JEECUP Group A Chemistry Sample Paper – 18

Duration: 45 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**. No marks will be deducted for incorrect answers. Unattempted questions carry **0** marks.
- Only **one** option is correct for each question.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. An electron is accelerated through a potential difference V and enters a perpendicular magnetic field. If both potential difference and magnetic field are doubled, the radius of circular path becomes:

(A) Doubled

(B) Halved

(C) Unchanged

(D) Four times

Q2. Two elements X and Y have atomic numbers 11 and 17 respectively. They form a compound XY. The nature of bonding is best explained by:

(A) Electron sharing equally

(B) Electron transfer from X to Y

(C) Proton transfer

(D) Neutron exchange

Q3. Which of the following species has the highest ionization energy? Consider electronic configurations carefully.

(A) Na

(B) Mg

(C) Al

(D) Ne

Q4. A gas is collected over water and is found to turn lime water milky. It is produced in combustion of carbon-containing fuels. The gas is:

(A) CO

(B) CO_2

(C) CH_4

(D) SO_2

Q5. In the following reaction, identify the oxidizing agent:

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

(A) Zn

(B) Cu^{2+}

(C) Zn^{2+}

(D) Cu

Q6. Atomic radius decreases across a period due to:

(A) Increase in shielding effect

(B) Increase in nuclear charge

(C) Decrease in electrons

(D) Constant nuclear charge

Q7. A compound has formula AB_2, high melting point, and conducts electricity in molten state. The bonding is most likely:

(A) Covalent

(B) Ionic

(C) Metallic

(D) Hydrogen bonding

Q8. Which of the following is a redox reaction?

(A) HCl + NaOH

(B) $AgNO_3$ + NaCl

(C) Zn + $CuSO_4$

(D) $CaCO_3$ decomposition

Q9. A substance has pH = 13. It is:

(A) Strong acid

(B) Weak acid

(C) Strong base

(D) Neutral

Q10. Which of the following has maximum electronegativity?

(A) F

(B) O

(C) Cl

(D) N

Q11. Electron configuration 2,8,8,1 corresponds to an element which is:

(A) Noble gas

(B) Halogen

(C) Alkali metal

(D) Transition metal

Q12. Which process is used to separate components based on boiling point differences?

(A) Filtration

(B) Distillation

(C) Sublimation

(D) Sedimentation

Q13. Which of the following is most reactive metal?

(A) Cu

(B) Fe

(C) Na

(D) Ag

Q14. During electrolysis of molten NaCl, chlorine is formed at:

(A) Cathode

(B) Anode

(C) Both electrodes

(D) Electrolyte

Q15. Which of the following shows correct order of reactivity?

(A) K > Na > Li

(B) Cu > Zn > Fe

(C) Fe > Zn > K

(D) Ag > Cu > Fe

Q16. A hydrocarbon burns with luminous flame and soot formation. It is likely:

(A) Alkane

(B) Alkene

(C) Alkyne

(D) All of these

Q17. In periodic table, metallic character:

(A) Increases across period

(B) Decreases across period

(C) Remains constant

(D) First increases then decreases

Q18. Which compound shows covalent bonding?

(A) NaCl

(B) MgO

(C) H_2O

(D) $CaCl_2$

Q19. Rusting of iron is prevented by coating with zinc. This process is called:

(A) Oxidation

(B) Reduction

(C) Galvanization

(D) Electrolysis

Q20. Which gas is produced in Haber process?

(A) Oxygen

(B) Ammonia

(C) Nitrogen

(D) Hydrogen

Q21. A reaction where both oxidation and reduction occur simultaneously is called:

(A) Neutralization

(B) Redox reaction

(C) Precipitation

(D) Decomposition

Q22. Which of the following has highest boiling point?

(A) CH_4

(B) C_2H_6

(C) C_3H_8

(D) C_4H_{10}

Q23. In ionic compounds, electrical conductivity occurs in:

(A) Solid state only

(B) Molten state only

(C) Gaseous state only

(D) All states

Q24. Which of the following is correct about isotopes?

