tube) that is used for preparation of HCl gas ?

(a) Calcium chloride
(b) Calcium bromide
(c) Calcium iodide
(d) Calcium fluoride

- **Answer :- (A)**
- A guard tube (drying tube) used in the preparation of hydrochloric acid (HCl) gas typically contains a drying agent to remove moisture from the gas.
- The material used for this purpose is:
- (a) **Calcium chloride**
- Calcium chloride is a hygroscopic substance that effectively absorbs moisture, making it suitable for drying gases.



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- **Calcium Chloride ($CaCl_2$)**: Used as a desiccant to absorb moisture in drying tubes, as well as in de-icing roads and in various industrial processes.
- **Calcium Bromide ($CaBr_2$)**: Utilized in oil and gas drilling as a component of completion fluids and in some chemical synthesis applications.
- **Calcium Iodide (CaI_2)**: Employed in veterinary medicine as a supplement for iodine, and also used in some chemical reactions and processes.
- **Calcium Fluoride (CaF_2)**: Used in the manufacture of optical lenses and glasses, as a flux in metallurgy, and in the production of hydrogen fluoride.

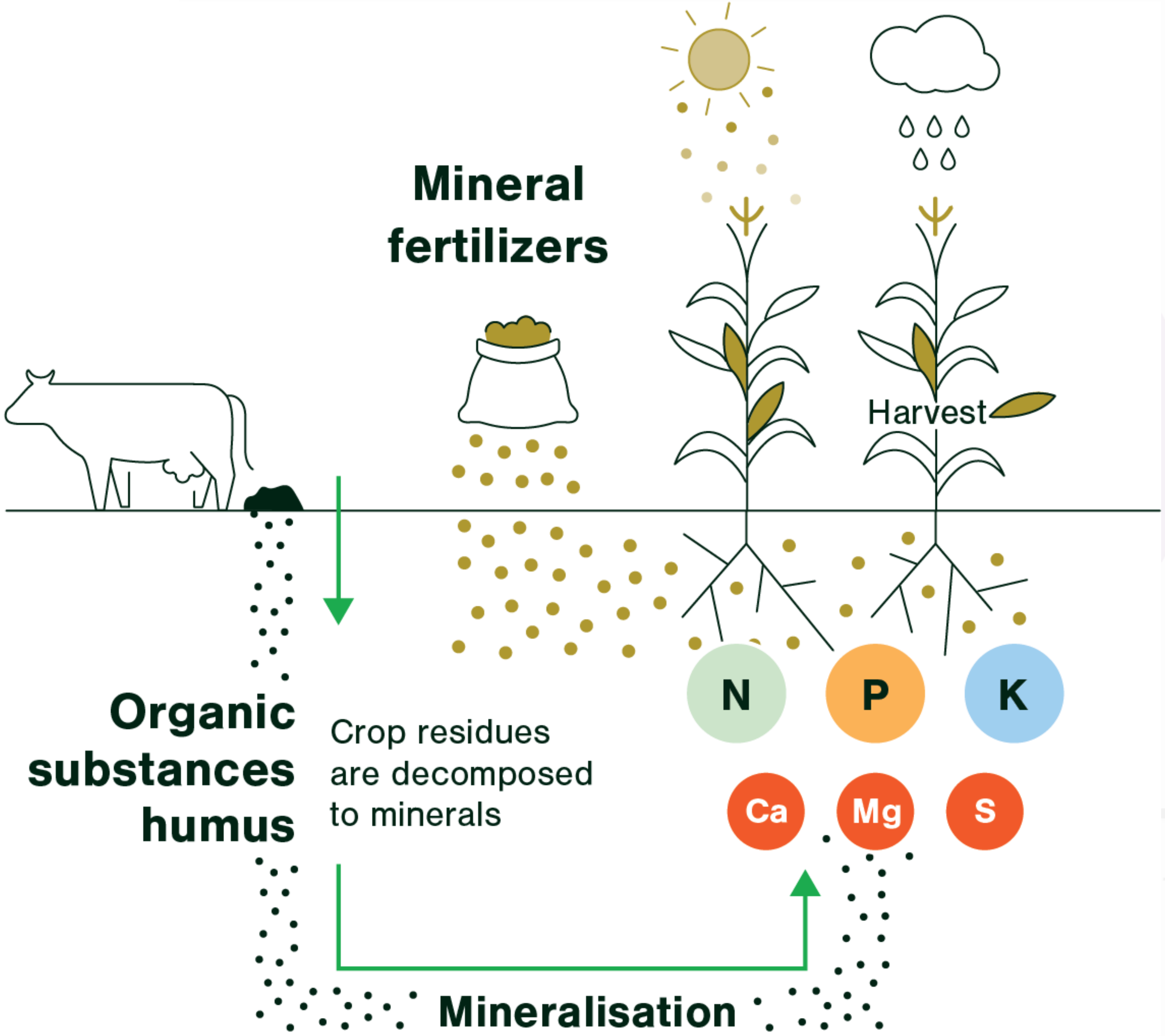
Q. Fertilizers are used to obtain higher yields of crops. However, all nutrients are usually not available in fertilizers. Which one of the following nutrients is usually not available in fertilizers ?

(a) Iron
(b) Potassium
(c) Nitrogen
(d) Phosphorus

- **Answer :- (A)**
- Among the nutrients listed, **iron** is usually not available in fertilizers in its pure form.
- Fertilizers typically provide the major nutrients:
- **Potassium (b)**
- **Nitrogen (c)**
- **Phosphorus (d)**
- Iron is often provided in specialized formulations or as part of micronutrient supplements rather than in standard fertilizers.

1. **Iron (Fe)**: Often not included in standard fertilizers because it is typically available in sufficient quantities in soil; deficiencies are usually addressed with specialized micronutrient supplements.
2. **Potassium (K)**: Commonly included in fertilizers as a key macronutrient essential for plant growth and development.
3. **Nitrogen (N)**: Frequently present in fertilizers because it is crucial for protein synthesis and overall plant growth.
4. **Phosphorus (P)**: Widely available in fertilizers as it is vital for energy transfer and root development in plants.

Iron is usually supplied in the form of micronutrient additives rather than in standard fertilizers.



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CDS 2022 (1 and 2)

PYQs

Chemistry

CDS -1 2022

Q. The number of moles of oxygen gas used in the complete combustion of 1 mole of glucose is :

(a) 1
(b) 3
(c) 6
(d) 12

- **Answer :- (C)**

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

- This equation shows that for every 1 mole of glucose, exactly 6 moles of oxygen gas are required.
- The oxygen molecules are used to fully oxidize the carbon and hydrogen atoms in glucose, producing carbon dioxide (CO_2) and water (H_2O) as products.
- So, option **(c) 6** is correct because it matches the stoichiometric requirement of 6 moles of oxygen for the complete combustion of 1 mole of glucose.

Q. Which one of the following is not an example of an oxidation reaction ?

(a) The taste of butter changes if left for a longer period
(b) A white substance is formed when an aqueous solution of barium chloride is mixed with sodium sulphate solution
(c) A reddish-brown powder gets coated on articles made of iron
(d) Wine gets sour with time

- An oxidation reaction is a chemical process in which an element loses electrons.
- This loss of electrons increases the oxidation state of the element. Here's a simple way to understand it:Oxidation Example:
- In the reaction between hydrogen and oxygen to form water, hydrogen is oxidized.
- Reaction: $2H_2 + O_2 \rightarrow 2H_2O$
- **Oxidation**: Hydrogen (H_2) loses electrons and combines with oxygen (O_2) to form water (H_2O).

- **Answer :- (B)**
- (a) **The taste of butter changes if left for a longer period**: This is an example of an oxidation reaction. The fats in butter undergo oxidation, leading to rancidity, which changes the taste.
- (b) **A white substance is formed when an aqueous solution of barium chloride is mixed with sodium sulphate solution**: This is not an oxidation reaction. It is a ***precipitation reaction*** where barium sulfate ($BaSO_4$) is formed as a white solid.
- (c) **A reddish-brown powder gets coated on articles made of iron**: This is an oxidation reaction.
- The reddish-brown powder is rust (Fe_2O_3), which forms when iron oxidizes.
- (d) **Wine gets sour with time:** This is an oxidation reaction. The alcohol in wine is oxidized to acetic acid, making the wine sour.

A **precipitation reaction** is a type of chemical reaction where two soluble substances react in solution to form an insoluble product, known as a precipitate, which separates out of the solution.

Key Points:

1. **Reaction**: Involves the mixing of two aqueous solutions, each containing soluble salts. When combined, the ions react to form an insoluble compound.
2. **Precipitate**: The solid that forms and settles out of the solution as a result of the reaction.
3. **Example**: Mixing solutions of silver nitrate ($AgNO_3$) and sodium chloride (NaCl) results in the formation of a white precipitate of silver chloride (AgCl) and a soluble sodium nitrate ($NaNO_3$):
4. AgNO3(aq)+NaCl(aq)→AgCl(s)+NaNO3(aq)\text{AgNO}_3(aq) + \text{NaCl}(aq) \rightarrow \text{AgCl}(s) + \text{NaNO}_3(aq)AgNO3(aq)+NaCl(aq)→AgCl(s)+NaNO3(aq)
5. **Applications**: Used in qualitative analysis to identify ions in a solution, in water treatment to remove contaminants, and in various industrial processes.
6. **Identification**: The formation of a precipitate is often used to confirm the presence of certain ions in a solution.

Q. Methanoic acid is normally found in :

(a) muscles
(b) urine
(c) ant stings
(d) human brain

Answer :- (C)

(a) muscles: Incorrect. Lactic acid, not methanoic acid, is produced in muscles during intense exercise.
(b) urine: Incorrect. Urine primarily contains urea, uric acid, and other waste products, but not methanoic acid.
(c) ant stings: Correct. Methanoic acid (formic acid) is found in ant stings and is responsible for the pain and irritation caused by the sting.
(d) human brain: Incorrect. Methanoic acid is not found in the human brain.
The correct answer is **(c) ant stings**.

Q. What is the number of moles of 'He' in 104 g of helium gas ?

(a) 52
(b) 26
(c) 13
(d) 6·5

Answer :- (B)

The molar mass of helium (He) is 4 g/mol.

Number of moles = $\frac{104g}{4g/mole}$ = 26 moles

Q. While burning hydrocarbon fuels, if we see a yellow flame with lots of black smoke, it means that the fuel is :

(a) made of saturated hydrocarbons.
(b) made of unsaturated hydrocarbons.
(c) burning completely.
(d) wet.

Answer :- (B)

(a) **<u>Made of saturated hydrocarbons</u>**: Incorrect. Saturated hydrocarbons usually burn with a clean blue flame when they undergo complete combustion.

(b) **<u>Made of unsaturated hydrocarbons</u>**: Correct. Unsaturated hydrocarbons (like alkenes and alkynes) can burn with a yellow flame and produce black smoke due to incomplete combustion, which results in the formation of carbon particles (soot).

(c) **<u>Burning completely</u>**: Incorrect. Complete combustion typically produces a blue flame with no black smoke, indicating all the carbon is being converted to carbon dioxide.

(d) **<u>Wet:</u>** Incorrect. Wet fuels typically burn with difficulty and do not produce a yellow flame with black smoke. Instead, they may sputter and burn inefficiently.

Q. The number of saturated and unsaturated bonds in cyclohexane are :

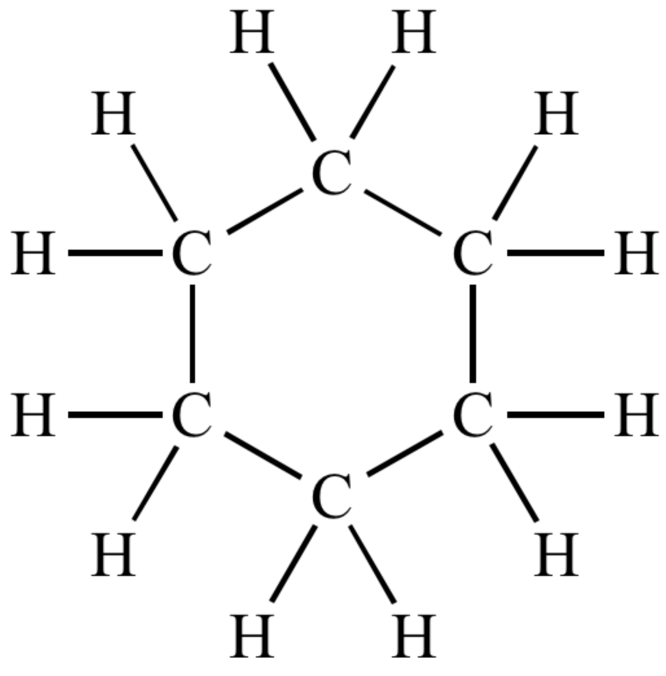
(a) 9 and 0 respectively.
(b) 18 and 3 respectively.
(c) 18 and 0 respectively.
(d) 9 and 3 respectively.

Answer :- (C)

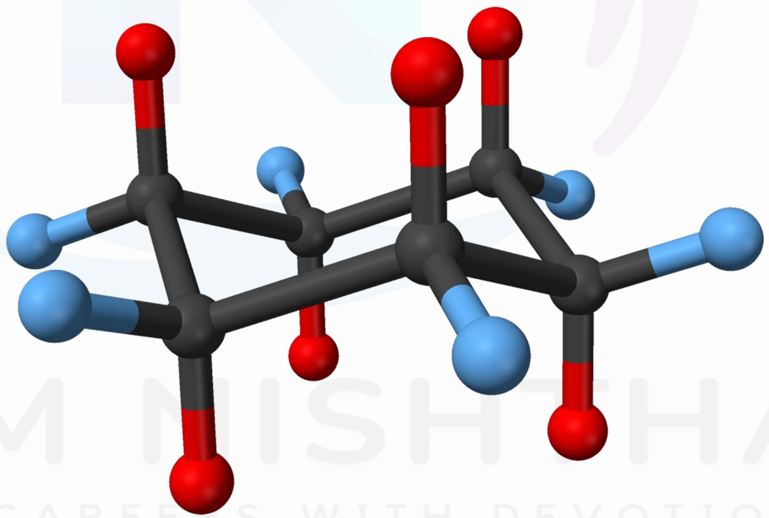
Cyclohexane has 18 saturated bonds (12 C-H bonds and 6 C-C bonds) and no unsaturated bonds.

Saturated Bonds: Single bonds; carbons have the maximum number of hydrogen atoms.

Unsaturated Bonds: Double or triple bonds; carbons have fewer hydrogen atoms.



cyclohexane



Q. Which one of the following statements is true when non-metals are dissolved in water ?

(a) They produce basic oxides.
(b) They produce acidic oxides.
(c) They produce neutral oxides.
(d) They provide hydroxides.

Answer :- (B)

(a) **<u>They produce basic oxides</u>**: Incorrect. Basic oxides are typically formed by metals, not non-metals.

(b) **<u>They produce acidic oxides:</u>** Correct. Non-metals generally form acidic oxides when dissolved in water, which then form acids. For example, carbon dioxide (CO_2) forms carbonic acid (H_2CO_3) when dissolved in water.

(c) **<u>They produce neutral oxides</u>**: Incorrect. While some non-metals can form neutral oxides (like water vapor or nitrous oxide), the general trend is the formation of acidic oxides.

(d) **<u>They provide hydroxides</u>**: Incorrect. Hydroxides are typically associated with bases, which are usually formed by metals.

Types of Oxides						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca	Ga	Ge	As	Se	Br
Rb	Sr	In	Sn	Sb	Te	I
Cs	Ba	Th	Pb	Bi	Po	At
Basic			Amphoteric		Acidic	

Q. Which of the following mineral acids is found in human stomach ?

(a) Hydrochloric acid
(b) Lactic acid
(c) Uric acid
(d) Methanoic acid

Answer :- (A)

(a) **Hydrochloric acid**: Correct. Hydrochloric acid (HCl) is the primary acid found in the stomach.

(b) It aids in digestion and helps kill harmful bacteria.

(c) **Lactic acid**: Incorrect. Lactic acid is produced in muscles during strenuous exercise, not in the stomach.

(d) **Uric acid:** Incorrect. Uric acid is a waste product found in the blood and excreted in urine, not in the stomach.

(e) **Methanoic acid**: Incorrect. Methanoic acid (formic acid) is found in ant stings, not in the stomach.

Q. Which one of the following is the main reason of acid rains ?

(a) Dissolution of sulphur and nitrogen oxides in rain
(b) Dissolution of minerals in rain
(c) Dissolution of dust particles in rain
(d) Dissolution of soil solution in rain

Answer :- (A)

(a) **Dissolution of sulphur and nitrogen oxides in rain**: This is correct.

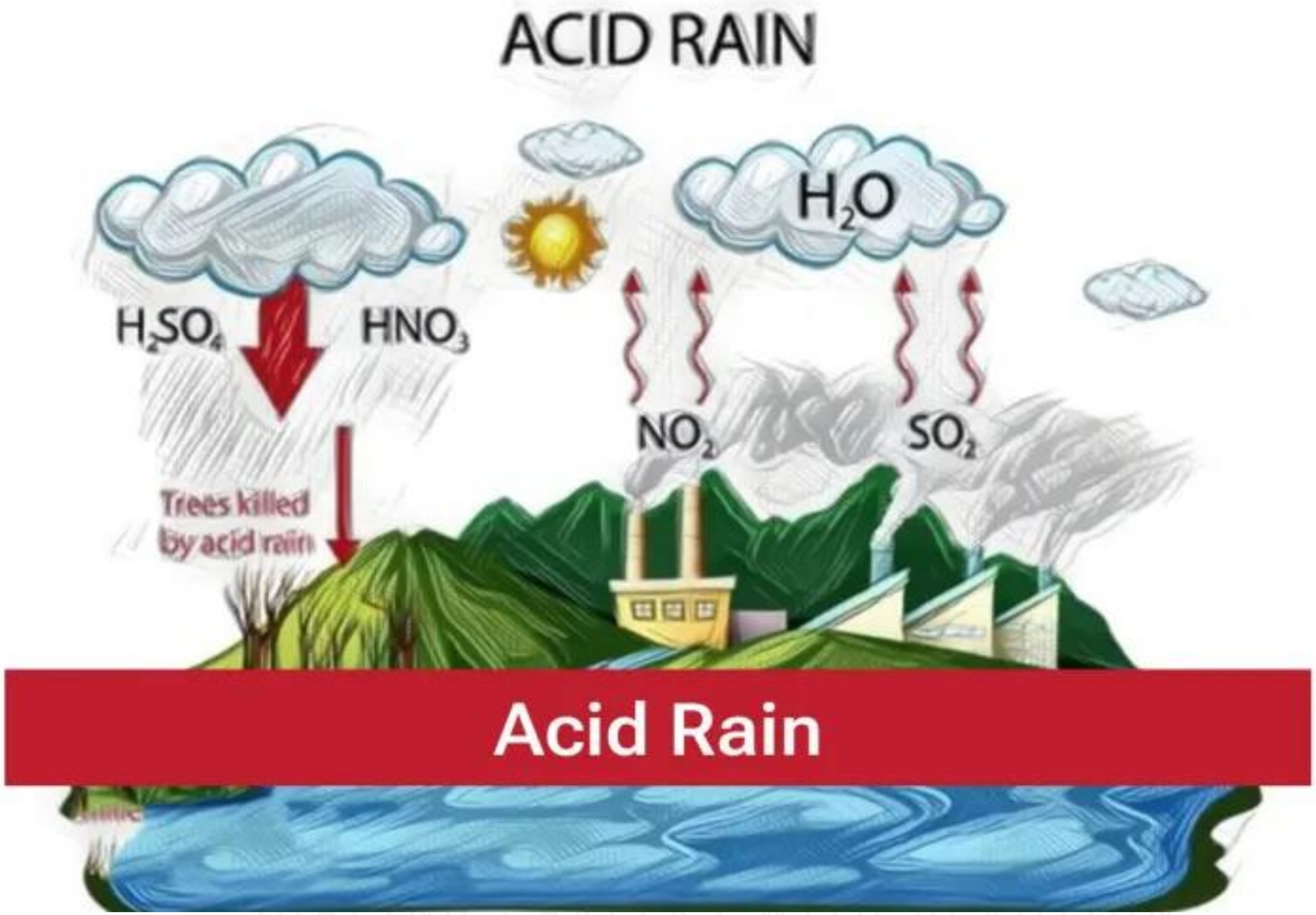
(b) Acid rain occurs when sulfur dioxide (SO_2) and nitrogen oxides (NO_x) from burning fossil fuels dissolve in rainwater, forming sulfuric acid (H_2SO_4) and nitric acid (HNO_3), making the rain acidic.

