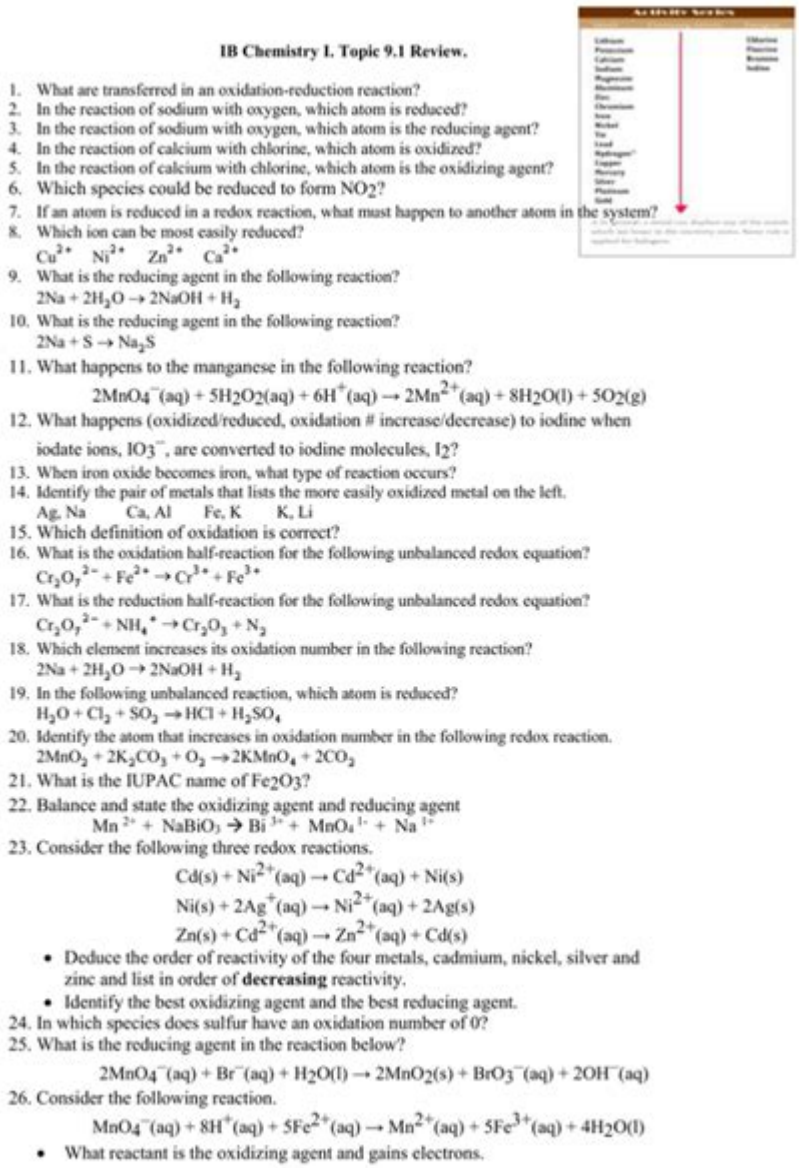
Ib Chemistry Redox Questions And Answers



IB Chemistry I. Topic 9.1 Review.

