Oxidation and Reduction Study Guide

Part I: Vocabulary and Terms

The loss of one or more electrons from an atom is called _________________. The gain of electrons by an atom is called _________________. Reduction and oxidation must go together, as electrons cannot be created or destroyed in a chemical reaction. A reaction where substances are oxidized and reduced is called a ______ reaction.

The __________________________________________ is defined as the number of electrons an atom needs to be given to return to its elemental form – the more positive this number is, the more oxidized an atom is, and the more negative this number is, the more reduced an atom is.

If an atom is oxidized in a reaction, it has a ________ oxidation number on the right-hand side of the equation than it does on the left. If an atom is reduced in a reaction, it has a _______ oxidation number on the right-hand side of the equation than it does on the left.

Word Bank: redox, oxidation, reduction, higher, lower, oxidation number.

Part II: Assigning Oxidation Numbers.

Rule 1: The oxidation number of an uncombined element is always ______. This includes polyatomic elements like H₂.

Rule 2: The sum of the oxidation numbers of the atoms in a __________ compound is always zero. The sum of the oxidation numbers in an ion is equal to the _______ of that ion.

Rule 3: Metals in compounds generally have positive oxidation numbers. Group 1 metals always have an oxidation number of ____, and Group 2 metals have an oxidation number of ____.

Rule 4: Oxygen generally forms compounds with an oxidation number of __________. The most common exception is ‘peroxide’ compounds like __________, where oxygen has an oxidation number of -1.

Rule 5: Hydrogen usually forms compounds with an oxidation number of +1. The only common exception is binary metal-hydrogen compounds, or ‘hydrides’, such as __________ (lithium hydride), in which hydrogen has an oxidation number of -1.

Rule 6: Halogens usually form compounds where they have an oxidation number of _______. The only exceptions are when they bond to oxygen or to other halogens. Fluorine always has an oxidation number of -1 in any compound.

Word Bank: neutral, +2, -2, 0, -1, +1, H₂O₂, LiH, charge
Part II (Continued): Write the Oxidation States for all Atoms in these Compounds or Ions

CO₂  NH₃  NO₂⁻
NO₃⁻  H₃PO₄  H₂O₂

Part III: Interpreting a Redox Reaction Equation (6 points)

*Iodide (I⁻)* is a colorless, water-soluble ion. *Reacting a solution of Ce⁺⁴ ion with a solution containing iodide ion causes it to precipitate as the purple solid I₂.*

The **UNBALANCED** equation for this reaction is as follows:

\[ \text{I}^- + \text{Ce}^{+4} \rightarrow \text{I}_2 + \text{Ce}^{+3} \]

12. (1 point) What is the oxidation number of iodide (I⁻) on the left side of the equation? ________

13. (1 point) What is the oxidation number of Cerium on the left side? ________

14. (1 point) What is the oxidation number of iodine (I₂) on the right side of the equation? ________

15. (1 point) What is the oxidation number of Cerium on the right? ________

16. (1 point) Iodide is OXIDIZED or REDUCED in this reaction? ________

17. (1 point) Cerium is OXIDIZED or REDUCED in this reaction? ________

Part IV: (HONORS) Balancing a Redox Equation by the Half-Reaction method (10 points)

18. (2 points) Balance the oxidation half-reaction:

\[ \text{___I}^- \rightarrow \text{___I}_2 + \text{____e}^- \]

19. (2 points) Balance the reduction half-reaction:

\[ \text{___e}^- + \text{___Ce}^{+4} \rightarrow \text{____Ce}^{+3} \]

20. (2 points) The total number of electrons needed to balance is the Least Common Multiple of the coefficient of e⁻ in equation (18) and equation (19). What is it? __________

21. (1 point) Multiply all the coefficients of (18) by a constant so that the coefficient of e⁻ is the answer to (20)

\[ \text{___I}^- \rightarrow \text{___I}_2 + \text{____e}^- \]

22. (1 point) Multiply all the coefficients of (19) by a constant so that the coefficient of e⁻ is the answer to (20)

\[ \text{___e}^- + \text{___Ce}^{+4} \rightarrow \text{____Ce}^{+3} \]

23. (2 points) Add together both sides of the half-reaction equations (21) and (22) and cancel the electrons to get a balanced redox equation for the overall reaction.