(c) **Dissolution of minerals in rain**: This is incorrect. While minerals can dissolve in rain, they do not cause acid rain.

(d) They are more associated with natural water hardness or nutrient content.

(e) **Dissolution of dust particles in rain**: This is incorrect. Dust particles do not contribute to acid rain. They can affect air quality but not the acidity of rain.

(f) **Dissolution of soil solution in rain**: This is incorrect. Soil solutions are not a primary cause of acid rain. Acid rain is mainly caused by the dissolution of sulfur and nitrogen oxides.


ACID RAIN
H_2O
H_2SO_4
HNO_3
NO_2
SO_2
Trees killed by acid rain
Acid Rain

CDS - 2 2022

Q. Stinging hair of nettle leaves inject fluid in the human body causing burning pain. The fluid is

(a) Methanoic acid
(b) Tartaric acid
(c) Hydrochloric acid
(d) Sulphuric acid

Answer :- (A)

(a) Methanoic acid: This is correct.

Nettle leaves contain methanoic acid (also known as formic acid), which causes the burning sensation when injected into the skin through their stinging hairs.

(b) **Tartaric acid**: This is incorrect. Tartaric acid is found in grapes, tamarinds, bananas, avocados, and citrus and cream of tartar, but it is not involved in the stinging of nettles.

(c) **Hydrochloric acid**: This is incorrect. Hydrochloric acid is a strong acid, it is present in our stomach but it is not found in nettles and does not cause their stinging effect.

(d) **Sulphuric acid**: This is incorrect. Sulphuric acid is a strong, corrosive acid, but it is not present in nettles and does not cause their stinging sensation.

Q. Milk of Magnesia is used when people suffer from indigestion of food. It is a

(a) Strong base
(b) Mild base
(c) Strong acid
(d) Mild acid

Answer :- (B)

(a) **Strong base**: This is incorrect. Milk of Magnesia is not a strong base. Strong bases, like sodium hydroxide, are highly corrosive and not used for indigestion.

(b) **Mild base:** This is correct. Milk of Magnesia is a mild base (magnesium hydroxide) that neutralizes excess stomach acid, relieving indigestion.

(c) **Strong acid**: This is incorrect. A strong acid would not help with indigestion; it would increase acidity.

(d) **Mild acid**: This is incorrect. Milk of Magnesia is a base, not an acid.

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Q. Which one of the following pairs of metals are very good conductors of heat ?

(a) Silver and Copper
(b) Silver and Lead
(c) Copper and Mercury
(d) Lead and Mercury

Answer :- (A)

(a) **<u>Silver and Copper</u>**: This is correct. Both silver and copper are excellent conductors of heat and electricity. Silver is the best conductor of heat, while copper is also very effective, though slightly less than silver.

(b) **<u>Silver and Lead</u>**: This is incorrect. Silver is a good conductor of heat, but lead is not. Lead is a poor conductor compared to silver.

(c) **<u>Copper and Mercury</u>**: This is incorrect. While copper is a good conductor of heat, mercury is a liquid metal and a poor conductor of heat compared to copper.

(d) **<u>Lead and Mercury</u>**: This is incorrect. Neither lead nor mercury are good conductors of heat. Lead is a poor conductor, and mercury is not efficient in conducting heat.

Relative Conductivities

Metal	Relative Electrical Conductivity @ 20°C	Relative Thermal Conductivity @ 20°C
Silver	106	108
COPPER	100	100
Gold	72	76
Aluminum	62	56
Magnesium	39	41
Zinc	29	29
Nickel	25	15
Cadmium	23	24
Cobalt	18	17
Iron	17	17
Platinum	16	18
Tin	15	17
Lead	8	9

Q. School bells are made of metals because metals are

(a) Malleable
(b) Sonorous
(c) Ductile
(d) Lustrous

Answer :- (B)

(a) **Malleable**: This is incorrect. Malleability refers to a metal's ability to be shaped or hammered into thin sheets. While metals are malleable, this property is not the reason school bells are made of metals.

(b) **Sonorous**: This is correct. Metals are sonorous, meaning they produce a clear, ringing sound when struck. This property makes them ideal for making bells.

(c) **Ductile**: This is incorrect. Ductility refers to a metal's ability to be drawn into wires. While metals are ductile, this is not the reason for their use in bells.

(d) **Lustrous**: This is incorrect. Lustrous means having a shiny surface. While metals are lustrous, this property does not contribute to the sound quality of bells.

Q. Consider the following statements about Tincture of Iodine :
1. It is an antiseptic solution.
2. Iodine is kept in alcohol-water mixture.
3. Concentration of iodine is very low.
How many of the above statements is/are correct ?

(a) 1
(b) 2
(c) 3
(d) None

Answer :- (C)

1. **<u>It is an antiseptic solution</u>**: Correct. Tincture of Iodine is used as an antiseptic to prevent infection in wounds.
2. **<u>Iodine is kept in alcohol-water mixture</u>**: Correct. Tincture of Iodine is made by dissolving iodine in a mixture of alcohol and water.
3. **<u>3. Concentration of iodine is very low</u>**: Correct. Although Tincture of Iodine contains iodine, its concentration is relatively low compared to other iodine solutions, making it suitable for topical antiseptic use.

Q. Cl^- is not isoelectronic with

(a) K^+
(b) Mg^{2+}
(c) S^{2-}
(d) P^{3-}

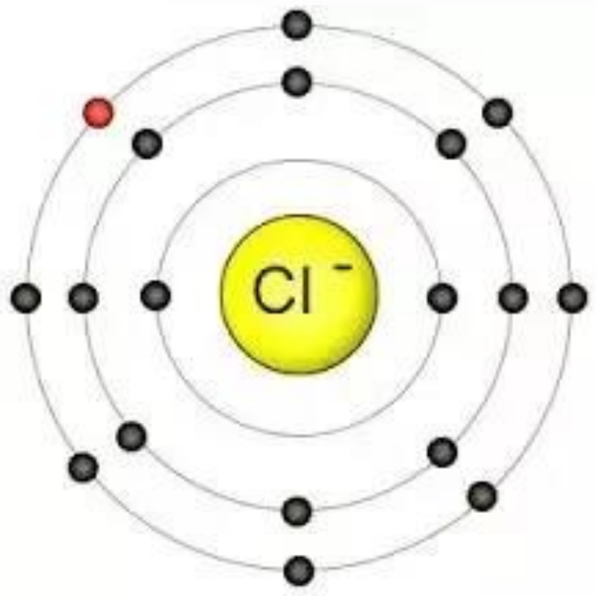
Answer :- (B)

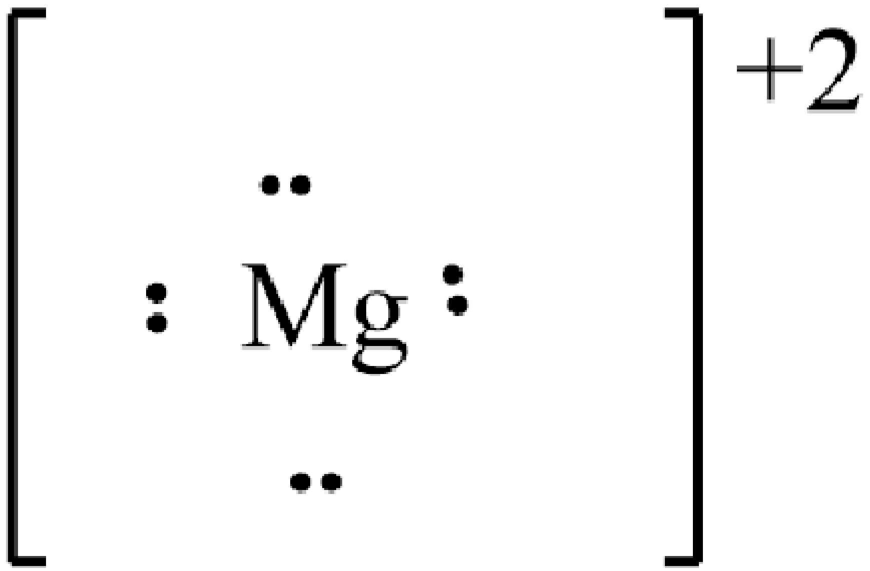
(a) **K^+**: This is incorrect. K^+ (potassium ion) has 18 electrons, the same as Cl^- (chloride ion), making them isoelectronic.

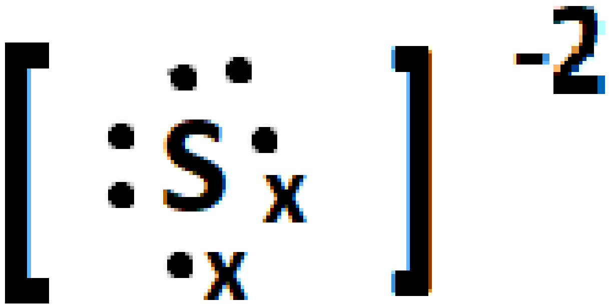
(b) **Mg^{2+}**: This is correct. Mg^{2+} (magnesium ion) has 10 electrons, whereas Cl^- has 18 electrons. Since they have different numbers of electrons, they are not isoelectronic.

(c) **S^{2-}**: This is incorrect. S^{2-} (sulfide ion) has 18 electrons, the same as Cl^-, making them isoelectronic.

(d) **P^{3-}**: This is incorrect. P^{3-} (phosphide ion) has 18 electrons, like Cl^-, so they are isoelectronic.


Cl⁻


Mg
+2


S
x
x
-2

Q. A patient's abdomen (alimentary canal) can be examined by X-ray after administering which one of the following metal salts in the patient's meal ?

(a) Barium sulphate
(b) Barium chloride
(c) Strontium sulphate
(d) Magnesium chloride

Answer :- (A)

(a) <u>**Barium sulphate**</u>: This is correct. Barium sulphate is used in X-ray imaging as a contrast agent because it absorbs X-rays, allowing clear visualization of the digestive tract on X-ray images.

(b) <u>**Barium chloride**</u>: This is incorrect. While barium chloride contains barium, it is not used for X-ray contrast because it is more toxic and not as effective as barium sulphate.

(c) <u>**Strontium sulphate**</u>: This is incorrect it is more commonly used in other applications, such as in the manufacture of fireworks.

(d) <u>**Magnesium chloride**</u>: It is primarily used as a dietary supplement or in various industrial processes.

Q. In the joining of railway tracks, iron oxide is made to react with

(a) Aluminium
(b) Zinc
(c) Copper
(d) Tin

Answer :- (A)

(a) **Aluminium**: This is correct. In the joining of railway tracks, iron oxide (rust) is made to react with aluminium in a process called ***the Thermite reaction***. *Aluminium reduces iron oxide to iron,* which helps in welding railway tracks.

(b) **Zinc**: This is incorrect. Zinc is not used in this reaction. Zinc is used in galvanizing to prevent rust but not in the Thermite reaction for joining tracks.

(c) **Copper**: This is incorrect. Copper is not involved in the Thermite reaction for welding railway tracks.

(d) **Tin**: This is incorrect. Tin is not used in the joining of railway tracks or in the Thermite reaction.

THERMITE REACTION

$$Fe_2O_3(s) + 2Al(s) \xrightarrow{\Delta} 2Fe(l) + Al_2O_3(s)$$

Iron (III) oxide | Aluminium | Molten iron | Aluminium oxide

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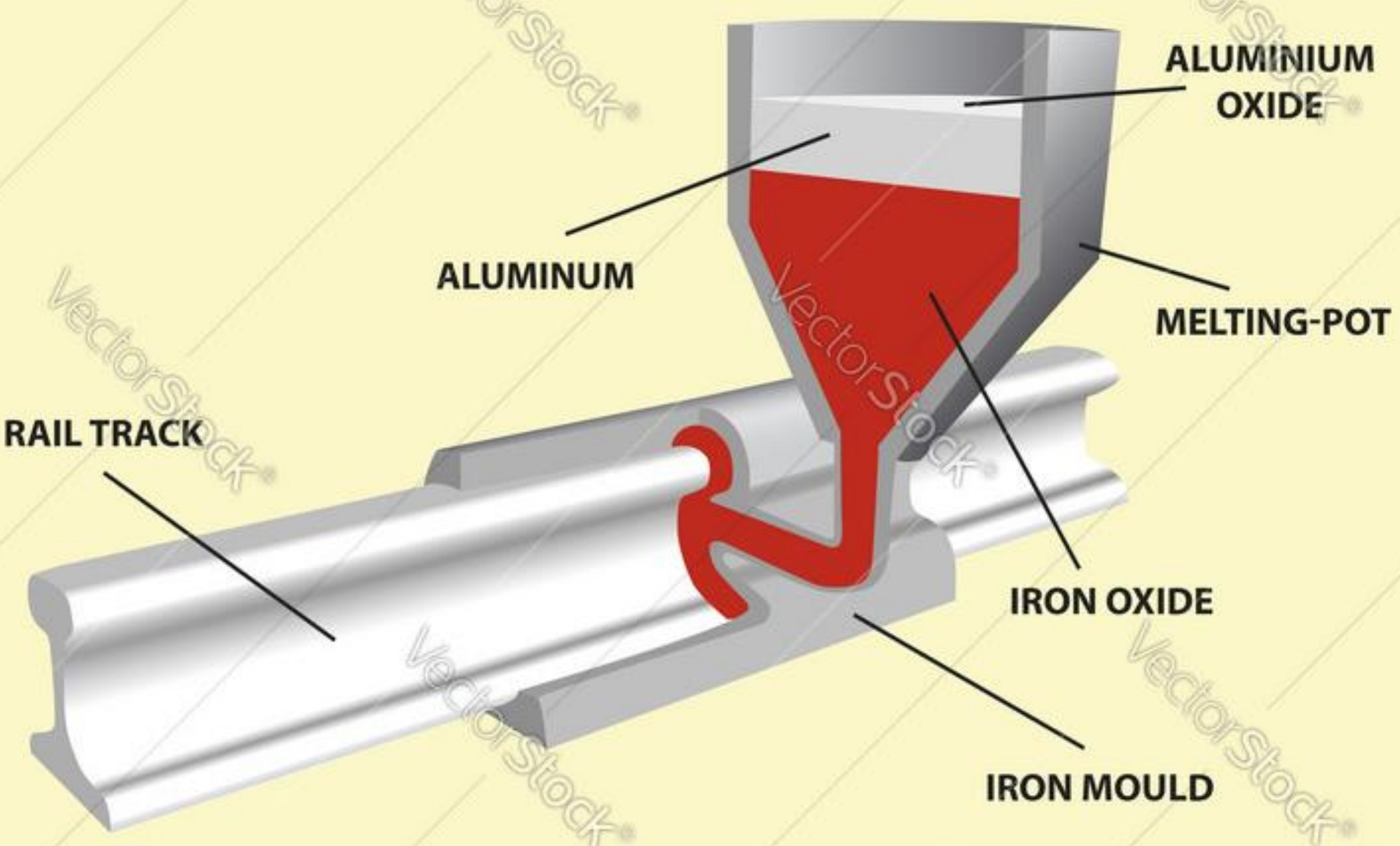
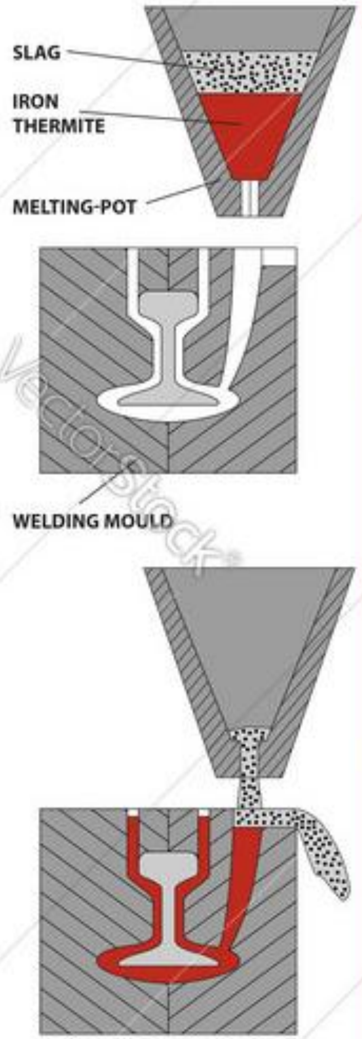
ALUMINOTHERMIC REACTION PROCESS.
THERMITE WELDING PROCESS.



$$2Al + Fe_2O_3 = 2Fe + Al_2O_3 + Q$$

ALUMINOTHERMIC PROCESS (SCHEME)



CDS 2023 (1 and 2)

PYQs

Chemistry

TEAM NISHTHA
SHAPING CAREERS WITH DEVOTION

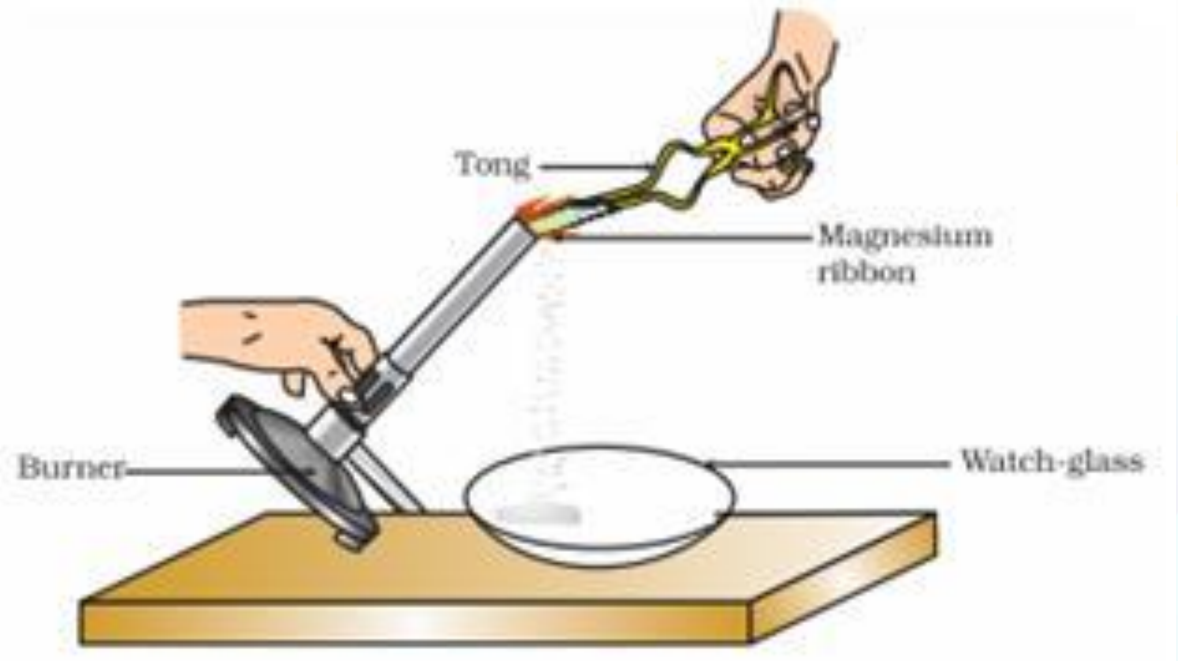
CDS - 1 2023

Q. Consider the following statements regarding burning of magnesium ribbon in air:

1. White powder of MgO is formed.
2. It is an example of combustion reaction.
3. Heat and light are produced.
Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

- **Answer :- (D)**
- **<u>White powder of MgO is formed</u>**: This is correct. When magnesium burns in air, it reacts with oxygen to form magnesium oxide (MgO), which appears as a white powder.
- **<u>It is an example of combustion reaction</u>**: This is also correct.
- The burning of magnesium involves a reaction with oxygen, releasing energy in the form of heat and light, which is characteristic of a combustion reaction.
- **<u>Heat and light are produced</u>**: Correct again.
- During the burning of magnesium, a bright white light is emitted along with heat.