1. What are transferred in an oxidation-reduction reaction?
2. In the reaction of sodium with oxygen, which atom is reduced?
3. In the reaction of sodium with oxygen, which atom is the reducing agent?
4. In the reaction of calcium with chlorine, which atom is oxidized?
5. In the reaction of calcium with chlorine, which atom is the oxidizing agent?
6. Which species could be reduced to form NO_2?
7. If an atom is reduced in a redox reaction, what must happen to another atom in the system?
8. Which ion can be most easily reduced?
   Cu^{2+} Ni^{2+} Zn^{2+} Ca^{2+}
9. What is the reducing agent in the following reaction?
   $2Na + 2H_2O \rightarrow 2NaOH + H_2$
10. What is the reducing agent in the following reaction?
    $2Na + S \rightarrow Na_2S$
11. What happens to the manganese in the following reaction?
    $2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 5O_2(g)$
12. What happens (oxidized/reduced, oxidation # increase/decrease) to iodine when iodate ions, IO_3^-, are converted to iodine molecules, I_2?
13. When iron oxide becomes iron, what type of reaction occurs?
14. Identify the pair of metals that lists the more easily oxidized metal on the left.
    Ag, Na Ca, Al Fe, K K, Li
15. Which definition of oxidation is correct?
16. What is the oxidation half-reaction for the following unbalanced redox equation?
    $Cr_2O_7^{2-} + Fe^{2+} \rightarrow Cr^{3+} + Fe^{3+}$
17. What is the reduction half-reaction for the following unbalanced redox equation?
    $Cr_2O_7^{2-} + NH_4^+ \rightarrow Cr_2O_3 + N_2$
18. Which element increases its oxidation number in the following reaction?
    $2Na + 2H_2O \rightarrow 2NaOH + H_2$
19. In the following unbalanced reaction, which atom is reduced?
    $H_2O + Cl_2 + SO_2 \rightarrow HCl + H_2SO_4$
20. Identify the atom that increases in oxidation number in the following redox reaction.
    $2MnO_2 + 2K_2CO_3 + O_2 \rightarrow 2KMnO_4 + 2CO_2$
21. What is the IUPAC name of Fe_2O_3?
22. Balance and state the oxidizing agent and reducing agent
    $Mn^{2+} + NaBiO_3 \rightarrow Bi^{3+} + MnO_4^{1-} + Na^{1+}$
23. Consider the following three redox reactions.
    $Cd(s) + Ni^{2+}(aq) \rightarrow Cd^{2+}(aq) + Ni(s)$
    $Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$
    $Zn(s) + Cd^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cd(s)$
    - Deduce the order of reactivity of the four metals, cadmium, nickel, silver and zinc and list in order of **decreasing** reactivity.
    - Identify the best oxidizing agent and the best reducing agent.
24. In which species does sulfur have an oxidation number of 0?
25. What is the reducing agent in the reaction below?
    $2MnO_4^-(aq) + Br^-(aq) + H_2O(l) \rightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-(aq)$
26. Consider the following reaction.
    $MnO_4^-(aq) + 8H^+(aq) + 5Fe^{2+}(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$
    - What reactant is the oxidizing agent and gains electrons.

IB Chemistry redox questions and answers are essential for students preparing for their International Baccalaureate exams. Redox reactions, which involve the transfer of electrons between species, form a critical part of the chemistry curriculum. Understanding these concepts not only helps in answering exam questions but also lays a foundation for further studies in chemistry and related fields. This article provides a comprehensive overview of redox reactions, common types of questions you might encounter, and detailed answers to help you grasp these concepts.

Understanding Redox Reactions

Redox reactions, short for reduction-oxidation reactions, involve two key processes: oxidation and reduction. Oxidation is the loss of electrons, while reduction is the gain of

electrons. These reactions are fundamental to many chemical processes, including combustion, respiration, and corrosion.

Key Concepts in Redox Chemistry

To effectively tackle IB Chemistry redox questions, it's important to understand the following concepts:

1. Oxidation State: The oxidation state (or number) indicates the degree of oxidation of an atom in a compound. It helps identify which species are oxidized and reduced.

2. Half-Reactions: Redox reactions can be split into two half-reactions—one for oxidation and one for reduction. This separation aids in balancing the overall reaction.

3. Electrochemical Cells: Understanding how redox reactions are utilized in galvanic and electrolytic cells is crucial for some IB questions.

4. Common Oxidizing and Reducing Agents: Familiarity with common oxidizers (e.g., potassium permanganate, dichromate ions) and reducers (e.g., zinc, iron) can simplify problem-solving.

Types of Redox Questions in IB Chemistry

Students can expect a variety of questions related to redox reactions in their IB Chemistry exams. Here are some common types:

1. Identifying Oxidation and Reduction

These questions often provide a chemical equation, asking students to identify which species is oxidized and which is reduced.

2. Balancing Redox Reactions

Students may be tasked with balancing redox reactions in acidic or basic solutions using the half-reaction method.

3. Calculating Standard Electrode Potentials

Questions might require students to calculate or interpret standard electrode potentials and relate them to the feasibility of redox reactions.

4. Applications in Real-World Scenarios

Some questions may involve applying redox concepts to real-world processes, such as

batteries or corrosion.