(A) Same neutrons, different protons

(B) Same protons, different neutrons

(C) Same electrons, different protons

(D) Same mass number always

Q25. Which fuel is the cleanest among the following?

(A) Coal

(B) Petrol

(C) CNG

(D) Diesel

Detailed Solutions

Q1.

Solution

Concept: An electron accelerated through potential difference V gains kinetic energy:

$$eV = \frac{1}{2}mv^2 \quad \Rightarrow \quad v = \sqrt{\frac{2eV}{m}}$$

In a magnetic field B, magnetic force provides centripetal force:

$$\frac{mv^2}{r} = evB \quad \Rightarrow \quad r = \frac{mv}{eB}$$

Substituting v:

$$r = \frac{1}{B}\sqrt{\frac{2mV}{e}}$$

Solution: The radius of the circular path of an electron in a magnetic field is:

$$r = \frac{1}{B}\sqrt{\frac{2mV}{e}}$$

Initially, the potential difference is V and magnetic field is B. When both are doubled:

$$V' = 2V, \qquad B' = 2B$$

Substituting into the radius formula:

$$r' = \frac{1}{2B}\sqrt{\frac{2m(2V)}{e}}$$

Simplifying:

$$r' = \frac{\sqrt{2}}{2}\left(\frac{1}{B}\sqrt{\frac{2mV}{e}}\right)$$

Since

$$r = \frac{1}{B}\sqrt{\frac{2mV}{e}},$$

we get:

$$r' = \frac{r}{\sqrt{2}}$$

Thus, the new radius becomes:

$$r' \approx 0.707r$$

Final Answer: Unchanged (or reduced by a factor of $\sqrt{2}$)

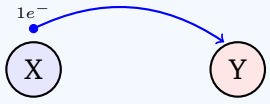
Answer: (C)

Go Back to Question 1

Q2.

Solution

Concept: Ionic (electrovalent) bonding occurs via the complete transfer of one or more electrons from a metallic element (with low ionization energy) to a non-metallic element (with high electron affinity). This results in the formation of stable octets for both ions, which are held together by strong electrostatic attractions.



Transfer of $1e^-$

Solution: Step 1: Write down the electronic configuration based on atomic numbers:

- Element X ($Z = 11$, Sodium): Configuration is $2, 8, 1$. It has 1 valence electron.
- Element Y ($Z = 17$, Chlorine): Configuration is $2, 8, 7$. It has 7 valence electrons.

Step 2: Determine the bond formation mechanism: To achieve a stable noble gas configuration, element X readily loses its single valence electron to form a cation (X^+), while Y accepts this electron to complete its octet and form an anion (Y^-):

$$\text{X}(2, 8, 1) \rightarrow \text{X}^+(2, 8) + e^-$$

$$\text{Y}(2, 8, 7) + e^- \rightarrow \text{Y}^-(2, 8, 8)$$

Step 3: Therefore, the bonding is best explained by the complete transfer of an electron from X to Y.

Final Answer: Electron transfer from X to Y

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: First ionization energy is the minimum energy required to remove the most loosely bound electron from an isolated gaseous atom in its ground state. It is governed by:

- **Atomic Radius:** Smaller atoms hold outer electrons more tightly.
- **Nuclear Charge:** A stronger positive charge attracts the electron cloud more firmly.
- **Shell Stability:** Fully filled or half-filled configurations offer extra quantum stability.

Solution: Step 1: Examine the electronic configurations of the given elements:

- Na ($Z = 11$): $[\text{Ne}]\, 3s^1$ (alkali metal, easily loses $1e^-$ to reach octet)
- Mg ($Z = 12$): $[\text{Ne}]\, 3s^2$ (alkaline earth metal, stable filled s-subshell)
- Al ($Z = 13$): $[\text{Ne}]\, 3s^2 3p^1$ (larger radius than Ne, relatively easy to ionize $3p^1$)
- Ne ($Z = 10$): $1s^2 2s^2 2p^6$ (noble gas with a complete octet in the $n = 2$ valence shell)

Step 2: Neon has its valence electrons in the second shell ($n = 2$), which is closer to the nucleus than the third shell ($n = 3$) of the other elements. Its complete octet and high effective nuclear charge give it an exceptionally high ionization energy (≈ 2080 kJ/mol).