Tong
Magnesium ribbon
Burner
Watch-glass

- A **combustion reaction** is a specific type of chemical reaction where a substance (usually a hydrocarbon) reacts rapidly with oxygen to produce energy in the form of heat and light.
- This reaction typically results in the formation of carbon dioxide (CO_2) and water (H_2O).

Q. Which of the following statements with regard to the reaction given below are correct?

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2\ (aq) + Heat$

1. Quicklime is used for white-washing of walls.

2. The solution of slaked lime is used for whitewashing of walls.

3. CaO reacts slowly with CO_2 in air to form a thin layer of $CaCO_3$ on walls.

4. Calcium hydroxide called 'slaked lime' is an inorganic compound.

Select the correct answer using the code given below.

(a) 1 and 4 only
(b) 2 and 4
(c) 2 and 3
(d) 1, 3 and 4

Answer :- (B)

1. **<u>Quicklime is used for whitewashing of walls</u>**: This is incorrect. Quicklime (CaO) is not directly used for whitewashing; instead, it is first mixed with water to form slaked lime ($Ca(OH)_2$).
2. **<u>The solution of slaked lime is used for whitewashing of walls</u>**: This is correct. Slaked lime, which is produced by adding water to quicklime, is the substance actually used for whitewashing.
3. **<u>CaO reacts slowly with CO_2 in air to form a thin layer of $CaCO_3$ on walls</u>**: This is correct. When slaked lime ($Ca(OH)_2$) is applied to walls, it gradually reacts with carbon dioxide in the air to form a layer of calcium carbonate ($CaCO_3$), which gives the wall a protective coating.
4. **<u>Calcium hydroxide called 'slaked lime' is an inorganic compound</u>**: This is correct. Slaked lime ($Ca(OH)_2$) is indeed an inorganic compound.

Organic Compound	Inorganic Compound
Organic compounds are composed of carbon, hydrogen and oxygen primarily	Inorganic compounds are composed of atoms usually other than carbon
The nature of organic compounds is covalent due to C-H bonding	The nature of inorganic compounds can be electrovalent, ionic, or covalent
Melting and boiling points of organic compounds are low	Melting and boiling points of inorganic compounds are higher
Their solubility in water is low	Their solubility in water is high
They are bad conductors of heat and electricity	Inorganic compounds are usually good conductors
Some organic compounds are volatile in nature	There are almost no inorganic volatile compounds
They have catenation property due to C	Only some inorganic compounds have catenation properties
Most of these compounds are colorless	Inorganic compounds generally have colors
Their rate of reactions is generally slow	Their rate of reaction is fast
These compounds are mostly found in living things	These compounds are mostly found in non-living things
Most organic compounds are biodegradable	Inorganic compounds are generally environment un-friendly
Examples of organic compounds are; enzymes, protein, DNA, RNA, and fuels, etc	Examples of inorganic compounds are; metals, non-metals, salts, etc

Q. Which of the following statements with regard to heating of lead nitrate powder over a flame are correct?

1. Brown fumes of NO are released.
2. Colourless O_2 gas is released.
3. It is an example of oxidation reaction.
4. It is an example of thermal decomposition used for the production of NO_2 gas.

Select the correct answer using the code given below.

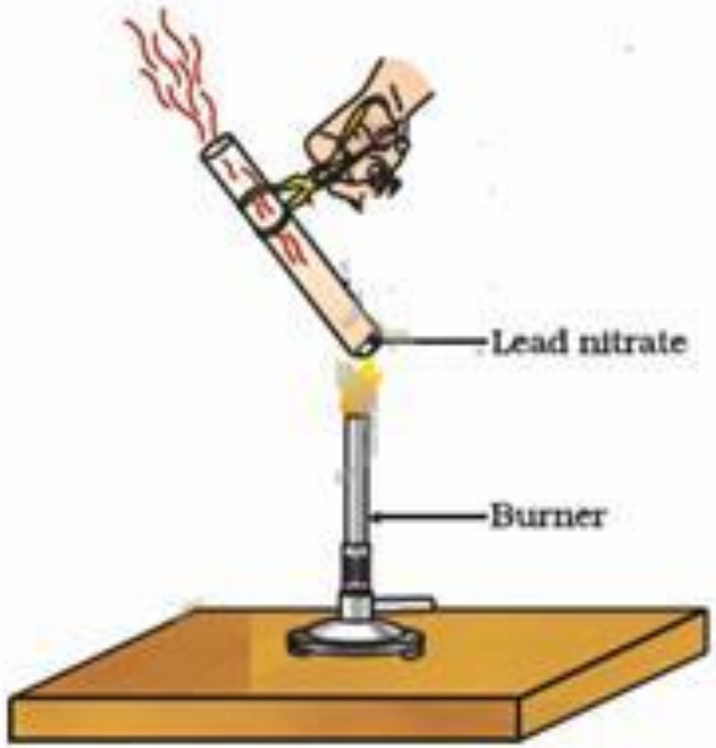
(a) 1 and 2
(b) 2, 3 and 4
(c) 1, 3 and 4
(d) 2 and 4 only

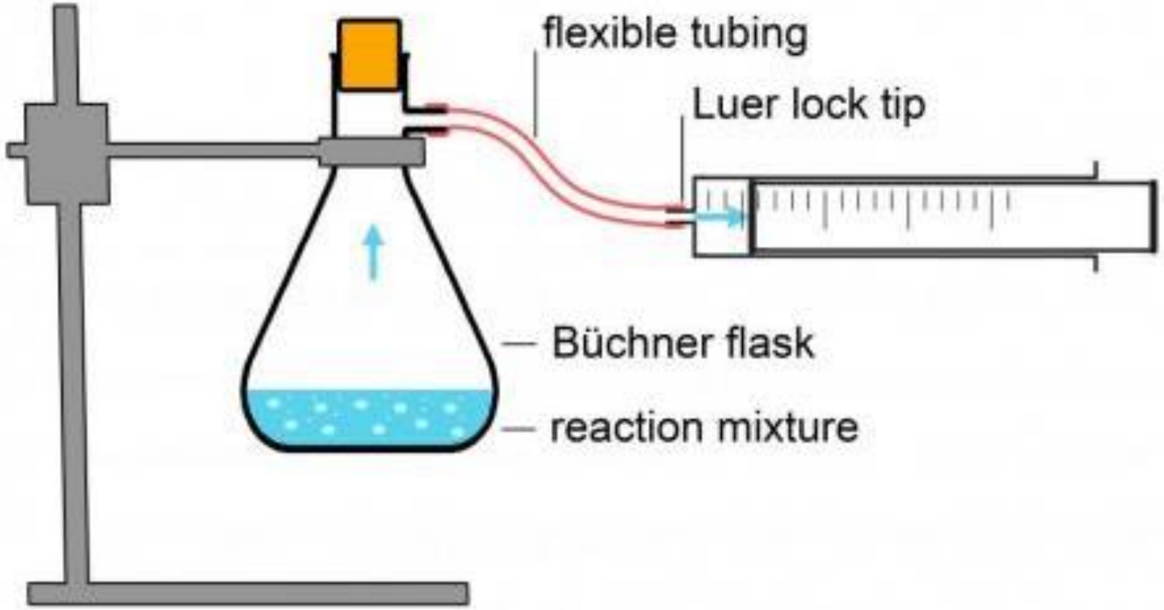
Answer :- (D)

1. **Brown fumes of NO are released**: This is incorrect. When lead nitrate is heated, brown fumes of nitrogen dioxide (NO_2) are released, not nitric oxide (NO).
2. **Colourless O_2 gas is released**: This is correct. Oxygen gas is released as a colorless gas when lead nitrate decomposes.
3. **It is an example of oxidation reaction**: This is incorrect. The heating of lead nitrate is primarily a thermal decomposition reaction, not an oxidation reaction.
4. **It is an example of thermal decomposition used for the production of NO_2 gas**: This is correct. Heating lead nitrate results in the decomposition of the compound and the production of nitrogen dioxide (NO_2) gas.

$$2Pb(NO_3)_2(s) \xrightarrow{\text{Heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$$

Lead nitrate (White salt) → Lead oxide (Residue) + Nitrogen dioxide (Brown fumes) + Oxygen

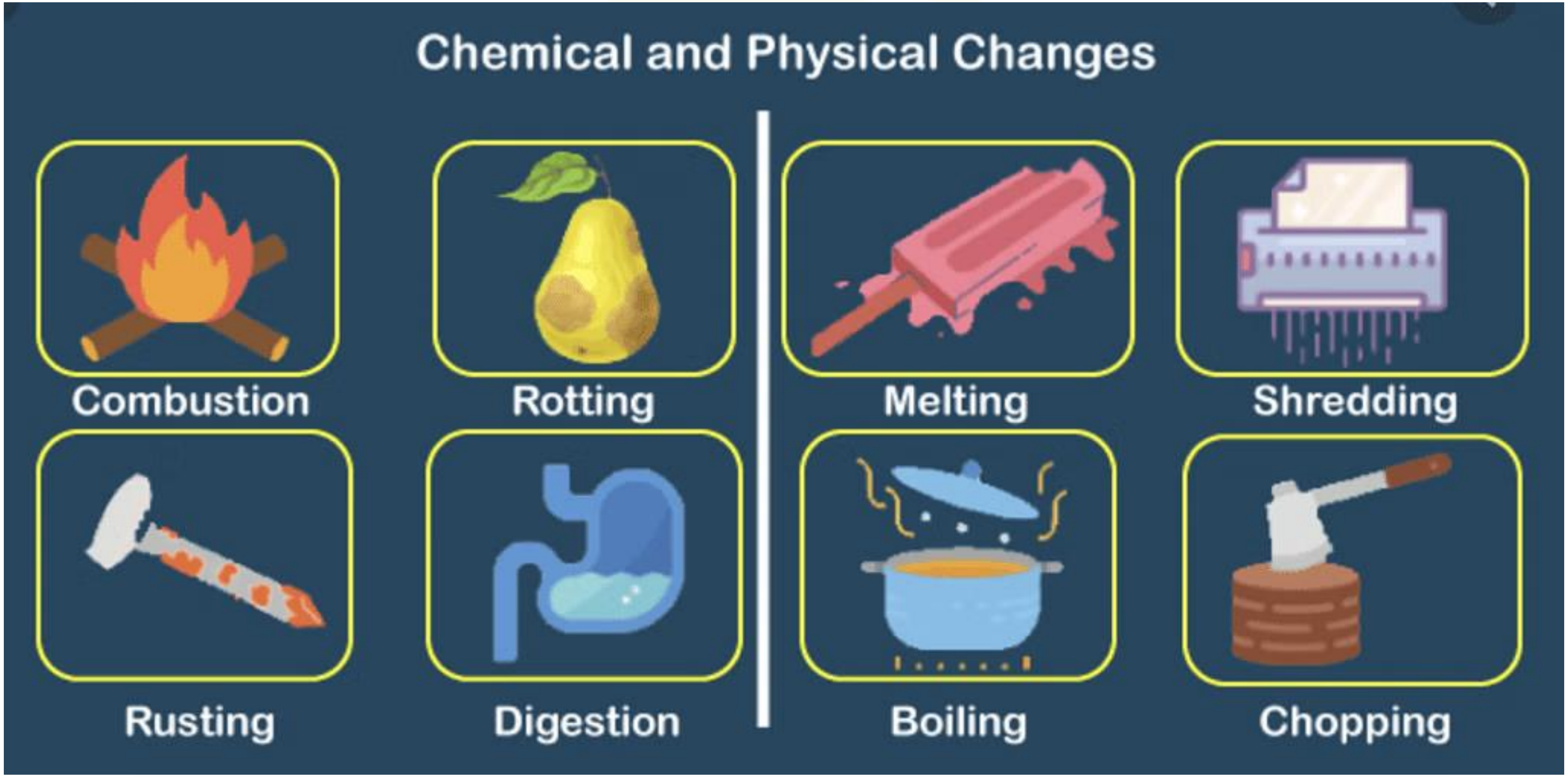




Q. Which one of the following is not an oxidation reaction?

(a) Rusting of iron
(b) Opening of soda bottle
(c) Rancidity
(d) Combustion

Answer :- (B)



Chemical and Physical Changes
Combustion
Rotting
Melting
Shredding
Rusting
Digestion
Boiling
Chopping

Q. What is the chemical composition of a soda-acid type fire extinguisher?

(a) Solution of sodium hydrogen carbonate and sulfuric acid
(b) Solution of sodium carbonate and sulfuric acid
(c) Solution of carbon dioxide and sulfuric acid
(d) Solution of sodium chloride and sulfuric acid

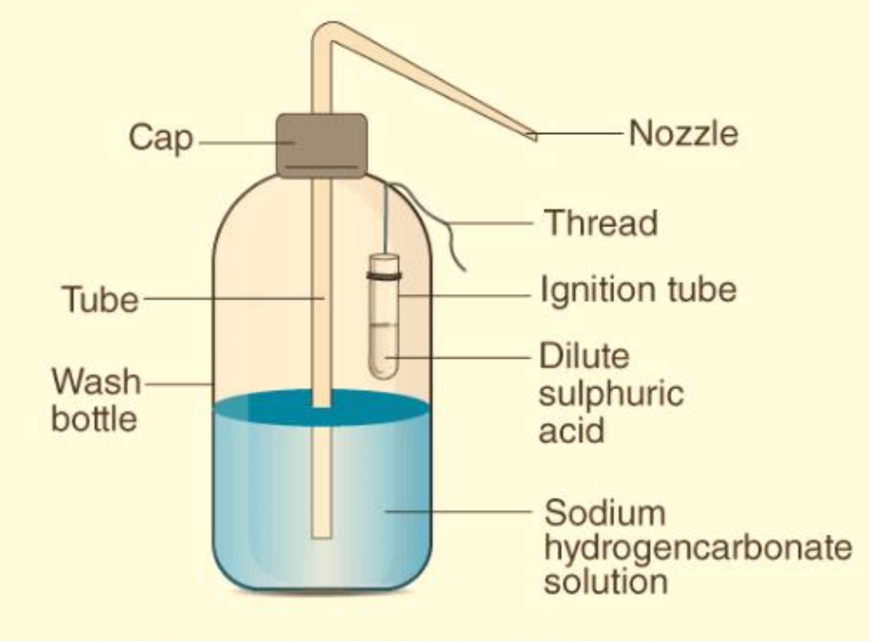
Answer :- (A)

(a) **Solution of sodium hydrogen carbonate and sulfuric acid**: This is correct. A soda-acid fire extinguisher contains a solution of sodium hydrogen carbonate (baking soda) and sulfuric acid. When the extinguisher is activated, these two substances react to produce carbon dioxide gas, which helps to extinguish the fire.

(b) **Solution of sodium carbonate and sulfuric acid**: This is incorrect. Sodium carbonate (washing soda) is not typically used in soda-acid fire extinguishers. The correct chemical is sodium hydrogen carbonate.

(c) **Solution of carbon dioxide and sulfuric acid**: This is incorrect. While carbon dioxide is produced in the reaction, it is not mixed directly with sulfuric acid in the extinguisher.

(d) **Solution of sodium chloride and sulfuric acid**: This is incorrect. Sodium chloride (table salt) does not react in a way that produces carbon dioxide, which is necessary to extinguish the fire.



Making a soda-acid fire extinguisher

$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$

$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

$CO_2 + H_2SO_4 \rightarrow H_2CO_3 + H_2SO_4$

$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

Q. Consider the following statements:
While diluting concentrated nitric acid solution

1. the concentration of $[H_3O^+]$ ions/ volume increases
2. water must be added slowly to concentrated acid
3. acid must be added slowly to water

Which of the statements given above is/are correct?

(a) 1, 2 and 3
(b) 1 and 2 only
(c) 3 only
(d) 2 and 3 only

Answer :- (C)

1. **<u>The concentration of [H_3O^+] ions/volume increases</u>**: This is incorrect. When diluting an acid, the concentration of [H_3O^+] ions (hydronium ions) actually decreases because the acid is being diluted with water, which increases the volume and decreases the concentration.
2. **<u>Water must be added slowly to concentrated acid</u>**: This is incorrect. It is dangerous to add water to concentrated acid because it can cause the mixture to splash or even result in an explosive reaction due to the exothermic nature of the dilution process.
3. **<u>Acid must be added slowly to water</u>**: This is correct. When diluting acid, the acid should always be added to water slowly to ensure that the heat generated is absorbed safely by the large volume of water, minimizing the risk of splattering.

Q. Which one of the following is the correct order of pH for the given substances?

(a) Coffee < Lemon juice < Milk of magnesia < Blood
(b) Milk of magnesia < Blood < Coffee < Lemon juice
(c) Lemon juice < Blood < Coffee < Milk of magnesia
(d) Lemon juice < Coffee < Blood < Milk of magnesia

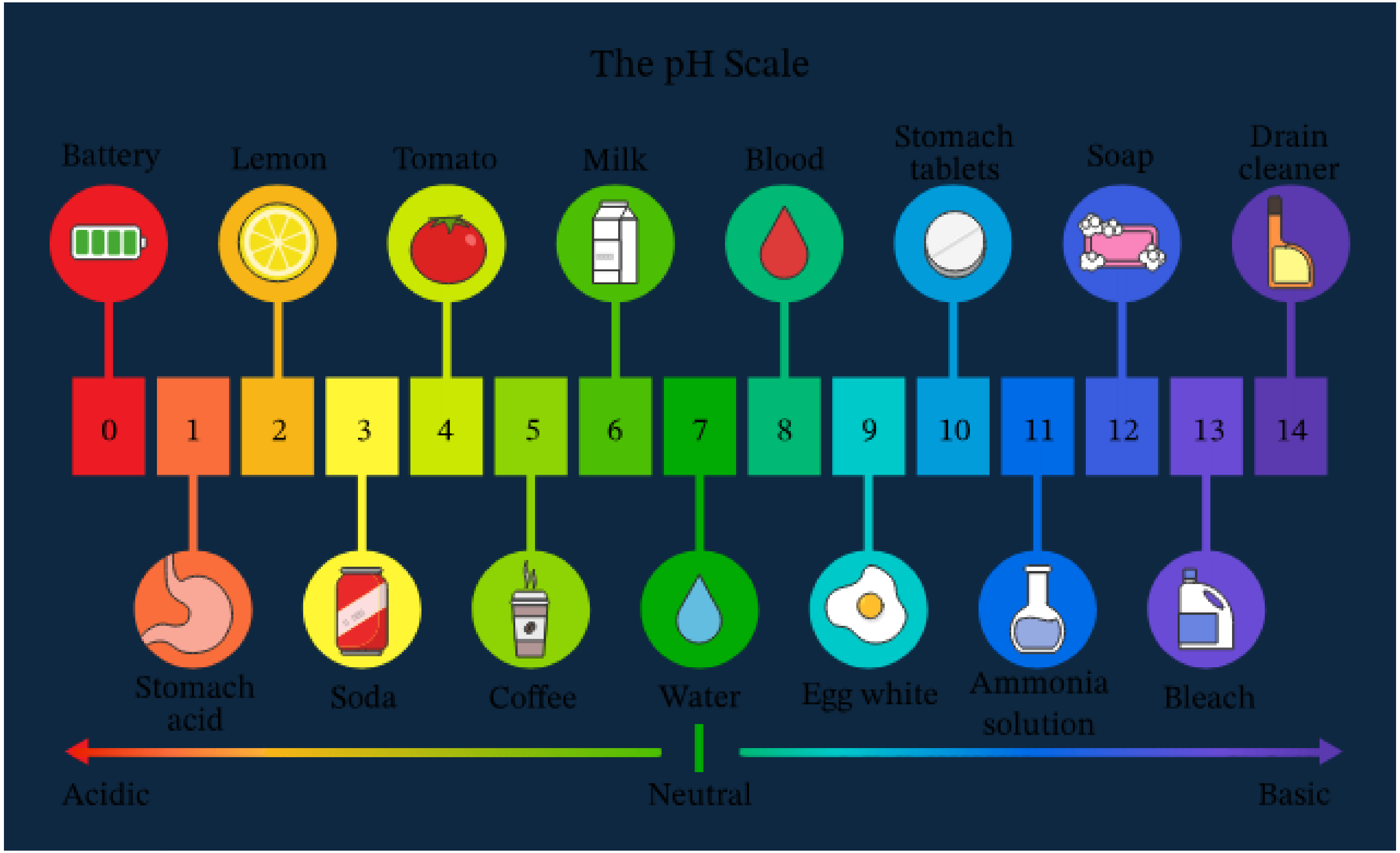
Answer :- (D)

Lemon Juice: Very acidic, with a pH around 2 to 3. This should be the lowest pH.