Sample IB Chemistry Redox Questions and Answers

To provide students with practical examples, below are sample redox questions along with detailed answers.

Question 1: Identify oxidation and reduction in the following reaction:

$$ \text{2MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 3\text{H}_2\text{O} $$

Answer:

- Oxidation: The oxidation state of carbon in oxalate ($C_2O_4^{2-}$) goes from +3 to +4 in CO_2. Thus, $C_2O_4^{2-}$ is oxidized.
- Reduction: The oxidation state of manganese in MnO_4^- goes from +7 to +2 in Mn^{2+}. Therefore, MnO_4^- is reduced.

Question 2: Balance the following redox reaction in acidic solution:

$$ \text{Cr}_2\text{O}_7^{2-} + \text{Fe}^{2+} \rightarrow \text{Cr}^{3+} + \text{Fe}^{3+} $$

Answer:

1. Write the half-reactions:
- Reduction: $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$
- Oxidation: $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$

2. Balance the reduction half-reaction:
- $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$

3. Balance the oxidation half-reaction:
- $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$

4. Multiply the oxidation half-reaction by 6:
- $6\text{Fe}^{2+} \rightarrow 6\text{Fe}^{3+} + 6\text{e}^-$

5. Combine the balanced half-reactions:

$$ \text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O} $$

Question 3: Calculate the standard electrode potential for the following half-reaction:

$$ \text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} $$

Answer:

The standard electrode potential (E°) for the copper half-reaction is +0.34 V. This positive value indicates that the reduction of copper ions is spontaneous under standard conditions.

Tips for Tackling Redox Questions

Here are some strategies for effectively answering redox questions in your IB Chemistry exam:

1. Understand Oxidation States: Be comfortable calculating oxidation states for various elements in compounds.

2. Practice Half-Reaction Balancing: Regularly practice the half-reaction method for balancing redox equations in both acidic and basic solutions.

3. Memorize Key Values: Familiarize yourself with standard electrode potentials for common half-reactions, as they often appear in exam questions.

4. Work on Past Papers: Reviewing past IB exam papers can provide insight into the types of redox questions commonly asked.

5. Use Visual Aids: Drawing diagrams for electrochemical cells can help visualize the flow of electrons and the processes of oxidation and reduction.

Conclusion

In conclusion, mastering **IB Chemistry redox questions and answers** is vital for success in the IB Chemistry exam. A solid understanding of redox concepts, practice with common types of questions, and effective problem-solving strategies will greatly enhance your ability to tackle these challenges. By regularly engaging with the material, utilizing practice questions, and familiarizing yourself with the key principles of redox chemistry, you can approach your exams with confidence. Remember, the more you practice, the more adept you will become at recognizing and solving redox-related problems.

Frequently Asked Questions

What is the definition of a redox reaction in the context of IB Chemistry?

A redox reaction, or reduction-oxidation reaction, is a chemical process in which one species is oxidized (loses electrons) and another species is reduced (gains electrons), resulting in a change in oxidation states.

How can you identify the oxidizing and reducing agents in a redox reaction?

The oxidizing agent is the species that is reduced (gains electrons) and thus causes oxidation, while the reducing agent is the species that is oxidized (loses electrons) and causes reduction. You can identify them by analyzing the changes in oxidation states of the elements involved.

What role do half-equations play in balancing redox reactions?

Half-equations break down a redox reaction into two separate equations: one for the oxidation process and one for the reduction process. This allows for easier balancing of electrons, atoms, and charges, ensuring that the overall reaction is balanced.

What is the significance of the standard electrode potential (E°) in redox reactions?

The standard electrode potential provides insight into the tendency of a species to be reduced. A higher E° value indicates a greater tendency to gain electrons (be reduced), while a lower or negative E° value suggests a lesser tendency. This information is crucial for predicting the direction and feasibility of redox reactions.

How do you calculate the overall cell potential in a galvanic cell?

To calculate the overall cell potential (E°cell) for a galvanic cell, you subtract the standard electrode potential of the anode (E°anode) from that of the cathode (E°cathode): E°cell = E°cathode - E°anode. A positive E°cell indicates that the reaction is spontaneous.

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