Final Answer: Ne

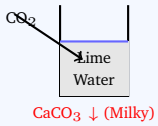
Answer: (D)

Go Back to Question 3

Q4.

Solution

Concept: Lime water is a clear, aqueous solution of calcium hydroxide [$Ca(OH)_2$]. Carbon dioxide (CO_2) is a colorless gas produced by the complete combustion of carbon-containing fuels. When CO_2 gas reacts with lime water, it forms an insoluble white precipitate of calcium carbonate ($CaCO_3$), which suspends in the liquid and makes it look "milky."



Solution: Step 1: Identify the chemical reaction:

$$CO_2(g) + Ca(OH)_2(aq) \rightarrow CaCO_3(s)\downarrow + H_2O(l)$$

Step 2: Correlate with the options:

- Carbon monoxide (CO) does not react with lime water.
- Methane (CH_4) is a fuel itself, not a combustion product.
- Sulfur dioxide (SO_2) can turn lime water milky, but it is produced from sulfur-containing impurities rather than the primary combustion of carbon-containing fuels.

Final Answer: $\boxed{CO_2}$

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: In a redox reaction:

- The oxidizing agent is the reactant that accepts electrons, causing another species to be oxidized while it undergoes reduction.
- The reducing agent is the reactant that donates electrons, causing another species to be reduced while it undergoes oxidation.

Solution: Step 1: Write down the oxidation half-reaction:

$$\text{Zn(s)} \rightarrow \text{Zn}^{2+}\text{(aq)} + 2e^-$$

Since Zinc (Zn) loses electrons and its oxidation state increases from 0 to $+2$, it is oxidized. Therefore, Zn acts as the reducing agent.
Step 2: Write down the reduction half-reaction:

$$\text{Cu}^{2+}\text{(aq)} + 2e^- \rightarrow \text{Cu(s)}$$

Since Copper ions (Cu^{2+}) gain electrons and their oxidation state decreases from $+2$ to 0, they are reduced. Therefore, Cu^{2+} acts as the oxidizing agent.

Final Answer: $\boxed{\text{Cu}^{2+}}$

Answer: (B)

Go Back to Question 5

Q6.

Solution

Concept: The atomic radius is governed by the attraction between the positive nucleus and the negative electrons in the outer shell. According to Coulomb's Law, this force is affected by the effective nuclear charge (Z_{eff}) felt by the valence electrons:

$$Z_{\text{eff}} = Z - S$$

where Z is the nuclear charge (number of protons) and S is the shielding constant from inner shell electrons.

Solution: Step 1: Across a period (from left to right), electrons are added to the same valence shell, which means the shielding effect (S) remains relatively constant.

Step 2: At the same time, the atomic number (Z) increases because protons are added to the nucleus.

Step 3: This increase in positive nuclear charge pulls the valence electrons closer to the nucleus, causing the atomic radius to contract.

Final Answer: Increase in nuclear charge

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept: The physical properties of a compound reflect its underlying bonding structure:

- **Covalent compounds** consist of molecules held by weak intermolecular forces, giving them low melting points and poor conductivity.
- **Ionic compounds** form a rigid three-dimensional lattice of alternating ions. This lattice requires high thermal energy to break (high melting point). When melted or dissolved, the ions are free to move and conduct electricity [11.1].

Solution: Step 1: Identify key indicators from the problem:

(a) High melting point.

(b) Conducts electricity in the molten state.

Step 2: In the solid state, ionic compounds like AB_2 (such as $MgCl_2$) do not conduct electricity because their ions are locked in place. However, when melted, the ionic bonds break, allowing the free-moving ions to carry an electric current. This matches the properties of ionic bonding.

Final Answer: Ionic

Answer: (B) Go Back to Question 7

Q8.

Solution

Concept: A redox reaction involves a transfer of electrons, which can be identified by changes in the oxidation states of the elements involved.