Coffee: Less acidic than lemon juice, with a pH around 4 to 5. Therefore, it comes after lemon juice.

Blood: Slightly alkaline, with a pH around 7.4, which is higher than coffee.

Milk of Magnesia: Strongly alkaline, with a pH around 10 to 11. This has the highest pH.


The pH Scale
Battery
Lemon
Tomato
Milk
Blood
Stomach tablets
Soap
Drain cleaner
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Stomach acid
Soda
Coffee
Water
Egg white
Ammonia solution
Bleach
Acidic
Neutral
Basic

Q. Which one of the following is not true for anodizing process?

(a) It makes aluminium corrosion resistant.
(b) Metals like aluminium, titanium and magnesium can be anodized.
(c) Clean aluminium article is the anode and oxygen gas is evolved at the cathode.
(d) It is used in aircraft industry.

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Answer :- (C)

(a) **<u>It makes aluminium corrosion resistant</u>**.True: Anodizing creates a protective oxide layer on aluminum, enhancing its corrosion resistance.

(b) **<u>Metals like aluminium, titanium and magnesium can be anodized</u>**: True: Anodizing is commonly used for aluminum, titanium, and magnesium.

(c) **<u>Clean aluminium article is the anode and oxygen gas is evolved at the cathode:</u>** Not True: In the anodizing process, the aluminum article is indeed the anode, but oxygen is evolved at the anode, not the cathode. The cathode typically involves a different reaction, such as hydrogen evolution or reduction of metal ions.

(d) **<u>It is used in aircraft industry</u>**.True: Anodizing is widely used in the aircraft industry for its corrosion resistance and durability.

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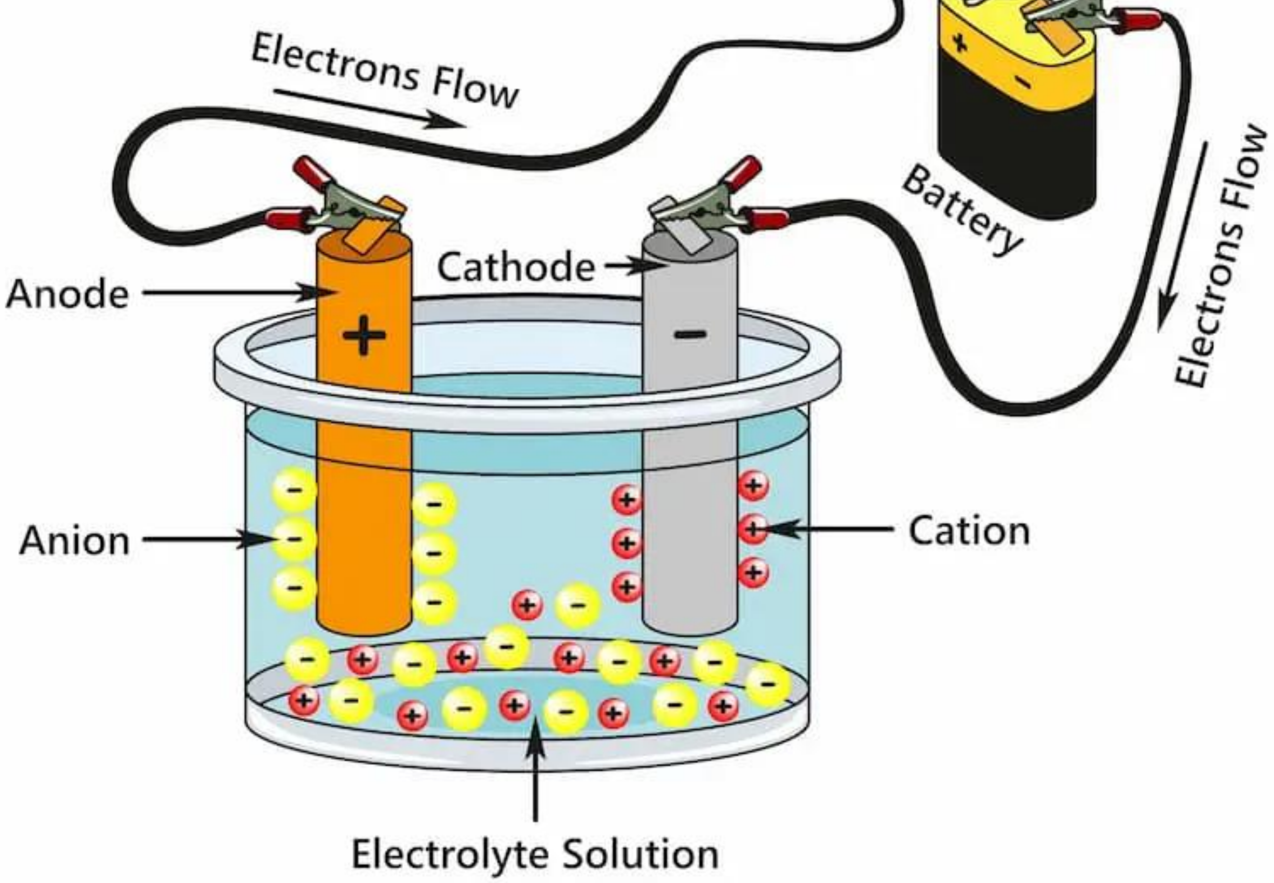
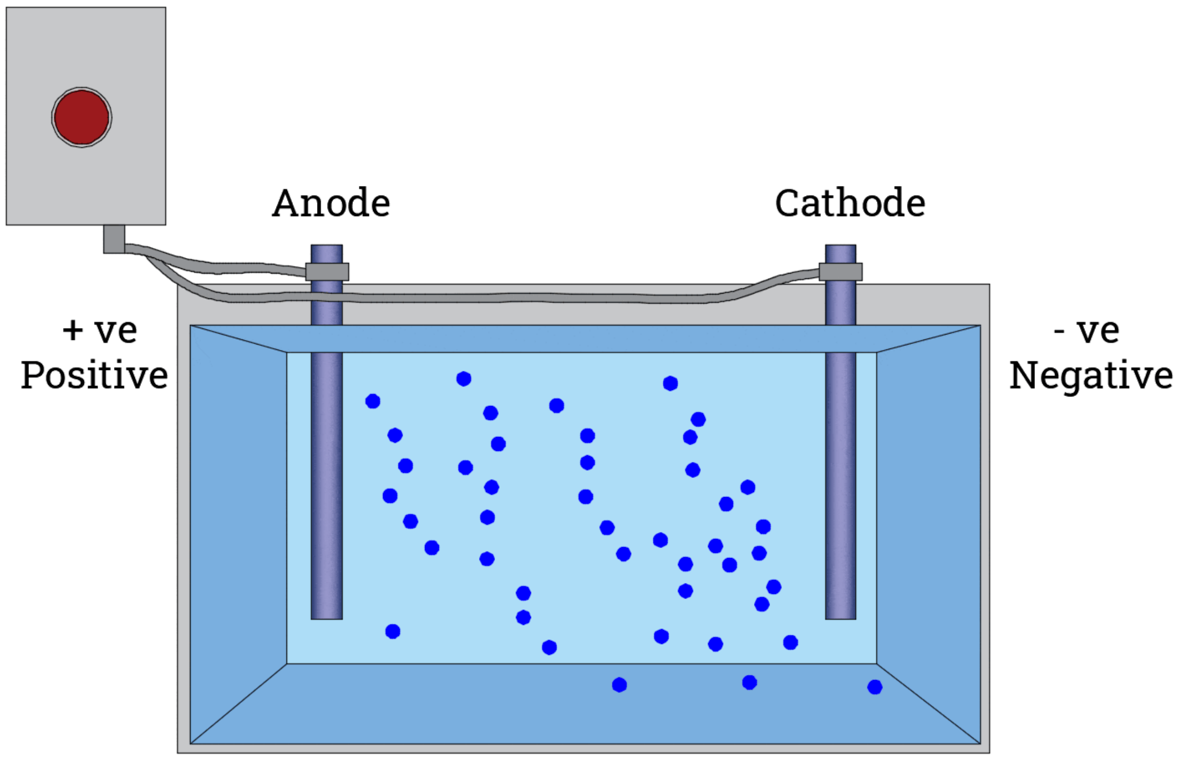
Factors Affect the Conductivity of Electrolyte



These factors are:-

* Nature of the electrolyte.
* Size of the ions.
* Solvation of the ions.
* Nature of the Solvent.
* Viscosity of the solvent.

Aluminum Anodizing



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Anodizing is an electrochemical process that converts the surface of a metal, typically aluminum, into a durable and corrosion-resistant oxide layer. Here's how it works:

1. **Electrolytic Process**: The metal piece (anode) is immersed in an electrolyte solution, usually sulfuric acid, and connected to the positive terminal of a power supply.
2. **Oxidation Reaction**: When an electric current passes through the electrolyte, the metal oxidizes. Oxygen from the electrolyte reacts with the aluminum at the surface to form aluminum oxide (Al_2O_3).
3. **Formation of Oxide Layer**: The aluminum oxide forms a hard, protective layer that adheres strongly to the underlying metal. This layer protects the metal from corrosion and wear.
4. **Coloring and Sealing (Optional)**: The anodized surface can be dyed for aesthetic purposes and then sealed to enhance the corrosion resistance.

Benefits of Anodizing:

- **Corrosion Resistance**: The oxide layer protects the metal from environmental damage.
- **Durability**: The anodized surface is hard and scratch-resistant.
- **Aesthetic Appeal**: Anodizing can be used to color and finish metal surfaces.

Anodizing is commonly used in various industries, including aerospace, automotive, and architectural applications, for its protective and decorative qualities.

Q. Naphthalene burns with a yellow sooty flame. This is because

(a) carbon to hydrogen ratio is low
(b) there is incomplete combustion
(c) there is excess supply of air
(d) of presence of impurities of nitrogen and sulfur

Answer :- (B)

(a) **<u>Carbon to hydrogen ratio is low,</u>** Not True: Naphthalene has a high carbon-to-hydrogen ratio ($C_{10}H_8$), which is typical of compounds that produce sooty flames. However, the ratio itself isn't the direct cause of the sooty flame.

(b) **<u>There is incomplete combustion</u>**, True: Naphthalene burns with a yellow sooty flame due to incomplete combustion. Incomplete combustion occurs when there is insufficient oxygen to completely convert carbon in the naphthalene to carbon dioxide. This results in the formation of carbon particles (soot), which give the flame its yellow color.

(c) **<u>There is excess supply of air</u>**, Not True: An excess supply of air would lead to more complete combustion, producing a blue flame with less soot. This is the opposite of what is observed with naphthalene.

(d) **<u>Presence of impurities of nitrogen and sulfur,</u>** Not True: While impurities can affect combustion, the yellow sooty flame of naphthalene is primarily due to incomplete combustion rather than impurities.

•Naphthalene balls work through a process known as sublimation. Sublimation is when a solid turns directly into a gas without passing through a liquid phase. When exposed to air, naphthalene balls gradually **sublimate**, releasing naphthalene vapors.

Mechanism of Action

1. **Vapor Release**: As naphthalene sublimates, it releases **naphthalene vapors** into the surrounding air. The concentration of these vapors increases in the immediate vicinity of the naphthalene balls.
2. **Repellent Effect**: The **naphthalene vapors are toxic to moths and other insects.** The high concentration of naphthalene vapor disrupts their respiratory systems, effectively repelling or killing them. The smell of naphthalene is also unpleasant to many insects, which helps in keeping them away from the treated area.
3. **Protection of Textiles**: By releasing naphthalene vapors, the **balls help to prevent insects from laying eggs on clothes and other textiles**. This is especially useful for protecting woolens, furs, and other fabrics prone to damage by insects.

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Q. Which one among the following are the correct symbols for the elements gold, tin and lead, respectively?

(a) Ga, Sb, Pb
(b) At, Sn, Le
(c) Au, Sn, Pb
(d) Au, Sb, Pb

Answer :- (C)

Ga, Sb, Pb: Ga: Gallium, Sb: Antimony, Pb: Lead

(b) At, Sn, Le: At: Astatine, Sn: Tin : Not a valid element symbol

(c) Au, Sn, Pb: Au: Gold, Sn: Tin, Pb: Lead

(d) Au, Sb, Pb: Au: Gold, Sb: Antimony, Pb: Lead

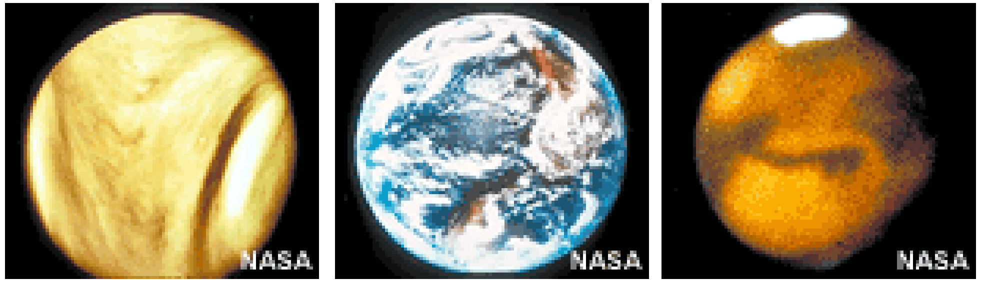
Option (c) is the correct one for gold, tin, and lead.

Q. How much percentage of carbon dioxide is present in the atmosphere of Venus and Mars?

(a) 45-47%
(b) 52-55%
(c) 74-77%
(d) 95-97%

Answer :- (D)

Venus: The atmosphere is about 96% carbon dioxide.
Mars: The atmosphere is about 95% carbon dioxide.



	Venus	Earth	Mars
Carbon Dioxide (CO_2)	96.5%	0.03%	95%
Nitrogen (N_2)	3.5%	78%	2.7%
Oxygen (O_2)	Trace	21%	0.13%
Argon (Ar)	0.007%	0.9%	1.6%
Methane (CH_4)	0	0.002%	0

Q. Which among the following methods is used to separate the constituents present in compound?

(a) Electrochemical method
(b) Heating method
(c) Fractional distillation
(d) Decomposition followed by ion exchange

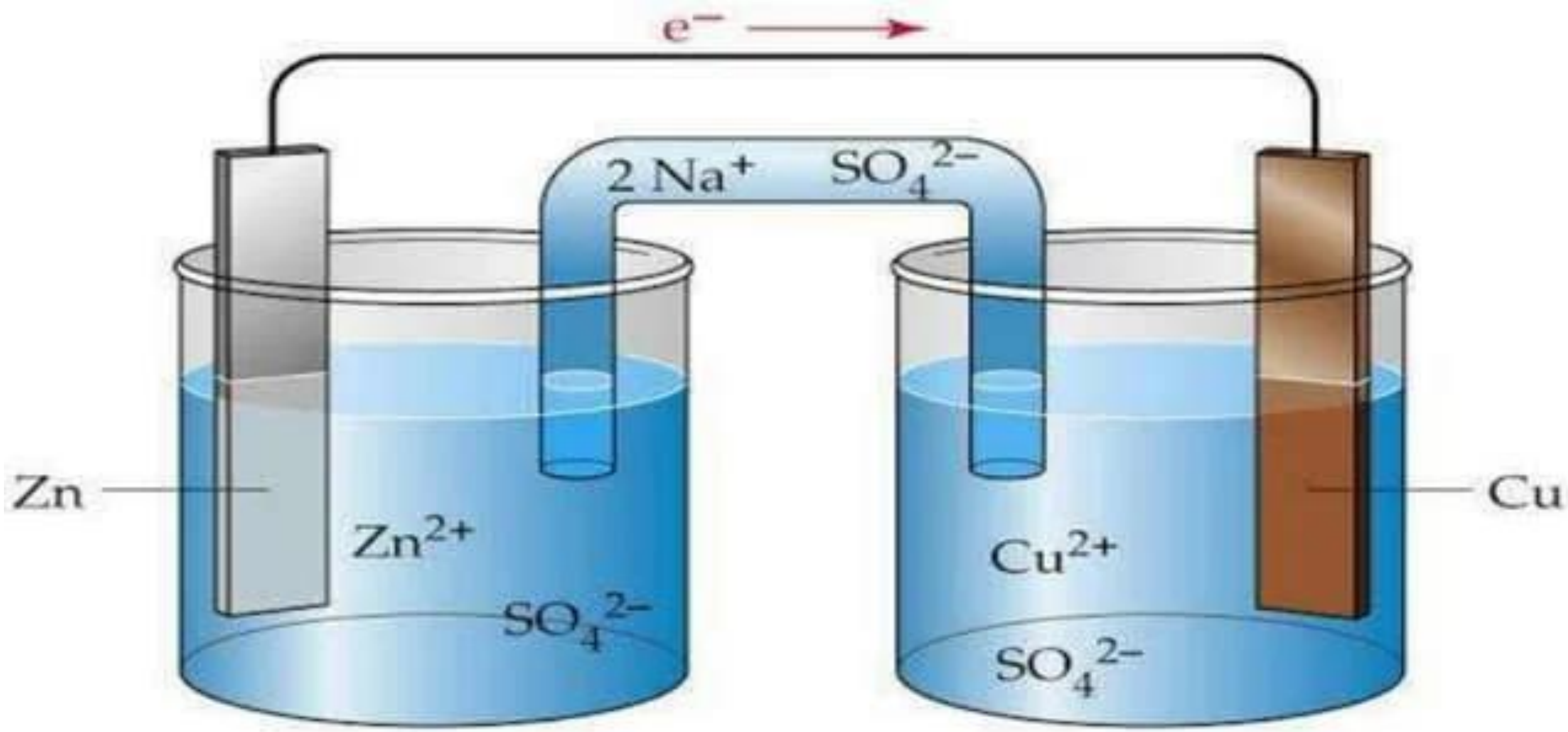
Answer :- (A)

(a) **Electrochemical method**: True: This method involves electrolysis, where an **electric current decomposes a compound into its individual elements**. For instance, electrolysis of water splits it into hydrogen and oxygen gases.

(b) **Heating method**: Not specifically for separation: While heating can cause a compound to decompose**, it's not a direct method for separating its constituents**. It generally results in a **breakdown of the compound rather than a controlled separation**.

(c) **Fractional distillation**: Not for separating constituents of a compound: Fractional distillation is used to separate components of a mixture based on boiling points, not for breaking down a single compound into its constituents.

