



CREST
Olympiads
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CREST Science Olympiad (CSO) Worksheet *for*

Class 10



Topic

Metal and Non-metals



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Worksheet on Metal and Non-metals

- 1. A zinc-coated steel nail is placed in a solution of hydrochloric acid (HCl), and hydrogen gas (H₂) is evolved. Which type of reaction is taking place, and what is the role of zinc in this reaction?**
 - a. Single displacement reaction; Zinc is the reducing agent
 - b. Double displacement reaction; Zinc is the catalyst
 - c. Displacement reaction; Zinc is the oxidising agent
 - d. Synthesis reaction; Hydrogen is the product
- 2. When calcium (Ca) reacts with chlorine (Cl₂) to form calcium chloride (CaCl₂), what type of ions do they become, respectively?**
 - a. Ca becomes a cation, and Cl₂ becomes an anion.
 - b. Ca becomes an anion, and Cl₂ becomes a cation.
 - c. Both Ca and Cl₂ become anions.
 - d. Both Ca and Cl₂ become cations.
- 3. A chemical reaction involving aqua regia produces nitrogen dioxide gas (NO₂), which is brown in colour. During an experiment, the colour of the gas evolved and changed from brown to colourless. What does this colour change indicate about the progress of the reaction?**
 - a. The reaction is incomplete.
 - b. The reaction is proceeding at a slow rate.
 - c. All the reactants have been consumed.
 - d. The reaction has released toxic gases.
- 4. You have a sample of lead (Pb) and aluminium (Al) strips. Which experimental condition could you use to determine which metal is more reactive, and what would be the expected outcome?**
 - a. Immerse both strips in water, and observe for gas evolution.
 - b. Immerse both strips in hydrochloric acid (HCl), and observe for bubbling.
 - c. Heat both strips to a high temperature, and measure the rate of melting.
 - d. Shine light on both strips and measure their conductivity.
- 5. Why do ionic compounds conduct electricity in the molten state or when dissolved in water but not in the solid state?**
 - a. In the solid state, ions are stationary and cannot carry a current.
 - b. In the solid state, ions are too close together to move.
 - c. In the solid state, ions are too far apart to interact.
 - d. In the solid state, ions are highly reactive and form covalent bonds.

Answer Key

1. a - In this scenario, a zinc-coated steel nail is placed in a solution of hydrochloric acid (HCl), resulting in the evolution of hydrogen gas (H₂). This is an example of a single displacement reaction.

In a single displacement reaction, one element displaces another element in a compound.

In this case: Zinc (Zn) from the zinc-coated nail displaces hydrogen (H) in hydrochloric acid (HCl), leading to the formation of zinc chloride (ZnCl₂).

The balanced chemical equation for this reaction is: $\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$

Zinc is the reducing agent: In this reaction, zinc undergoes oxidation by losing electrons to form Zn²⁺ ions. It donates electrons to hydrogen ions (H⁺) in the hydrochloric acid, causing the hydrogen ions to be reduced to hydrogen gas (H₂). Zinc acts as the reducing agent because it facilitates the reduction of hydrogen ions.

2. a - In this reaction, calcium (Ca) loses two electrons to form a Ca²⁺ ion because it gives away two electrons to achieve a stable electron configuration similar to argon. Chlorine (Cl₂) gains one electron from each of the two calcium atoms to form two Cl⁻ ions because it needs one additional electron to complete its outermost electron shell. As a result, calcium becomes a positively charged ion also known as a cation, and chlorine becomes negatively charged ions called anions.
3. c - In the context of this chemical reaction involving aqua regia, a change in the colour of the gas evolved from brown to colourless indicates that all the reactants have been consumed. This colour change suggests that the reaction is complete, and the products formed no longer contain the brown-coloured nitrogen dioxide gas (NO₂).
4. b - To determine which metal is more reactive, you can immerse both lead (Pb) and aluminium (Al) strips in hydrochloric acid (HCl) and observe for bubbles. The expected outcome would be that the metal strip which bubbles more vigorously or produces more gas is the more reactive metal. In this case, aluminium (Al) is more reactive than lead (Pb), so you would observe more bubbling with the aluminium strip when it reacts with the HCl.
5. b - Ionic compounds conduct electricity when they are in the molten state or dissolved in water because in these states, the ions are free to move and carry an electric current. In the solid state, however, the ions are held in a rigid lattice structure, and they are closely packed and immobile. This immobility of ions in the solid state prevents them from carrying an electric current, as they cannot move to complete an electrical circuit.

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