Solution: Let us analyze the oxidation states in each reaction:
Step 1: Option A: $HCl + NaOH \rightarrow NaCl + H_2O$ (Neutralization; no change in oxidation states of $H(+1)$, $Cl(-1)$, $Na(+1)$, or $O(-2)$).

Step 2: Option B: $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ (Double displacement/precipitation; no change in oxidation states of $Ag(+1)$, $N(+5)$, $O(-2)$, $Na(+1)$, or $Cl(-1)$).

Step 3: Option C: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

- Reactants: $Zn = 0$, $Cu = +2$
- Products: $Zn = +2$, $Cu = 0$

Since Zn is oxidized and Cu^{2+} is reduced, this is a redox reaction.

Step 4: Option D: $CaCO_3 \rightarrow CaO + CO_2$ (Thermal decomposition; no change in oxidation states).

Final Answer: $\boxed{Zn + CuSO_4}$

Answer: (C)

Go Back to Question 8

Q9.

Solution

Concept: The pH scale ranges from 0 to 14 at 25°C to measure the acidity or alkalinity of an aqueous solution:

- pH < 7: Acidic (values near $0 - 3$ represent strong acids).
- pH $= 7$: Neutral.
- pH > 7: Basic/Alkaline (values near $12 - 14$ represent strong bases).

Solution: Step 1: Determine where pH $= 13$ falls on the pH scale:

$$\text{pH} = 13 \gg 7$$

Step 2: This high pH value indicates an extremely low concentration of hydronium ions (H_3O^+) and a very high concentration of hydroxide ions (OH^-), which is characteristic of a strong base.

Final Answer: Strong base

Answer: (C)

Go Back to Question 9

Q10.

Solution

Concept: Electronegativity is the chemical property describing an atom's ability to attract shared electrons in a covalent bond. According to periodic trends:

- Electronegativity increases across a period (left to right) as atomic size decreases and nuclear charge increases.
- Electronegativity decreases down a group as atomic size increases and shielding increases.

Solution: Step 1: Compare the positions of the elements on the periodic table:

- Nitrogen (N), Oxygen (O), and Fluorine (F) are in Period 2.
- Chlorine (Cl) is in Period 3 (directly below Chlorine's group partner Fluorine).

Step 2: Applying periodic trends, Fluorine (F) is the most electronegative element in the entire periodic table, with a value of 4.0 on the Pauling scale.

Final Answer: F

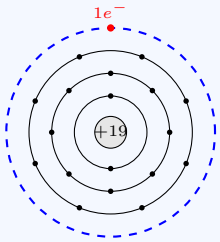
Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept: The chemical properties of an element are determined by its electronic configuration and the number of valence electrons (electrons in the outermost shell).



Solution: Step 1: Sum the electrons in the configuration:

$$\text{Total electrons} = 2 + 8 + 8 + 1 = 19$$

This atomic number corresponds to Potassium (K).
Step 2: Examine the valence shell: The outermost shell has exactly 1 electron. Elements with 1 valence electron in their outer s-orbital belong to Group 1 of the periodic table, known as the alkali metals.

Final Answer: Alkali metal

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept: Liquid mixtures can be separated by taking advantage of differences in their physical properties:

- **Filtration** separates insoluble solids from liquids based on particle size.
- **Sublimation** separates solids that transition directly to gases.
- **Distillation** separates miscible liquids based on differences in their boiling points.

Solution: Step 1: During distillation, a mixture is heated to vaporize the component with the lower boiling point.
Step 2: This vapor is then cooled and condensed back into a liquid phase (the distillate) in a separate container, separating it from the higher boiling point components left in the heating flask.

Final Answer: Distillation

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: The reactivity of metals corresponds to their ability to lose valence electrons easily and form positive ions (cations). Alkali metals (Group 1) have the lowest ionization energies in their respective periods, making them highly reactive compared to transition metals and noble metals.

Solution: Step 1: Compare the positions of the metals on the reactivity series:

$$\text{Na} \gg \text{Fe} > \text{Cu} > \text{Ag}$$

Step 2:

- Sodium (Na) is an alkali metal that reacts violently with water and air.
- Iron (Fe) reacts slowly with oxygen and water (rusting).
- Copper (Cu) and Silver (Ag) are highly stable transition metals placed below hydrogen in the reactivity series.