(d) **Decomposition followed by ion exchange**: Not a primary method for separation: Decomposition can break down a compound into its constituents, but **ion exchange is typically used for separating ions in solutions rather than separating the components of a decomposed compound.**



Electrochemical Methods

Q. During white-washing of walls, slaked lime reacts slowly with carbon dioxide in air to form a thin layer of calcium carbonate on the walls. Which of the following reactions represents this correctly?

(a) $CaO\ (s) + CO_2\ (g) \longrightarrow CaCO_3\ (s)$
(b) $CaO\ (l) + CO_2\ (g) \longrightarrow CaCO_3\ (s)$
(c) $Ca(OH)_2\ (l) + CO_2\ (l) \longrightarrow CaCO_3\ (s) + H_2O\ (l)$
(d) $Ca(OH)_2\ (aq) + CO_2\ (g) \longrightarrow CaCO_3(s) + H_2O\ (l)$

Answer :- (D)

(a) **<u>CaO (s) + CO_2 (g) → $CaCO_3$ (s):</u>** Incorrect: This represents the reaction of quicklime (calcium oxide) with carbon dioxide, not slaked lime.

(b) **<u>CaO (l) + CO_2 (g) → $CaCO_3$ (s):</u>** Incorrect: Calcium oxide (CaO) is typically a solid, not a liquid. This reaction also does not involve slaked lime.

(c) **<u>$Ca(OH)_2$ (l) + CO_2 (l) → $CaCO_3$ (s) + H_2O (l):</u>** Incorrect: Calcium hydroxide is usually in an aqueous solution ($Ca(OH)_2$ (aq)), and carbon dioxide is a gas (CO_2 (g)), not a liquid.

(d) **<u>$Ca(OH)_2$ (aq) + CO_2 (g) → $CaCO_3$ (s) + H_2O (l):</u>** Correct: This accurately represents the reaction of slaked lime (aqueous calcium hydroxide) with carbon dioxide to form calcium carbonate and water.

Q. Which one of the following equations is the balanced chemical equation for the given reaction?

$Fe + H_2O \longrightarrow Fe_3O_4 + H_2$

(a) $Fe + 4H_2O \longrightarrow Fe_3O_4 + H_2$

(b) $3Fe + H_2O \longrightarrow Fe_3O_4 + 2H_2$

(c) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(d) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + H_2$

Answer :- (C)

Q. In which one of the following cases do both physical and chemical changes take place?

(a) Burning of candle
(b) Freezing of water
(c) Cooking of food
(d) Rusting of iron

Answer :- (A)

(a) Burning of candle:

Physical Change: The wax melts as the candle burns, which is a change in state from solid to liquid.

Chemical Change: The wax undergoes combustion, reacting with oxygen to produce carbon dioxide and water vapor, which is a chemical reaction.

(b) Freezing of water:

Physical Change: Water changes from liquid to solid (ice) as it freezes. This is a change in physical state but not a chemical change.

No chemical change takes place; the chemical composition of water (H_2O) remains the same.

(c) **Cooking of food**:Cooking food is an irreversible chemical change. As food is cooked, its molecules undergo transformations to create new substances. Additionally, once food is cooked, it cannot be returned to its original raw state.

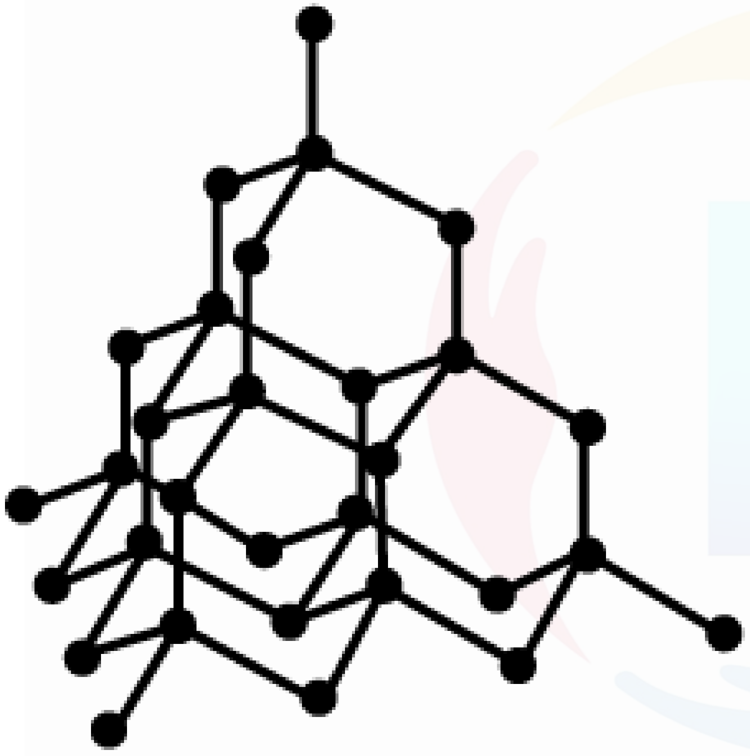
(d) Rusting of iron:

Chemical Change: Iron reacts with oxygen and moisture to form iron oxide (rust). This process involves a chemical reaction.

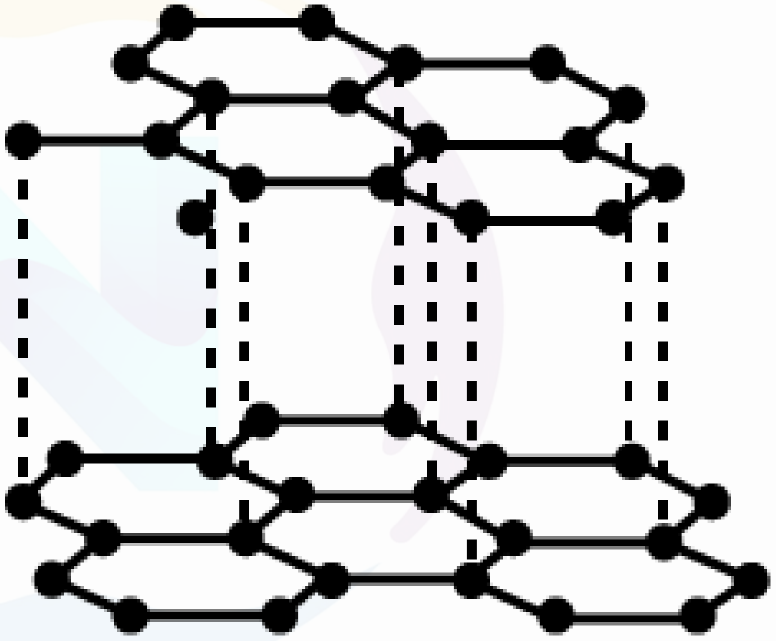
No physical change is involved in the rusting process directly; the primary change is chemical.

Q. Which one of the following statements is correct about diamond and graphite?

(a) Diamond and graphite have similar physical and chemical properties.
(b) Diamond is hard but graphite is smooth and slippery.
(c) Diamond and graphite are both non-conductors of electricity.
(d) Both diamond and graphite have similar structures.



diamond



graphite

Answer :- (B)

(a) **<u>Diamond and graphite have similar physical and chemical properties</u>**:

Incorrect: Diamond and graphite have different physical and chemical properties. Diamond is a hard, transparent crystal, whereas graphite is a soft, opaque material that is used as a lubricant and in pencils.

(b) **<u>Diamond is hard but graphite is smooth and slippery</u>**:

Correct: Diamond is extremely hard due to its tetrahedral lattice structure, while graphite is smooth and slippery because of its layered structure, where layers can slide over each other easily.

(c) **<u>Diamond and graphite are both non-conductors of electricity</u>**:

Incorrect: Diamond is an electrical insulator, while graphite is a good conductor of electricity due to the mobility of its delocalized electrons within the layers.

(d) **<u>Both diamond and graphite have similar structures</u>**:

Incorrect: Diamond and graphite have very different structures. Diamond has a tetrahedral lattice structure with each carbon atom bonded to four others, whereas graphite has a planar hexagonal lattice with layers of carbon atoms that can slide over each other.

Q. Which one among the following substances is a compound?

(a) Sugar
(b) Air
(c) Milk
(d) Tea

Answer :- (A)

(a) **Sugar**:

Correct: Sugar, specifically sucrose, is a chemical compound with the formula $C_{12}H_{22}O_{11}$. It consists of carbon, hydrogen, and oxygen atoms chemically bonded together in a fixed ratio.

(b) **Air**:

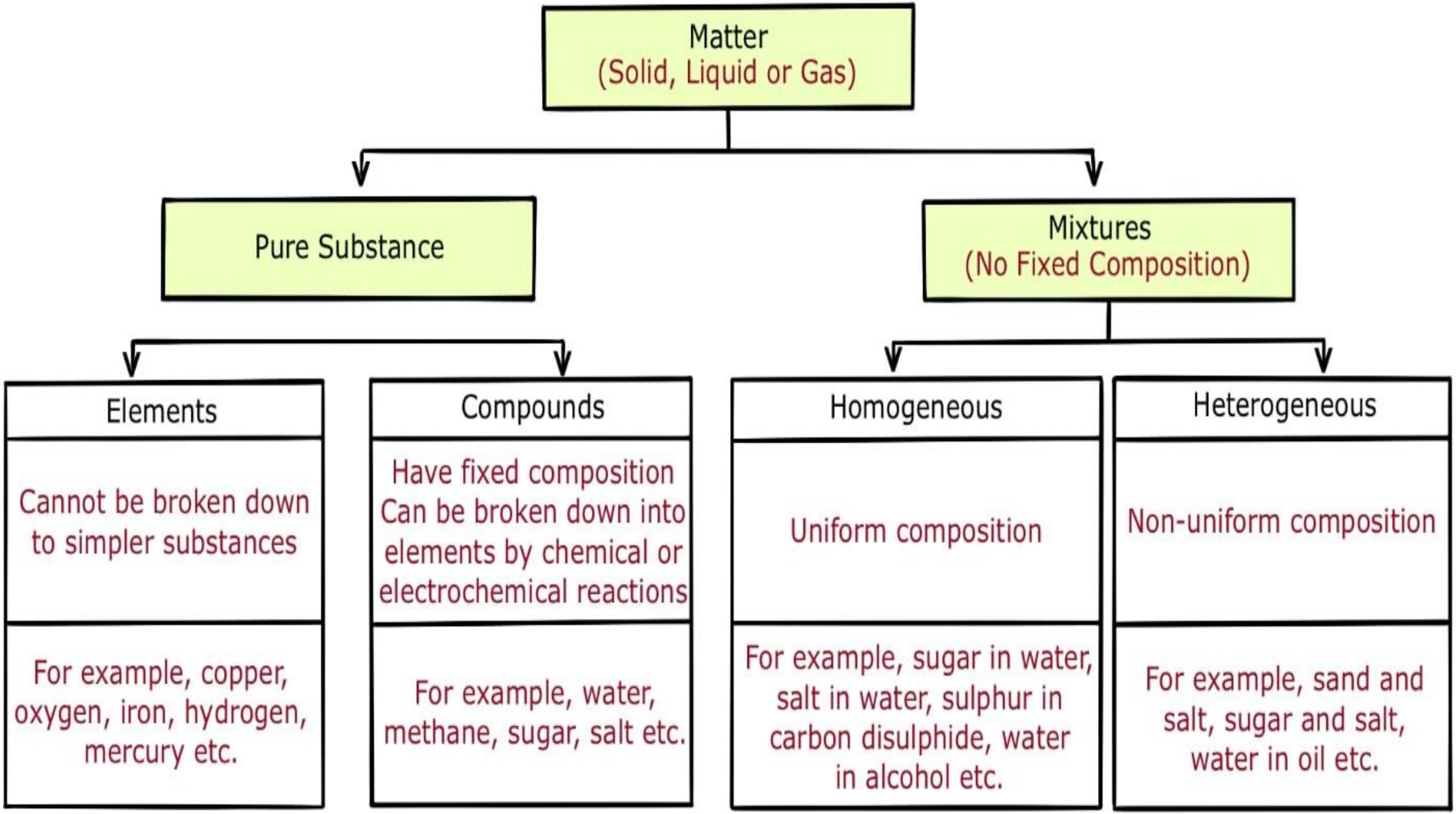
Incorrect: Air is a mixture of gases, primarily nitrogen, oxygen, argon, and carbon dioxide. It is not a single chemical compound.

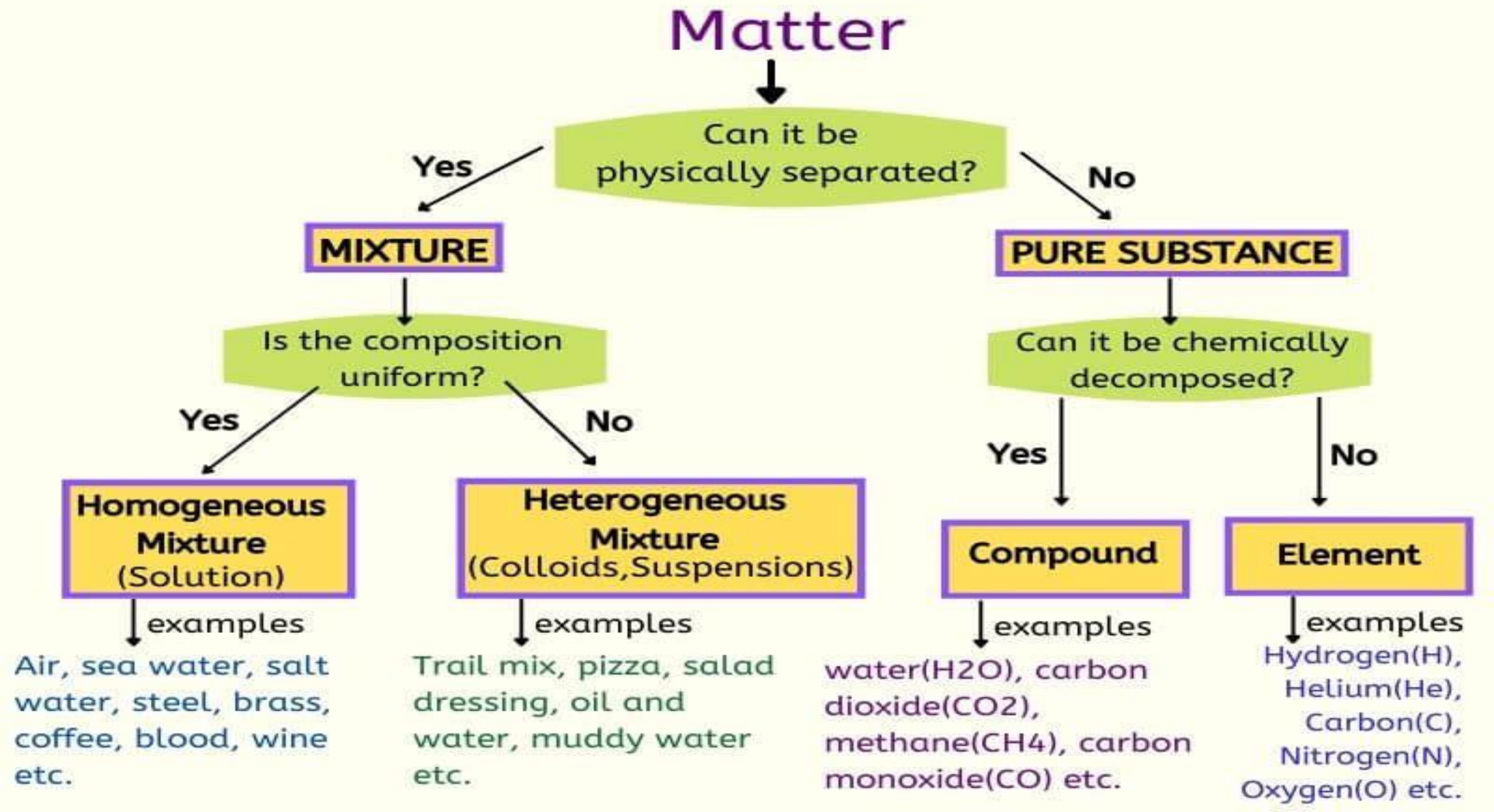
(c) **Milk**:

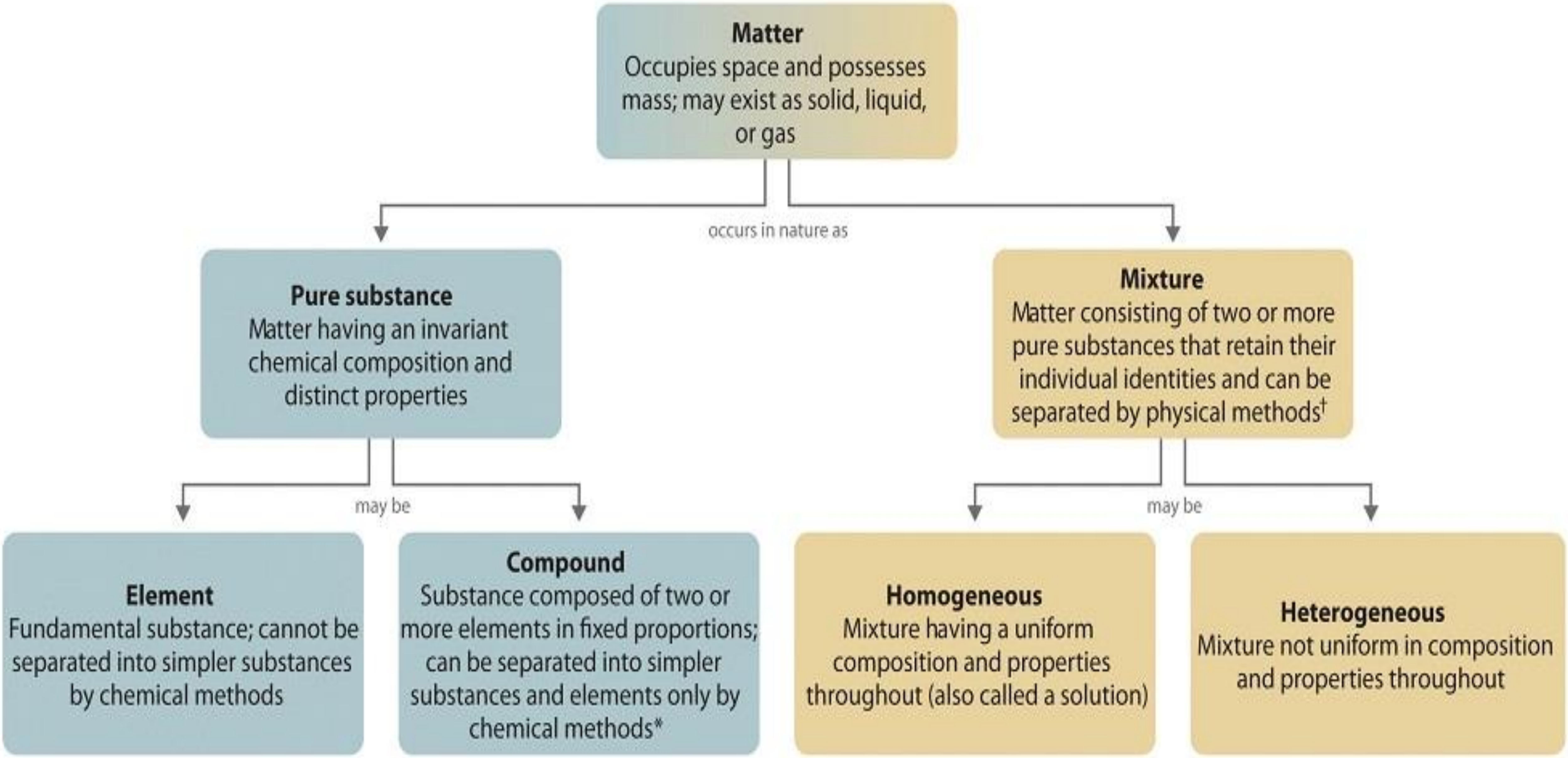
Incorrect: Milk is a complex mixture of water, proteins, fats, lactose, and other components. It is not a single chemical compound but rather a mixture of compounds.

