

Name _____

Honors Chemistry

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Redox Reactions

Rules for Assigning Oxidation Numbers		
Oxidation state of:	Charge	Examples
Neutral monoatomic or molecular elements	0	Na(s), Cl ₂ (g), S ₈ (s), O ₂ (g), Hg(l)
Fluorine	-1	HF, PF ₃
Oxygen	-2	H ₂ O, Al ₂ O ₃
Hydrogen	+1	H ₂ O, H ₃ P

- When determining the oxidation numbers of elements in an ion or compound, first determine the overall net charge of the ion or molecule. A molecule like ammonia (NH₃) is neutral. The ion ammonium (NH₄⁺) has an overall net charge of +1.
- In a neutral atom, the amount of positive charge must equal the amount of negative charge. In an ion, the amount of positive and negative charge will not be equal but their difference will represent the overall net charge on the ion.

The Characteristics of Oxidation-Reduction (Redox) Reactions

- Involves the transfer of electrons
- **Oxidation** Involves a **Loss** of electrons which leads to an increase in oxidation state (from – to + charge)
- **Reduction** Involves a **Gain** of electrons which leads to a decrease in oxidation state (from + to – charge)
- The **oxidizing agent** is the substance that is **reduced** (it gains electrons – electron acceptor)
- The **reducing agent** is the substance that is **oxidized** (it loses electrons – electron donor)
- The oxidizing agent and reducing agent refers to the entire compound or ion, not just the specific element that undergoes the change in oxidation state.
- If one reactant is oxidized the other will be reduced; you can't have one process without the other.

Example: Determine which substance is oxidized, which is reduced, which is the oxidizing agent and which is the reducing agent in the following reaction: $2\text{K}(s) + \text{Cl}_2(g) \rightarrow 2\text{KCl}(s)$

First determine the charges of each element: 0 0 +1 -1

Potassium changes from a neutral molecule with no charge to a cation in an ionic compound with a +1 charge. Chlorine changes from a neutral molecule with no charge to an anion with a -1 charge.

In synopsis: K loses an electron. It is oxidized and also the reducing agent.

Cl gains an electron. It is reduced(charge goes from 0 → -1) and also the oxidizing agent.

Practice Problem: Determine which substance is oxidized, which is reduced, which is the oxidizing agent and which is the reducing agent in the following reaction: $4\text{Fe}(s) + 3\text{O}_2(g) \rightarrow 2\text{Fe}_2\text{O}_3(s)$

Substance Oxidized:**Substance Reduced:****Oxidizing Agent:****Reducing Agent:**

Practice Problem: Determine which substance is oxidized, which is reduced, which is the oxidizing agent and which is the reducing agent in the following reaction: $3\text{CuCl}_2(aq) + 2\text{Al}(s) \rightarrow 2\text{AlCl}_3(aq) + 3\text{Cu}(s)$

Substance Oxidized:**Substance Reduced:****Oxidizing Agent:****Reducing Agent:**

Net-Ionic Equations

- When writing chemical equations all aqueous solutions should be written dissociated.
- Gases, liquids and solids should be written as complete molecules.
- All alkali, ammonium, nitrate and acetate salts are soluble.
- Strong acids should be written as ions: Hydrochloric acid would be: H^+ & Cl^- . Strong Acids: HCl, HBr, HI, HClO_4 , HNO_3 , and H_2SO_4 .
- Weak acids(all other acids) should be written undissociated.
- Strong bases should be written as ions: Sodium hydroxide would be: Na^+ & OH^- . Strong Bases: LiOH, NaOH, KOH, RbOH, CsOH, $\text{Ca}(\text{OH})_2$, $\text{Sr}(\text{OH})_2$, and $\text{Ba}(\text{OH})_2$

Homework/Practice Test:

For each of the following reactions, write a balanced equation for the reaction. Coefficients should be in terms of lowest whole numbers. Omit formulas for any ions or molecules that are unchanged by the reaction. If the reaction is a Redox reaction, indicate which substance is oxidized and which substance is reduced.

1. Solid copper(II) sulfate pentahydrate is gently heated.
2. Propane(C_3H_8) is burned completely in excess oxygen gas.
3. A barium nitrate solution and a potassium fluoride solution are combined and a precipitate forms.
4. Lithium metal is strongly heated in nitrogen gas.
5. A sample of solid iron(III) oxide is reduced completely with solid carbon.
6. Solid mercury(II) oxide decomposes as it is heated in an open test tube in a fume hood.
7. Equal volumes of 0.1 M solutions of lead(II) nitrate and magnesium iodide are combined.
8. A solution of barium chloride is added drop by drop to a solution of sodium carbonate.

9. Solid potassium oxide is added to water.

10. Cadmium metal is placed in a solution of tin(II) chloride.

11. A solution of sodium hydroxide is added to a solution of lead(II) nitrate.

12. A solution containing silver(I) ion (an oxidizing agent) is mixed with a solution containing iron(II) ion (a reducing agent).

13. Solid sodium carbonate is strongly heated.

14. Magnesium pellets are placed in hydrochloric acid.

15. Propanal, C_3H_6O , is burned in air.

16. Solid potassium chlorate is strongly heated.

17. Zinc metal is placed in a solution of copper(II) sulfate.

18. A solution of nickel(II) bromide is added to a solution of potassium hydroxide.

19. Octane(C_8H_{18}) is combusted in air.

20. A solution of potassium carbonate is added to a solution of strontium chloride.

21. Propene(C_3H_6) is burned in air.

22. A small piece of potassium is added to water.

23. Powdered barium oxide is mixed with water.

24. A solution of sodium fluoride is added to a solution of hydrochloric acid.

25. A strip of lead metal is added to a solution of silver nitrate.

26. A strip of zinc is placed in a solution of nickel(II) nitrate.

27. Ethyne (C_2H_2) is burned in air.

28. A solution of copper(II) sulfate is spilled onto a sheet of freshly polished aluminum metal.

29. Dimethyl ether(C_2H_6O) is burned in air.

30. A solution of sodium phosphate is added to a solution of aluminum nitrate.

31. Concentrated hydrochloric acid is added to a solution of sodium sulfide.

32. Hot hydrogen gas is passed over heated copper(II) oxide solid.

33. A solution of lead(II) nitrate is added to a solution of potassium sulfate.

34. Sulfur trioxide(SO_3) gas is bubbled into water.

35. Solid sodium acetate is added to 1.0 *M* hydrobromic acid.