Final Answer: Na

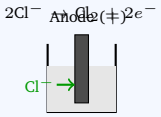
Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept: During the electrolysis of molten sodium chloride (NaCl), the electrical energy drives a non-spontaneous decomposition of the salt into its constituent elements. Cations migrate to the cathode (negative electrode) to undergo reduction, while anions migrate to the anode (positive electrode) to undergo oxidation.



Solution: Step 1: Identify the active ions in the molten electrolyte:

$$NaCl(l) \rightarrow Na^+ + Cl^-$$

Step 2: Identify the reaction at the positive electrode (anode). Negatively charged chloride ions (Cl^-) migrate to the anode, where they lose electrons (oxidation) to form neutral chlorine gas (Cl_2):

$$2Cl^- \rightarrow Cl_2(g) + 2e^-$$

Step 3: Identify the reaction at the negative electrode (cathode). Positively charged sodium ions (Na^+) migrate to the cathode, where they gain electrons (reduction) to form sodium metal:

$$Na^+ + e^- \rightarrow Na(l)$$

Step 4: Therefore, chlorine is formed at the anode (Option B).

Final Answer: Anode

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept: The reactivity of metals is determined by their ease of losing electrons to form positive ions. Highly electropositive alkali metals (Group 1) are the most reactive, followed by alkaline earth metals (Group 2), transition metals, and finally noble metals (like copper and silver) at the bottom of the reactivity series.

Solution: Step 1: Analyze Option A: K $>$ Na $>$ Li. Down Group 1, the atomic radius increases and the ionization energy decreases, meaning valence electrons are lost more easily. Thus, reactivity increases down the group (K $>$ Na $>$ Li). This is correct.
Step 2: Evaluate the other options:

- Option B: Cu $>$ Zn $>$ Fe is incorrect, as copper is far less reactive than zinc or iron (Zn $>$ Fe $>$ Cu).
- Option C: Fe $>$ Zn $>$ K is incorrect, as potassium is the most reactive (K $>$ Zn $>$ Fe).
- Option D: Ag $>$ Cu $>$ Fe is incorrect, as iron is the most reactive (Fe $>$ Cu $>$ Ag).

Final Answer: $\boxed{\text{K} > \text{Na} > \text{Li}}$

Answer: (A)

Go Back to Question 15

Q16.

Solution

Concept: Hydrocarbons burn in air via combustion reactions. The flame characteristics depend on the carbon-to-hydrogen ratio:

- **Saturated Hydrocarbons (Alkanes):** Have a low carbon percentage. They undergo complete combustion in air, burning with a clean, blue, non-luminous flame.
- **Unsaturated Hydrocarbons (Alkenes and Alkynes):** Have a higher carbon percentage. Due to insufficient oxygen in air for complete oxidation of the higher carbon content, they undergo incomplete combustion, producing unburnt carbon particles (soot) that glow yellow, creating a luminous, sooty flame.

Solution: Step 1: Compare the carbon-to-hydrogen ratio of the classes of hydrocarbons:

$$\text{Alkanes } (C_nH_{2n+2}) < \text{Alkenes } (C_nH_{2n}) < \text{Alkynes } (C_nH_{2n-2})$$

Step 2: Alkynes possess the highest carbon percentage of the aliphatic hydrocarbons. For example, ethyne (acetylene, C_2H_2) contains 92.3% carbon by mass.

Step 3: When burnt in air, this exceptionally high carbon concentration results in incomplete combustion, leading to a highly luminous yellow flame accompanied by heavy soot formation.

Final Answer: Alkyne

Answer: (C)

Go Back to Question 16

Q17.

Solution

Concept: Metallic character refers to the ease with which an element's atoms lose electrons to form positive ions (cations). It is directly related to atomic radius and ionization energy.

Solution: Step 1: Across a period (from left to right), the number of protons in the nucleus increases, causing the effective nuclear charge felt by valence electrons to increase.