(d) **Tea**:

Incorrect: Tea is a mixture that includes various compounds such as caffeine, tannins, and essential oils, along with water. It is not a single chemical compound.


Matter
(Solid, Liquid or Gas)
Pure Substance
Mixtures
(No Fixed Composition)
Elements
Cannot be broken down to simpler substances
For example, copper, oxygen, iron, hydrogen, mercury etc.
Compounds
Have fixed composition
Can be broken down into elements by chemical or electrochemical reactions
For example, water, methane, sugar, salt etc.
Homogeneous
Uniform composition
For example, sugar in water, salt in water, sulphur in carbon disulphide, water in alcohol etc.
Heterogeneous
Non-uniform composition
For example, sand and salt, sugar and salt, water in oil etc.


Matter
Can it be physically separated?
Yes
No
MIXTURE
PURE SUBSTANCE
Is the composition uniform?
Yes
No
Can it be chemically decomposed?
Yes
No
Homogeneous Mixture (Solution)
Heterogeneous Mixture (Colloids,Suspensions)
Compound
Element
examples
Air, sea water, salt water, steel, brass, coffee, blood, wine etc.
examples
Trail mix, pizza, salad dressing, oil and water, muddy water etc.
examples
water(H2O), carbon dioxide(CO2), methane(CH4), carbon monoxide(CO) etc.
examples
Hydrogen(H), Helium(He), Carbon(C), Nitrogen(N), Oxygen(O) etc.



** Chemical methods of separation include electrolysis.*

† Physical methods of separation include filtration, distillation, and crystallization.

Q. What is the total number of naturally occurring elements?

(a) 114
(b) 94
(c) 86
(d) 82

Answer :- (B)

The Periodic Law revealed important analogies among the 94 naturally occurring elements (neptunium and plutonium like actinium and protoactinium are also found in pitch blende – an ore of uranium).

Q. Which one of the following statements regarding acids is not correct?

(a) Hydrochloric acid is present in the gastric juice secreted by the stomach.
(b) Acetic acid is the main constituent of vinegar.
(c) Oxalic acid is found in tamarind paste.
(d) Lemon and orange juices contain citric acid and ascorbic acid respectively.

Answer :- (C)

(a) **<u>Hydrochloric acid is present in the gastric juice secreted by the stomach</u>**:

Correct: Hydrochloric acid (HCl) is indeed a major component of gastric juice, aiding in digestion and creating an acidic environment in the stomach.

(b) **<u>Acetic acid is the main constituent of vinegar</u>**:

Correct: Acetic acid (CH_3COOH) is the primary component of vinegar, typically present in concentrations of about 4-8%.

(c) **<u>Oxalic acid is found in tamarind paste</u>**:

Incorrect: While oxalic acid is present in many plants, such as spinach and rhubarb, it is not a significant component of tamarind paste. <u>Tamarind contains tartaric acid</u>, not oxalic acid.

(d) **<u>Lemon and orange juices contain citric acid and ascorbic acid respectively</u>**:

Correct: Lemon juice contains citric acid ($C_6H_8O_7$), and orange juice contains ascorbic acid (vitamin C), which is a different acid.

Table 6.1 Acid and its source

SOURCE	ACID PRESENT
Apple	Malic acid
Lemon	Citric acid
Grape	Tartaric acid
Tomato	Oxalic acid
Vinegar	Acetic acid
Curd	Lactic acid
Orange	Ascorbic acid
Tea	Tannic acid
Stomach juice	Hydrochloric acid
Ant, Bee	Formic acid

CDS 2024 (1) PYQs

Chemistry

CDS-1 2024

Q Which one of the following is an amphoteric oxide?

(a) MgO
(b) P_4O_{10}
(c) Na_2O
(d) Al_2O_3

Answer :- D

(a) MgO (Magnesium Oxide):

Explanation: MgO is a basic oxide, meaning it reacts with acids to form salts and water, but it doesn't react with bases.

Correct/Incorrect: Incorrect

(b) P_4O_{10} (Phosphorus Pentoxide):

Explanation: P_4O_{10} is an acidic oxide. It reacts with water to form phosphoric acid and doesn't react with bases.

Correct/Incorrect: Incorrect

(c) Na_2O (Sodium Oxide):

Explanation: Na_2O is also a basic oxide. It reacts with water to form a strong base, sodium hydroxide, and doesn't react with other bases.

Correct/Incorrect: Incorrect

(d) Al_2O_3 (Aluminum Oxide):

Explanation: Al_2O_3 is an amphoteric oxide, meaning it can react with both acids and bases to form salts and water.

Correct/Incorrect: Correct

$$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$$

$$Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$$

Types of Oxides

Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca	Ga	Ge	As	Se	Br
Rb	Sr	In	Sn	Sb	Te	I
Cs	Ba	Th	Pb	Bi	Po	At
Basic			Amphoteric		Acidic	

Q The correct order of octane number of butane, pentane, hexane and cyclohexane is

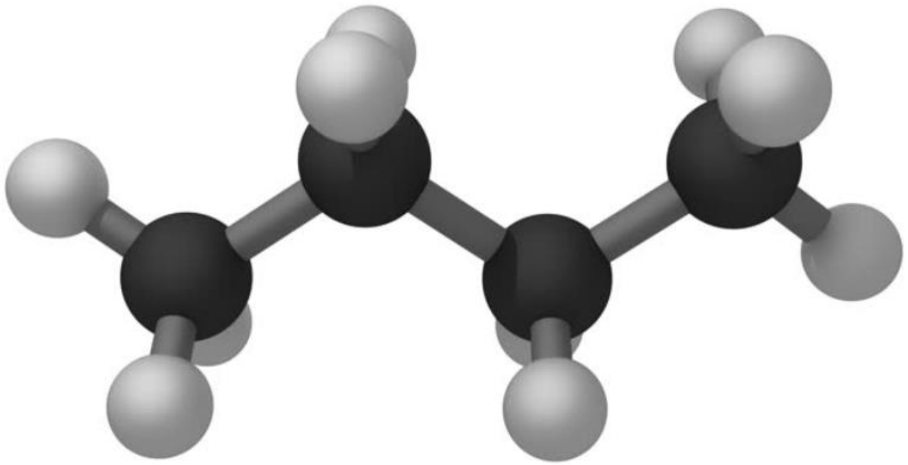
(a) butane > pentane > hexane > cyclohexane
(b) butane > pentane > cyclohexane > hexane
(c) butane > cyclohexane > pentane > hexane
(d) cyclohexane > butane > pentane > hexane

OCTANE NUMBER VERSUS CETANE NUMBER

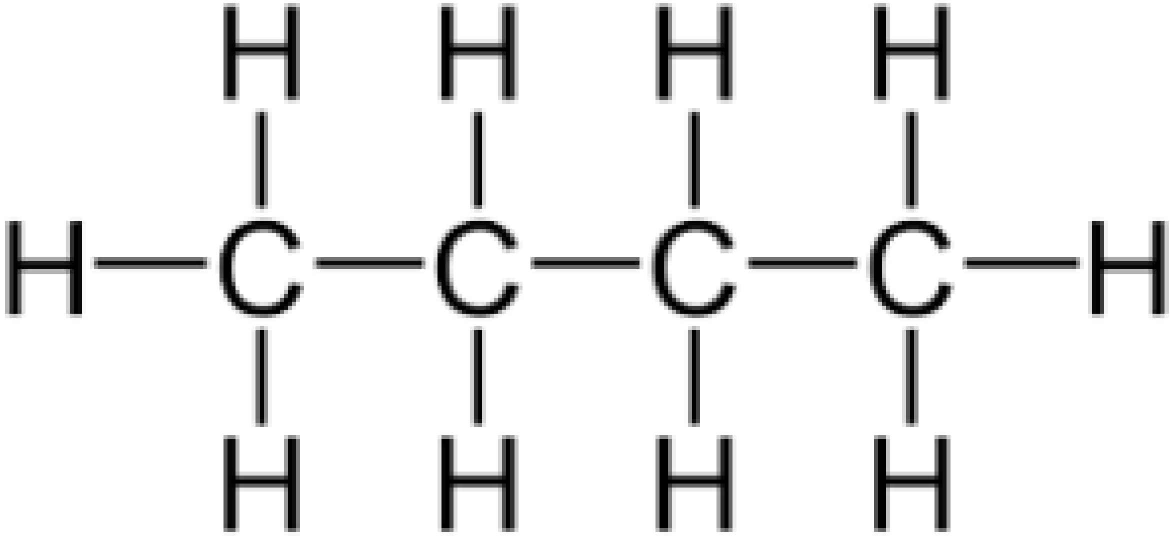
OCTANE NUMBER	CETANE NUMBER
Octane number is a measure of the performance of a fuel	Cetane number is the measure of the delay of the ignition of a fuel
Important for predicting the knocking of an engine	Important for predicting the ignition of an engine
Given for gasoline	Given for diesel
Octane rating is done considering the octane number of isooctane as 100	Cetane rating is done considering the ignition of cetane

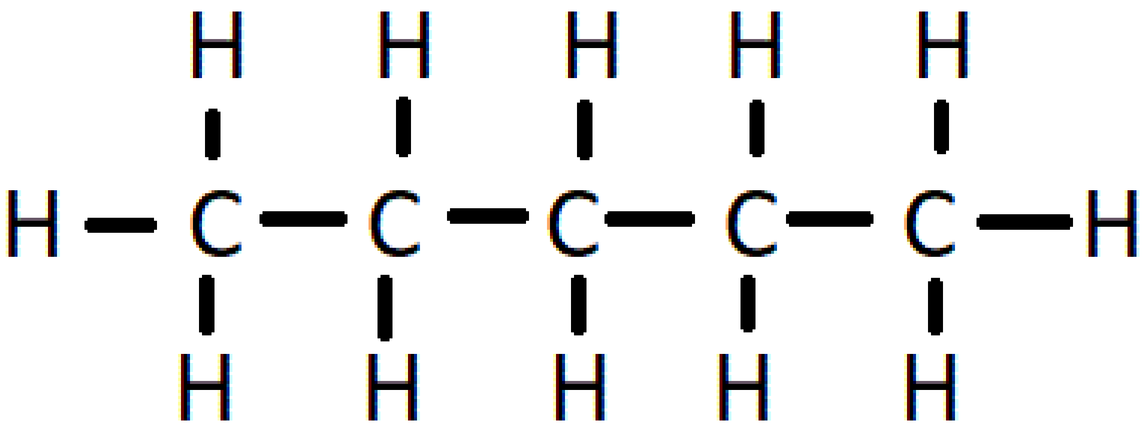
Answer :- A

- The octane number indicates the fuel's ability to resist knocking. The order of octane numbers for the compounds is:
- **Butane** has a relatively high octane number.
- **Pentane** has a lower octane number compared to butane.
- **Hexane** has a lower octane number than both butane and pentane.
- **Cyclohexane** has the lowest octane number among these.

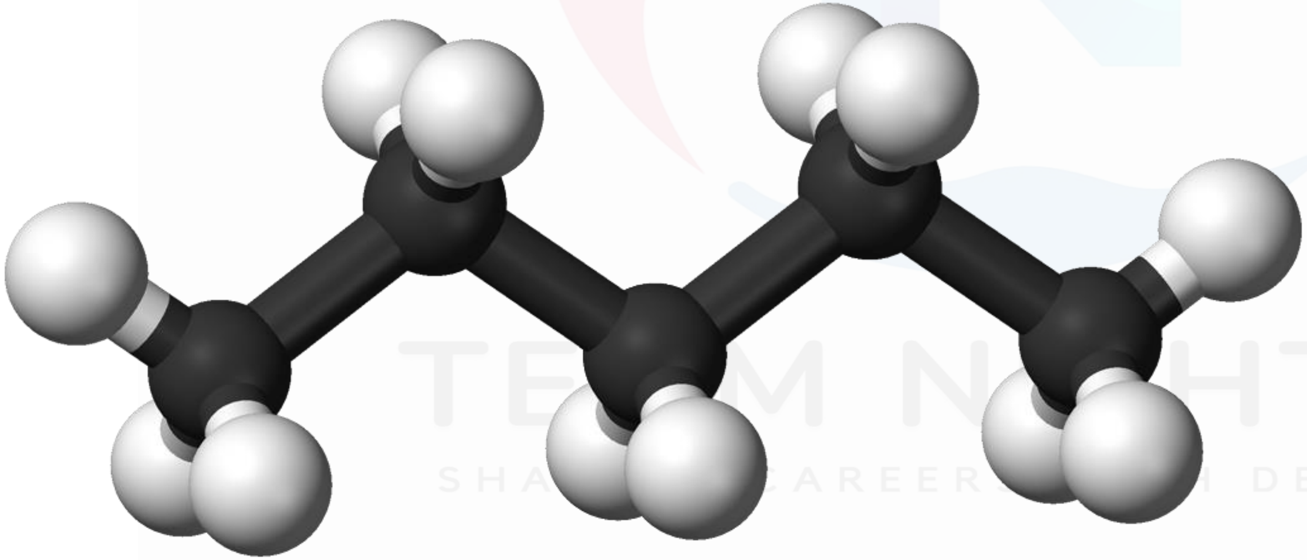


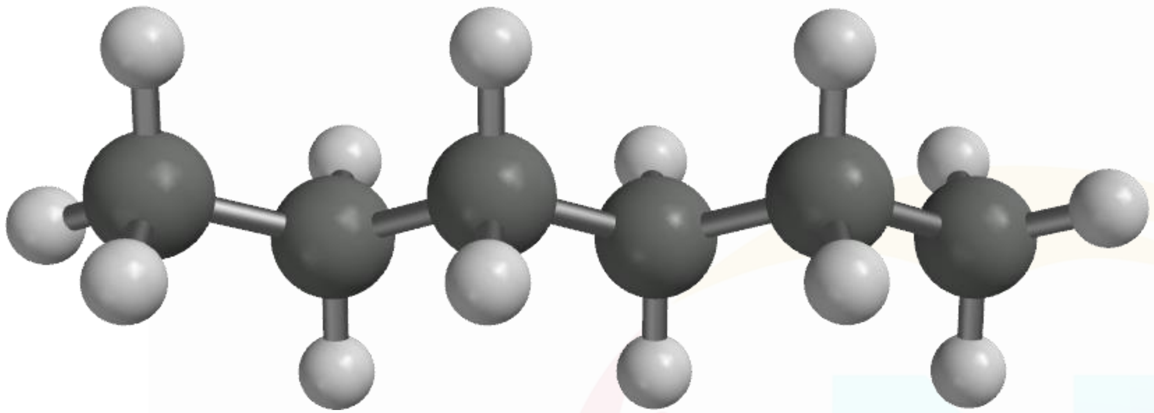
BUTANE C_4H_{10}



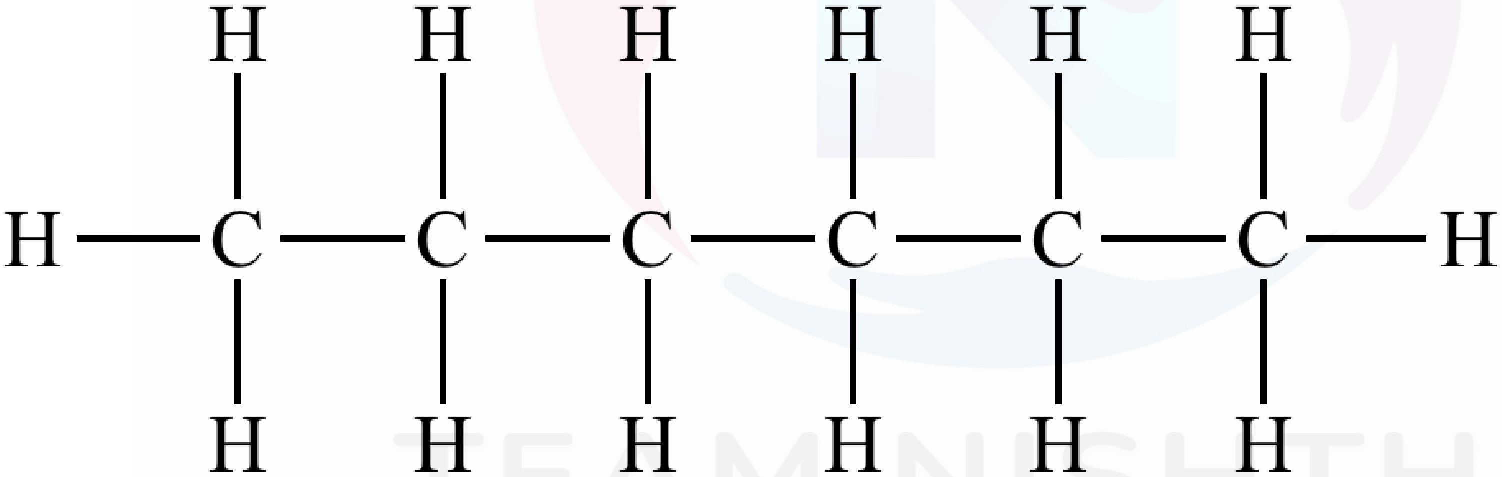


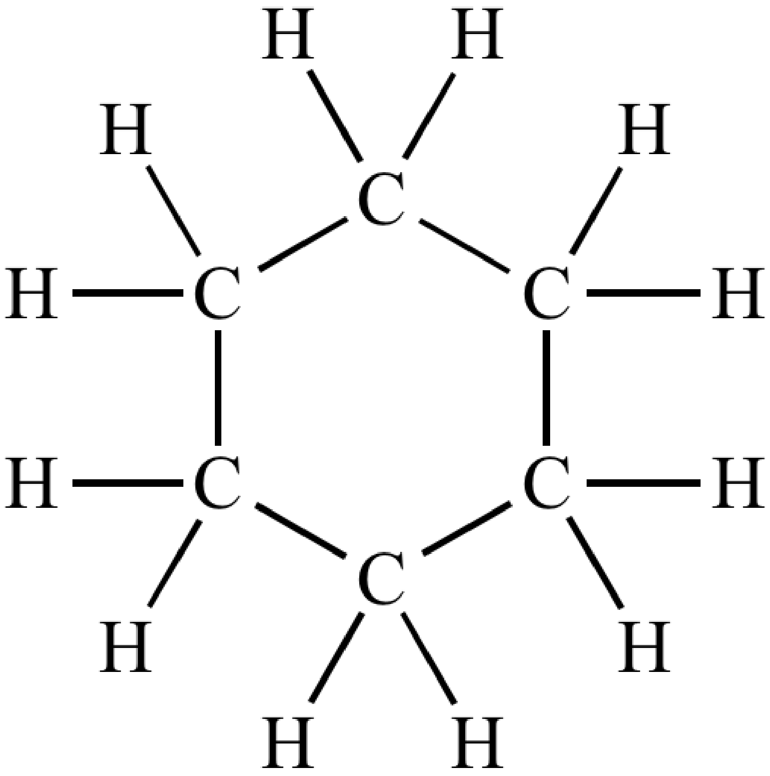
Pentane



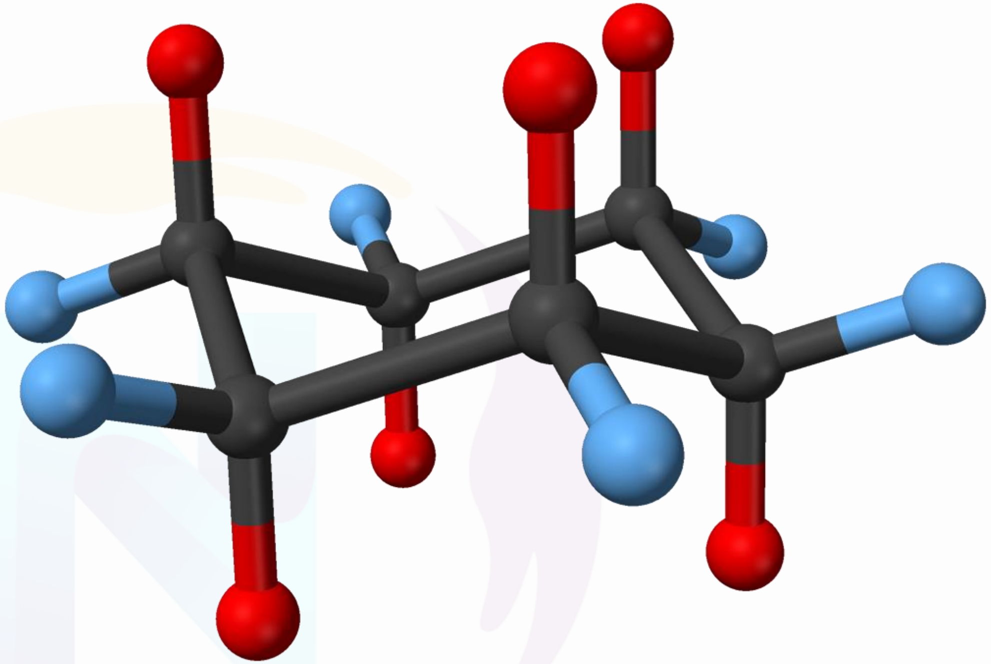


Hexane





cyclohexane



Q. Which one of the following is the correct order of reactivity of Mg, Al, Zn and Fe with HCl?

(a) Mg > Al > Zn > Fe
(b) Mg > Al > Fe > Zn
(c) Zn > Fe > Mg > Al
(d) Fe > Al > Zn > Mg

Answer :- A

Mg > Al > Zn > Fe

Magnesium (Mg) reacts most readily with HCl.

Aluminum (Al) reacts next, though it forms a protective oxide layer that can slow the reaction.

Zinc (Zn) reacts less readily than aluminum.

Iron (Fe) reacts the least with HCl among these metals.

Correct order is: Mg > Al > Zn > Fe.

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carrbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

Q. Methanol is toxic because

(a) methanol coagulates the protoplasm
(b) methanol gets oxidised to methanal in liver which coagulates the protoplasm
(c) methanol gets oxidised to acetic acid in liver which coagulates the protoplasm
(d) methanol gets oxidised to CO in liver which coagulates the protoplasm

Answer :- B

(a) **Methanol coagulates the protoplasm**

Incorrect. Methanol itself does not directly coagulate protoplasm.

(b) **Methanol gets oxidised to methanal in liver which coagulates the protoplasm**

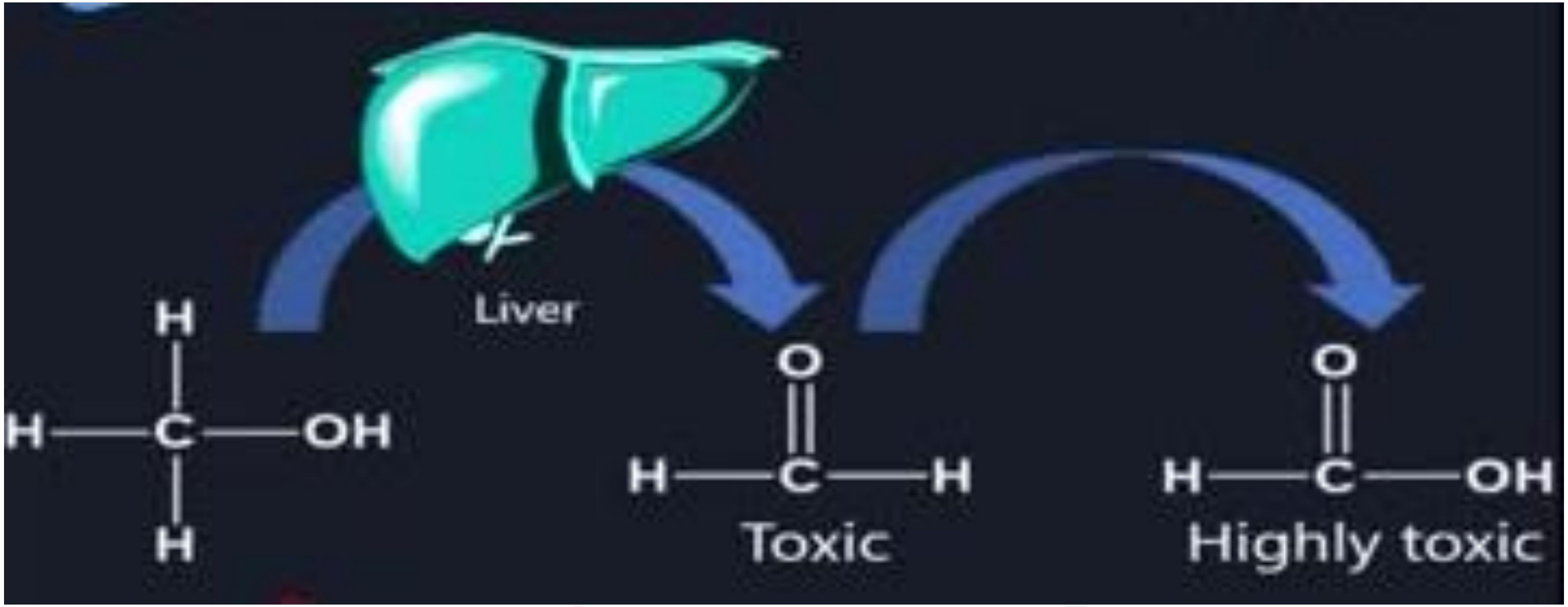
Correct. Methanol is metabolized to formaldehyde (methanal) in the liver, which is toxic and can coagulate protoplasm.

(c) **Methanol gets oxidised to acetic acid in liver which coagulates the protoplasm**

Incorrect. Methanol is first oxidized to formaldehyde, not acetic acid.

(d) **Methanol gets oxidised to CO in liver which coagulates the protoplasm**

Incorrect. Methanol is not oxidized to carbon monoxide (CO) in the liver.


Liver
Toxic
Highly toxic

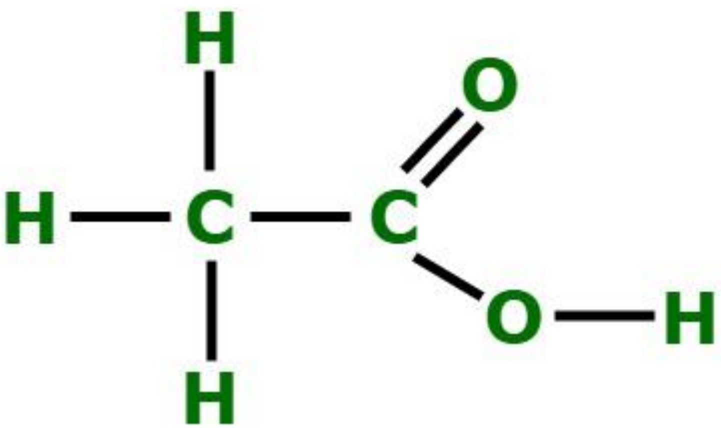
Q. Vinegar is

(a) 5-8% solution of acetic acid in water
(b) 5-8% solution of carbonic acid in water
(c) 5-8% solution of ethanol in water
(d) 10-15% solution of propionic acid in water

Answer :-A

5-8% solution of acetic acid in water
Correct. Vinegar is a solution of acetic acid (usually 5-8% by volume) in water.


La nature's
WE CARE YOUR HEALTH
WHITE
VINEGAR
For Salad's and Cooking
Net Vol.: 500ml



Vinegar

Q. Which one of the following is related to global dimming?

(a) Fall of atmospheric pressure due to increased particulates
(b) Raise of atmospheric pressure due to increased particulates
(c) Raise of temperature due to increased particulates
(d) Fall of temperature due to increased particulates

Answer :- D

(a) **Fall of atmospheric pressure due to increased particulates**

Incorrect. Global dimming is not directly related to a fall in atmospheric pressure.

(b) **Raise of atmospheric pressure due to increased particulates**

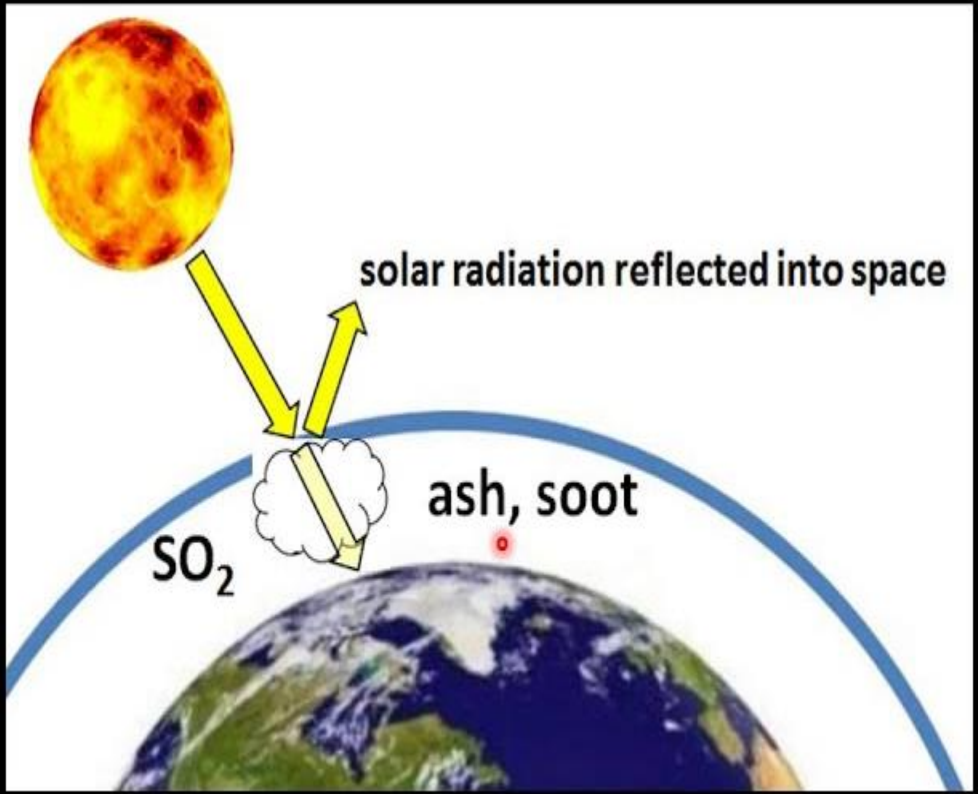
Incorrect. Global dimming is not associated with an increase in atmospheric pressure.

(c) **Raise of temperature due to increased particulates**

Incorrect. Global dimming actually leads to a decrease in temperature, not an increase.

(d) **Fall of temperature due to increased particulates**

Correct. Global dimming refers to the reduction in sunlight reaching Earth's surface due to increased particulates in the atmosphere, which can lead to a cooling effect.



Global dimming is the decrease in the amount of solar radiation reaching the surface of the Earth. Particulate matter in the atmosphere directly absorbs solar radiation and reflects it back into space before it reaches the surface of the Earth.

The particulate matter includes SO_2, ash, and soot (unburned carbon).

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Q. Which one of the following is known as cetane?

(a) Hexadecane
(b) Heptadecane
(c) Octadecane
(d) Nonadecane

Answer :- A

(a) **Hexadecane**

Description: A saturated hydrocarbon with 16 carbon atoms. It is commonly used as a reference in determining the cetane number of diesel fuels, which measures ignition quality.

(b) **Heptadecane**

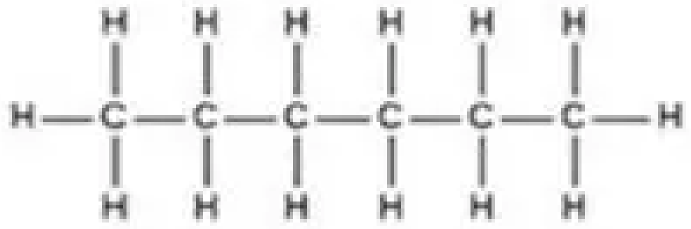
Description: A saturated hydrocarbon with 17 carbon atoms. It is used in various industrial applications but is not associated with cetane measurement.

(c) **Octadecane**

Description: A saturated hydrocarbon with 18 carbon atoms. It is used in the manufacture of various chemicals and as a component in some lubricants, but it is not related to cetane.

(d) **Nonadecane**

Description: A saturated hydrocarbon with 19 carbon atoms. It is used in research and industrial applications but is not used as a standard for cetane.



Hexadecane

Heptadecane

Octadecane

Nonadecane

Q. Which one of the following is not a ferromagnetic material?

(a) Cobalt
(b) Iron
(c) Silver
(d) Ferric chloride

Answer :- C

(a) **Cobalt**

Ferromagnetic. Cobalt is a ferromagnetic material, meaning it can be magnetized and maintain its magnetism.

(b) **Iron**

Ferromagnetic. Iron is a classic example of a ferromagnetic material with strong magnetic properties.

(c) **Silver**

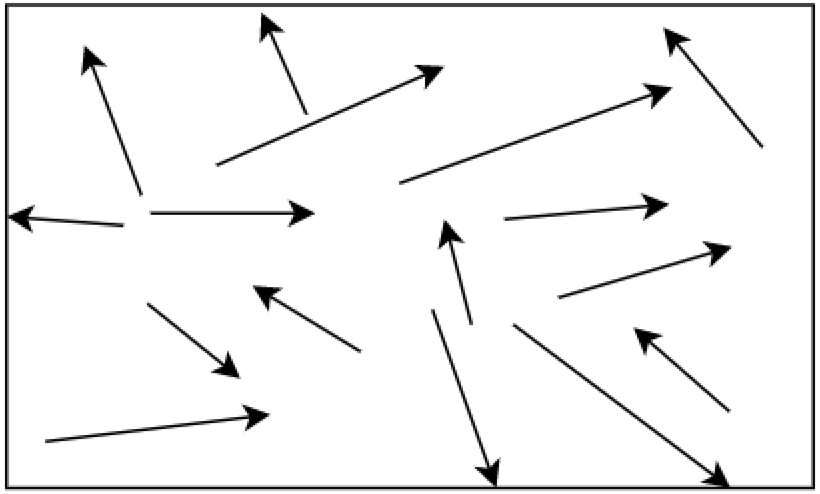
Not ferromagnetic. Silver is not ferromagnetic. It does not exhibit significant magnetic properties.

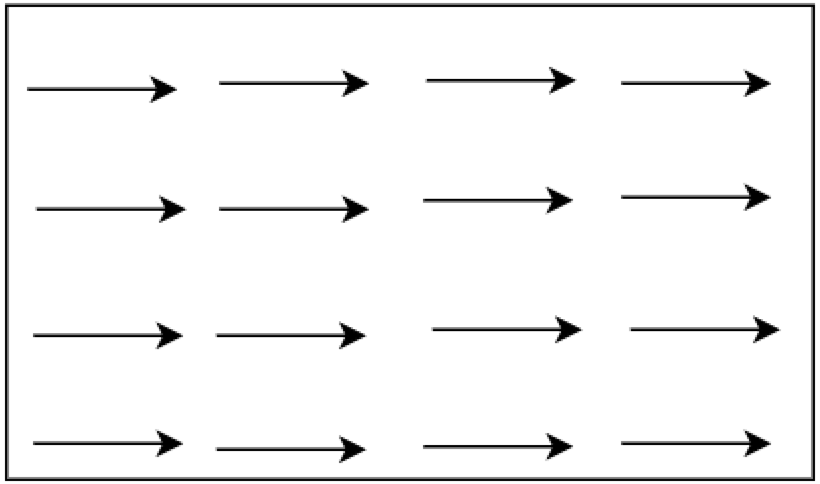
(d) **Ferric chloride**

Not ferromagnetic. All forms of ferric chloride are paramagnetic, owing to the presence of unpaired electrons residing in 3d orbitals.

Ferromagnetic Materials

- **Definition**: These materials have a strong and permanent magnetic response. They can be magnetized and maintain their magnetism even after the external magnetic field is removed.
- **Examples**: Iron, cobalt, and nickel.
- **Properties**:
    - High magnetic permeability.
    - Magnetization can be retained (remanent magnetism).
    - Align their magnetic domains in the direction of the applied magnetic field.





<u>Ferromagnetic Materials</u>

Paramagnetic Materials

- **Definition**: These materials have a weak and temporary magnetic response. Their magnetic dipoles align with an external magnetic field but do not retain magnetism once the field is removed.
- **Examples**: Aluminum, platinum, and certain metal ions like those of transition metals.
- **Properties**:
  - Weakly attracted to magnetic fields.
  - Magnetization is proportional to the applied magnetic field but disappears once the field is removed.

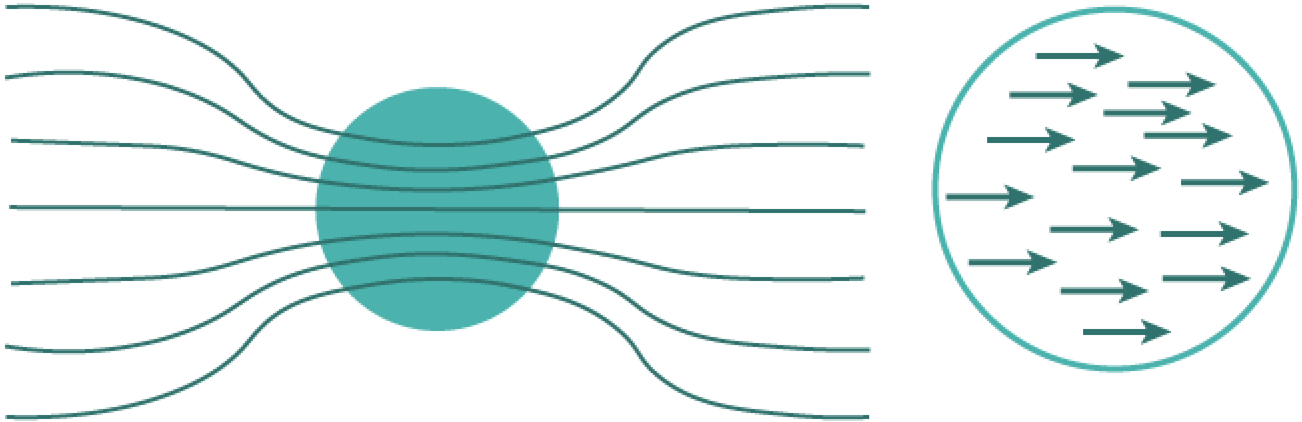
Paramagnetism

Magnetic Field Absent

Paramagnetic Material
(eg. Chromium, Aluminium)

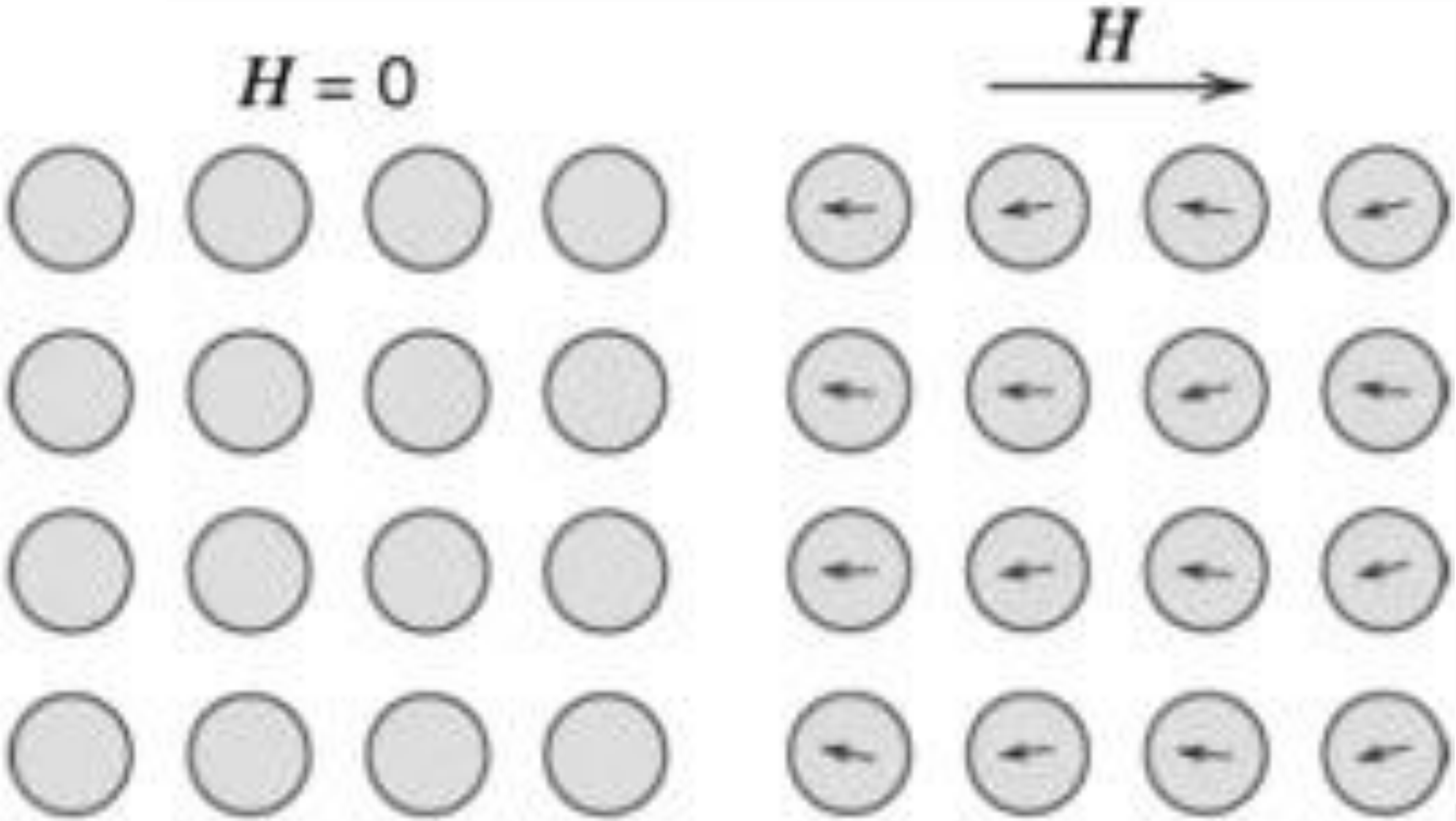
Random Alignment
of Magnetic Moments

Magnetic Field Present



Diamagnetic Materials

- **Definition**: These materials do not have any net magnetic moment and are weakly repelled by a magnetic field. They create an induced magnetic field in the opposite direction of the applied field.
- **Examples**: Bismuth, graphite, and most nonmetals.
- **Properties**:
  - Very weakly repelled by magnetic fields.
  - Magnetization is negative and very weak compared to ferromagnetic or paramagnetic materials.
  - The effect is generally very small and only noticeable in strong magnetic fields.