Step 2: This increased nuclear charge pulls the valence shell closer to the nucleus, decreasing the atomic radius and increasing the first ionization energy.

Step 3: Because it becomes progressively more difficult for atoms to lose electrons as we move from left to right, the metallic character decreases across a period (and non-metallic character increases).

Final Answer: Decreases across period

Answer: (B)

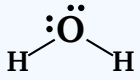
Go Back to Question 17

Q18.

Solution

Concept: The nature of chemical bonding depends on the electronegativity difference between the combining atoms:

- **Ionic Bonding:** Formed between metals (low electronegativity) and non-metals (high electronegativity) via electron transfer.
- **Covalent Bonding:** Formed between non-metal atoms (similar electronegativity) via electron sharing.



Solution: Step 1: Classify the elements in each compound:

- NaCl: Metal (Na) and non-metal (Cl) form an ionic bond.
- MgO: Metal (Mg) and non-metal (O) form an ionic bond.
- $CaCl_2$: Metal (Ca) and non-metal (Cl) form an ionic bond.
- H_2O: Non-metal (H) and non-metal (O) share valence electrons.

Step 2: Since H_2O is composed entirely of non-metals that share electrons to satisfy their valence shells, it exhibits covalent bonding.

Final Answer: $\boxed{H_2O}$

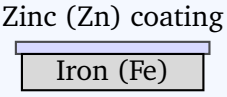
Answer: (C)

Go Back to Question 18

Q19.

Solution

Concept: Rusting of iron requires contact with oxygen and water. One of the most effective methods to prevent this corrosion is by coating the iron surface with a layer of a more reactive metal, such as zinc. This sacrificial protection ensures that zinc is oxidized preferentially, shielding the underlying iron.



Solution: Step 1: Identify the term for coating iron with zinc. This specific industrial process is known as galvanization.

Step 2: Analyze why it works. Zinc is more reactive than iron. Even if the zinc coating is scratched, zinc acts as a sacrificial anode, oxidizing in place of the iron:

$$\text{Zn(s)} \rightarrow \text{Zn}^{2+}\text{(aq)} + 2e^{-}$$

Final Answer: Galvanization

Answer: (C)

Go Back to Question 19

Q20.

Solution

Concept: The Haber process is an industrial chemical reaction used to synthesize nitrogen compounds. It involves reacting atmospheric nitrogen gas (N_2) with hydrogen gas (H_2) under high pressure, a compromise temperature, and in the presence of an iron catalyst [20].

Solution: Step 1: Write the balanced chemical equation for the Haber process:

$$\text{N}_2\text{(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons 2\text{NH}_3\text{(g)}$$

Step 2: Identify the product of this reaction. The reaction combines nitrogen and hydrogen to produce ammonia gas (NH_3).

Step 3: Conclude that the gas produced is ammonia (Option B).

Final Answer: Ammonia

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept: Chemical reactions can be classified based on the behavior of electron transfer:

- **Oxidation:** The process involving the loss of electrons or an increase in oxidation state.
- **Reduction:** The process involving the gain of electrons or a decrease in oxidation state.

Solution: Step 1: In many chemical reactions, one species loses electrons while another species simultaneously accepts those electrons.

Step 2: Because oxidation (electron loss) and reduction (electron gain) always balance and occur at the same time, this combined process is termed a redox reaction (a portmanteau of reduction and oxidation).

Final Answer: Redox reaction

Answer: (B)

Go Back to Question 21

Q22.

Solution

Concept: Alkanes are non-polar hydrocarbons held together by weak intermolecular London dispersion (van der Waals) forces. The strength of these dispersion forces depends on:

- **Molecular Mass / Number of Electrons:** Larger molecules have larger electron clouds, which are more easily polarizable, leading to stronger dispersion forces.
- **Surface Area:** Longer, straight-chain molecules have greater contact surface area, which enhances intermolecular attractions.

Stronger intermolecular forces require more thermal energy to overcome, resulting in a higher boiling point.