$H = 0$
H

Q. On a day when I am in hurry to go to office, I have a fixed quantity of rice which was just cooked and kept in a bowl. In order to cool it quickly, which one of the following is the best option?

(a) Let it be kept on the table in a room where there is no fan, no air conditioner
(b) Let it be kept in a room with AC set at a temperature around 23 °C and a ceiling fan (or table fan) operating at slow speed
(c) Let it be kept in a bowl of water (at room temperature) and operating a ceiling fan (or table fan) at full speed
(d) Let it be kept in a bowl of water at room temperature only

Answer :- C

(a) **<u>Let it be kept on the table in a room where there is no fan, no air conditioner</u>**

Slow cooling. Without airflow or cooling mechanisms, the rice will cool very slowly.

(b) **<u>Let it be kept in a room with AC set at a temperature around 23°C and a ceiling fan (or table fan) operating at slow speed</u>**

<u>Faster cooling</u>. The combination of air conditioning and a fan will facilitate better heat dissipation, cooling the rice faster than without any cooling mechanisms.

(c) **<u>Let it be kept in a bowl of water (at room temperature) and operating a ceiling fan (or table fan) at full speed</u>**

<u>Best cooling</u>. The bowl of water helps absorb heat from the rice, and the fan increases air circulation, making this method very effective for quick cooling.

(d) **<u>Let it be kept in a bowl of water at room temperature only</u>**

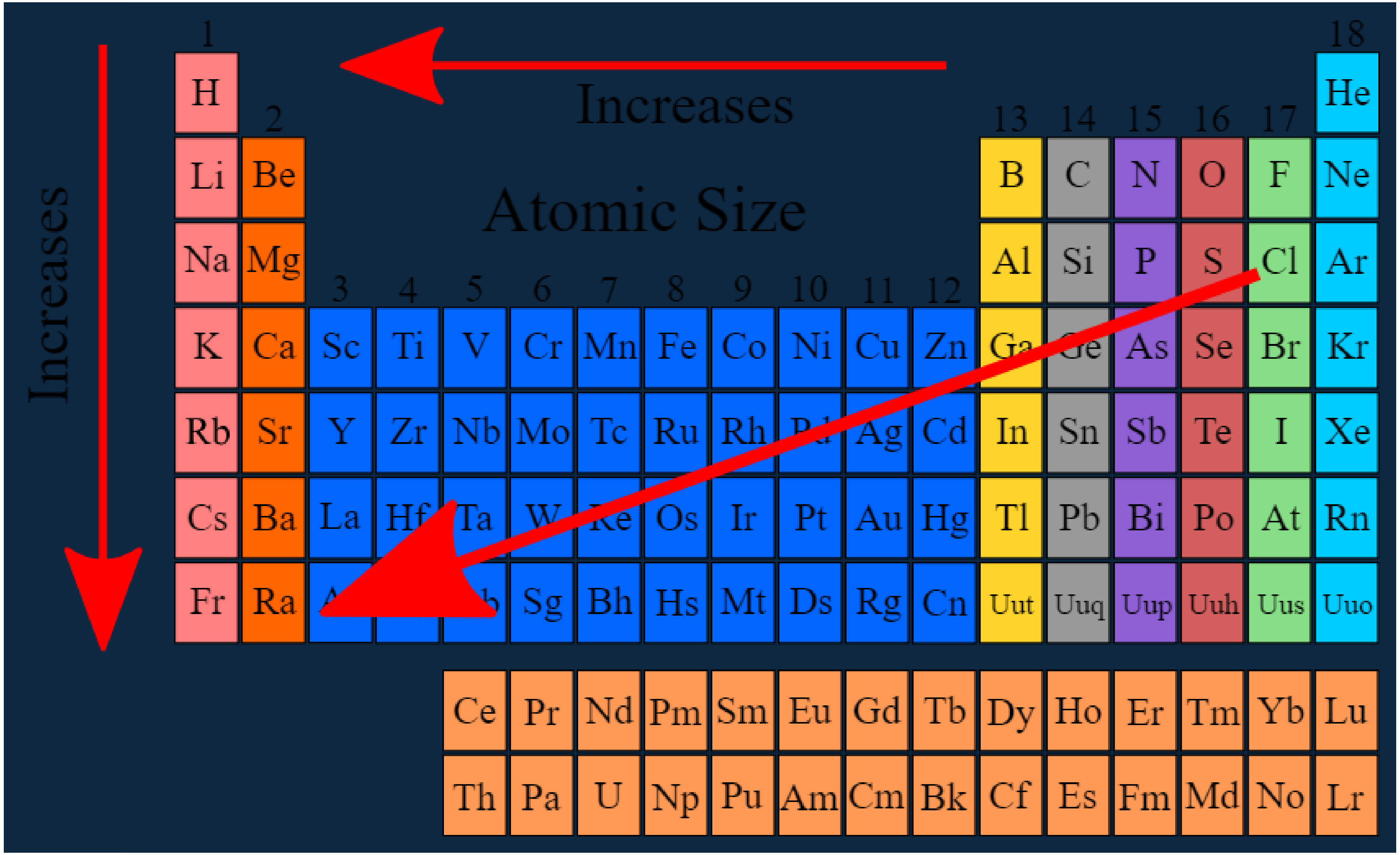
<u>Moderate cooling</u>. While the water helps absorb heat, the lack of air circulation makes this method less effective than using a fan.

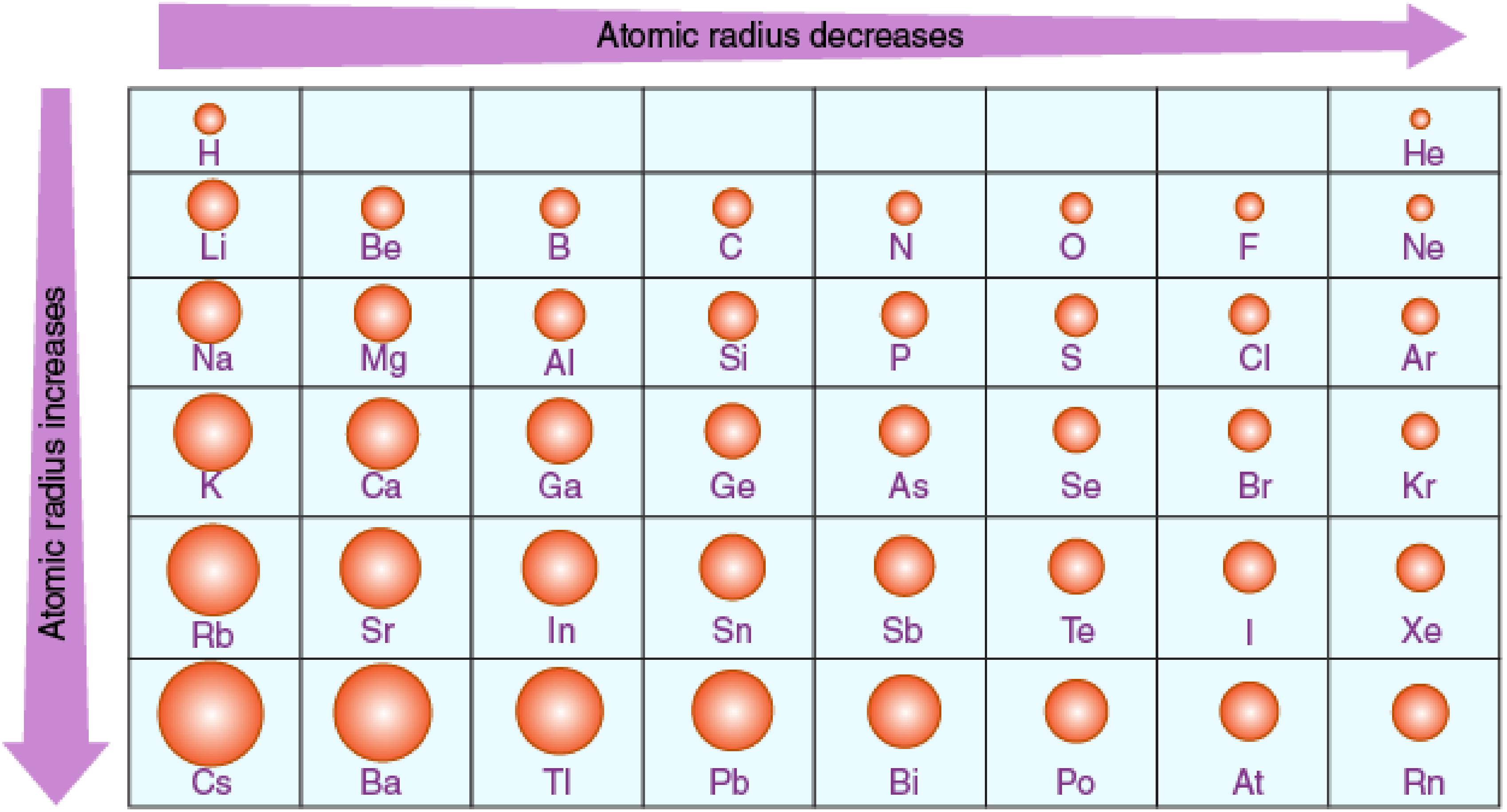
Q. The correct order of atomic radius of Li, Na, Be and O is

(a) Na > Li > Be > O
(b) Na > Be > Li > O
(c) Be > Li > Na > O
(d) O > Be > Li > Na

Atomic Radius Trends

1. ***Across a Period***: As you move from left to right across a period in the periodic table, the atomic radius decreases. This happens because electrons are added to the same energy level while the number of protons in the nucleus increases, which pulls the electrons closer to the nucleus.
2. ***Down a Group***: As you move down a group, the atomic radius increases. This is because additional electron shells are added, increasing the distance between the nucleus and the outermost electrons.


Increases
Atomic Size
Increases
1
2
3 4 5 6 7 8 9 10 11 12
13 14 15 16 17
18
H He
Li Be B C N O F Ne
Na Mg Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Ag Cd In Sn Sb Te I Xe
Cs Ba La Hf Ta W Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra Sg Bh Hs Mt Ds Rg Cn Uut Uuq Uup Uuh Uus Uuo
Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr



TEAM NISHTHA
SHAPING CAREERS WITH DEVOTION

Answer :- A

1. Sodium (Na) and Lithium (Li) are both in Group 1 (alkali metals), but sodium is in Period 3 and lithium is in Period 2.

Sodium has more electron shells than lithium, so sodium has a larger atomic radius than lithium.

2. Beryllium (Be) is in Group 2 and Period 2. It has a smaller atomic radius compared to lithium because beryllium has more protons in its nucleus than lithium, pulling the electrons closer despite being in the same period.

3. Oxygen (O) is in Group 16 and Period 2.

It has the smallest atomic radius among these elements because, even though it is in the same period as lithium and beryllium, it has more protons in the nucleus, which pulls the electrons closer.

Q. Which of the following catalytic systems is used for the reduction of unsaturated hydrocarbon to saturated hydrocarbon?

(a) Copper and H_2
(b) Iron and H_2
(c) Zinc and H_2
(d) Nickel and H_2

Answer :- D

Nickel is a common catalyst used in the hydrogenation process, which reduces unsaturated hydrocarbons (like alkenes) to saturated hydrocarbons (like alkanes).

Reduction of Unsaturated Hydrocarbons to Saturated Hydrocarbons:

1. Unsaturated Hydrocarbons: These are hydrocarbons with double or triple bonds between carbon atoms (like alkenes and alkynes). Examples include ethene (C_2H_4) and ethyne (C_2H_2).

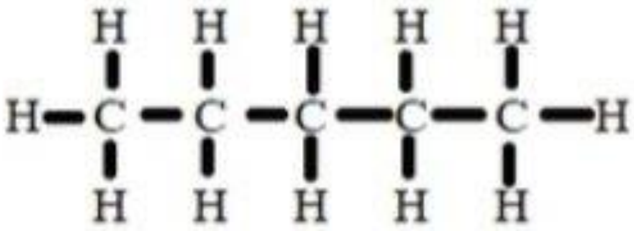
2. Saturated Hydrocarbons: These hydrocarbons have only single bonds between carbon atoms (like alkanes). Examples include ethane (C_2H_6).

3. Hydrogenation: This is the process used to convert unsaturated hydrocarbons to saturated hydrocarbons. It involves adding hydrogen (H_2) to the unsaturated hydrocarbon.

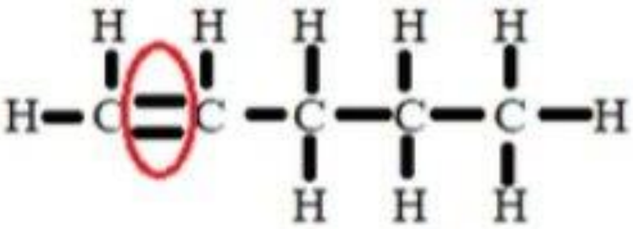
4. Catalyst: To speed up this reaction, a catalyst is used. Nickel (Ni) is a common catalyst for this process.

5. Reaction: When unsaturated hydrocarbons react with hydrogen in the presence of a nickel catalyst, the double or triple bonds are converted to single bonds, turning them into saturated hydrocarbons.

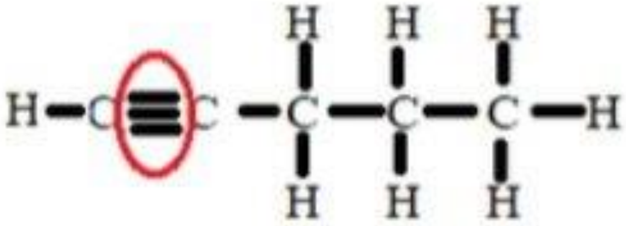
In simple terms: Hydrogenation is a way to add hydrogen to unsaturated hydrocarbons to make them saturated, and nickel is a common catalyst that helps make this reaction happen faster.



Pentane [Alkane]
Saturated hydrocarbon



Pentene [Alkene]
Unsaturated hydrocarbon



Pentyne [Alkyne]
Unsaturated hydrocarbon

Q. Which one of the following has the highest ionic character?

(a) BeF_3
(b) SiO_2
(c) NCl_3
(d) K_2S

Answer :- D

(a) **BeF_3**

Incorrect. BeF_3 does not exist in a stable form. The most stable compound with beryllium and fluorine is BeF_2, which has a high covalent character.

(b) **SiO_2**

Incorrect. SiO_2 (silicon dioxide) is primarily covalent. Silicon and oxygen form strong covalent bonds, so its ionic character is low.

(c) **NCl_3**

Incorrect. NCl_3 (nitrogen trichloride) has covalent bonds between nitrogen and chlorine. Its ionic character is relatively low.

(d) **K_2S**

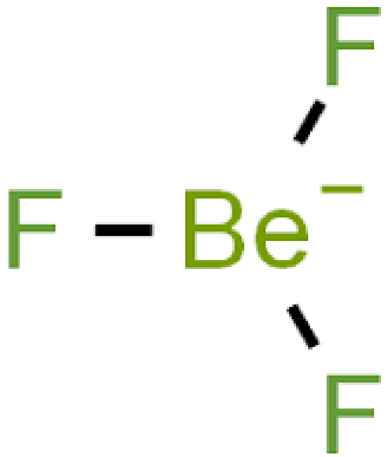
Correct. K_2S (potassium sulfide) has the highest ionic character among the options. Potassium (a metal) and sulfur (a non-metal) form a compound with significant ionic character due to the large difference in their electronegativities.

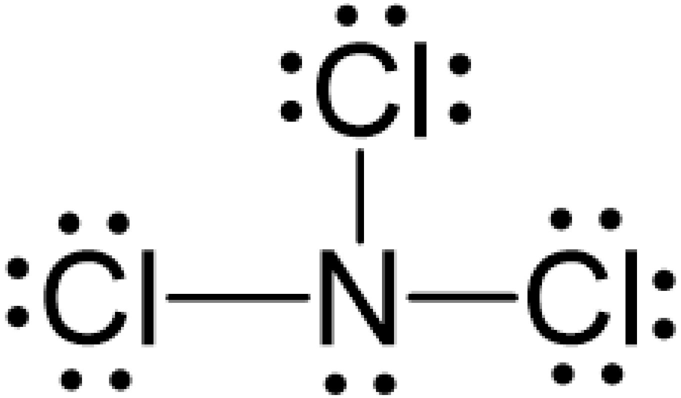
1. **<u>Ionic Character</u>**: This refers to the extent to which a chemical bond has ionic properties, meaning the electrons are transferred from one atom to another, creating positively and negatively charged ions. It usually occurs between atoms with a large difference in electronegativity. High ionic character means the bond is more ionic in nature.

2. **<u>Covalent Character</u>**: This refers to the extent to which a chemical bond has covalent properties, meaning the electrons are shared between atoms. It generally occurs between atoms with similar electronegativities. High covalent character means the bond is more covalent in nature.

<u>Ionic Character</u>: High in bonds between atoms with a large electronegativity difference.

<u>Covalent Character</u>: High in bonds between atoms with similar electronegativities.



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