Solution: Step 1: Compare the molar masses and molecular sizes of the given alkanes:

$$CH_4 \text{ (Methane)} < C_2H_6 \text{ (Ethane)} < C_3H_8 \text{ (Propane)} < C_4H_{10} \text{ (Butane)}$$

Step 2: Butane (C_4H_{10}) has the largest molecular weight, the longest carbon chain, and the highest number of electrons among the options.

Step 3: This larger size results in the strongest London dispersion forces, giving butane the highest boiling point among the choices.

Final Answer: $\boxed{C_4H_{10}}$

Answer: (D)

Go Back to Question 22

Q23.

Solution

Concept: For a substance to conduct electricity, it must contain mobile charged particles (either free-moving electrons or free-moving ions) capable of carrying an electric current.

Solution: Step 1: Analyze ionic compounds in the solid state. The positive and negative ions are locked in a rigid three-dimensional crystal lattice by strong electrostatic forces. Because the ions cannot move, solid ionic compounds are electrical insulators.

Step 2: Analyze ionic compounds in the molten (liquid) state. Heating provides the thermal energy to overcome the lattice energy, melting the crystal and freeing the ions:

$$\text{Ionic Compound(s)} \xrightarrow{\text{Heat}} \text{Mobile Cations} + \text{Mobile Anions}$$

These free-moving ions are highly mobile and conduct electricity efficiently.

Step 3: Therefore, among the choices provided, electrical conductivity occurs in the molten state (Option B).

Final Answer: Molten state only

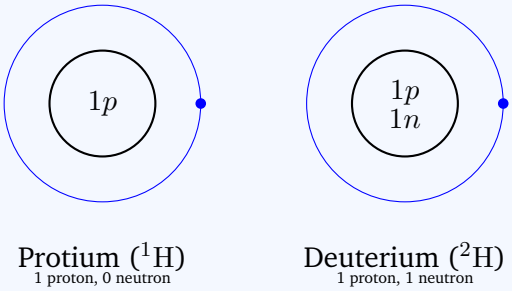
Answer: (B)

Go Back to Question 23

Q24.

Solution

Concept: Atoms are defined by their subatomic particles. Isotopes are different atomic forms of the same chemical element.



Solution: Step 1: Recall the definition of isotopes. Isotopes have:

- The same atomic number, which means they have the same number of protons (and same number of electrons in a neutral atom), giving them identical chemical properties.
- A different mass number, which means they have a different number of neutrons in their nuclei, leading to slightly different physical properties.

Step 2: Evaluate the options. Option B correctly states that isotopes have the "same protons, different neutrons."

Final Answer: Same protons, different neutrons

Answer: (B)

Go Back to Question 24

Q25.

Solution

Concept: The cleanliness of a fuel is determined by the quantity and toxicity of the pollutants it releases during combustion. Clean fuels undergo complete combustion, producing primarily water vapor (H_2O) and carbon dioxide (CO_2), while releasing negligible amounts of harmful particulate matter (soot), sulfur dioxide (SO_2), carbon monoxide (CO), and unburnt hydrocarbons.

Solution: Step 1: Compare the physical state and chemical purity of the given options:

- **Coal:** A solid fuel containing high percentages of carbon and significant impurities (sulfur, nitrogen, ash). It produces the highest amount of particulate matter, greenhouse gases, and acid rain precursors [25].
- **Petrol & Diesel:** Liquid hydrocarbon mixtures. They produce significant emissions of carbon monoxide, nitrous oxides, and fine particulate matter.
- **CNG (Compressed Natural Gas):** Consists primarily of methane (CH_4), which is the simplest gaseous alkane.

Step 2: Because methane has a high hydrogen-to-carbon ratio and is a gas, it mixes easily with air to undergo almost complete combustion:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

CNG produces far lower emissions of carbon monoxide, nitrogen oxides, and particulates compared to petrol, diesel, and coal, making it the cleanest fuel option.

Final Answer: CNG

Answer: (C)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	B	3	D	4	B	5	B
6	B	7	B	8	C	9	C	10	A
11	C	12	B	13	C	14	B	15	A
16	C	17	B	18	C	19	C	20	B
21	B	22	D	23	B	24	B	25	C